BREN SCHOOL OF ENVIRONMENTAL SCIENCE & MANAGEMENT
UNIVERSITY OF CALIFORNIA, SANTA BARBARA

PROJECT BRIEF

SUSTAINABLE WATER USE IN THE VENTURA RIVER WATERSHED

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ON THE WEB AT HTTP://WWW.BREN.UCSB.EDU/~VENTURARIVER SPRING 2013

Ventura River Watershed Overview

The Ventura River Watershed is one of the few watersheds in Southern California that does not import water. Local residents, farms, businesses, and ecosystems are entirely dependent on local resources to meet their water needs. Because there is a limited amount of water available each year, these groups are in competition for a finite resource. Population growth, land use changes, and climate change could cause an increase in water demand or decrease in water availability. With water already in limited supply, these changes may result in unmet water demand for residents or local ecosystems.

Detailed studies have been conducted on the groundwater, surface flows, and aquatic ecosystems within the watershed. Previous research, however, has not been integrated into a complete water budget for the Ventura River Watershed. This project combined previous research into a comprehensive water budget model that incorporates both demand and supply side components.

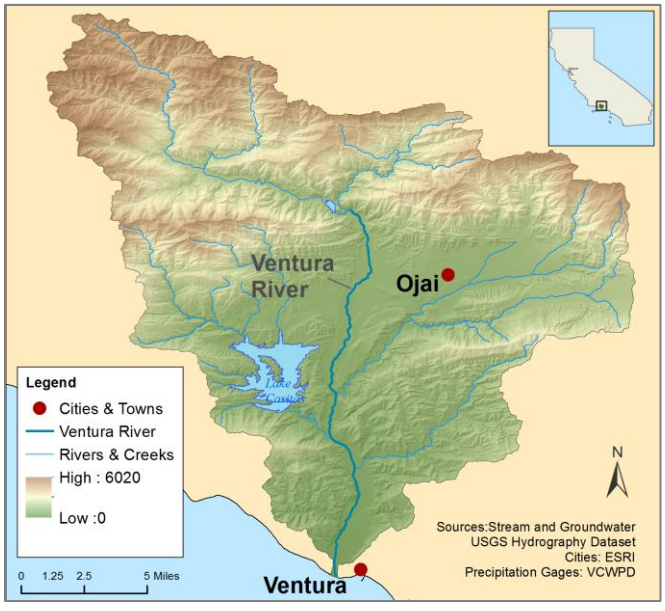

Figure 1: The Ventura River Watershed is located along the South-Central California coast, stretching from the rugged Los Padres National Forest in the north to the Pacific Ocean in the south.

Project Objectives

1) **Create a comprehensive water budget model**
2) **Evaluate the effects of climate change and land use change on the water budget**
3) **Identify actionable water resource management projects**
4) **Propose a set of recommendations relevant to securing Proposition 84 funding, increasing water availability, and improving ecosystem function**

Approach

The Water Evaluation and Planning System (WEAP) was used to create a water budget model for the Ventura River Watershed. The model was combined with economic analysis to study the impacts of eight water management strategies on water resources within the region. Six evaluation criteria were used to evaluate the effectiveness of the water management strategies. The model was also used to evaluate the impacts of population growth, climate change, and land use change on water availability.

Figure 2: Endangered Steelhead Trout are present in the watershed. Stream flow increases in the Ventura River benefit local populations.

WEAP Model Setup

The WEAP model encompasses both demand and supply components of water resources. Including supply and demand components enabled this study to determine how changes in water availability and changes in end-user behavior affect the water budget. The combination of both supply and demand side components enables the consideration of a wide-range of options for meeting water management goals. A simplified conceptual diagram of the WEAP model is shown in Figure 3.

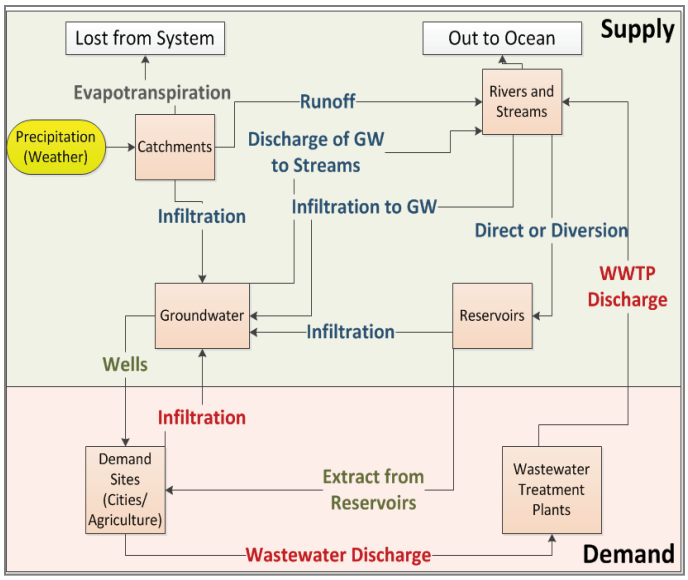

Figure 3: Conceptual model of the WEAP system. Supply components (top) are green, demand (bottom) are red.

After constructing the WEAP model, stream flow and Lake Casitas storage volumes were calibrated against observed data. The calibrated model was used to generate a water budget for the watershed (Figure 4).

Water Resource Management Strategies

The following eight water management strategies were investigated to study their effects on water resource availability within the watershed:

Ocean friendly gardens replace traditional lawns with rain gardens and plants with low-water requirements. Ocean friendly gardens capture and infiltrate runoff, and substantially reduce water demand compared to lawns.

Figure 5: An ocean friendly garden uses less water and fertilizer than a lawn and captures and infiltrates runoff.

Greywater systems investigated in the study utilize wastewater from washing machines to irrigate outdoor plants. These systems, known as laundry-to-lawn, reduce residential water demand.

The **San Antonio Spreading Ground** diverts water from San Antonio Creek during high flows and allows it to infiltrate into the Ojai Groundwater Basin, increasing local groundwater supplies.

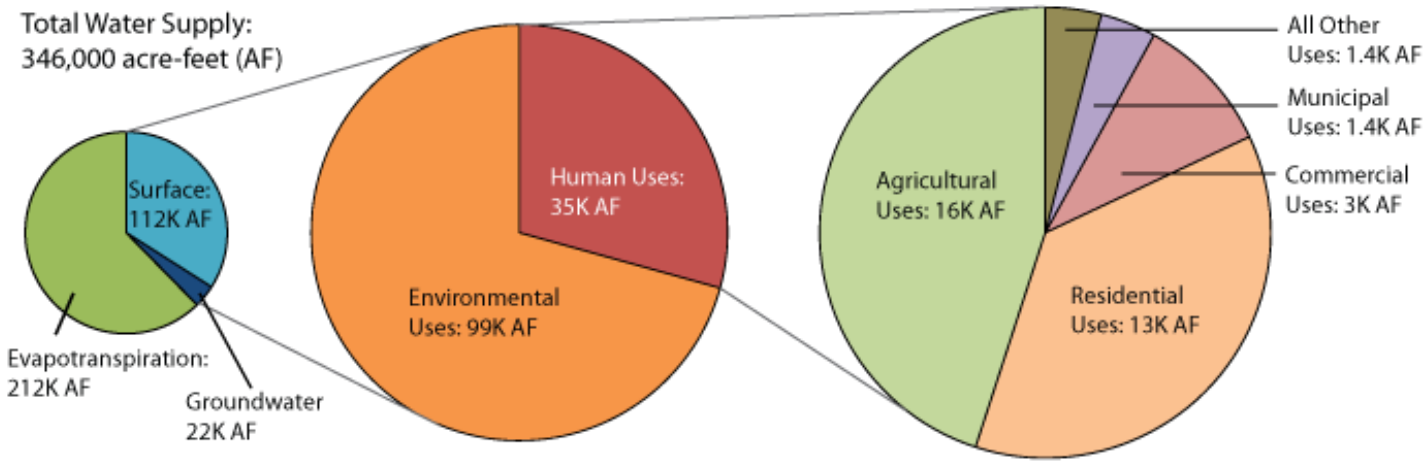

Figure 4: Average annual water budget for Ventura River Watershed, 2004-2009.

A **Scalping Plant** in Ojai could be used to reclaim wastewater for the purpose of irrigating local parks or golf courses and decreasing demand on groundwater.

Urban Water Rate Increases would incentivize households to use less water and would increase the cost-effectiveness of other projects.

Infiltration Basins capture stormwater runoff from urban areas and allow it to infiltrate into groundwater aquifers.

Climate and Land Use Change

In order to determine the possible effects of future land use and climate change, several scenarios were run which investigated changes in precipitation, temperature, and crop types. The land use change scenario investigated the effect on switching from oranges to raspberries, and the climate scenarios investigated the effect of increases in temperature and changes in precipitation.

Evaluation Criteria

Six criteria were used to evaluate the effectiveness of each water management strategy. The criteria we used were cost- effectiveness (cost per acre-foot of water saved over 20 years), the ability to decrease demand, the ability to increase supply, the ability to improve water quality, the ability to improve ecosystem health, and suitability for Proposition 84 grants. Proposition 84 is a California initiative which seeks to fund projects that increase water quantity and quality within the state.

Normalization

The results for each water management strategy were normalized to facilitate comparison. A score between 0 and 3 was given for each evaluation criteria. 0 indicates that the strategy is not significant for a criterion and a 3 indicates that the strategy is very effective.

Evaluation Criteria

1) Cost-Effectiveness
2) Ability to decrease demand
3) Ability to increase supply
4) Ability to improve water quality
5) Ability to improve ecosystem health
6) Suitability for Proposition 84

Results

The results of the evaluation of the water management strategies are shown in the radar diagrams below. Each axis on the diagram represents one of the six evaluation criteria, and each ring represents a normalization score, with 0 in the center and 3 on the outside of the graph. Ocean friendly gardens, greywater, and infiltration basins score highly on multiple criteria. Although the rate increase to state average does not score as highly across multiple criteria, it is the most effective at reducing demand while being cost-effective.

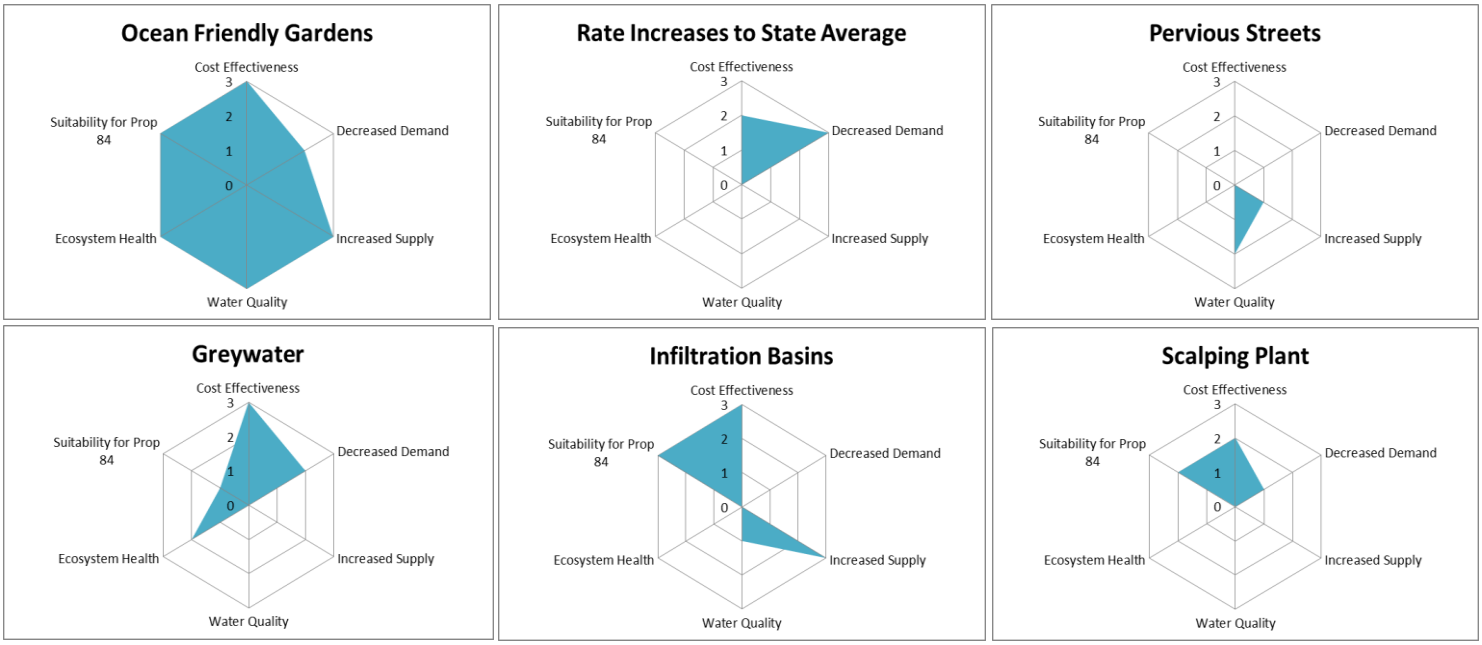

Figure 6: Results of water management strategy analysis. Criteria are represented on each axis. The larger the blue area, the better the strategy is overall. Pervious streets and an additional rate increase strategy were not as effective and are not shown.

Suites

In order to determine the ability of the water conservation strategies to mitigate the negative effects of climate and land use change, the water management strategies were combined into suites using the WEAP model. The baseline suite models the Ventura River Watershed's water budget to the year 2099. To create this model, historical weather data from 1990 – 2009 was repeated to 2099. In the second suite, the temperature was increased by 4^0 C. In the worst-case scenario, temperature was increased by 4^0 C, precipitation decreased by 20%, and 50% of orange crops were converted to raspberries. The consumer based water management strategies, including ocean friendly gardens, greywater, and rate increases, were used in both the temperature increase and worst-case scenarios to determine their ability to mitigate the negative impacts of land use and climate change. The suite results can be seen in Figure 8.

Recommendations

This project recommends widespread installation of ocean friendly gardens and greywater systems in single-family homes throughout the watershed. These strategies can decrease urban water demand, increase groundwater supplies, and improve ecosystem health and water quality. Decentralized infiltration basins should be installed to capture stormwater runoff from urban areas, increase groundwater supplies, and improve water quality.

Increasing Casitas Municipal Water District and Meiners Oaks Water District residential water rates to the state average will encourage water conservation and decrease urban water demand. Ocean friendly gardens, greywater, and decentralized infiltration basins are suitable for Proposition 84 funding, potentially making them even more cost-effective.

More Information

For more information on the project, visit us on the web at http://www.bren.ucsb.edu/~venturariver.

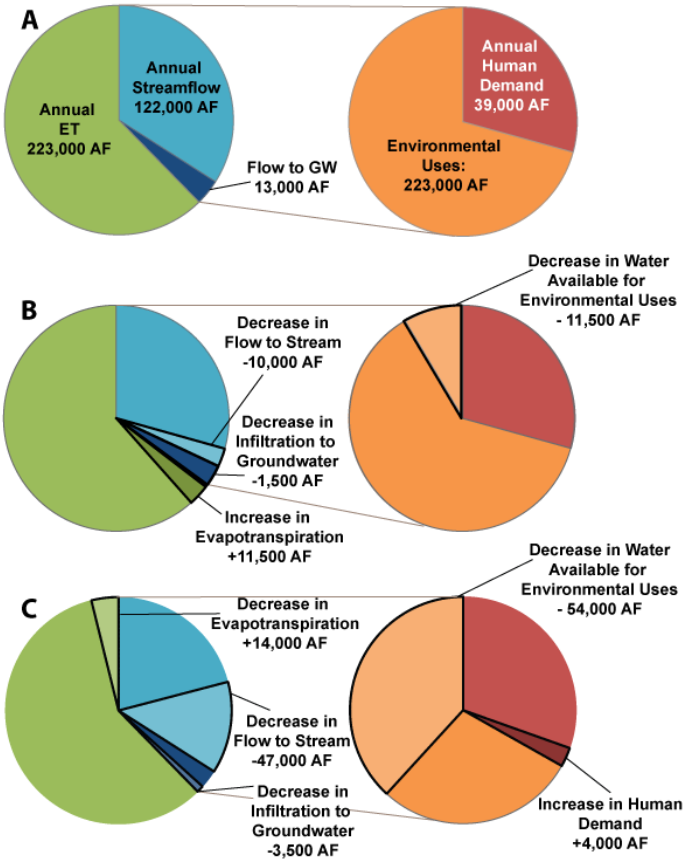

Figure 7: Average annual water budget for Ventura River Watershed with climate and land use change. A) The baseline flow with no climate or land use change. B) 4^0 C temperature increase. C) 4^0 C increase, a twenty percent precipitation decrease, and 50% of orange crops converted to raspberries.

Acknowledgements

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Project Team (left to right; Brenda Ponton, Austin Love, Naheed Iqbal, Dan Yocum, Ryan Gardner, Dr. Arturo Keller, Jake Sahl)

Project Team with the Ventura River Watershed Council