



Recommendations

Conservation Easements – Best Practices

For best management it is recommended that for pastureland cattle screening fences or access-points be added to prevent animals from entering the stream and increasing pollutant loading. Within forestland, meadow restoration and on-slope stabilization projects are recommended for water quality and storage. Within shrubland, riparian buffers are recommended to filter pollutants and stabilize slopes.



River Fork Ranch Easement

Prioritized Conservation Efforts

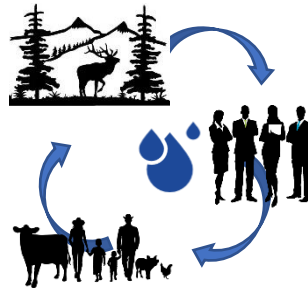
Land areas within the top 20th percentile of pollutant loading and experiencing the top 20th percentile in base flow reduction were isolated. In the Carson River Watershed, these land areas consisted of **47% shrub, 9% pasture, and 29% forest.** In the Walker River Watershed, the land areas consisted of **24% shrub, 5% pasture, and 7% forest.** TNC could prioritize conserving forest and shrublands in the priority areas for the most impact (as modeled) downstream.



Forests and Meadowlands

Stakeholder Working Groups

Based on the initial feasibility scoping performed, it is recommended that TNC and neighboring stakeholders create stakeholder working groups (a committee with select meetings) for further discussions. These groups will meet to discuss cost-sharing for existing projects and facilitate communication between managers.



Next Steps

The Nature Conservancy (TNC) manages numerous conservation easements lands in Douglas County and is concerned with climate resiliency and water security for the future. Local circumstances suggest that a water fund may not be the best option for these watersheds. Rather than pooling funds in this way, it is recommended that TNC and their partners invest in a central database to digitally track projects from numerous agencies throughout the area -with options to match funds and group resources on a project-by-project basis. Communication and facilitating joint conservation efforts are paramount to future success. These next steps are motivated by a local need for adaptive management options and opportunities for future investment in these alternative management tactics.

Acknowledgments

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References & Resources

- ¹ Szeptycki, -Leon F, et al (2015). A Review of State Laws Prepared by Water in the West
- ² Department of Environment, Food, and Rural Affairs (2013). *Payments for Ecosystem Services: A Best Practice Guide*

For more information please visit our website for the full graduate thesis report, accompanying maps and models, as well as video content for these watersheds.



Investing in Future Water Resources

Evaluating Watershed Ecosystem Services and Market Mechanisms in Douglas County, NV

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The Eastern Sierra Nevada: Climate Change Concerns, Land Use Development, and Population Growth



Background

Douglas County, located at the base of the Eastern Sierra Nevada Mountain range, is served primarily by seasonal snowmelt runoff. Water supply is sourced from the Carson and Walker Rivers (and supplemented by the Truckee River) whose headwaters originate in the Sierra Nevada. Originally founded in 1861, the county experienced significant population growth (~70% increase) between 1990 and the early 2000s. Increasing water demands and changing runoff timing from climate change motivated variations to seasonal snowpack is anticipated to stress both agricultural and municipal water users downstream. In addition, developmental pressures for new population growth have led to subdivisions placed along the floodplain, further intensifying the risk of human impacts from flood events.

Objectives

The Nature Conservancy's (TNC) mission to conserve the natural land and waters lead to three major objectives for this research including 1) perform a watershed analysis to determine the current ecosystem baseline in the area 2) evaluate changes to ecosystem services in respect changing climatic conditions and 3) identify feasible market mechanisms to mitigate these changes.



Perform Watershed Analysis



Evaluate Ecosystem Services



Identify Feasible Market Mechanisms

Key Findings

- 1) Current **baseline conditions** indicate poor water quality in farming & headwater sectors due to ample nutrient release.
- 2) All **modeled climate change scenarios** predict decreased baseflow in the two basins studied (Carson and Walker).
- 3) Water transfers, adaptive management, and shared project funding are **more feasible** than establishing a water fund for this area.

1

Watershed Baseline Conditions

Conditions in the Carson and Walker basins were analyzed to determine which areas of land contribute the most to nutrient release and how water is delivered through the year. Data from snow stations and stream gages indicated that the majority of each basin's water supply is released in the springtime from snowmelt. Between April and June, nearly two thirds of the river's annual water budget is released as snowmelt with the average Sierra Nevada snowpack offering an equivalent of 21 inches of water per year.

Areas at the headwaters appear to be the greatest contributors to baseflow by delivering water downstream during warmer months when wildlife and local communities need it the most. Individuals downstream depend on this water supply for their livelihoods. Both basins utilize the spring melt for irrigation on crop and ranching lands which then carries abundant amounts of nutrients back into the rivers. While this process motivates a decrease in water quality, data between models and baseline conditions also indicate that lands in the headwaters substantially impact water supply and water quality in the basins downstream.



2

Ecosystem Services Evaluation

To determine how water supply and water quality parameters would be altered in the future by climate change, the change in baseflow contribution, nitrogen export, and phosphorus export were estimated in 2050 for both the Carson and Walker basins. These results were compared to the current baseline conditions to determine the areas where these factors would experience the most change in the future. In both basins, large areas in the Sierra Nevada headwaters would experience the most decrease in baseflow as a result of climate change. This means that not only are these areas currently the largest contributors to baseflow, but they are also expected to experience the largest decrease in the amount of water they contribute to baseflow in the future. A large increase in nitrogen and phosphorus export would also occur in the agricultural regions in both basins including the Carson Valley and Newlands Project near Fallon in the Carson basin and near the Topaz Reservoir in the Walker basin. Additionally, in the high elevation, steep slope, and sparsely vegetated areas near the mountain peaks in the headwaters of both basins would experience adverse changes in all three-water supply and water quality parameters.

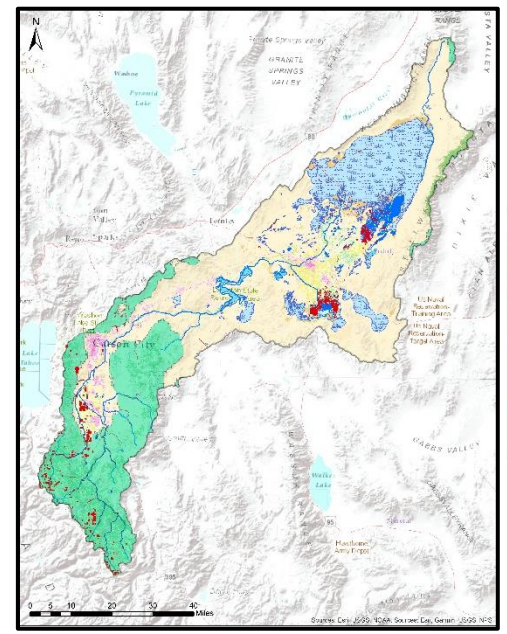


Figure 1. Carson Basin Modeled Priority Areas

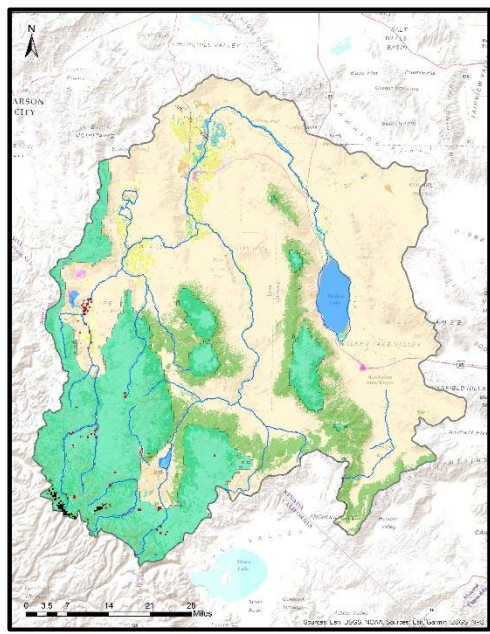


Figure 2. Walker Basin Modeled Priority Areas

3

Priority Areas

Based on the change in water supply and water quality analysis, three general priority areas for management were identified for the Carson basin: the headwaters in the Sierra Nevada (large decrease in baseflow and adverse changes for all three parameters), the Carson Valley agricultural area (large increases in phosphorus and nitrogen export), and the Newlands Project agricultural area near Fallon (large increases in phosphorus and nitrogen).

In the Walker basin two general priority areas were identified that would experience the most adverse changes to water supply and water quality as a result of climate change: the headwaters in the Sierra Nevada (large decrease in baseflow and adverse changes for all three parameters) and the agricultural area near Topaz Reservoir (large increases in phosphorus and nitrogen export). These areas are both the largest current baseline contributors to water supply and water quality in both basins and the areas that would experience the most adverse changes to water supply and water quality in the future.

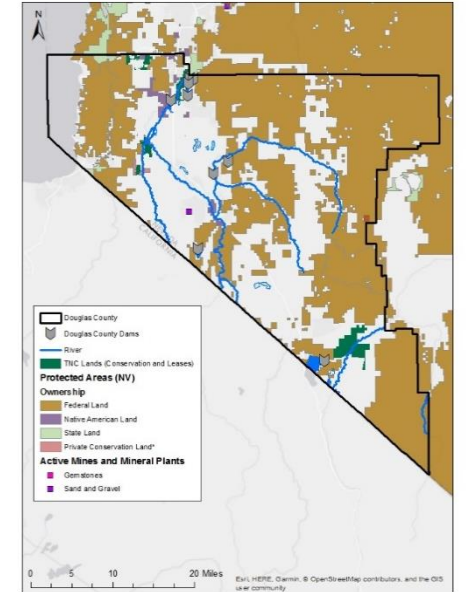


Figure 3. Douglas County Land Ownership

Additional Considerations

Land Ownership: The majority of Douglas County is covered by federal lands. When planning additional conservation easements or restoration projects it is important to consider neighboring landownership for partnerships and cost-sharing.

Connectivity between Parcels: Some lands may be unavailable for sale based on ownership and designation. Conservation efforts may be enhanced by connecting parcels and projects across the basin as TNC continues to establish easements throughout the county.

3

Market Feasibility Study

Relevant Mechanisms

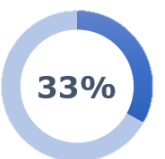
Water Fund: Payments for watershed services where beneficiaries (usually downstream users) pay into a central fund that is managed for conservation projects throughout the area.

Water Trades and Transfers: The temporary or permanent exchange of a water right's point of diversion, nature of use, or point and place of use between a buyer and seller.

Payments for Ecosystem Services: Voluntary transactions where defined ecosystem services (land uses and practices) are purchased (funded) by a service buyer under a form of conditional agreement. For example, a water agency paying ranchers to reduce irrigation use or place in BMPs.

BMP* Best Management Practices

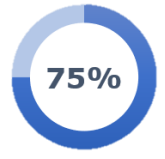
Feasibility Score



With a population under 50,000 people, resources split between over 10 different water purveyors, and a central environmental "champion" present a water fund does not appear feasible here.



Statewide half of the recommended legal and political components are met to facilitate trades¹. Transfers programs are already active on the Truckee and Walker Rivers.



Three of four recommended Payment for Ecosystem Services schemes² are applicable with motivated stakeholders present in the area to carry-out these actions.