

Informing Biodiversity Conservation and Water Quality Management in the Morro Bay Watershed

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The Morro Bay Watershed

The Morro Bay watershed is a 48,000 acre region located in San Luis Obispo County on the central coast of California. This land drains to the Morro Bay estuary, which was designated as an "estuary of national significance" in 1995 as a result of community based efforts to protect this iconic landscape and valuable resource.



The area's biological significance can be seen in the variety of different habitats, including maritime chaparral, oak woodland, pioneer dune, grasslands, and estuarine habitats, which collectively support a diverse assemblage of species. This assemblage includes a variety of endemic, threatened, and endangered species such as the Morro shoulderband snail, steelhead trout, and Morro manzanita.

The watershed and estuary also support a vibrant local economy through tourism, agriculture, ranching, aquatic recreation, and commercial fishing. Given the importance of the estuary and surrounding watershed, many government agencies, non-profits, and citizens are working to protect the region and address degradation of watershed resources.

The Morro Bay National Estuary Program (Estuary Program) is a non-regulatory, non-profit organization that brings together citizens, local governments, non-profits, agencies, and landowners to protect and restore the Morro Bay estuary. The Estuary Program conducts monitoring and research, restores natural habitats, and educates residents and visitors about how to keep Morro Bay clean and healthy. The Estuary Program collaborates closely with many partners and landowners to accomplish shared goals.



Watershed Threats

In California, over 90% of all coastal wetlands have been lost., The Morro Bay estuary supports one of the last remaining relatively intact coastal wetland systems, but the system is facing serious threats from the surrounding watershed. Two of the biggest concerns within the watershed and estuary are the loss of biodiversity and water quality degradation. The loss of biodiversity is in large part due to continual habitat loss from development. One of the region's most endangered species, the Morro Bay kangaroo rat, is now presumed extinct, and it is thought that its demise was caused by extensive habitat loss., The conversion of land to agriculture, rangeland, and urban areas has also had serious impacts on water quality. Fertilizers, pesticides, manure, wastewater, and stormwater pollute waterways with excess nitrate, phosphate, sediment, and E. coli. This pollution harms sensitive species, increases human health risks, and negatively impacts local industries dependent on having clean, healthy water.

1. USEPA, 2015. "Estuaries and Coastal Watersheds | Estuaries and Coastal Watersheds | US EPA." 2. Tear, Timothy H., et al. "Status and prospects for success of the Endangered Species Act." Science 262 (1993): 976-977.

Project Objectives

This project aimed to inform the development of a conservation plan for the Morro Bay watershed that supplements the Estuary Program's Comprehensive Conservation and Management Plan, based on the following objectives.

1. Address biodiversity loss in the watershed by determining areas of highest conservation priority.

2. Identify source areas of nitrate, phosphate, and *E. coli* that contribute to water quality degradation.

Recommendations

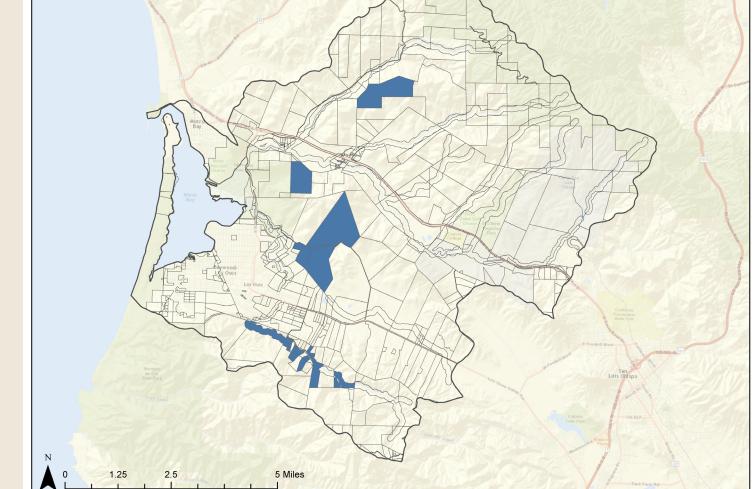
Biodiversity Conservation

Conservation should begin in parcels selected in multiple Marxan scenarios as highlighted in blue in the map to the right, while conservation goals are considered

Conducting population viability analyses (PVA) should be considered for particularly vulnerable species to ensure an adequate conservation target is set that best ensures the species' long-term persistence.

Water Quality Management

Chorro Valley: Address phosphate loading from the California Men's Colony effluent and increase cattle exclusion fencing and rural road management



Parcels selected in multiple Marxcan scenarios

Los Osos Valley: Reduce fertilizer application on croplands, increase cattle exclusion fencing, monitor the town of Los Osos' transfer off

Increase frequency and spatial distribution of nitrate, phosphate and *E.coli* monitoring. Increase storm event monitoring to better assess sediment loading.

Acknowledgments

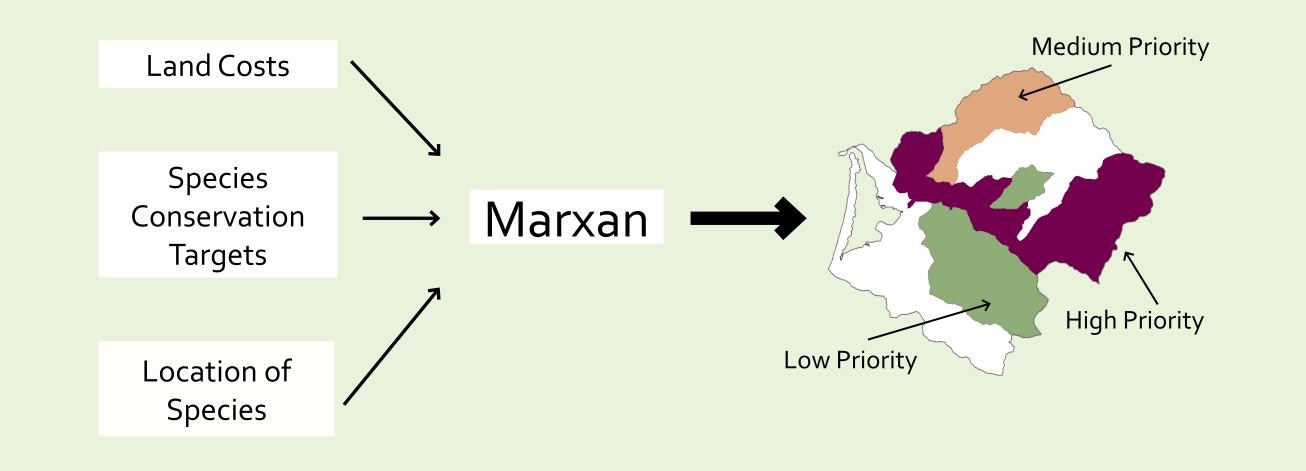
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For more information, visit our website: http://www2.bren.ucsb.edu/~morrowatershed/ Or email us at: morrowatershed@lists.bren.ucsb.edu

Biodiversity Conservation Methods

Marxan Tool

Marxan balances the tradeoffs between conservation goals and economic costs to achieve efficient conservation reserve layouts. By running Marxan many times with the same parameters the relatives importance of various sites can be ascertained. Higher selection frequencies indicate greater priority for incorporating into the conservation reserve.



What is a conservation target?

Hypothetical Example

If there are 10 sites where a species occurs in the watershed and the conservation target is 30%



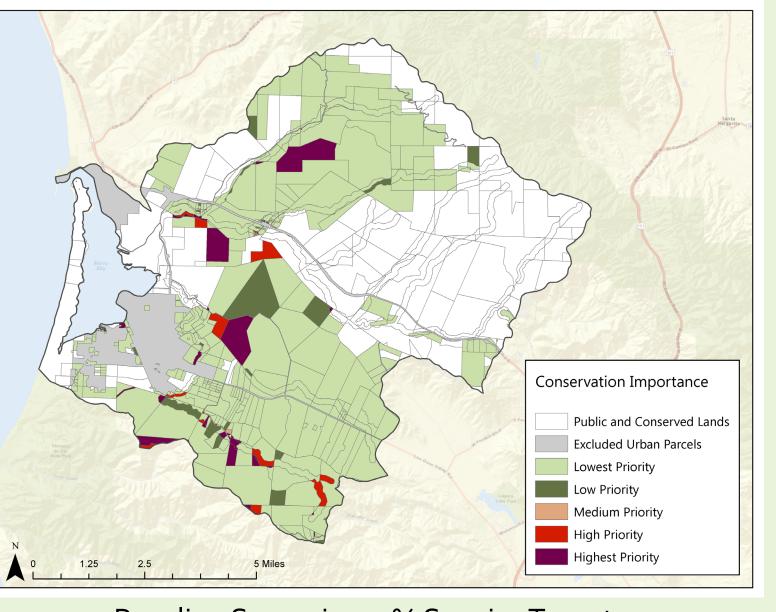
If you combine the species targets for all the sensitive species present in the watershed, Marxan can determine the optimal sites for conservation.



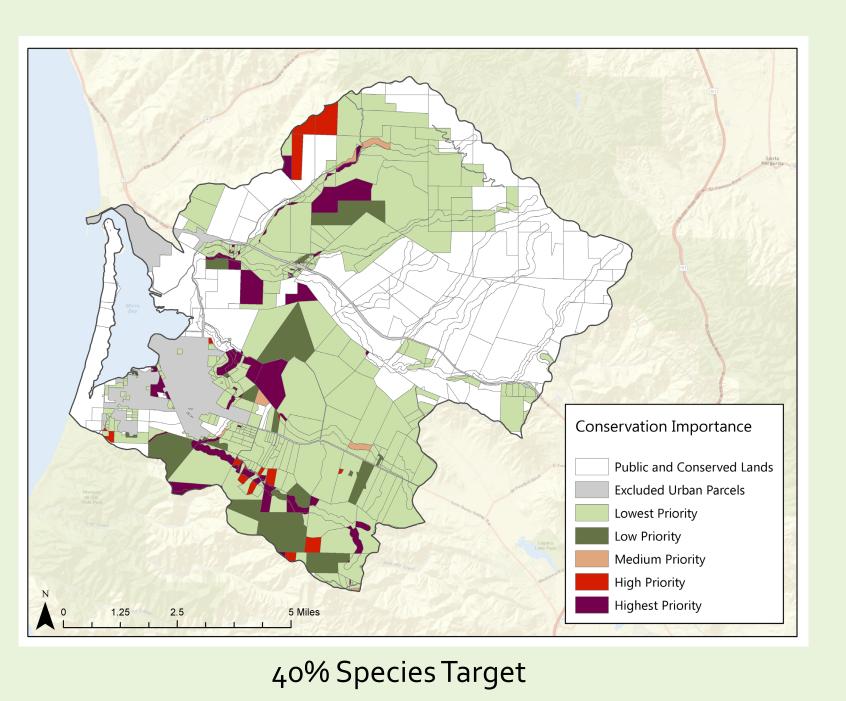
Biodiversity Conservation Results and Conclusions

1. Achieving more species conservation requires more land

The higher the conservation targets for all species, the greater the number of parcels Marxan selects for the reserve network. Conversely, lowering the conservation targets reduces the number of parcels selected.

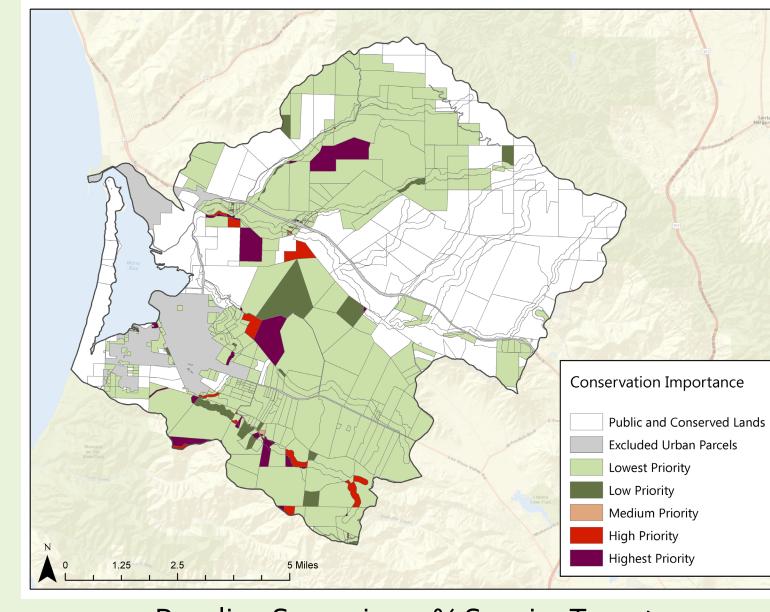


Baseline Scenario: 30% Species Target

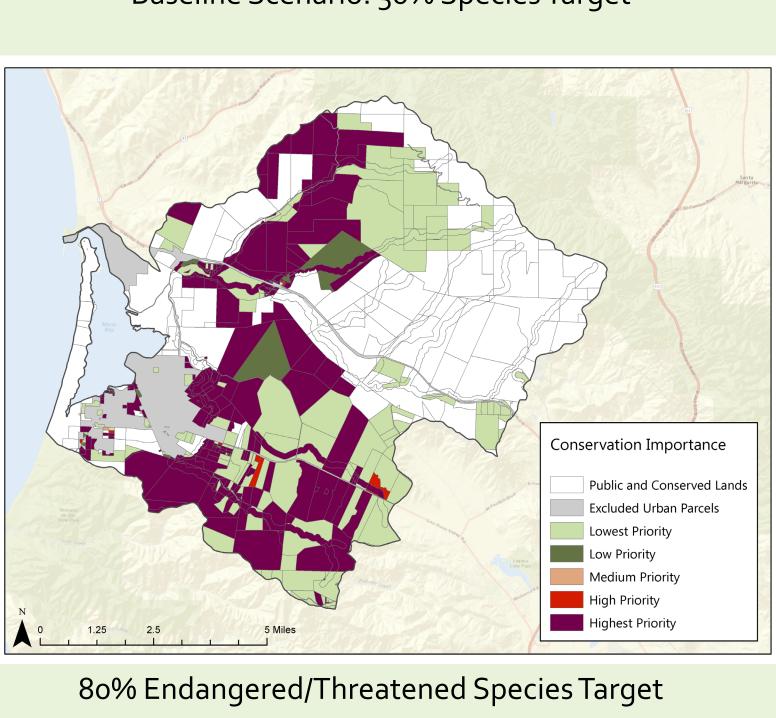


2. Providing robust protection for all endangered/threatened species requires most of the watershed for conservation

Protecting 80% of the known occurrences of threatened or endangered species led to an infeasible number of parcels to protect. Conservation efforts may need to focus on regionally important or particularly vulnerable

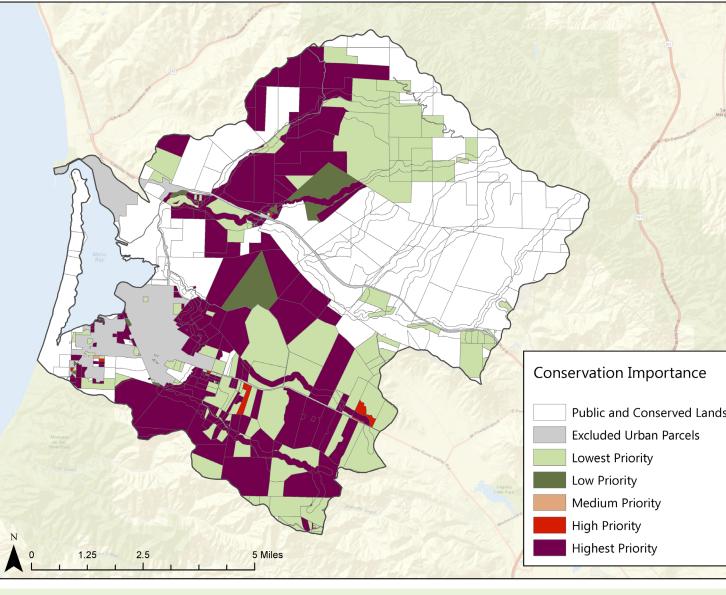


Baseline Scenario: 30% Species Target

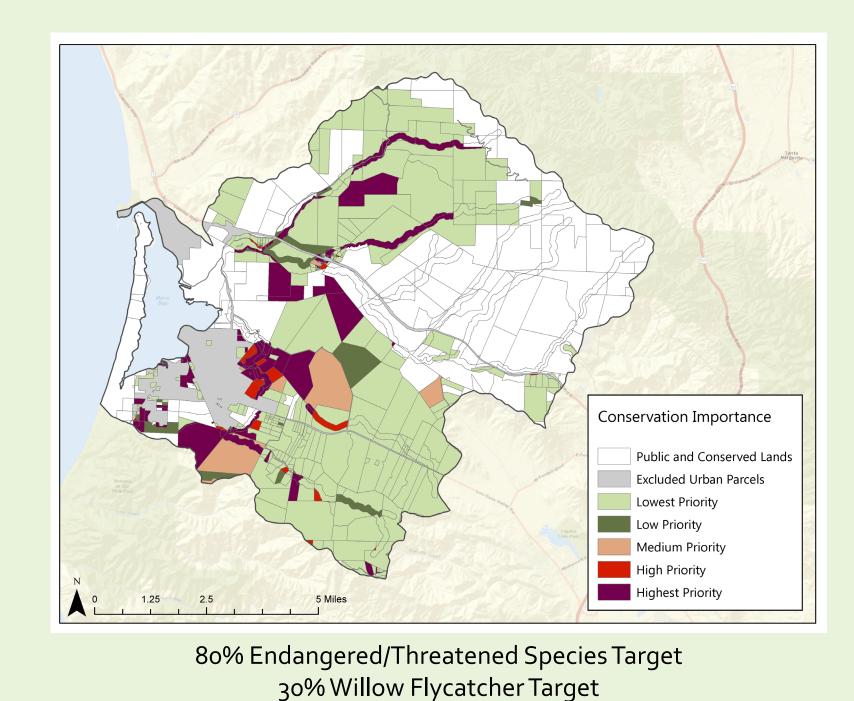


3. One endangered species' mobility and widespread local distribution skewed the endangered/threatened species analysis

Reducing the target of just the willow flycatcher from 80% to 30% substantially reduced the number of parcels selected. Robust protection can likely be achieved for the vast majority of threatened/ endangered species.



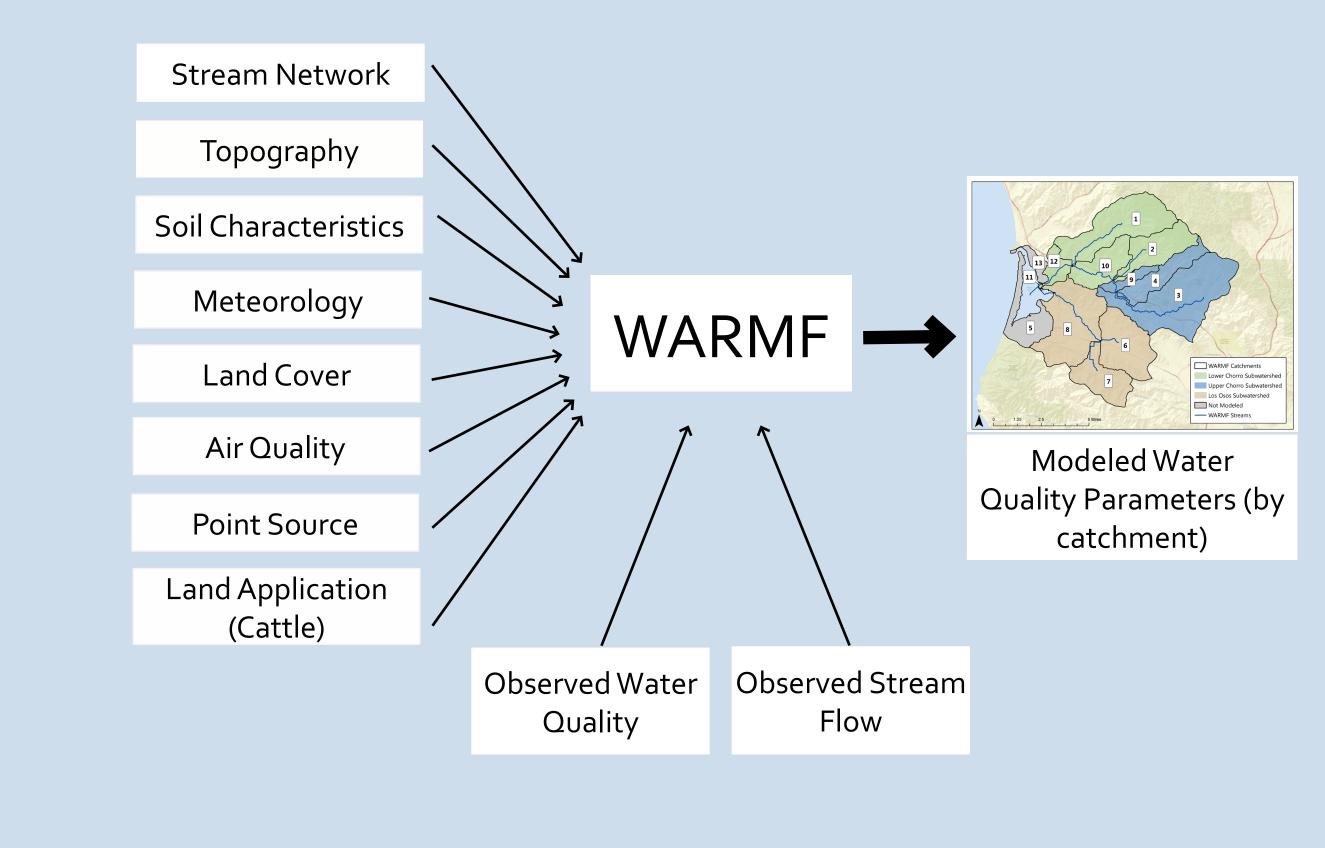
80% Endangered/Threatened Species Target

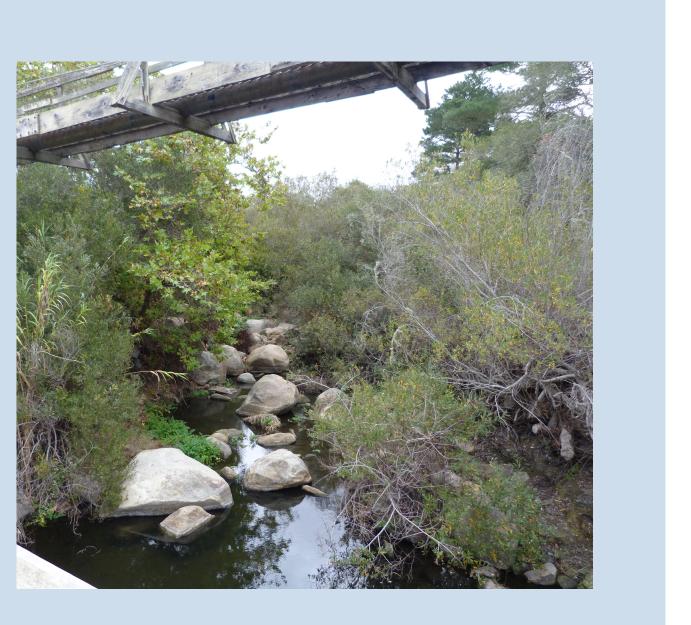


Water Quality Methods

Watershed Analysis Risk Management Framework (WARMF)

WARMF models water quality parameters on a per catchment basis on a daily time-step. It allows watershed processes and trends to be observed and compared when observational data is limited.

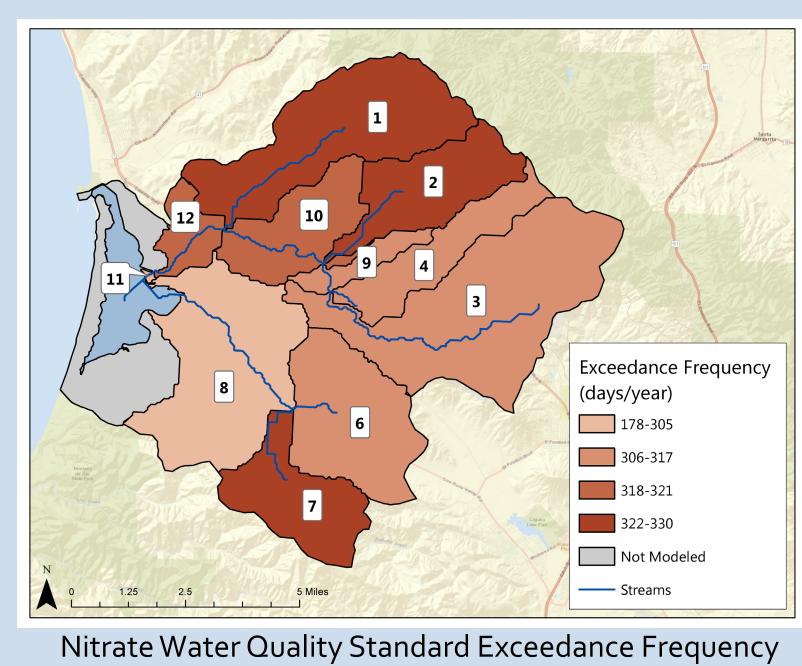




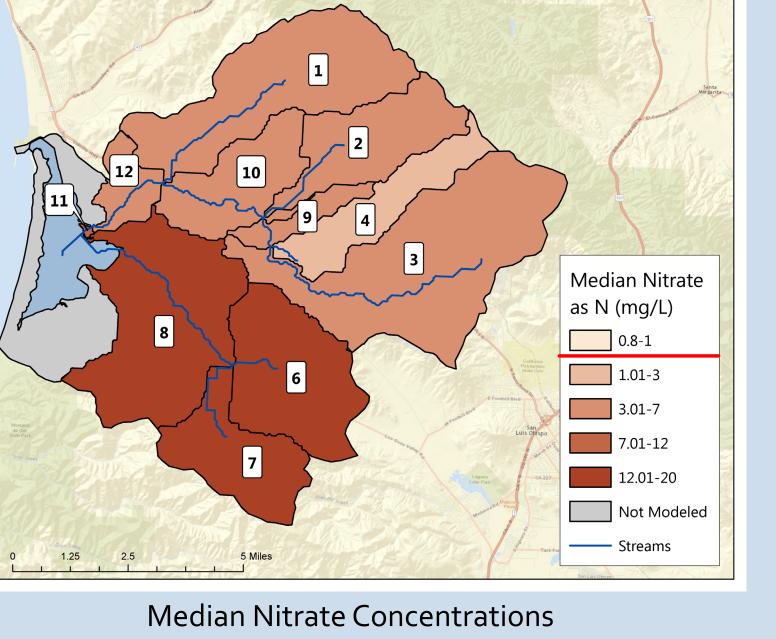
1. Nitrate is of concern across the entire

Nitrate is of concern across the entire watershed, but especially in Los Osos Valley. Agriculture and outflow from the California Men's Colony seem to be primary contributors to nitrate concentrations with lesser contributions from cattle.

watershed







(red line indicates water quality standard threshold - 1.0 mg/L)

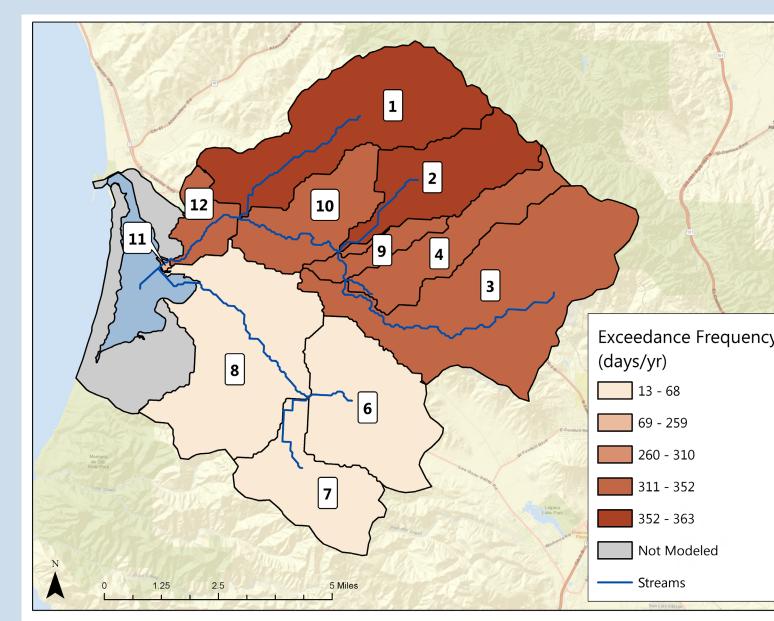
Water Quality Results and Conclusions

2. High phosphate concentrations are

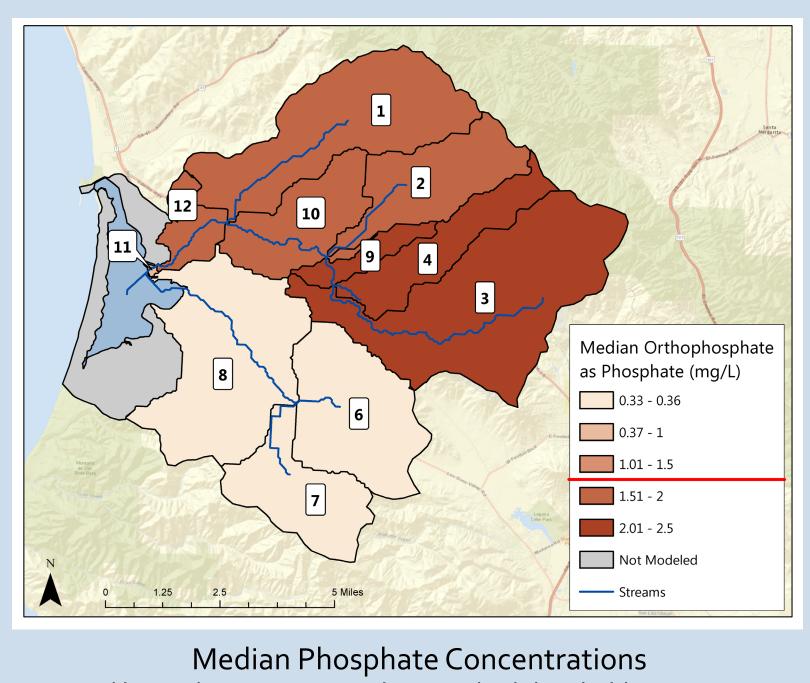
frequent in Chorro Valley

Phosphate median concentrations and exceedance frequency are highest in Chorro Valley. Cattle, higher erosion rates, and California Men's Colony outflow appear to be the driving forces behind the high

concentrations and frequency of exceedances.



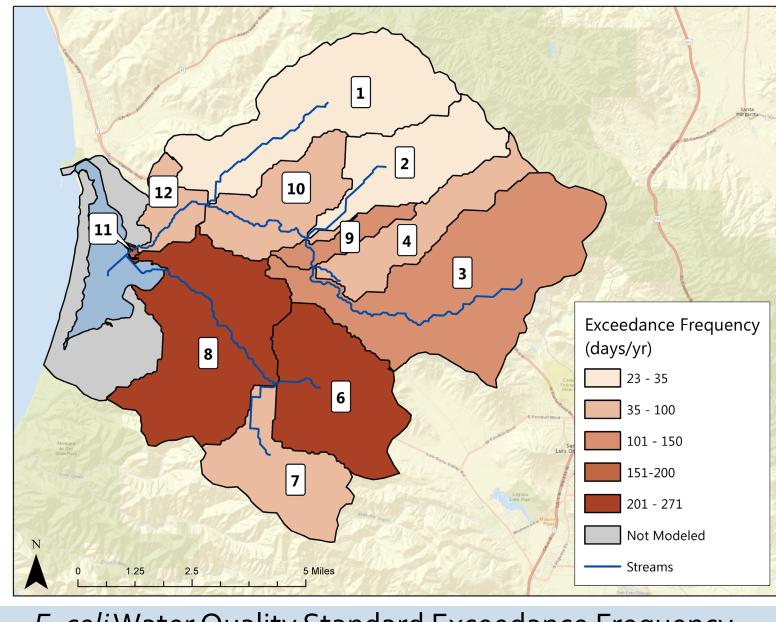
Phosphate Water Quality Standard Exceedance Frequency



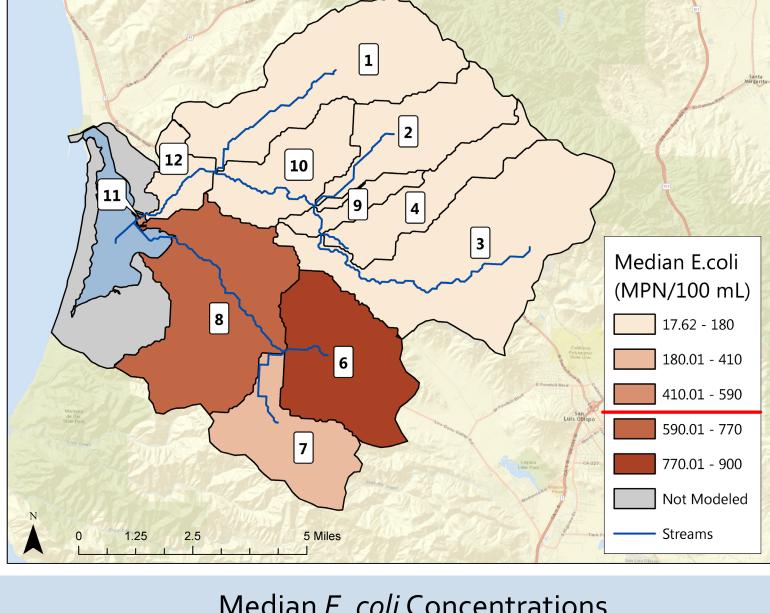
(red line indicates water quality standard threshold - 0.36 mg/L)

3. E. coli is more frequently concentrated in Los Osos Valley

Los Osos Valley is of greatest concern for E. coli median concentrations and exceedance frequency. Lack of cattle exclusion fencing in Los Osos Valley and the town of Los Osos' septic system are likely driving these results. California Men's Colony outflow and cattle present localized concerns in Chorro Valley.



E. coli Water Quality Standard Exceedance Frequency



Median *E. coli* Concentrations (red line indicates water quality standard threshold - 410MPN/mL) Base maps credit: Esri, HERE, DeLorme, USGS, Intermap, Increment P Corp., NRCAN, Esri Japan, METI, Esri China