

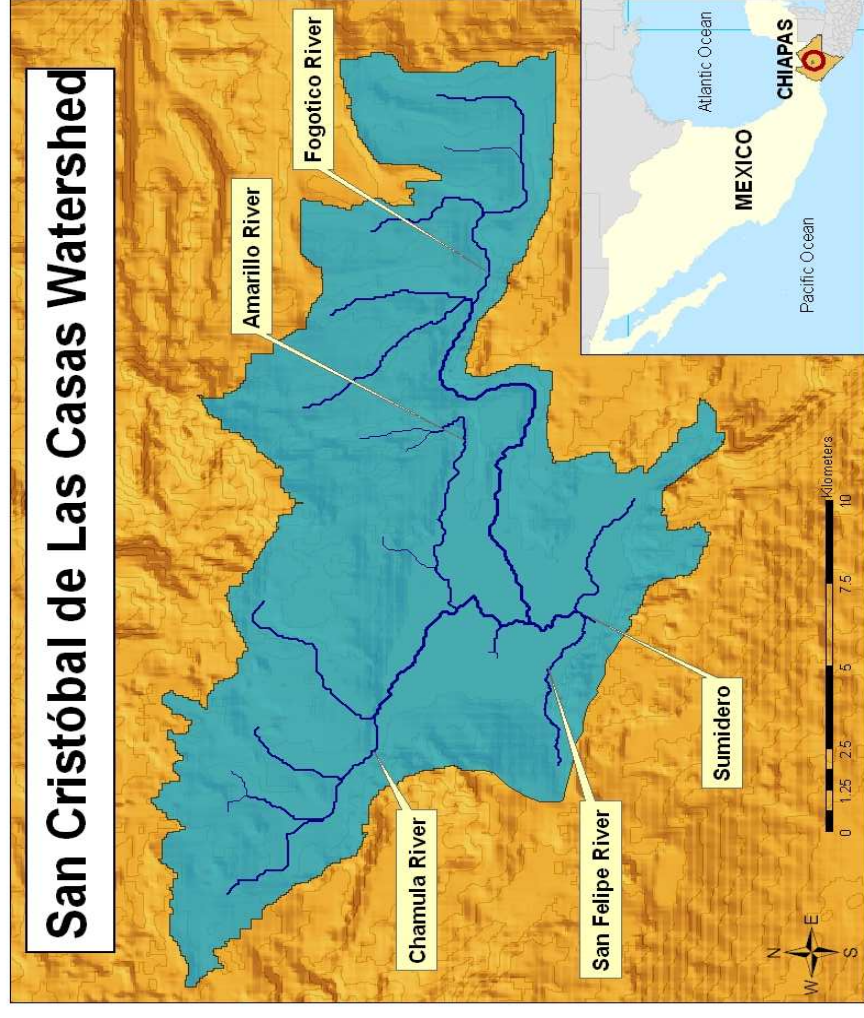


# Framework for Developing a Sustainable Watershed Management Plan for San Cristóbal de Las Casas, Chiapas, Mexico



## Problem Statement

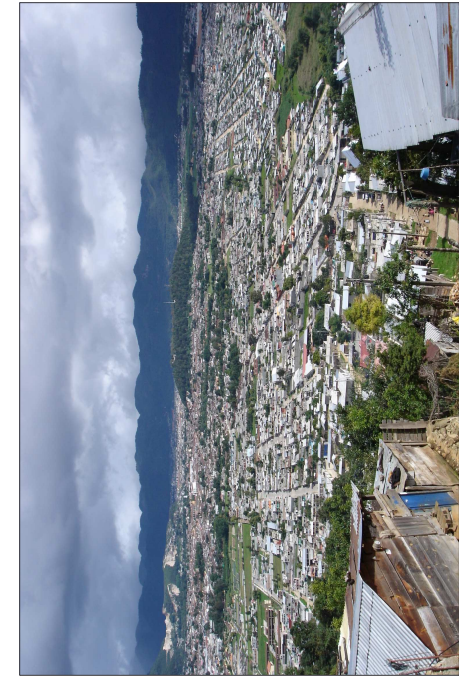
The colonial city of San Cristóbal de Las Casas, in the central highlands of Chiapas, is a cultural and economic center for the indigenous Mayan population of southern Mexico. The city experiences a water supply deficit for human consumption due to a lack of management and adequate infrastructure. The rapid population growth of the last two decades has deteriorated the surface water quality and increased pressure on the tenuous local water supply.



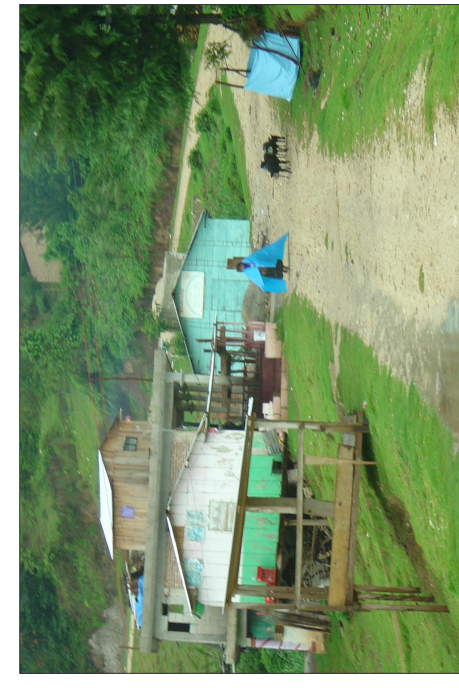
## Stakeholders



Citizens on the urban periphery only have community water taps and no municipal sanitation services.



Citizens in the city center have a reliable supply of water who can also afford to buy drinking water.



Smaller communities dispersed throughout the watershed are generally not connected to the municipal water system.



Communities on the urban periphery who have piped water and basic sanitation services.



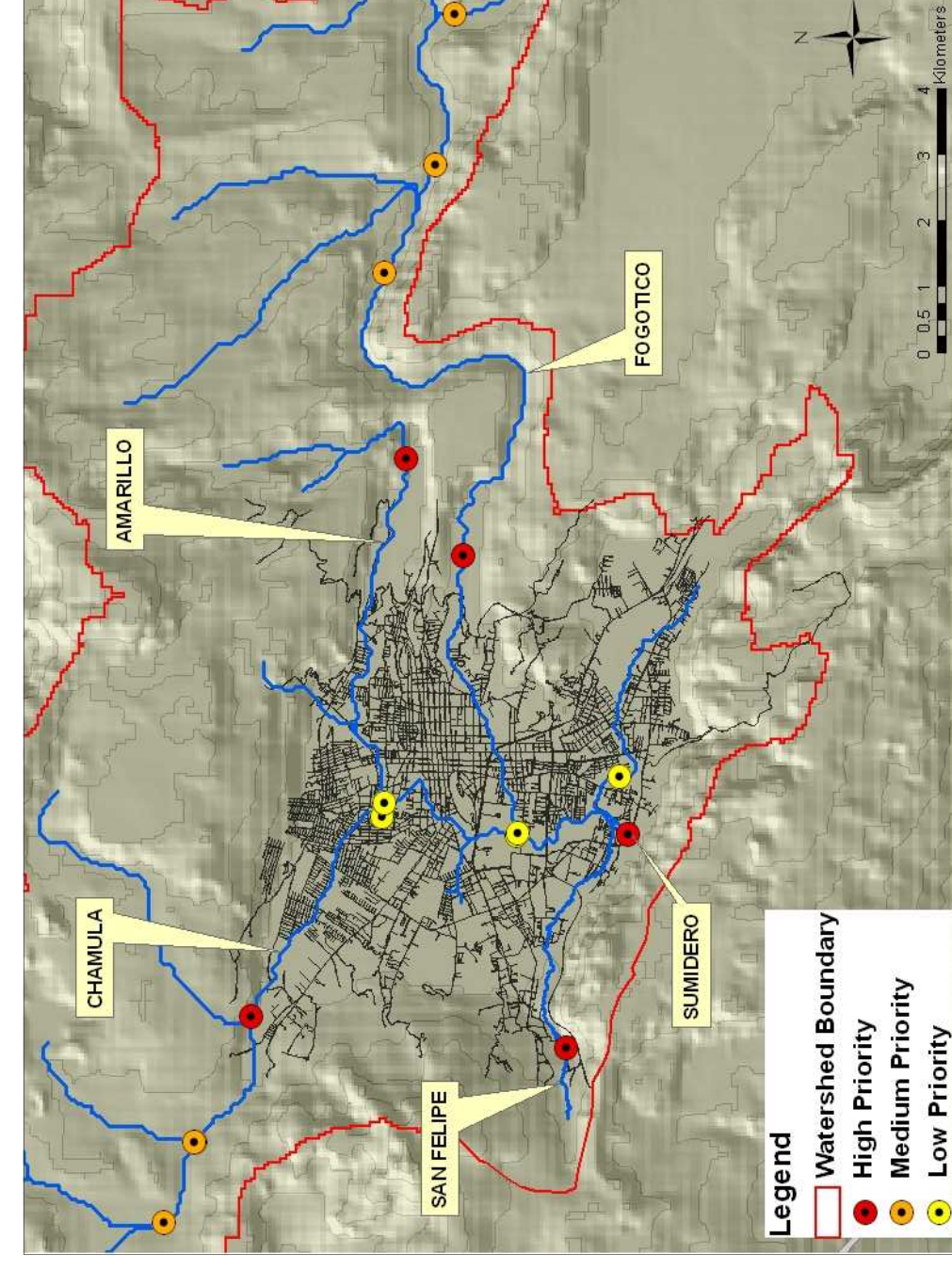
Communities outside the watershed who receive downstream contaminated water and use it for agricultural purposes.

## Primary Concerns

- Water quality
- Water quantity
- Access to water
- Sanitation

## Deliverables

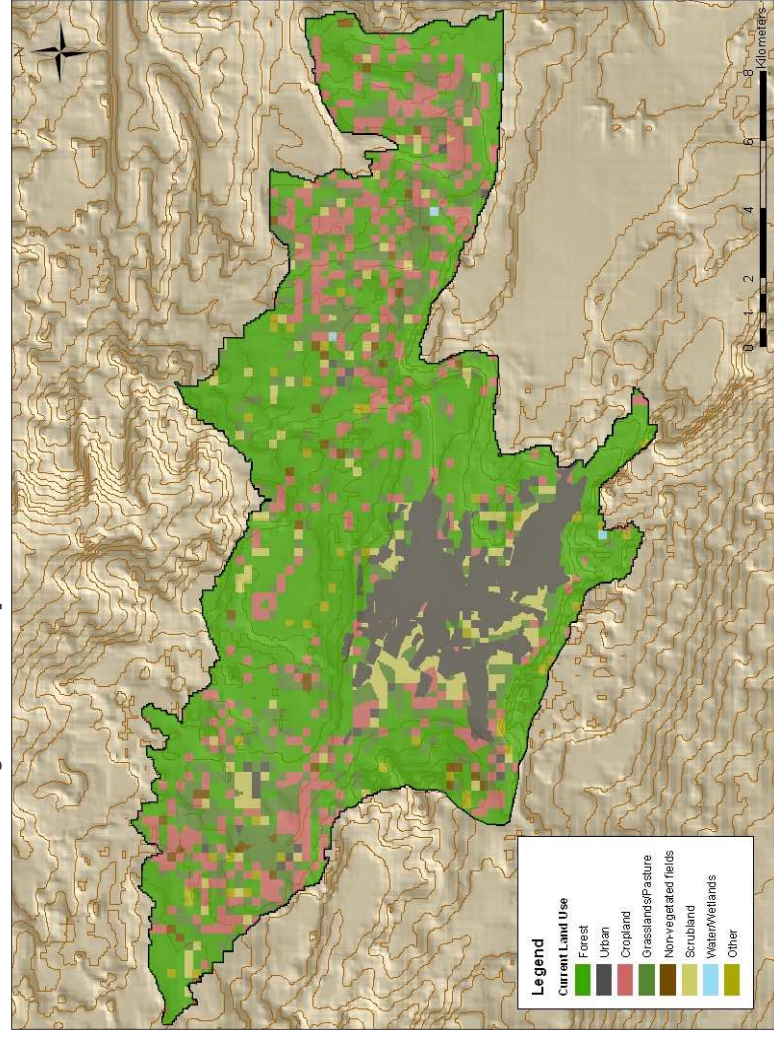
**1) Water Quality Monitoring Plan**  
A surface water monitoring program was designed for the watershed in order to provide a better understanding of the sources, amounts, movement, and fluxes of contaminants in the region.



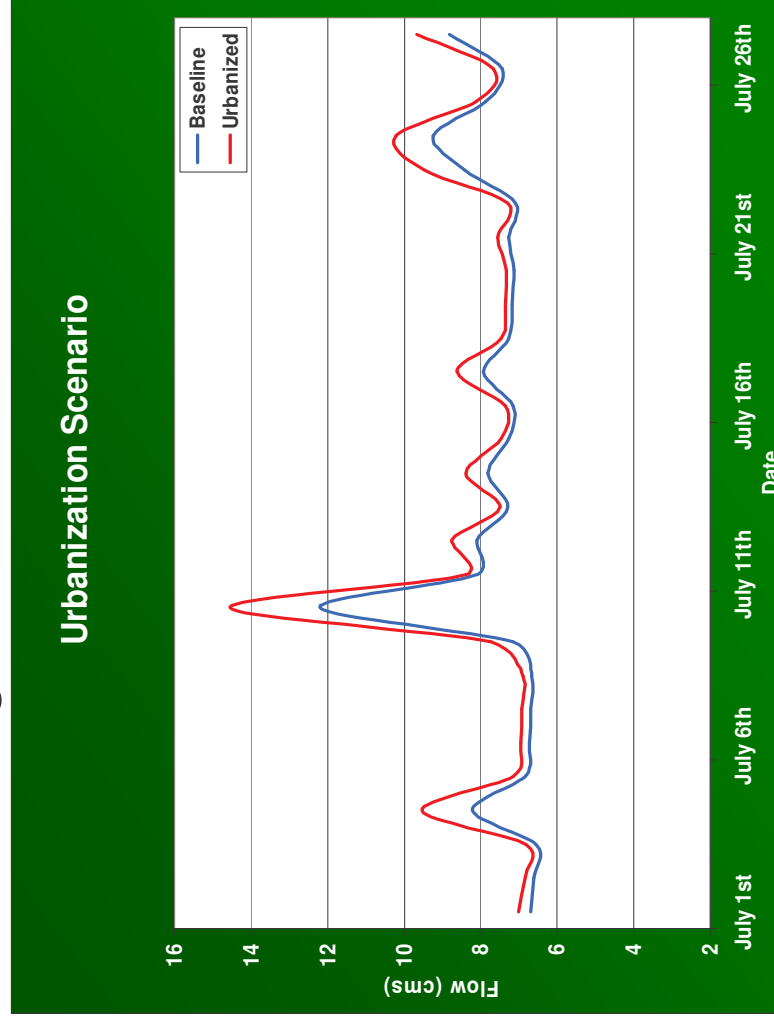
Monitoring points grouped by order of priorities.

## 2) Watershed Model

Modeling the watershed allowed for the integration of available data into a unified framework for understanding water flow and transport of pollutants within the watershed. The model will be augmented and utilized by our partners to evaluate various management scenarios.



Current land use in the watershed.



Flow variation caused by land use change

## 3) Best Management Practices

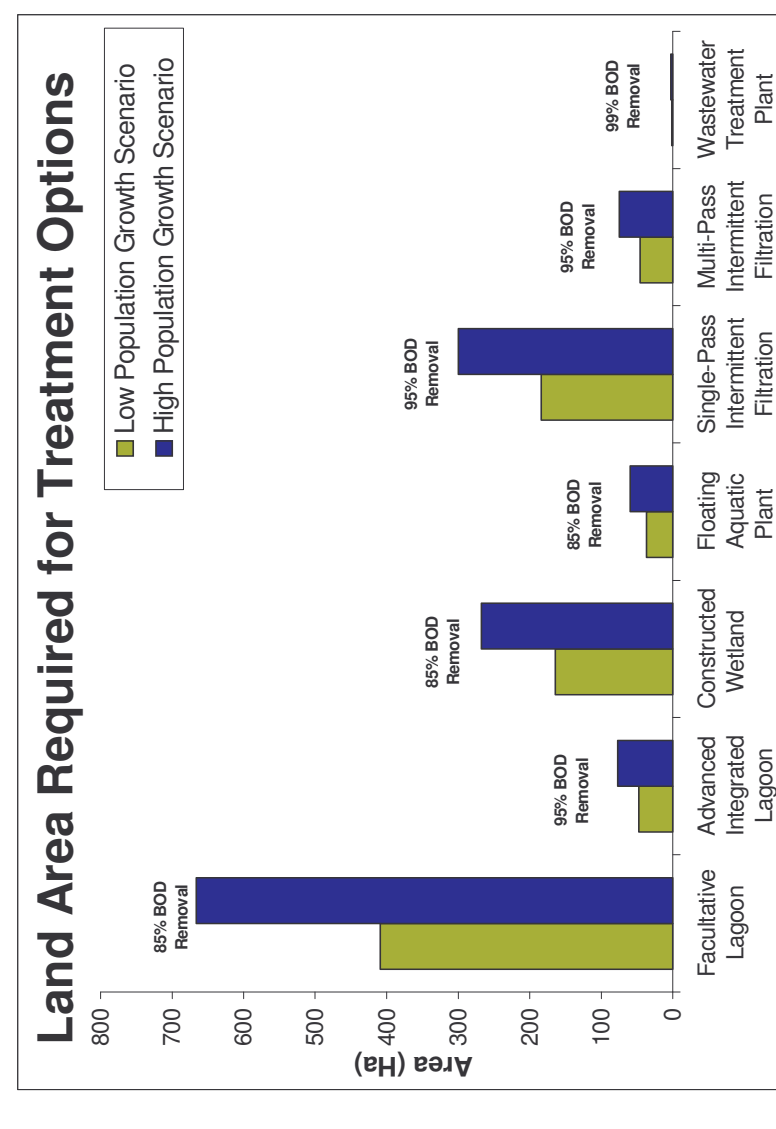
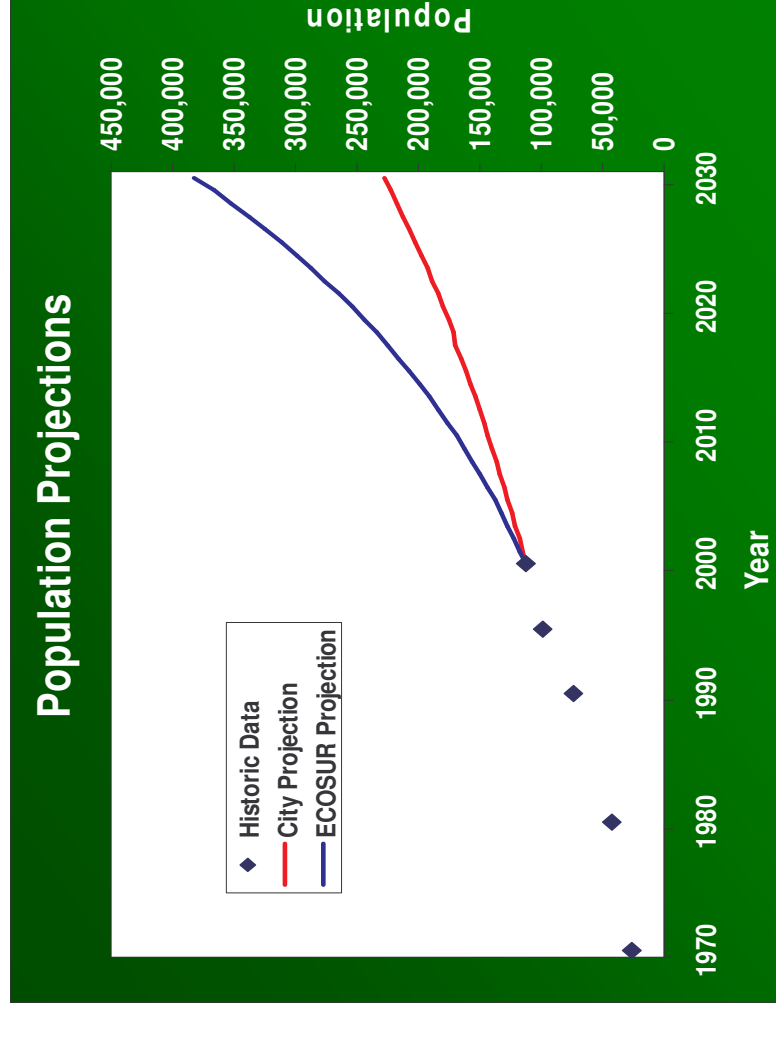
Twenty-five BMPs were evaluated based on effectiveness (towards meeting a primary goal and alternative benefits) and feasibility (cost, physical requirements and local considerations). The following BMPs were recommended for a pilot project consideration:

- Contour water retention trenches
- Buffer zones and bioswales
- Rainwater harvesting
- Composting latrines
- Retention basins
- Educational campaigns.

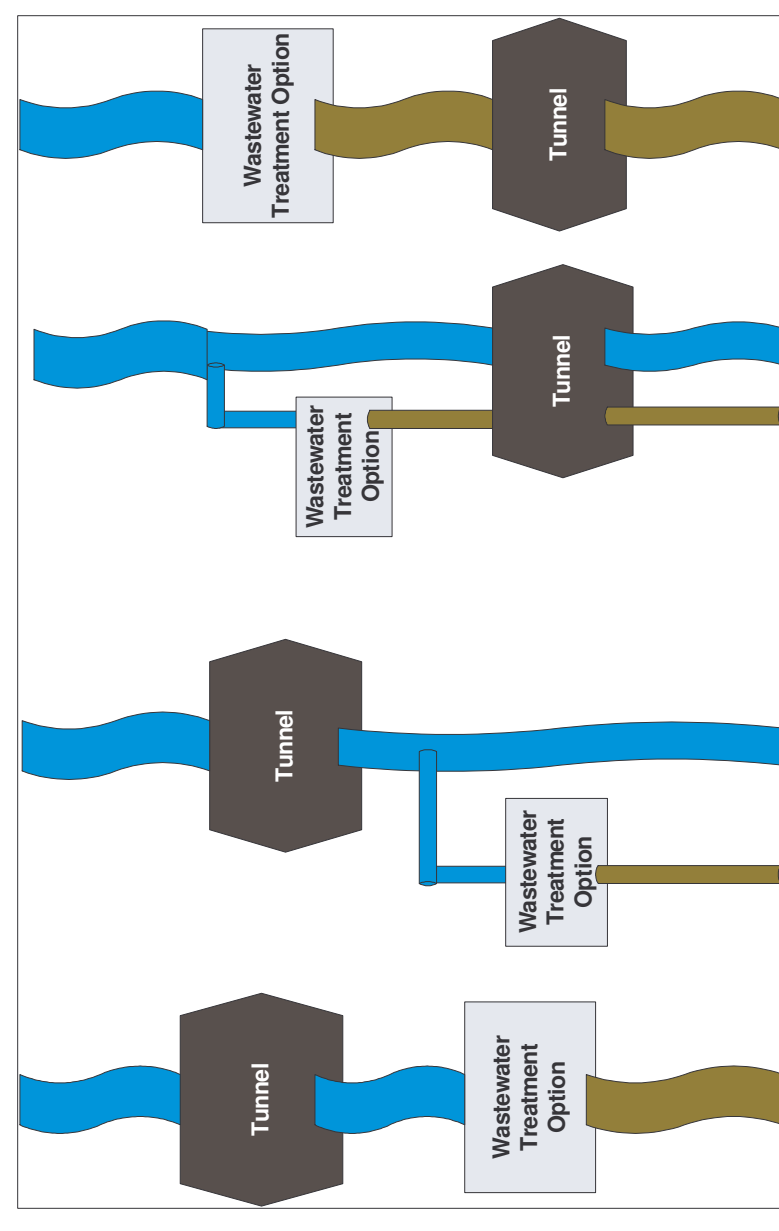


## 4) Wastewater treatment options

In order to meet national water quality standards, treatment of the municipal wastewater load is required. A variety of treatment systems were evaluated based on preliminary design criteria needed to effectively treat the current load, as well as the load under two likely population growth scenarios.



There are four scenarios under which each treatment option can be considered as depicted in the figure to the right.



## Recommendations

- Implement the water quality monitoring plan.
- Establish pilot projects of selected BMP to determine local effectiveness and costs.
- Use preliminary design considerations to further explore advanced treatment lagoons, intermittent filtration systems, or modular treatment plants to treat the city's wastewater.
- Implement a water resources educational campaign.

## Partners



- SYJAC- Non-governmental organization primarily concerned with community development projects in San Cristóbal
- ECOSUR- Research university with a campus in San Cristóbal
- SAPAM - San Cristóbal municipal water and sewage system utility

**Group Members:** Karin Bencala, Rolf Hains, Eric Liu, Theresa Nogueire, Dan Segan, and Samantha Stevens  
**Advisor:** Arturo Keller

For more information visit : <http://fiesta.bren.ucsb.edu/~chiapas/>  
Or contact: [Chiapas@bren.ucsb.edu](mailto:Chiapas@bren.ucsb.edu)