

The Lake Tahoe Water Clarity Model

Lake Tahoe is world renowned for its striking blue color and amazing clarity. In fact, the US Environmental Protection Agency (USEPA) has granted Tahoe the status of Outstanding National Resource Water (ONRW). This designation affords the highest level of protection, strictly forbidding degradation of water quality. However, since 1968, there has been a decline of Lake Tahoe's clarity at an alarming rate of nearly one foot per year (measured by lowering a dinner plate sized disk, known as a Secchi disk, into the lake until it is no longer visible). Many factors have interacted to degrade the Lake Tahoe Basin's environmental quality. These factors include increasing resident and tourist populations, habitat destruction, air pollution, soil erosion, roads and road maintenance, and loss of natural landscapes capable of detaining and infiltrating rainfall runoff. Subsequently, the lake has become impaired.

Total Maximum Daily Loads (TMDLs) are water quality restoration plans required by the federal Clean Water Act to ensure that water quality standards in impaired water bodies are achieved and beneficial uses are restored and protected. The Lake Tahoe Water Clarity Model is being developed to support the TMDL process. Data generated from the model will be used to calculate the TMDL for Lake Tahoe. Specifically, the model will be used to help answer the questions:

- How much pollution reduction is needed to restore Lake Tahoe's water clarity to its 1967-1971 average Secchi depth of 97 feet? and
- How quickly will water clarity be restored?

Water clarity depends on two factors, light absorption and scattering. In Lake Tahoe, light is absorbed by algae and dissolved organic materials. Algae need nutrients such as phosphorus and nitrogen to grow, linking water clarity directly to the levels of nutrients entering the lake through streams, runoff, and atmospheric deposition. Light scattering is caused by fine, inorganic particles that enter the lake in the same manner. Modeling these interactions is a challenging task.

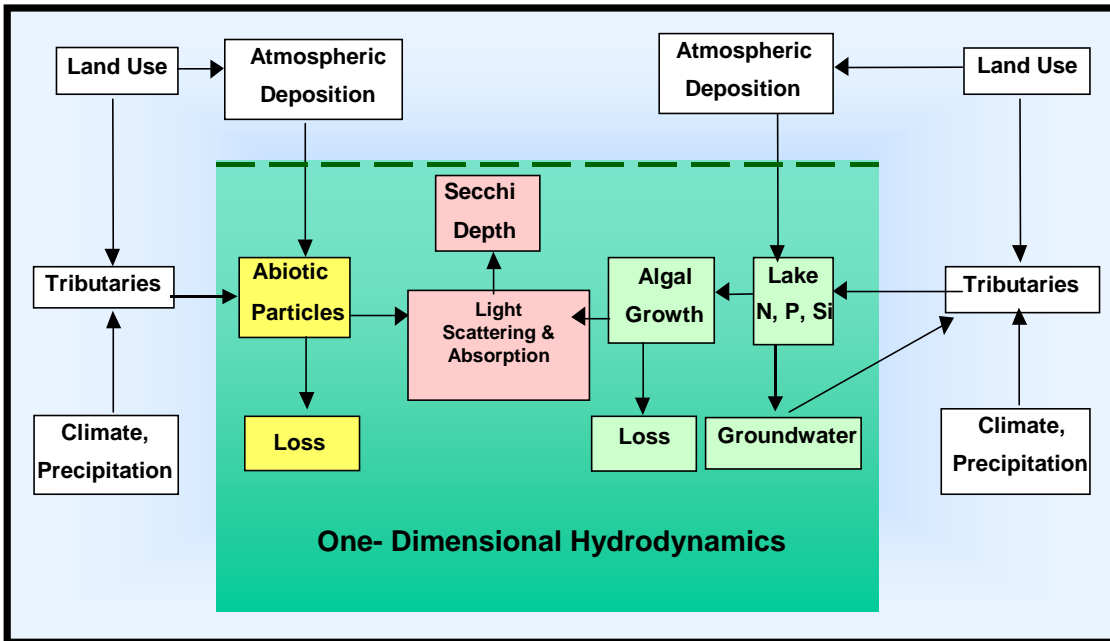
The model is a complex system of sub-models including the hydrodynamic sub-model, ecological sub-model, water quality sub-model, and optical sub-model.

- The hydrodynamic sub-model predicts the lake temperature layers and mixing produced by weather changes.
- The ecological sub-model represents the growth and uptake of algae within the lake as well as their release of nutrients and dissolved oxygen.
- The water quality sub-model represents nutrient cycling, dissolved oxygen swings, and how different classes of inorganic particles aggregate and settle within the lake.
- The optical sub-model uses the other sub-models' predictions of algal distribution and particle distribution to calculate the amount of light scattering and absorption within each layer of the lake.

The Lake Tahoe Water Clarity Model uses outputs from the Watershed Model as well as meteorological data including precipitation, temperature, wind speed, and radiation as inputs. Scientists from the Hydrologic Research Laboratory at the University of California at Davis (UC Davis) are using a state-of-the-art atmospheric model to provide meteorological data for use in

the Lake Tahoe Water Clarity Model. Data from the atmospheric model are also used to drive the Watershed Model.

Clarity Model Schematic



Under the leadership of Dr. Geoff Schladow, who developed the first iteration of the model in 1997, a team of researchers at UC Davis is developing the complex Lake Tahoe Water Clarity Model. It is scheduled for completion in the Spring of 2005.

For more detailed information about the model, refer to the Spring 2003 edition of the *Lake Tahoe Nutrient and Sediment Total Maximum Daily Load newsletter* (http://www.swrcb.ca.gov/rwqcb6/TMDL/Tahoe/Spring_2003_TMDL_Newsletter.pdf)

For additional information about the TMDL process and the models being developed to calculate the TMDL, contact Dave Roberts, Lahontan Regional Water Quality Control Board, at (530) 542-5469, droberts@rb6s.swrcb.ca.gov.

References

Lake Tahoe Nutrient and Sediment Total Maximum Daily Load, Spring 2003 Newsletter, Nevada Division of Environmental Protection and Lahontan Regional Water Quality Control Board, http://www.swrcb.ca.gov/rwqcb6/TMDL/Tahoe/Tahoe_index.htm

Personal communication, Dave Roberts, Project Lead, Lahontan Regional Water Quality Control Board, at (530) 542-5469, droberts@rb6s.swrcb.ca.gov.