

Clean Water Initiative Program



A landscape view of Lake Champlain from the sandy, tree-lined shore of North Beach in Burlington, Vermont on a partly cloudy day.

Modeled vs. Measured Phosphorus

Some waterbodies in Vermont have Total Maximum Daily Loads (TMDLs). TMDLs are plans required by federal regulation that set pollution reduction targets to meet water quality standards. Examples of common water pollutants include bacteria, nutrients like phosphorus, and sediment. Clean water projects that reduce water pollution help the state meet its TMDLs.

Scientists measure water quality indicators to document the health of a waterbody. In Vermont, waterbodies are monitored using the following types of indicators:

- ▶ **Physical** indicators: assess the physical characteristics of water. Examples:
 - **Clarity:** A measure of how far from the surface light can pass through the water column. Soil erosion and excess nutrients can reduce water clarity and impact water quality.
 - **Temperature:** The temperature of the water. Short and long-term changes in water temperature can impact water quality.
- ▶ **Chemical** indicators: assess the concentration of chemicals in water. Examples:
 - **Nitrogen and phosphorus:** These are naturally occurring nutrients in aquatic ecosystems. In excess, they can cause

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water quality problems. For example, excess phosphorus can cause cyanobacteria blooms.

- **pH:** A measure of how acidic or basic a substance is on a scale from zero to 14. Zero is the most acidic, seven is neutral, and 14 is the most basic. The U.S. Environmental Protection Agency states that 6.5 to 9 is the acceptable pH range for a freshwater body of water.
- ▶ **Biological** indicators: assess the health of aquatic ecosystems. Examples:
- **Algae:** Algae are organisms that occur as single cells, strands, or colonies. Algae use carbon dioxide and nutrients, such as nitrogen and phosphorus, to make their own food through photosynthesis.
 - **Bacteria:** Bacteria are small, single-celled organisms. Excess phosphorus can lead to cyanobacteria blooms. Cyanobacteria blooms can produce toxins that may be harmful to people, animals, and the environment.
 - **Invasive species:** Invasive species are organisms that are not native to Vermont. They outcompete native species and can negatively impact the economy, environment, and human health.

The State of Vermont Lakes and Ponds, Rivers, and Wetlands Programs monitor water quality. The State also supports local monitoring initiatives. Measuring water quality through monitoring is the ultimate indicator of clean water progress.

Vermont uses monitoring data to set up and calibrate models. For example, data from the Lake Champlain Long-Term Water Quality and Biological Monitoring Project served as inputs for the models that established the phosphorus TMDL for Lake Champlain. Data from the Lay Monitoring Program informed the phosphorus TMDL for Lake Memphremagog.

Scientists create models for many purposes. Models help estimate results when measured data is not available. For example, we use models where monitoring is cost prohibitive. In the Lake Champlain and Lake Memphremagog basins, we use models to estimate phosphorus reductions from clean water projects. Modeled estimates of phosphorus reductions provide a measure of progress in meeting the TMDLs. Models are a useful tool, but do not always capture real-world factors that influence water quality conditions, like climate change. Ongoing monitoring is important to ensure that models accurately describe on the ground conditions.

Measuring and modeling water quality are both key to managing Vermont's waters. These tools help us understand how pollution impacts our waters, how our waters are

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responding to clean water management efforts, and how we can further protect, enhance, and restore water quality across the state.

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