

# Introduction to Lake Capacity Modelling and the Factors Affecting Lake Capacity

**Key takeaway: Protecting lake water quality supports healthy ecosystems, recreation, and property values. The Lake Capacity Model provides a consistent, science-based tool to guide shoreline development while preserving lakes for future generations.**

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## What controls water quality?

Lake water quality is influenced by multiple interacting factors. Lake characteristics, such as size, depth, and shoreline complexity, affect internal processes including flushing rates and thermal stratification. Watershed features - such as the extent of wetlands, agriculture, and forest cover - control the amount of nutrients delivered to lakes (known as *catchment export*). Climatic factors, including storm intensity and seasonal variability, can further influence runoff, erosion, and nutrient loading.

## Phosphorus and water quality management

The Lakeshore Capacity Model (LCM) focuses on *phosphorus*, a nutrient linked to excess algal growth and water quality degradation in Ontario waters. Phosphorus can be linked to septic systems, soil erosion, vegetation loss, fertilizer use, and runoff from developed areas. Excess phosphorus in lakes can result in algal blooms, reduced water clarity, reduced deep-water oxygen concentrations, and the loss of cold-water fish habitat.

## What is the Lakeshore Capacity Model?

The LCM is a science-based planning tool developed to help protect lake water quality, particularly in deep, moderate-to-large Shield lakes with cold-water fisheries under development pressure. *Lakeshore capacity* refers to how much shoreline development can occur before water quality begins to decline.

The LCM estimates both baseline (pre-development) and current or future phosphorus concentrations to compare these values. A lake is considered “*at capacity*” when predicted phosphorus levels exceed an allowable threshold (a 50% increase above baseline). Lakes *below capacity* may accommodate limited additional development, while development on lakes at capacity is typically discouraged through Official Plans and by-laws due to the risk of water quality degradation.

The model includes several assumptions and limitations. It was calibrated for deep (>10 m), large (>25 ha), and clear (DOC <15 mg/L) Shield lakes, and its application to other lake types

has had mixed success. Phosphorus-based planning tools represent one of several strategies for protecting water quality, alongside septic inspection programs, lake monitoring (e.g., the Lake Partner Program), low-impact development practices, and responsible lot development - including minimized soil disturbance, appropriate septic placement, shoreline buffers, reduced shoreline hardening, and limited fertilizer use. Other lake-specific assessments, such as boating capacity or broader environmental studies, can also inform planning decisions.

### **What can Council do to support water quality management?**

1. Use land-use planning tools to limit impacts by incorporating lake capacity or other lake- or watershed-based assessments into Official Plans and zoning.
2. Establish protective development setbacks for shorelines, wetlands, floodplains, and riparian areas.
3. Require or encourage vegetated shoreline buffers. Shoreline buffers act as natural filters for phosphorus, sediment, and runoff. Limiting shoreline hardening, infilling, and dredging can promote good shoreline stewardship. Shoreline protection standards could be incorporated as part of Site Plan or Building Plan controls.
4. Support and strengthen septic management programs. Examples include mandatory septic inspections on a cycle, re-inspection at property transfer, and restricting development where soils or lot sizes are unsuitable for septic systems. Over time, septic system inputs will increase, even if the system does not fail. The efficacy of advanced treatment systems is also strongly influenced by appropriate installation and maintenance.
5. Climate impacts and resiliency should be incorporated into planning decisions. Climate change can influence water quality through more intense rainfall, longer warm-water periods, and hotter temperatures. Integrating climate decisions into planning could include promoting low-impact development, avoiding development likely to cause erosion or runoff, and protecting natural features that enhance watershed resiliency (e.g., wetlands, forested areas, and natural flow paths). Careful management of construction activities - such as sediment and erosion controls and minimized or phased site clearing - is critical to preventing short-term disturbances from causing long-term lake impacts, particularly under a changing climate.

### **What can residents do to support water quality management?**

1. Maintain and regularly inspect septic systems.
2. Keep or restore natural shoreline vegetation buffers.
3. Minimize soil disturbance and erosion near the water.
4. Participate in the Lake Partner Program or lake association monitoring.
5. Share lake stewardship information within the community (e.g., newsletters).