The Cumulative Effects of Forest Management on Self-sustaining Brook Trout Lakes – A Case Study

(Mike Wilton – www.algonquin-eco-watch.com)

(Algonquin Park is the only Provincial Park in Ontario where logging is allowed)

There are more than 250 identified self-sustaining (lacustrine) brook trout lakes in Algonquin Provincial Park –

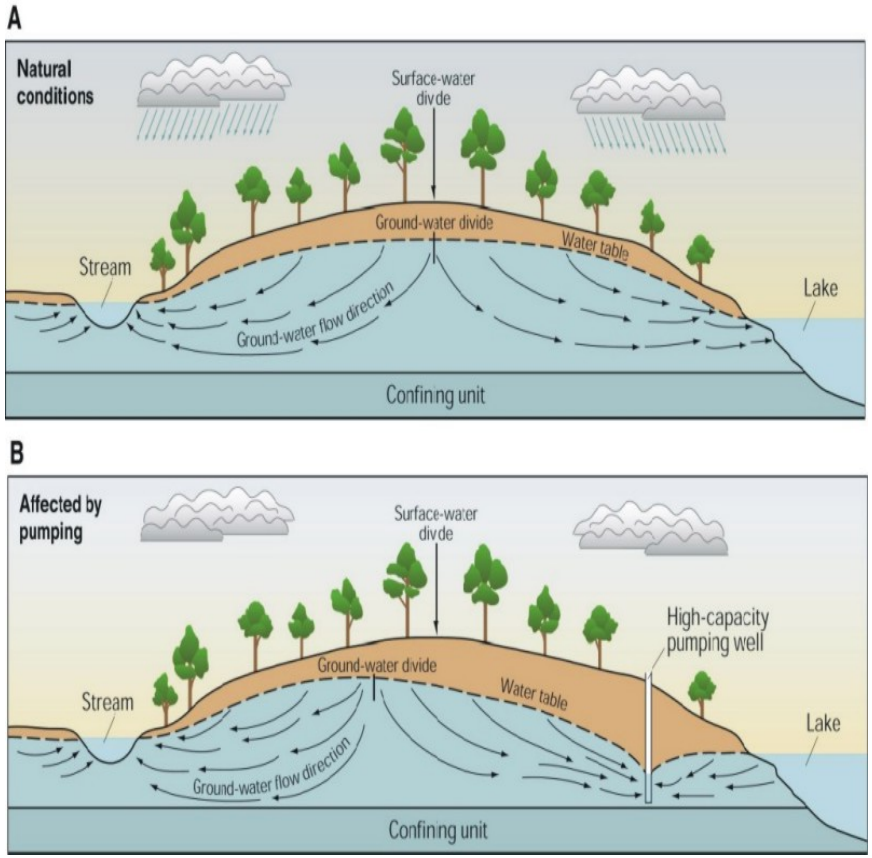
The highest concentration in the world.

Tiny headwater lakes like these require upwellings of cold groundwater through gravel substrate for spawning, plus inflowing coldwater “nursery “ creeks, to support self-sustaining brook trout populations.

Groundwater Follows the Earth's Natural Topography, also known as the "Nap 0f the Earth"

Groundfog follows the above ground natural topography (below).

Similarly, if undisurbed, groundwater follows the natural topography below the surface of the ground ("A" below). When disturbed however, the groundwater seeks a new level ("B" below).



Groundwater Follows the Nap of the Earth*

*From "Freeze and Cherry, 1979".

Let us consider the two-dimensional, vertical cross section of Figure 6.1. The section is taken in a direction perpendicular to the strike of a set of long, parallel ridges and valleys in a humid region. The geologic materials are homogeneous and isotropic, and the system is bounded at the base by an impermeable boundary. The water table is coincident with the ground surface in the valleys, and forms a subdued replica of the topography on the hills. The value of the hydraulic head on any one of the dashed equipotential lines is equal to the elevation of the water table at its point of intersection with the equipotential line. The flowlines and equi-

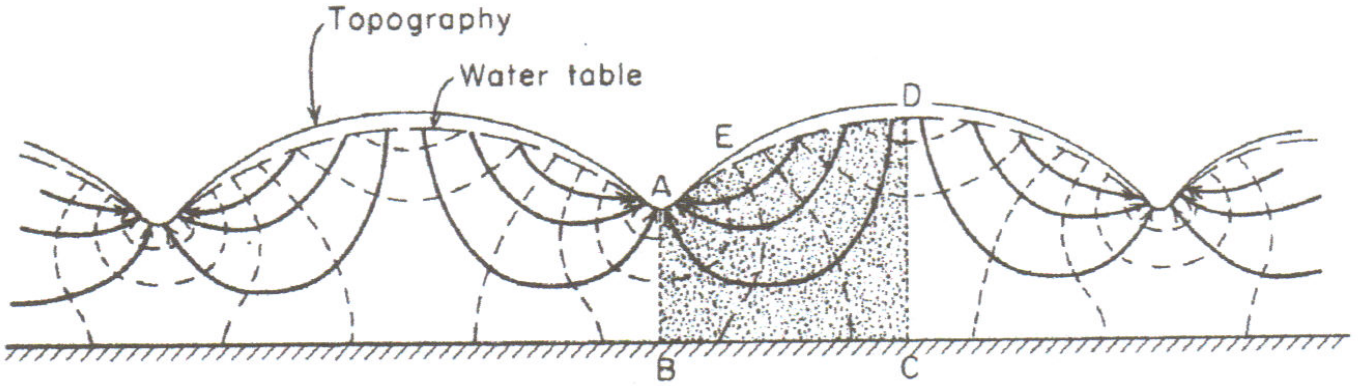


Figure 6.1 Groundwater flow net in a two-dimensional vertical cross section through a homogeneous, isotropic system bounded on the bottom by an impermeable boundary (after Hubbert, 1940).

Groundwater Will Always Seek Its Own Level

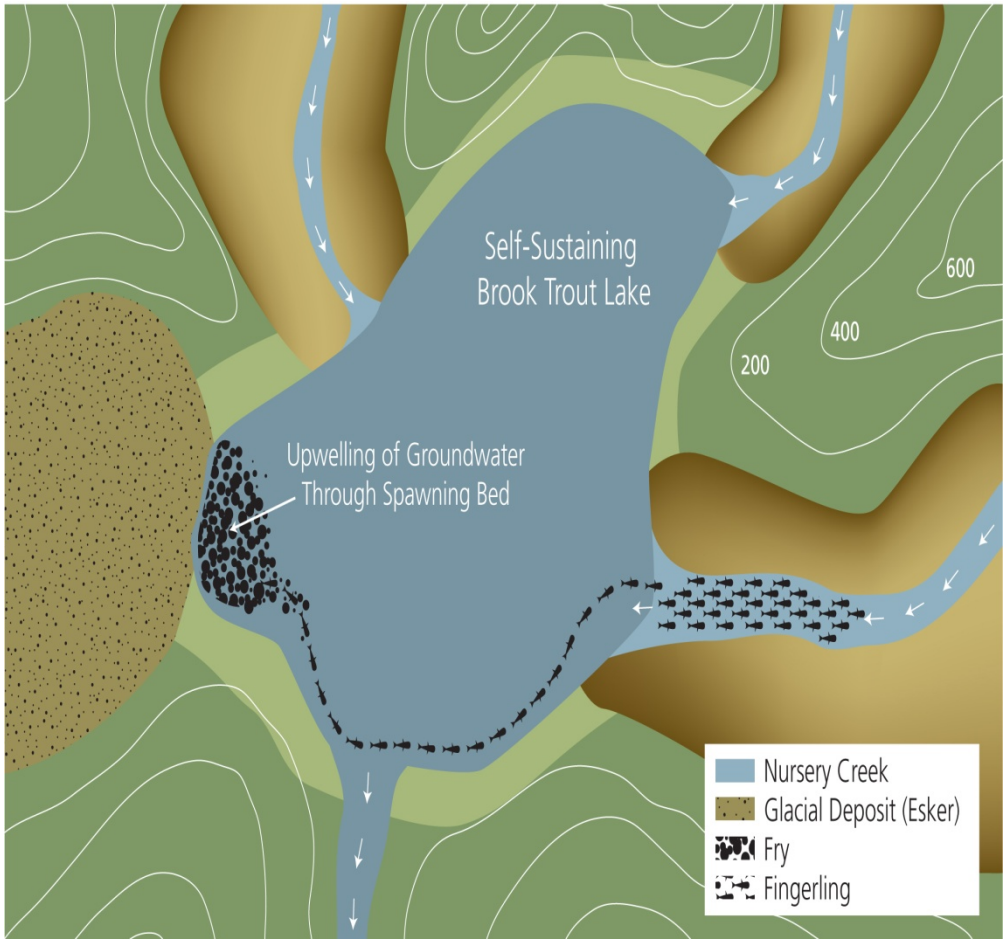
Layered Fractured Granite illustrating interrupted groundwater flow.

Layered Fractured Limestone illustrating interrupted groundwater flow.

Self-sustaining Headwater Brook Trout Lakes

Stylized self-sustaining (lacustrine) brook trout lake showing spawning bed provided by groundwater upwelling via a lens through clean gravel (aggregate), which is necessary for successful spawning of brook trout. Also, an inflowing nursery creek, which is beneficial for upstream migration of fry to avoid predation during their first year of life.

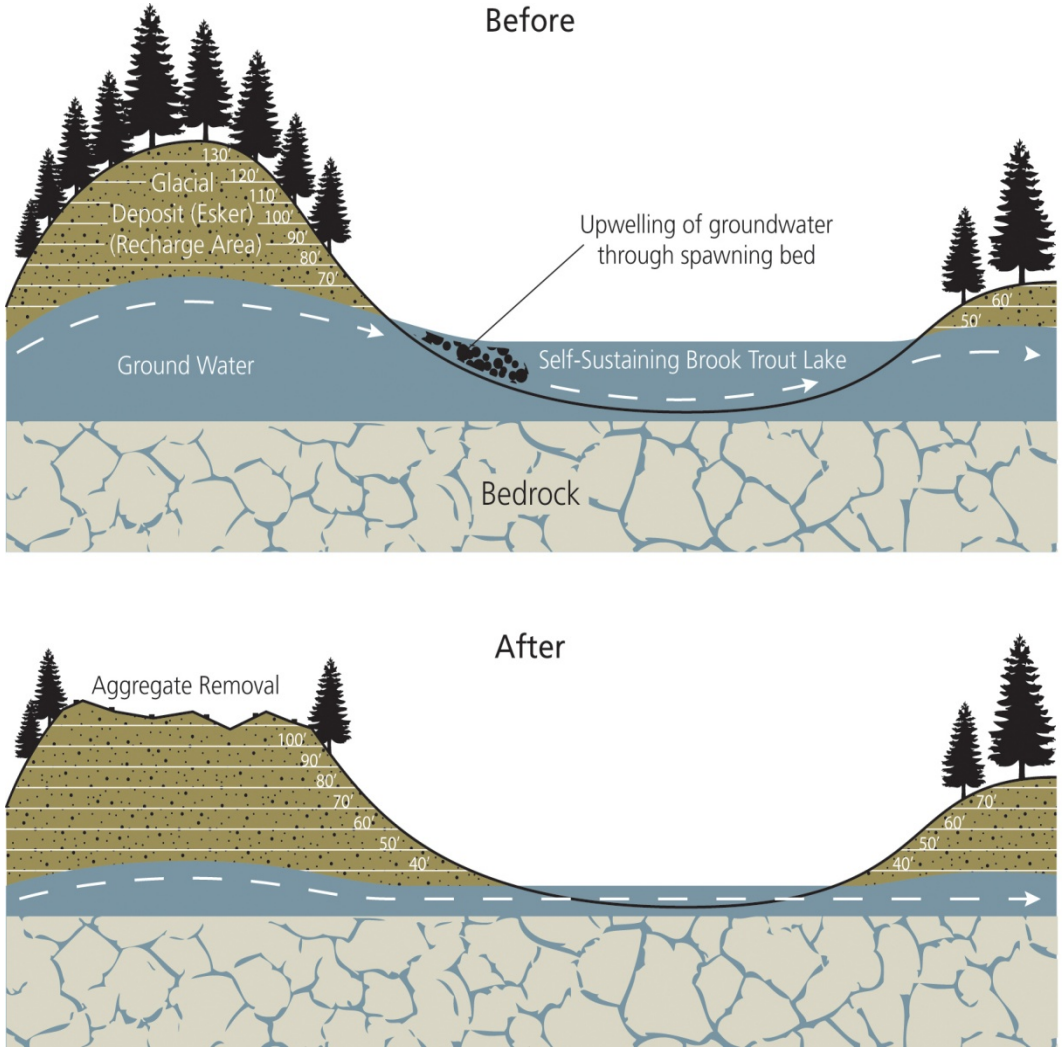
Actual Algonquin Park headwater lake (centre , facing north) located at a height-of-land. No visible above-ground inflow; year-round outflow to the south. Expected groundwater source from glacial deposit (esker?) at northwest corner of lake. Lakes to the north flow northward. Spills from logging haul-road around lake margin could result in long-term pollution owing to low flushing rate in headwater lakes, which by definition, are situated at upper end of flowage.



Headwaters sourcing from surface water (left) often give rise to “warmwater” creeks, while headwaters sourcing from groundwater (right) usually give rise to “coldwater” creeks. Active coldwater nursery creeks may have an above ground flow of less than 1 litre per minute. Disturbance of any kind may disrupt this flow.

EFFECT OF AGGREGATE REMOVAL ON GROUNDWATER FLOW

STYLIZED SCENARIO: When vegetation and mass are removed from a glacial aggregate source supplying groundwater to a self-sustaining brook trout lake, lowering the nap of the earth results in a lower water table, which in turn diminishes groundwater flow necessary for successful brook trout reproduction and rearing.



Actual Example: Recurrent heavy logging and aggregate removal adjacent to this Algonquin park headwater lake will inevitably result in cumulative reduced groundwater flow, as well as higher water temperature. (See next slide)

Serious Lack of Headwater Protection

Red pine seed tree logging together with an elevated aggregate pit located closely adjacent to this Algonquin Park headwater lake. Repeated extraction of timber and aggregate over time will inevitably result in cumulative groundwater flow reduction. (See adjacent photo)

Seen from ground level, it can be better understood why the continued mining of this aggregate source will negatively affect the adjacent groundwater table significantly.

Some Cumulative Effects of Logging on Self-sustaining Brook Trout Lakes Through Repeated Logging Rotations

-Stream and lake sedimentation (from machinery disturbance).

-Water temperature elevation (from canopy removal).

-Soil compaction (from heavy machinery).

-Rutting (from heavy machinery).

-Calcium loss (from airborne pollutants on non-buffered granitic soils), resulting from repeated logging extraction.

-Aggregate mining (for road building and maintenance).

-Soil pollutants (from diesel fuel, coolant, hydraulic fluid).

- Elevated conductivity (from winter road salt).

What's the Solution?

The only certain way to ensure sustainability of self-sustaining (lacustrine) brook trout lakes in protected areas such as Algonquin Provincial Park, is to prohibit all logging and associated operations within the encircling catchment basin.