

# Potential effects of lowering the water level of Magaguadavic Lakes

## Introduction

This report was commissioned by the Magaguadavic Lakes Association (MLA) and relates to the status of the Magaguadavic Lakes (Little and Big Magaguadavic). Their water levels are regulated by a dam at the mouth of the Magaguadavic River in accordance with a 1978 Watercourse Alteration Permit. The MLA communicates with the owners of the dam, J.D. Irving Limited (JDI), about its operation. Most years, after the spring freshet is over (late April early May), JDI will close all but 1 gate in the dam. Historically this has worked fairly well with keeping the lake at a reasonable level into July and August, depending on rainfall amounts. This also helps with trying to keep the level somewhat consistent during the month of June during the critical nesting phase for loons. The MLA has been asked if the lake can be kept at a lower level than before so that more land can be freed up for beach use around the lake. In order to evaluate potential ecological effects of a lower water level in summer this report summarizes findings from the scientific literature and describe experiences from other lakes where water level has been drawn down.

## Effects of water level changes.

Changes in water level have been shown to influence pretty much all aspects of the lake ecosystem. Effects of water level changes have been observed in water quality (including for example salinity<sup>1</sup>, pH<sup>3</sup>, nutrient concentration<sup>1,2</sup>, and Secchi depth<sup>4</sup>), aquatic plants<sup>5</sup>, benthic macroinvertebrates<sup>3,6</sup>, fish<sup>7,8</sup>, algae & cyanobacteria<sup>1,2,9</sup>, and even the bacterial communities affecting the cycling of carbon dioxide to and from the lake<sup>10,11</sup>.

However, the specific effects of lowering the lake level are very hard to predict because they are influenced by a number of other factors such as the timing and amount of water level change, size and depth of the lake, its nutrient status, climate and more.

Some of these factors are to some extent under your control because they are determined by how you go about your water regulation: It matters whether the level change is permanent or if the regulation leads to water level variation within a year or between years. For non-permanent changes the impacts will vary depending on during which season you lower the water level. Finally, the amount and rate of change also matters. A large and rapid change in water level is more likely to have noticeable effects than a small one. What is considered a large change depends on the lake. Changing the water level by one metre is likely to have much bigger effects in a small and shallow lake than in a large and deep lake. Magaguadavic Lake is not very small, but it is shallow and therefore relatively sensitive to water level changes.

## Plants.

The effects of lowering water levels manifest on several time scales. Immediate impacts of lowering water levels in summer will be that aquatic plants which are most common near shore, in shallow waters, will desiccate and die. The vegetated near shore habitat is typically the host of the highest biodiversity found in lakes and has importance for both lake- and land-living animals<sup>12,13</sup>. However, the long-term outcome for aquatic plants is not necessarily straight forward. The reduced water level may lead to plant colonisation of areas that were previously too deep and the long-term effects are therefore hard to predict. Shallow and nutrient rich lakes can range from turbid with high algal concentration and few plants, to clear water with very rich thick stands of water plants, or anything in between. Sometimes the same lake can move from having many plants to few, from clear to turbid or vice versa and one potential factor that can cause such a change is alterations of lake water level<sup>1</sup>.

## Water quality and algae

Lowering the lake level in summer often results in higher nutrient concentrations, higher phytoplankton biomass and lower water transparency<sup>1</sup>. This means that the risk for algal blooms is likely to increase as a result of a lower water level. In a shallow lake like Magaguadavic the lowered volume is likely to lead to higher temperatures during summer, further increasing the risk for algal blooms<sup>2</sup>. If submerged plants end up increasing in more central parts of the lake, they may dampen the risk of increased algal growth because they compete with the algae and promote biodiversity. Submerged plants are, however, often considered a nuisance by those who wish to use the lake for recreational boating etc.

Turbidity may also increase because a larger portion of the lake becomes more sensitive to resuspension of sediments by boating if the lake level is lowered.

## Fish.

Many fish species use the near shore vegetated zone for spawning. The timing of water level change will determine the effect on fish spawning in any given season. Species that may be sensitive into early summer include alewife, bass, some shiners and pumpkinseeds. Plants also provide shelter and foraging for most fish species throughout the summer and loss of this habitat has been shown to have negative effects<sup>14</sup>. In nutrient rich lakes, the combination of lowered water level, increased temperature and algal blooms has been known to cause fish kills in large shallow lakes<sup>7,8</sup>.

## Birds

Birds that use the nearshore vegetation for nesting will also be immediately affected as their nesting is likely to fail. The most sensitive species include protected species such as loons and grebes. In addition to effects on

nesting, other birds such as ducks, feed on shore plants and the insects that live on them and may be negatively affected by a reduction of submerged plants.

### Invertebrates

Many small animals are tied to aquatic vegetation and the sediment. When this habitat dries out most of them have limited ability to relocate and will die. Examples of sensitive aquatic species include insect larvae and mollusks such as freshwater mussels and snails. These types of animals are an important food source for fish.

### Potential setbacks on recovered areas

In many lakes where water levels have been lowered many years, the recovered land has compacted and been reflooded<sup>15</sup>. This happens if near shore sediments are rich in organic material. When exposed to air, these can oxidize, decompose and slump. Hence, there is a possibility that intended effect can be counteracted and the exposed shoreline reflooded.

There are also cases where the land recovered has been rapidly infested with reeds<sup>16</sup>.

### Conclusions and recommendations

When the outcome of a suggested action, such as the lowering of the lake levels in summer, is likely to be both profound and unpredictable, my experience is that it is sound advice to caution against it unless there are some very pressing reasons calling for the change in regulation. Even though the actual outcome of a lowering of the water level in Magaguadavic Lakes during summer is hard to predict, it is fair to say that most experiences and studies from other lakes suggest that the effects will be negative for lake health and wildlife.

The most important potential effects to point out are:

- a negative effect on the protected nesting of loons
- a lower resilience to climate change and warmer water in the summers
- a higher risk of algal blooms.

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