# Causes and consequences of algal blooms in Loch Logan, an urban impoundment

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## Abstract

Loch Logan is situated at the "Waterfront" in the city centre of Bloemfontein. During the rainy season it collects stormwater from the surrounding catchment areas as well as other urban runoff water. During summer, Loch Logan frequently experiences algal blooms. The system can be classified as eutrophic due to high dissolved reactive phosphate ($PO_4$-P) and chlorophyll-*a* (Chl-*a*) concentrations. Nitrogen is probably the limiting factor to algal growth. The consequences of the eutrophication are algal blooms, oxygen depletion, fish kills, excessive macrophyte growth, odour problems and extreme oscillations occur in physical and chemical parameters.

**Keywords:** impoundment, nutrients, nitrogen, phosphorus, oxygen, pH, bacteria, chlorophyll-*a*, algae.

## Introduction

Impoundments within South African towns and cities are not recent developments. For example, Zoo Lake in Johannesburg is a man-made impoundment that was built during the first decade of the 20th century. Additionally, natural water bodies, such as pans and vleis, have been gradually surrounded by urban development in certain cities (e.g. North End Lake, Port Elizabeth) and these have also become important aesthetic and recreational attractions for urban residents. More recently, commercial and recreational developments have increasingly been built with impoundments as their central feature, e.g. Bruma Lake and the Brightwater Commons (formerly the Randburg Waterfront) in Johannesburg (Freeman et al., 2000).

Local authorities provide urban impoundments primarily for recreational purposes, stormwater control, and to improve the psychological well-being of city dwellers by relieving the pressure of modern urban life (Wiechers et al., 1996).

Water quality problems associated with urban impoundments are also not something new, e.g. Jan Smuts Dam in Brakpan has a documented record of such problems stretching back to 1940. Unfortunately many urban impoundments act as receptacles for upstream waste, resulting in silted up impoundments. The impoundments' enrichment with plant nutrients (referred to as eutrophication) often leads to the associated growth of undesirable algae and water plants, increased health risks due to bacteriological contamination; and aesthetic problems such as unsightly algal scum, floating debris and malodours (Freeman et al., 2000) – see Photograph 1.

Because of these problems, what should be a public asset can turn into a liability. Even more seriously, it can pose a health risk. Such water quality problems also tend to be accentuated in urban areas where man's activities are wide-ranging, densely concentrated and frequently culminate in the generation of numerous waste streams, which may enter watercourses (Freeman et al., 2000).

***Photograph 1***
*Intrusion of Kikuyu grass and undesirable growth of* Lemna gibba *(duckweed) and* Azolla filiculoides *(red water fern) in Loch Logan, Bloemfontein*

Natural processes of rainfall, erosion and solution, evaporation, and sedimentation regulate the chemical composition of natural waters (Horne and Goldman, 1994). Climate affects water quality in a number of ways. For instance, temperature determines the rate and extent of various chemical interactions. Mean annual rainfall and seasonal differences in rainfall; determine the amount of water flowing in rivers or entering wetlands and lakes at different times of the year. Therefore, these factors also determine the degree of dilution of natural chemical constituents and of pollutants. Evaporation, on the other hand, concentrates dissolved substances in the water.

It has been well known even before 1960 that urban stormwater discharge may contain high concentrations of a wide variety of potentially toxic chemicals. However, the chemical forms in which those contaminants exist and the duration of exposure that aquatic life would receive from such discharges are such

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