Executive Summary

Increase in nutrient concentrations in surface waters can contribute to increased growth of algae and aquatic macrophytes and distinct shifts in species composition. In some systems, blooms of cyanobacteria contribute to a wide range of water quality problems including summer fish kills, foul odours, and tainted drinking water. Furthermore, certain cyanobacteria produce and release toxins that can kill livestock and may pose a serious health threat to humans.

In an effort to develop national environmental quality guidelines for phosphorus, the "Canadian Guidance Framework for the Management of Phosphorus in Freshwater Systems" was developed by the Canadian Council of Ministers of the Environment (CCME, 2004; Environment Canada, 2004). The framework discussed the potential of developing ecoregion-based phosphorus guidelines in the context of overall management of phosphorus in freshwater systems because regional differences exist in geology, soil, vegetation and climate and that these factors may influence water quality.

This study was initiated to investigate the feasibility of developing ecoregion-based phosphorus guidelines in Canada by using Ontario as a case study. Ontario provided a suitable combination of variation in geology, soil types, and anthropogenic influences, coupled with a good database of phosphorus measurements, to test the feasibility of developing ecoregion-based phosphorus guidelines. Nutrient data from a variety of sources was collected, assessed and screened for quality. Relationships between phosphorus and other descriptors of water chemistry were also examined. Subsequently, spatial variations in phosphorus concentrations in rivers and lakes of Ontario were identified, and the variance in phosphorus levels between and within ecozones and ecoregions was measured.

The 25th percentile classification reduced the influence of human sources and allowed for the successful classification of ecoregions on the basis of estimated reference (natural baseline) phosphorus concentrations. The data analysis identified significant variance in phosphorus concentrations in both the lake and river data-sets that could be explained by classifying them into one of three "ecozones" (Hudson Plains, Boreal Shield, and the Mixed Wood Plains) for the Province, or into the fourteen "ecoregions". The ecoregional phosphorus concentrations were within the trophic state categories proposed in the phosphorus framework.

The ecoregion concept is feasible as a means of classifying natural trophic status of lakes and rivers, and is proposed as a means of identifying "trigger ranges" in phosphorus concentration that would stimulate further assessment. However, the approach may not provide sufficient resolution of phosphorus concentrations to serve as the sole basis for nutrient management. Finer resolution may be useful to limit changes in trophic status, or to identify surface waters where phosphorus has increased by 50% above background. It may be possible to improve the resolution of the variance in phosphorus concentrations within ecoregions by incorporating data

from the bedrock and surficial geology, GIS mapping of wetlands, and lake surface and watershed areas.

The ecoregion approach is proposed as a means of estimating the reference or "background" phosphorus condition, of differentiating between natural and anthropogenic contributions to nutrient enrichment; of selecting region specific trigger ranges; and therefore contributing to improved assessment and development of management tools. The phosphorus ecoregion approach is not intended for use as the only tool in assessing and managing eutrophication. However, it is an initial screening step that managers may find useful when applying it within a tiered approach developed for managing phosphorus in surface waters.