Chapter 6: Recommendations

The Synoptic Water Quality Investigation provides important information regarding current limnological conditions and limnological trends within the Finger Lakes. Findings from this investigation indicate substantial changes over the past several decades. However, important questions remain unanswered, and additional study is warranted as follows.

First, given the importance of these lakes to the Finger Lakes Region and New York State as a whole, and observed changes to date, it is recommended that the Long-term Synoptic Investigation continue for several more years. Continued study of the Finger Lakes should prove valuable in several regards, including: (a) evaluating the influence of anthropogenic activities within the Finger Lakes Region, (b) assessing the influence of exotic flora and fauna within the lakes (e.g., zebra mussels, spiny water flea, milfoil, etc.), (c) providing a sound statistical basis upon which to assess water quality trends within the Finger Lakes – natural inter-annual fluctuations necessitate long-term data sets, (d) assessing resultant water quality benefits derived from environmental management initiatives such as the 1996 Environmental Bond Act expenditures, lake/watershed management plans, best management practices, etc. and (e) providing valuable information in development of nutrient criteria for the state and/or ecoregion. Finally, as indicated by Birge and Juday nearly a century ago, this series of lakes provide an ideal laboratory for understanding limnological concepts.

Second, it is recommended that the Long-term Synoptic Investigation be expanded to encompass biotic indices for the Finger Lakes. By-in-large this investigation has focused upon chemical and/or physical parameters, with only a cursory look (e.g., chlorophyll *a*) at the biological components of the lakes. While there has been a parallel study ongoing within the western 7 Finger Lakes by the agency's Region 8 Fisheries unit which has involved additional biotic indices (e.g., zooplankton), it would clearly be beneficial to expand biotic monitoring to all 11 of the Finger Lakes and to add additional biotic indices. Additional biotic indices of interest include: (a) P*hytoplankton* – which represents the top of the food web for freshwater systems, and can provide valuable insight regarding the stability of the aquatic food web; (b) M*acrophytes* – several of the Finger Lakes are adversely effected by excessive growth of certain aquatic plant species which can interfere with certain uses of the lakes. Thus, a sound understanding of macrophyte coverage and dynamics within the lakes would be a valuable addition to the water quality investigation of these lakes; (c) *Bacteriological* – the Finger Lakes are used extensively as a source of drinking water and for primary contact recreation (e.g., swimming). Thus, it would be prudent to include systematic study of bacteriological and pathogen levels within the lakes. This should focus upon near shore areas and areas proximate to public water supplies and/or public beaches; (d) *Zebra mussels* – as discussed above, Zebra mussel infestation within the Finger Lakes may result in significant changes in both chemical cycling and ecosystem dynamics within the Finger Lakes. Therefore, it is suggested that a monitoring program be initiated within the Finger Lakes to track Zebra mussel infestation within the lakes. This should involve monitoring of both veligers and adult populations, and should parallel study of limnological conditions within the lakes; and (e) Other exotic flora and fauna – a number of other exotic species have become established within the Finger Lakes which should be monitored on a periodic basis.

Third, the apparent dichotomy in trophic response to nutrient load reductions between large and small lakes should be investigated more fully. It is recommended that efforts be made to assess nutrient loading reductions within the Finger Lakes watersheds (or a subset thereof) during the last several decades, and to assess whether those reductions have resulted in concomitant improvements in lake water quality. In addition, an assessment should be made of internal phosphorus dynamics within several of the smaller Finger Lakes, in an effort to understand the interplay between hypolimnetic dissolved oxygen levels and the release of phosphorus from benthic sediments.

Fourth, given that Conesus Lake, Honeoye Lake, and, on occasion, the southern end of Cayuga Lake exceed the New York State total phosphorus guidance value of 20 ug/l, efforts should be made to reduce phosphorus loading to these waters. Where best usage of the waters is impaired or precluded, a Total Maximum Daily Load (TMDL) should be developed to redress the water quality impairment condition(s).

Fifth, given the extensive use of the Finger Lakes for water supply, it would seem warranted to assess trihalomethane (THM) formation potential within these important water sources. THMs are a class of chlorinated organic contaminants which are under increasing scrutiny by public health agencies due to their potential cancinogenic properties and other possible health effects. THM production is a byproduct of the chlorine disinfection process. The production of THMs is also influenced by other factors such as the level of organic material present in the source water. Thus, cultural eutrophication can exacerbate THM related concerns.

Sixth, dissolved oxygen levels within several of the smaller Finger Lakes currently fall below existing water quality standards. Observed excursions include both hypoxia (DO < 4.0 mg/l) and anoxia (DO < 1.0 mg/l), and are limited to hypolimnetic waters. The cause(s) and possible impacts of these dissolved oxygen depletions should be investigated – see related recommendation #3 above. With respect to causality, efforts should be made to determine if observed dissolved oxygen depletions are primarily the result of natural conditions (e.g., lake morphometry) or are anthropogenically mediated (e.g., cultural eutrophication). Possible impacts of dissolved oxygen depletions should also be evaluated. These should include both ecosystem and human health related concerns relating to chemical availability.

Seventh, the causes and possible ramifications of increasing calcium levels should be assessed. In particular, Zebra mussel population dynamics should be evaluated in the context of existing food web structure and resource impairments (e.g., clogging of intake pipes, etc.).

Eighth, while continued study of the Finger Lakes is clearly warranted, it is critical that monitoring activities include sampling of tributary waters as well. Tributary monitoring efforts are, in fact, underway in several Finger Lakes watersheds (e.g., Canandaigua Lake, Keuka Lake, Seneca Lake, etc.). However, a coordinated approach to assessing event-based/nonpoint source loading within the Finger Lakes would be extremely valuable. It is suggested that the tributary sampling program be composed of two distinct components, as follows: (a) *Geographically Specific*: there are several locations within the Finger Lakes which should be specifically targeted for event-based tributary monitoring to support development of waste assimilative capacity estimates. These include Conesus and Honeoye Lakes, as well as the southern end of Cayuga Lake; and (b) *Reference Conditions*: a second component would involve the development of a tributary monitoring program designed to characterize generalized runoff coefficients within the Finger Lakes Region. These estimates could be used to calibrate basic water quality screening models which would be of value in watershed management activities. These local and regional efforts could best be carried out as collaborative efforts between local, state, and federal entities and with the possible involvement of academic and other institutions within the given locations.