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James E. Burke, PE
Regional Water Engineer
NYSDEC – Division of Water
615 Erie Boulevard West
Syracuse, NY 13204

RE: Cornell University Lake Source Cooling SPDES Permit # NY024 4741
Before-After-Control-Impact Analysis Report and Response to DEC's
comments

Dear Mr. Burke:

We received your letter dated June 13, 2008, in regard to the NYSDEC's comments on the draft Before-After-Control-Impact Analysis Report (BACI Report) for the Lake Source Cooling Facility (SPDES Permit # NY024 4741). In that letter, the NYSDEC requested a response by July 31, 2008. We later received approval from the NYSDEC to extend the response deadline to November 1, 2008.

Because the draft BACI Report was prepared by Upstate Freshwater Institute (UFI), Cornell requested that UFI prepare a NYSDEC requested revision to the draft BACI Report addressing NYSDEC's comments. UFI prepared the report in accordance with the NYSDEC's comment letter, and the revised BACI Report is enclosed. The report indicates that there are no statistically significant changes in total phosphorus, chlorophyll a or turbidity from before to after startup of the LSC facility.

The approach undertaken in the draft BACI is compromised due to the following factors: 1) the analysis should be conducted with comparisons chosen *a priori* (beforehand), and 2) because so many multiple comparisons were performed, the effectiveness of the analysis is reduced.

For that reason, the Cornell LSC Faculty Advisory Committee proposed an alternative approach to analyze the data that would eliminate these issues. This alternative analysis is enclosed for your information. The alternative analysis:

- utilizes data from all the lake sites (except Site 2) holistically.
- provides a method to analyze the data set that addresses the concern about *a priori* selections in order to perform a before-after control-impact analysis.
- does not require adjustments for multiple comparisons. It is very powerful in its ability to assess changes in the trophic indicators, chlorophyll a and total phosphorus.

While this analysis does not make individual site comparisons, it groups them based on their expected level of impact from LSC. All data is then used to perform the analysis, avoiding the issue of multiple comparisons.

This alternative analysis was prepared by Stephen Ellner, Professor of Ecology and Evolutionary Biology at Cornell University, who has extensive expertise in statistics applied to ecological data sets. The approach is endorsed by the Cornell Faculty Advisory Committee. The alternative analysis also concludes that there are no statistically significant changes in total phosphorus, chlorophyll a or turbidity from before to after startup of the LSC facility.

Most of the NYSDEC's comments have been addressed directly in the enclosed revised BACI Report. Below is Cornell's response to NYSDEC's comments:

Comment 1: There was one *a priori* selection that was agreed upon between NYSDEC and Cornell as an impact indicator for LSC before LSC began and data was collected. This was the arithmetic mean of sites 1, 3, 4 and 5, considered to be representative of conditions on the southern shelf and reported as such in Cornell's monthly SPDES Discharge Monitoring Reports (DMRs). An analysis of the mean of sites 1, 3, 4 and 5 (impact) vs. site 8 (control) was also included in the BACI Report. This is the comparison originally envisioned for the sampling program conducted by Cornell and it indicates no statistically significant changes.

An outlier analysis is included in the BACI Report, and the statistical analysis was performed both with and without including the identified outliers.

Comment 1a-d: Although Site 7 brackets the LSC discharge (along with Site 1), Site 7 was never considered to be an impact site. Due to the proximity of the Cayuga Heights Wastewater Treatment Plant (CHWWTP), Site 7 was chosen so that differences between Sites 1 and 7 would not necessarily be attributed to LSC, but to discern the impacts that might be seen from CHWWTP. Site 7 represents an important area for the Ithaca community, but it should not be characterized as the particular site that represents LSC, given all that we know about circulation patterns and confounding affects from CHWWTP. Regardless, the site 7 vs. 4 and site 7 vs. 8 comparisons were included in the report, per the NYSDEC's request. Additionally, sites 1 and 7 together were evaluated as the sites with the greatest potential for impact in the alternative analysis. None of these comparisons indicate a statistically significant change.

Comment 2: NYSDEC's comments are addressed throughout the BACI Report, and especially in Section 8, Limnological Interpretation. Additionally, the alternative analysis adds an evaluation of date variation of the data and indicates that most all of the variation of data is due to site, date and random variability, not LSC.

Time series of flow is included in the BACI Report under section 5, and time series of chlorophyll a, total phosphorus and turbidity are included under Appendix 5.

Comment 3: Addressed in the BACI Report.

Comment 4: See response to Comment 1. This is further explained in the BACI Report. Because of the concerns in the BACI Report regarding multiple comparisons, a more defensible approach might be to consider the alternative analysis provided by Stephen Ellner, where an adjustment for multiple comparisons is not required.

Comment 5: The correction for multiple comparisons was taken into further consideration for the revision to the draft BACI Report. As a result, the correction for multiple comparisons was addressed in two ways:

- 1) UFI evaluated statistical significance using Benjamini-Hochberg adjusted p-values rather than the Bonferonni correction. Benjamini-Hochberg is more conservative than the Bonferonni correction with respect to Type II errors (probability of not detecting an impact when there is one).
- 2) Cornell has provided an additional report by Stephen Ellner as a supplement to the BACI Report, which has more power to detect a statistically significant impact of LSC by assessing the comparison it is making than the BACI Report does to assess its sitewise comparisons, while reducing the chance of a Type II error by one half.

A power analysis was conducted using pre-operational data. This analysis was not updated for this revision of the BACI Report. This was negotiated verbally between UFI and NYSDEC because an assessment of statistical power is useful for the design of a monitoring program and is of little use afterward. Additionally, the statistical power was not expected to change substantially from the previous draft BACI Report. This assessment may still be performed at a later time, if the NYSDEC later requests it.

Comment 6: Addressed in the BACI Report.

Comment 7: Addressed in the BACI Report.

Comment 8: Addressed in the BACI Report.

Comment 9: Addressed in the BACI Report.

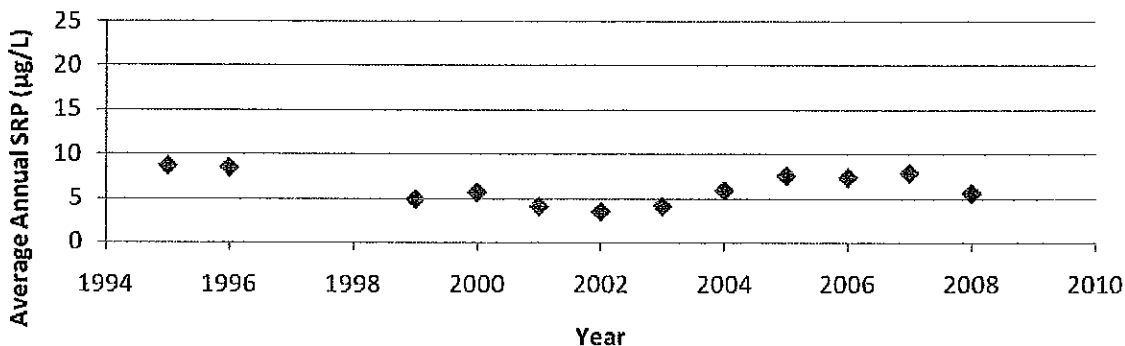
Comment 10: Addressed in the BACI Report.

Comment 11: No further action required.

Comment 12: Trends of hypolimnetic SRP levels are presented in the BACI Report. No method has been proposed to assess SRP trends in this submittal because we are not aware of any legitimate mechanistic models that could accomplish this. The historical hypolimnetic SRP data set shows an increase in hypolimnetic SRP from 2004 through 2007. However, this increase reflects a return to hypolimnetic SRP levels observed during 1994-1996 when the LSC Environmental Impact Statement (EIS) was done and before LSC operation. The BACI Report includes only LSC effluent SRP data collected after the startup of LSC. The graph shown below provides an historical perspective of the hypolimnetic SRP spanning the full duration of monitoring conducting from 1995-

2008. Fluctuations in SRP in the hypolimnion in the post LSC startup period appear to be consistent with SRP fluctuations prior to LSC startup. The higher SRP levels from 2004 – 2007 are still lower than what was the modeled input to the LSC EIS. The causes of the SRP increase are not clear and future trends cannot be predicted based on the data collected. A statistical analysis of the effluent data cannot be used a predictor of hypolimnetic SRP levels in the future.

Historical Hypolimnetic SRP near LSC Intake (70m depth)



Data in 1995-1996 taken from LSC EIS at 70 meter depth near LSC Intake location, data from Ichthyological Associates.

Data from 1999-2008 is from samples collected at 3 meters from the bottom of the lake near the LSC Intake, except in year 1999 samples are from 1 meter from the bottom of the lake near the LSC Intake. Data from these years were analyzed by Upstate Freshwater Institute.

SRP averages for this graph were determined by averaging available data from the sampling season of April – October each year.

We will be sharing this information with our local lake monitoring partnership early next week. If you have any questions regarding this submittal, please contact me at (607) 255-6648 or Cheryl Brown at (607) 254-8687.

Sincerely,

James R. Adams
Senior Director, Utilities Department

Enclosures

cc: Fred Gillette, NYSDEC Region 7
Clifford Callinan, NYSDEC Albany
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Patrick McNally, Cornell University
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