APPENDIX C

DRINKING WATER IMPAIRMENT - NUTRIENT LEVELS

ENSR INTERNATIONAL

ENSR

Memorandum

To:	Matt Liebman, Beth Card	**Date:**	September 10, 2000
From:	David F. Mitchell	**File:**	4933001-510
RE:	Drinking Water Impairment - Nutrient Levels	**CC:**	File Isabelle Morin

This memorandum reviews information gathered by ENSR regarding the potential for determining nutrient levels (i.e., nitrogen, phosphorus) that are likely to be protective of a sensitive designated use – public drinking water supplies. This information is part of an overall attempt to provide a closer linkage between nutrient levels and impairment of specific designated uses, as requested by the RTAG following review and comment on the Final Report: "*Collection and Evaluation of Ambient Nutrient Data for Lakes, Ponds, and Reservoirs in New England.*"

ENSR contacted a number of drinking water facilities in New England to evaluate information used by these facilities regarding at what threshold levels algal community composition or numbers could potential impair drinking water production and/or quality. Two thresholds were considered – the first was connected with aesthetic taste and odor problems and the second levels was associated with filtration difficulties due to clogging of the filters by algal biomass. It was hoped that problematic algal cell counts or concentrations could be correlated with waterbody chlorophyll a concentrations and/or phosphorus concentrations.

Discussions were had with Ted Kenney, Deputy Executive Director, New England Water Works Association; Larry Pistrang, MWRA; and Bob Hoyt, Water Quality Director, City of Worcester Filtration Works. This is not a definitive list of contacts, but provided some insight as to the likely availability of information from similar facilities around New England. From these contacts it was established that:

- chlorophyll a is not routinely measured at intakes of drinking water facilities, since it is only indirectly related to critical levels of algal species that drive drinking water quality treatment decisions (see below);
- total phosphorus was monitored in tributaries of some reservoirs as part of watershed assessment, but the method detection limits (ND = < 100 ug/L) are not sufficient sensitive to distinguish trophic states;
- cell counts or functional algal standard units (ASU) were regularly collected. These were the based for decision-making regarding treatment to control algal populations;
- an alternative means of measuring biomass is via chemical doses (chlorination) required to oxidize levels of total organic material as a pre-disinfectant. The higher the phytoplankton bloom, the greater the chlorination dose used. Records of dose rates are indirectly indicative of seasonal patterns of runoff and bloom formation.

At Wachusett Reservoir, weekly (or more frequent during bloom conditions) sampling at six depths are used to determine exactly what algal genera are present and how their populations are changing. Relating historic data to complaint information in a somewhat arbitrary manner has led to the development of some "thresholds". Treatment of the reservoir with copper sulfate sometimes occurs if one or more of these threshold is exceeded.

Synura was indicated as the most troublesome genus for the MWRA Wachusett facility, primarily because it causes taste and odor problems at very low concentrations. Treatment normally was conducted when *Synura* concentrations exceed 20 ASU/mL (2 colonies per mL). The diatom *Asterionella*, on the other hand, while also reported in the literature as a taste and odor genus, could be present in concentrations of 1000-1500 ASU/mL (1200-1800 cells per mL) without causing problems. Some of the treatment thresholds reported by MWRA

Synura: treat at 20 ASU (2 colonies per mL); [average colony - 12 ASU; colony range 3-50 ASU]

Anabaena: treat at 50 ASU (250 cells per mL); [during exponential growth phase, average cell - 0.2 ASU]

Asterionella: treat at 1000 ASU (1200 cells per mL); [usually not done, average cell - 0.8 ASU]

Dinobryon: treat at 300 ASU (150 cells per mL); [average cell + lorica - 2 ASU]

Uroglena: treat at 300-400 ASU (3 colonies per mL); [average colony size - 120 ASU, range 6-350 ASU]

It should be obvious from this comparison that any use of a simple chlorophyll number is not likely to be appropriate since both the species composition and relative biomass are critical. Accordingly, drinking water facilities are unlikely to be able to directly correlate chlorophyll a concentrations with direct impairment.

The preliminary results of this survey were discussed with NEIWPCC and EPA during the July 15, 2000 project status meeting. The overall focus of the Nutrient Criteria project is on potential impairment as a L/P/R waterbody shifts from mesotrophic to eutrophic conditions; whereas drinking water operational difficulties are associated with less measurable levels of eutrophication that may be undistinguishable with a reference waterbody. Accordingly, it was agreed not to pursue this area of investigation further at this point.