CHRISTINE O. GREGOIRE
Director

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STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
7171 Cleanwater Lane, Building 8, LH-14 • Olympia, Washington

April 4, 1990

TO: Steve Saunders

FROM: Jim Cubbage

SUBJECT: Copper in Steilacoom Lake

You requested criteria with which to judge copper concentrations in freshwater sediment. We are in the midst of reviewing efforts to determine freshwater sediment criteria. Here's a quick review.

The Provincial government of Ontario has recently published a set of criteria (Persaud et al. 1990) intended to replace Open Water Disposal Guidelines. These Sediment Quality Guidelines (SQGs) are intended to guide decisions in sediment issues (remediation or contamination prevention) and are based on the Screening Level Concentration approach. This approach links abundance of invertebrates in sediments with concentrations of contaminants. The SQGs are defined in three tiers. The "no-effect level" for copper is 25 ppm, below which no impact on benthic is anticipated. For copper, the "lowest effect level" is the same 25 ppm dry weight. The "limit of tolerance" is 125 ppm copper and is defined as the threshold above which sediment use by benthic organisms will be significantly impaired. Above the "limit of tolerance" pronounced disturbance of the sediment-dwelling community can be expected. Thus 125 ppm copper is the least stringent quality criterion. Wisconsin DNR has also proposed criteria, based on a background approach, at 100 ppm copper (Sullivan et al. 1985).

The sole Steilacoom Lake sediment taken this last summer has a high concentration of copper (1025 ppm). Figure 1 compares the concentration found in the lake with concentrations measured in other State of Washington freshwater sediments by the Lakes Monitoring project and those recorded in STORET. The Steilacoom Lake sediment is the highest of 107 samples and it exceeded the Ontario Sediment Quality Guidelines by eightfold.

Several papers review effects of copper on invertebrates and show direct effects of copper at concentrations equivalent to those found in Lake Steilacoom. Cairns et al. (1984) found LC50 (lethal concentration for half the animals) values of copper in sediments for a variety of invertebrates to range from 681 to 2296 ppm. Growth of chironomid larvae (midge) was significantly reduced to 50% at a copper concentration of 1602 ppm dry weight in sediment (Kosalwat and Knight 1987). The same study found copper in

sediments caused mouthpart deformities and concentrations greater than 1800 ppm delayed adult emergence. Tubificid oligochaetes moved away from sediments spiked with copper sulfate at a concentration of 570 ppm copper to sediments that were not contaminated (McMurtry 1984). The highest concentration that produced no mortality was 655 ppm. Finally, Hanson and Stefan (1984) review side effects of copper sulfate treatment of lakes and conclude that continual copper treatment tends to reduce benthic macro invertebrates and shift algae from green to blue-green (toxic) varieties.

If you need more info, let me know.

JC:krc
Attachment
cc: Jon Bennett
Keith Phillips
Dave Hallock
Tom Luster
Art Johnson
Bill Yake

REFERENCES

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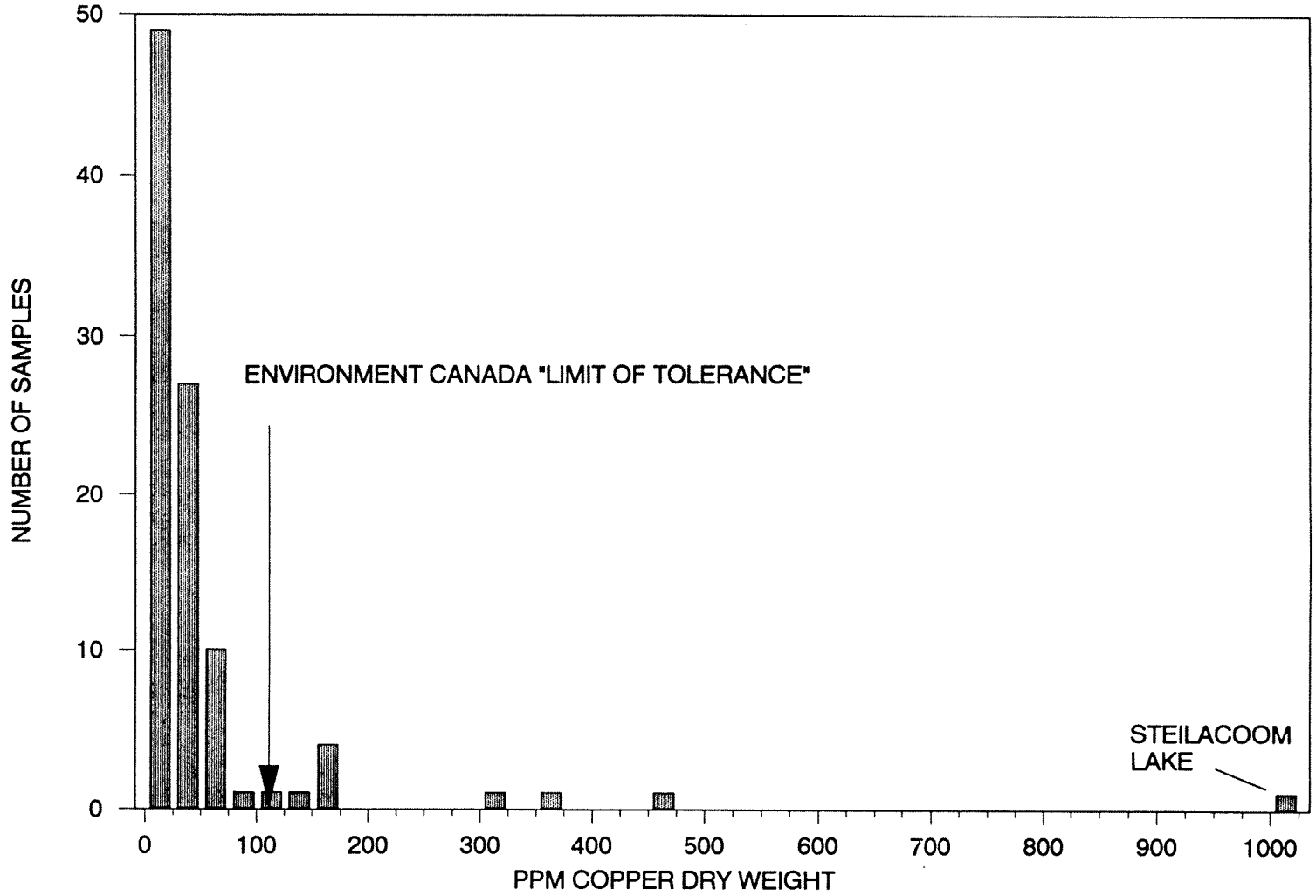

Figure 1. Distribution of copper in Washington State freshwater sediments. Data from EPA STORET and Lakes Monitoring Project.