State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

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Charlie Shong
Pewaukee Sanitary District
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Subject: Sediment Core

Dear Charlie:

Bob Wakeman called me today and related that you would like some results from the sediment core that was taken in 1992. I had previously sent Bob a memo concerning the sediment core but he couldn't find it. It is probably just as well because my thinking has changed for some of the interpretation. I am including a PowerPoint file which includes graphics which highlight the results.

Figure 1. This figure shows the sedimentation rate trend for the last 90 years. The core wasn't analyzed to a depth deep enough that we could measure sedimentation rate prior to the arrival of European settlers. It is likely that the rate would have been lower if the core had been deeper. However, it appears that during the last 90 years the sedimentation rate has been higher than many lakes in the area. More importantly is that the sedimentation rate has steadily increased from 1910 through 1980. The rate has remained high during the period 1980-1992. This elevated rate was about 4 times higher than it was around 1910.

Figure 2. The increased sedimentation rate is the result of increased sediment from the watershed as well as increased precipitation of calcium carbonate (marl). The increase from soil erosion is indicated from the profile of aluminum. Soil erosion first began to increase around 1940 but it has further increased since 1980. This increased soil erosion is undoubtedly the result of landuse changes in the watershed. Calcium (Ca) profiles reflect changes in the primary productivity of the lake. As algal and macrophyte productivity increases, the pH increases, and in marl lakes like Pewaukee, calcium carbonate becomes supersaturated and precipitates to the lake bottom. Therefore, increases in Ca reflect changes in productivity of the lake. The lake' productivity began to increase around 1940 but the highest rate has occurred since 1980. Along with the increase in productivity has been an increase in the deposition of the nutrients nitrogen and phosphorus. The increased deposition of these nutrients is in part the result of co-precipitation with calcium.

Figure 3. The diatom community was used to estimate past concentration of mean summer phosphorus and water clarity (Secchi). This was done using a statistical model called weighted average regression and calibration (WACALIB). This model indicates that summer P levels were highest around 1950 when concentrations were around 80 $\mu g\ L^{-1}$. Phosphorus levels generally declined after 1980 and the modeling indicated that summer mean phosphorus levels in the early 1990s were around 20 $\mu g\ L^{-1}$ which were levels that were measured in the lake. This indicates that the WACALIB model is providing a reasonable estimate of historical phosphorus trends. The model was also used to estimate long-term trends in water clarity. Not surprising, the water clarity trends reflect the phosphorus trends. The model predicts that the mean summer Secchi depth in the early 1990s was about 2.4 meters.

Summary The results show that landuse changes in the watershed have had a profound affect on the lake's water quality during the twentieth century. The infilling of sediment significantly increased during this century and the rate during the early 1990s was much higher than it had been during the early part of the century. These landuse changes also had a profound effect on the lake's productivity. Marl deposition (calcium carbonate) has been especially high since 1980. The diatom community indicates this has not been reflected in increased phosphorus levels in the open water of the lake. Instead it appears that much of the increased productivity is occurring in the lake's littoral zone in the form of increased productivity of the macrophytes. This is also indicated in part in the diatom community with an increase in diatom species that grow attached to plants. The decrease in phosphorus levels in the open water of the lake is probably due in part to the increased deposition of the marl. When the marl precipitates to the bottom it also transports some phosphorus with it that chemically bound with the marl.

Sincerely

Paul Garrison
Research Scientist

cc. Robert Wakeman