Excerpts From Scientific Literature Supporting Mean Depth Criterion of 3 Meters in the Proposed Criteria

Compiled by Tom Wilton, 1/12/2010

From: Restoration and Management of Lakes and Reservoirs, Third Edition. 2005. G. D. Cooke, E. B. Welch, S. A. Peterson, and S. A. Nichols. CRC Press, Taylor and Francis Group, Boca Raton, FL.

Chapter 2. Basic Limnology, Section 2.7 Characteristics of Shallow and Deep Lakes. Pages 33-34:

"Shallow lakes and reservoirs (< 3 m mean depth) are more common than larger, deeper ones, and many are eutrophic or heavily impacted by siltation and high turbidity. Their problems, and solutions to those problems, are reflected in their characteristics…"

"Table 2.2 is a comparison of the characteristics of deep and shallow lakes, primarily based on European research (e.g., Moss et al., 1996, Jeppesen, 1998; Scheffer 1998; Havens et al., 1999; Cooke et al., 2001; NALMS 2003)."

"Shallow lakes are less sensitive to significant reductions in external nutrient loading because benthic-pelagic interactions tend to maintain high nutrient levels. Nutrients released from bottom sediments of shallow lakes affect the entire water column, in contrast to stratified, deep lakes. In shallow lakes, nutrient release may be very high from bioturbation, wind disturbance, the effects of gas bubbles, high pH from intense photosynthesis, and from DO deficits at the sediment-water interface. Diversion of external nutrient loading, while necessary, may not be sufficient to rehabilitate a shallow lake and a sediment treatment may be necessary."

Table 2.2. Characteristics of Shallow and Deep Lakes (from: Restoration and Management of Lakes and Reservoirs, Third Edition. 2005. G. Dennis Cooke, Eugene B. Welch, Spencer A. Peterson, Stanley A. Nichols. CRC Press, Taylor and Francis Group, Boca Raton, FL. Page 34.

Characteristic	Shallow	Deep
1. Likely size of drainage area to lake area	Large	Smaller
2. Responsiveness to diversion of external loading	Less	More
3. Polymictic	Often	Rarely
4. Benthic-pelagic coupling	High	Low
5. Internal loading impact on photic zone	High	Lower
6. Impact of benthivorous fish on nutrients/turbidity	High	Lower
7. Fish biomass per unit volume	Higher	Lower
8. Fish predation on zooplankton	Higher	Lower
9. Nutrient control of algal biomass	Lower	Higher
10. Responsiveness to strong biomanipulation	More	Lesser
11. Chance of turbid state with plant removal	Higher	Lower
12. Probability of fish winterkill	Higher	Lower
13. % Area/volume available for rooted plants	High	Low
14. Impact of birds/snails on lake metabolism	Higher	Lower
15. Chance of macrophyte-free clear water	Low	Higher

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I also wish to point out that two widely-recognized limnological researchers, Dr. Roger Bachmann and Dr. John Downing, have also noted the important relationship between lake mean depth and lake water quality characteristics. Their independent analyses of Iowa lake data identified a mean depth threshold exactly or very close to that contained in the proposed nutrient rule.

From: A Classification of Iowa's Lakes for Restoration. 1979. R.W. Bachmann et al., Iowa State University. Page 13:

"Limnologists have known for a long time that shallow lakes are generally more productive and are more likely to have water quality problems than deeper lakes. Analyses of Iowa data from the 1979 lake survey showed that lakes with a mean depth greater than about 4 meters (13 feet) tended to have the best water quality of the Iowa lakes."

From: A Classification of Iowa's Lakes for Restoration. 2005. J.A. Downing et al., Iowa State University. Pages 16-17:

"Because nutrient criteria and nutrient reference conditions need to be set for Iowa lakes, it is important to know whether qualitative differences exist among Iowa lakes that set limits on minimum and maximum nutrient concentrations. We therefore sought breakpoints in relationships between physical characteristics of the lake settings in Iowa, their nutrient chemistry and biotic responses to nutrients. Such breakpoints can be used by managers for determining classes of lakes that are likely to respond differently to management intiatives…" One variable stands out as preeminently important above all others: mean depth *(emphasis not added)*. It has long been known and understood (Bachmann et al. 1994; Bachmann et al. 1980) that shallow lakes are prone to nutrient loading through wind mixing."

"A variety of methods indicate that the break point in these relationships occurs at around 3 meters of mean depth. "

"Biological systems in lakes are responding to the controlling influence of lake depth. For example, chlorophyll a concentrations are substantially higher in lakes with mean depth <3m (Fig. 9) with no shallow lakes showing low plankton abundance. Likewise, Cyanobacteria blooms also respond to mean depth, with shallow lakes comprising Iowa's most Cyanobacterially dominated ecosystems (Fig. 10)."