Indicator 2.1 - Lake Okeechobee Phosphorus

What is the desired restoration condition?

The desired restoration condition for Lake Okeechobee phosphorus is to reduce pelagic (open water) total phosphorus concentrations in the lake to 40 parts per billion (ppb) in order to reduce the occurrence of blue-green algal blooms, reverse the trend in loss of macro-invertebrate diversity in the lake sediments, and ameliorate impacts of phosphorus on downstream ecosystems when water is released from the lake. The scientific basis for this goal is Havens and Walker (2002).

Why is this indicator important and why is it a good indicator of CERP restoration?

This indicator is important for the following reasons:

- High total phosphorus concentrations in Lake Okeechobee have resulted in nitrogen limited conditions, blooms of blue-green algae, loss of macroinvertebrate diversity, impacts to drinking water, and impacts to downstream ecosystems including the St. Lucie and Caloosahatchee Rivers and Estuaries and the Everglades.

- The total phosphorus concentrations in the lake are predicted to respond, with a one-to-three decade time lag to agricultural source controls and regional Comprehensive Everglades Restoration Plan (CERP) projects planned for construction in the Lake Okeechobee watershed.

- The current state is one where high total phosphorus concentrations have adversely impacted the lake's flora and fauna, as summarized by Havens et al. (1996) and Havens and Schelske (2001).

How is the interim goal for this indicator predicted?

The total phosphorus concentrations in the pelagic zone of Lake Okeechobee are modeled using the Lake Okeechobee Water Quality Model (LOWQM) (James et al. 1997). This model also was used to evaluate water quality responses during the Restudy, and it is the model being used for the lake in the Initial CERP Update (ICU). One key aspect of using the LOWQM for the interim goals is specification of boundary conditions, in particular the historic changes in nutrient inputs to the lake. The model considers the fact that the total phosphorus load must be reduced to 105 metric tons per year (plus 35 metric tons per year from atmospheric deposition) by 2015. This is a legally-mandated loading reduction associated with the Lake Okeechobee Total Maximum Daily Load (TMDL) Rule (FDEP 2000). For restoration planning purposes in the Lake Okeechobee Protection Program, the Florida Department of Environmental Protection, the Florida Department of Agriculture and Consumer Services, and the South Florida Water Management District consider that agricultural best management

practices will accomplish 25 percent of the necessary load reduction, and that the remaining 75 percent will occur due to the CERP and other watershed projects identified in the Lake Okeechobee Protection Plan. Estimating only very general timelines for completion of CERP's Lake Okeechobee Watershed Project features and the Lake Okeechobee Protection Plan (see below), we arrive at the following boundary condition for the LOWQM:

- A linear decline in phosphorus loading to the lake to 75 percent of the current loading rate by 2010
- Between 2010 and 2015, a reduction of phosphorus loading to the TMDL target of 105 metric tons per year from surface inflows
- No reduction in nitrogen loading (a default assumption since we have no data regarding how CERP projects will affect this parameter)

The LOWQM was run starting in 1973 to 1995, using the 2-by-2 model inflows and outflows and inflow phosphorus concentrations corresponding to those expected to occur based on the assumptions listed above. In order to estimate uncertainty of model output, a Bayesian uncertainty analysis was done; this involved 100 simulations that varied the numeric values of boundary conditions and model parameters.

What are the predictions for five-year increments?

Model output (Figure 2.1.1) shows predicted concentrations of phosphorus in the lake when inflow total phosphorus concentrations start at the expected 1995 baseline (95 Base), 2010, 2015, and full CERP implementation (Alt D13R) values and the model is allowed to run for the South Florida Water Management Model (SFWMM) simulation period. The final predictions in each of these models were used as the initial conditions for the next model. For example, the predictions of 95 Base for December 31, 2005 were used as the initial conditions (January 1, 2006) for the 2010 simulation. The data plotted here are the total phosphorus concentrations averaged from the last 5 years of those model runs. Given this fact, it is best to consider the results in a relative sense. They indicate that total phosphorus concentrations in the lake will progressively decline with CERP implementation between present conditions and full CERP implementation.

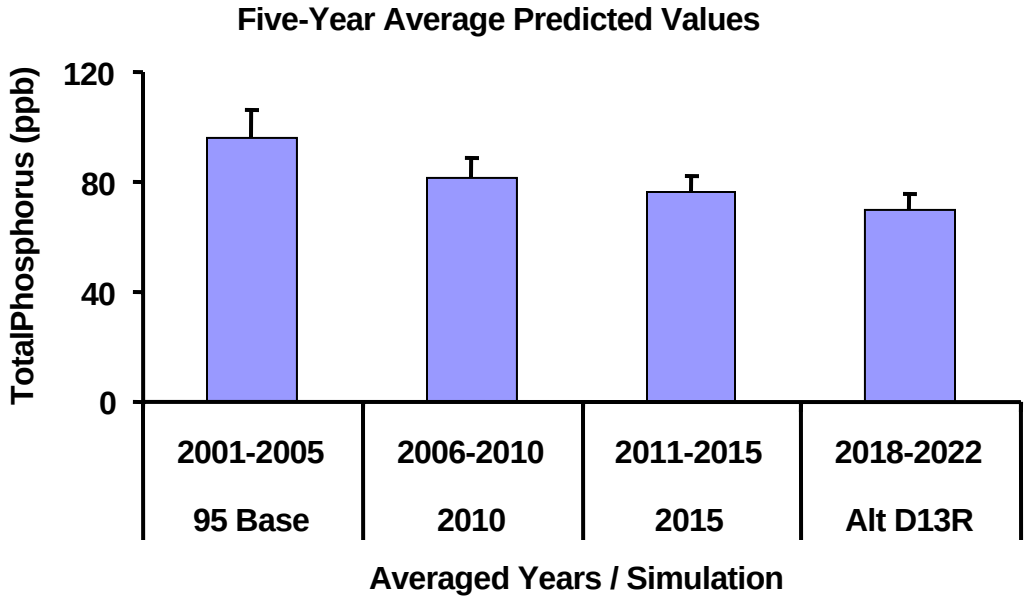

Figure 2.1.1. Predictions of phosphorus concentrations in Lake Okeechobee.

How will we track whether the interim goals established for the indicator have been achieved?

In the *CERP Monitoring and Assessment Plan: Part 1, Monitoring and Supporting Research* (RECOVER 2004), RECOVER recommends measuring phosphorus concentrations both within Lake Okeechobee and at inflow and outflow structures. The South Florida Water Management District collects samples at 33 in-lake sites, most located at the interface of the pelagic zone and the littoral zone and at all major tributary structures where water enters and exits the lake (32 sites).

What additional work is needed to improve this interim goal?

This interim goal could be improved by additional calibration and verification of the LOWQM.

References

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