Federal technical response to June 2006 Goforth memo to TOC
November 7, 2006

Finding

By December 31, 2006, the Technical Oversight Committee (TOC) is to compare the Consent Decree's levels and limits to the Class III phosphorus criterion. In June 2006, Dr. Gary Goforth, consultant to the South Florida Water Management District, submitted a memorandum to the TOC (Goforth 2006) that purports to show that the consent decree levels are higher than the Class III 10 parts per billion criterion. Dr. Goforth's methodology compares the state's long-term geometric mean phosphorus criterion with the Consent Decree's *monthly* levels. Because his methodology uses monthly levels, and not the long-term average, his calculations produce results that are 60 to 70% higher than the actual Consent Decree's long-term geometric mean values. The technical representatives of the federal parties believe that the long-term values are the correct metric to be used in the comparison of the long-term levels of Appendix B of the Consent Decree with the Class III numeric criterion. The values that Dr. Goforth used are higher because they include a confidence factor to be applied for monthly determination of compliance. When the long-term geometric means approach is used (as contemplated by Appendix B of the Decree), and a comparison is made between the Consent Decree's long-term geometric mean values and the Class III long-term geometric mean, the Consent Decree's long-term levels always are lower than the state's criterion. Table 1 is taken from Dr. Goforth's memo, and has been adjusted (changes shown in italics) to illustrate the comparison between the Consent Decree's long-term geometric mean values and the Class III long-term geometric mean. The federal technical representatives believe that Dr. Goforth's methodology is in error, and that the long-term geometric mean value methodology, adjusted for stage, described above is the technically correct approach.

There are two other findings that support the determination described above. First, even if Dr. Goforth's comparison was to be accepted, his comparison excludes DEP's rounding procedure for the four-part test described by Frank Nearhoof at the October 3, 2006 TOC meeting. Mr. Nearhoof indicated that values will be rounded to the nearest part-per-billion unit before applying the four-part test. Therefore, the test's one-year limit effectively is 11.5 parts per billion and the five-year limit effectively is 10.5 parts per billion. When this rounding procedure is applied to Dr. Goforth's original Table 1, the Consent Decree's monthly levels are lower than the Class III long-term geometric mean in three out of four years. Second, historical data (1999-2005) data from the 14 stations pass the four-part test (Nearhoof testimony, March, 2006). During this same historical period, there were several exceedances and excursions of both the interim and long-term levels. This observation is consistent with the fact that the target for the long-term levels (7 parts per billion) is below the 10 parts per billion criterion.

Background

The current goal of the Consent Decree in the interim period ending in December 2006 is to have the 14-station monthly geometric mean total phosphorus concentration in the

Refuge typically to be no worse than conditions in 1978. As of December 31, 2006, however, the Consent Decree requires a more stringent long-term level that generally requires the geometric means of phosphorus values collected in monthly Refuge samples to be no higher than that observed at the three Refuge sites having the best water quality in 1978. The Consent Decree states that compliance with the long-term levels would result in a long-term geometric mean of approximately 7 parts per billion of total phosphorus (µg P L^{-1}) across the 14 stations.

The derivation of the Consent Decree interim and long-term levels for the monthly geometric mean total phosphorus was documented in Appendix E of the State of Florida "Surface Water Improvement and Management Plan for the Everglades" (SFWMD 1992). The equations calculating these levels are based on the height of water (stage) in the Refuge on the day of sampling. These levels are defined by the product of two numbers. The first is the predicted geometric mean (approximately the median). The second is the 90 percent confidence factor (1.6 to 1.7) to provide an indication from the observations of whether the goal of the Consent Decree is met. The Consent Decree then defines an exceedance when the level is violated twice over a period of 12 consecutive sampling events. The occurrence of an exceedance is evidence that the water quality goals are not being met.

Over the past decade, average water height (stage) was approximately 16.5 feet. Under these average conditions, the interim and long-term target geometric mean concentrations, as applied in the Consent Decree level equations, are 7 and 6 parts per billion, respectively (Figure 1). The long-term target concentration varies, depending on stage, ranging from a maximum of 10.7 parts per billion to 4.2 parts per billion. Over the state's water years from 1999 to 2006, the annual geometric mean of values for the monthly long-term target calculations has been, at most, 7.4 parts per billion, with an average of 6.5 parts per billion.

Citations

Goforth, G. (2006). "Comparison of Florida Class III Phosphorus Concentrations and the Long-Term Levels of the Consent Decree for the Refuge." *available at* <*http://www.sfwmd.gov/org/ema/toc/archives/2006_06_16/comp_cl3_p_levels_refuge.pdf*>, South Florida Water Management District, West Palm Beach.

SFWMD. (1992). "Surface Water Improvement and Management Plan for the Everglades: Supporting Information Document (DRAFT)." *SFWMD Technical Draft*, South Florida Water Management District, West Palm Beach, FL.

Table 1. Corrected comparison of Class III criterion and the long-term geometric means of the Consent Decree (corrected table following that originally presented by Goforth, 2006). *Changes shown in italics.*

Water Year*	Consent Decree Long-Term Levels based on measured daily stage from WY1999 - WY2006		Class III Criteria	
	Annual Geomean of Monthly Levels (1)	5-year Geomean of Monthly Levels (2)	Annual Geomean Limit	5-year Geomean Limit
WY1999	*6.5*		11.0**	10.0
WY2000	*5.9*		11.0	10.0
WY2001	*7.4*		11.0	10.0
WY2002	*6.0*		11.0	10.0
WY2003	*6.3*	*6.4*	11.0	10.0
WY2004	*5.9*	*6.3*	11.0	10.0
WY2005	*7.1*	*6.5*	11.0	10.0
WY2006	*6.8*	*6.4*	11.0	10.0
Average	*6.5*	*6.4*	11.0	10.0

* Water Year = May 1 - April 30

** Class III criteria specifies an annual limit of 11 ppb with the annual geometric mean of at least three out of each 5 years being 10 ppb or less.

(1). Annual geometric mean calculated as the geometric mean of monthly arithmetic average TP levels calculated based on the daily average 3-gage stage using the long-term level equation from Appendix B of the Consent Decree.

(2). 5-year geometric mean calculated as the geometric mean of the 5 annual geometric means comprising the 5-year period.

Comparison of Consent Decree with Class III Criteria (4-part test) Based on 1999-2006 Data			
Component of 4-Part Test	**Consent Decree**	**Class III Criteria**	**Lower/More Protective**
Part 1: 5-year geometric mean of 10 ppb or less	*6.3-6.5 ppb (6.4 ppb avg)*	10.0 ppb	***Consent Decree***
Part 2: Annual geometric mean of 11 ppb or less **Part 3:** Annual geometric mean of 10 ppb or less in 3 of 5 years	*5.9-7.4 ppb (6.5 ppb avg) (never above the 11 ppb Class III Max.)*	11 ppb limit (Part 2) and 3/5 years below 10 ppb (Part 3) (max average =10.4 ppb)	
Part 4: Individual station annual geometric mean of 15 ppb or less	Consent Decree does not assess individual sites.	Class III criteria specifies a 15 ppb limit for individual sites.	

Other Factors to Consider

Compliance with the Consent Decree algorithm is evaluated using a 14 site network. Compliance with the Class III criteria *will be evaluated using a sampling network that is not yet finalized. Impacted and unimpacted sites will be evaluated separately.*

Class III criteria derived based on biological response not dependent on water level management. Under the WY1999-WY2006 stage conditions in the Refuge, the algorithm of the Consent Decree *never allows 5-year geometric means above 10 ppb during any period*.

Figure 1. Calculated interim (dashed line) and long-term (solid line) geometric mean total phosphorus concentrations (µg L^{-1} = parts per billion) as outlined in the Consent Decree.