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Mr. Benjamin H. Grumbles
Acting Assistant Administrator for Water
Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Dear Mr. Gumbles:

We are writing you in your capacity as Chair of the Mississippi River/Gulf of Mexico Task Force. The electronic circulation of a report entitled *Evaluation of the Role of Nitrogen and Phosphorus in Causing or Contributing to Hypoxia in the Northern Gulf* by Region 4 of the Environmental Protection Agency is being suggested by some as a reason to delay pursuing the reduction in Mississippi River nitrogen loading called for in the Gulf Hypoxia Action Plan. While it is always important to consider new data and analyses concerning the most effective strategies to reduce Gulf hypoxia, it should be noted that this report includes the disclaimer that it "does not represent the Agency position or recommendations regarding the Gulf Hypoxia Action Plan." Furthermore, and more importantly, the report has not yet been subjected to peer review, as were the technical elements of the Integrated Assessment of Hypoxia in the Northern Gulf of Mexico that supported the Gulf Hypoxia Action Plan and is usually required by EPA policy.

The undersigned are scientists who were engaged in preparation (DS) or review (DFB) of the Integrated Assessment or who have evaluated its results in a National Research Council study of the broader problem of eutrophication of coastal waters (RWH). We believe that the Region 4 report should receive due consideration after appropriate peer review and revision. Periodic scientific re-evaluation such as planned in the Task Force's 2005 Reassessment is critical to the adaptive management approach recommended in the Integrated Assessment. However, mindful of the August 31-September 1 meeting of the Task Force we offer for consideration the following perspectives on the Region 4 report:

1. We underscore that the Region 4 report states that "nitrogen reduction would likely reduce the extent of the hypoxic zone," thus agreeing with the Integrated Assessment and Action Plan that reducing nitrogen (N) loading to the Gulf is an important requirement for hypoxia reduction. The report's main point is that phosphorus (P) loads should also be reduced. The northern Gulf of Mexico, like many other coastal ecosystems, has clearly been enriched by both N and P as a result of human activities.

Reductions in both N and P loading are being pursued in a number of other coastal management efforts in the U.S. and around the world (Boesch, 2002. *Estuaries* 25: 744-758), thus reductions in P loading *may* prove, on further analysis, to be beneficial in the Gulf. However, worldwide experience and contemporary scientific understanding of coastal eutrophication, as well as the Integrated Assessment, strongly indicate that N-source reduction is essential for hypoxia reduction.

2. The analyses and perspectives in the Region 4 report reveal an inadequate understanding of the contemporary science of biogeochemistry and nutrient dynamics in coastal marine ecosystems and of serious limitations in its use of ratios of nutrient concentrations to infer nutrient limitation. Ratios of inorganic N to P are often not good indicators of the relative availabilities of N and P in coastal systems because of the differing biogeochemistry of these elements (Howarth and Marino, 1990. *Limnology and Oceanography* 35: 1859-1863). This is particularly so when the inorganic N:P ratio is within a factor of 2-3 of the Redfield ratio of 16:1 by moles. True determination of nutrient limitation depends upon knowing the *rates of supply* of N and P, which are affected by the faster recycling of organic P than N, N losses due to denitrification, and exchanges of P with both bottom and suspended sediments. This is discussed in detail in the National Research Council's 2000 report, *Clean Coastal Waters: Understanding and Reducing the Effects of Nutrient Pollution*, a comprehensive reference which we note with surprise was not cited in the Region 4 report.

3. While the authors acknowledge that the USGS analysis for the Integrated Assessment "concluded that there was insufficient phosphorus data to statistically calculate the relative change in load with respect to time" (p. 11), they nonetheless make the case for an increase of available P since the 1960s based on "reconstructed data." However, using their own comparisons of recent to reconstructed concentration data (Table 4), N has increased by a factor of at least 50% more than P, while N-fertilizer use has increased by a factor of 5 in contrast to a factor of 2 for P-fertilizer (Figure 8). What has clearly happened, as pointed out in the Integrated Assessment and numerous other publications, is a huge increase in N loadings relative to the other plant nutrients (P and Si). Such disproportionate increases in N loading, rather than increases in P loading, are driving coastal waters toward a higher tendency of P limitation (Turner et al., 2003. *Marine Pollution Bulletin* 46: 1032-1034). It is totally unsurprising, therefore, that the availability of P may limit primary production in the immediate river plume where there is a huge surplus of N from river water. If reducing primary production in the river plume were the objective, then P source reduction might be just the ticket. But, the objective is to reduce hypoxia along the continental shelf stretching for hundreds of miles away from the mouths of the Mississippi or Atchafalaya. This large-scale hypoxia feature is sustained by primary production occurring over the far-field shelf, which is driven by nitrogen that escapes the plume or is recycled from organic matter produced in the plume area. According to the aforementioned National Research Council report, such a situation with P limitation in the low-salinity mixing zone and N limitation over a wide area of higher salinity is commonly observed in coastal marine ecosystems.

4. Because of potential P limitation where highly N-enriched river water is mixed with estuarine or coastal waters, hypoxia may in fact be increased, not decreased, by reductions in P loading without concomitant reductions in N loading. For example, reductions in P loading in the Neuse River estuary (within EPA Region 4 in North Carolina) resulted in an alleviation of noxious blue-green algal blooms in the near-field tidal freshwater reaches, but also in a dramatic increase in hypoxia downstream in the brackish reaches of the estuary (EPA-sponsored research recently reported in Paerl et al., 2004. *Environmental Science and Technology* 38: 3068-3073). As primary production was reduced at the head of the estuary in response to reduced P load, more of the N was then available to fuel hypoxia down the estuary, where, like the Louisiana shelf, the water masses are stratified and N-limited.

5. The authors also state that the water quality model used in the Integrated Assessment "showed high uncertainties in the response of dissolved oxygen and chlorophyll concentration in the northern Gulf under different nitrogen reduction scenarios." They fail to mention that a recently published comparison of three separate modeling approaches (including that used in the Integrated Assessment) shows strong agreement in hindcasts, simulation, and forecasts of control of hypoxia in response to nitrogen loading (Scavia, et al., 2004. *Estuaries* 27: 419-425). We believe this adds significantly greater confidence in predictions of reduction of hypoxia with reductions in N loading than existed at the time of the Integrated Assessment.

We hope these comments help the Task Force consider how to place the EPA Region 4 report in a broader context and how to proceed with the Reassessment.

Sincerely yours,

Donald F. Boesch
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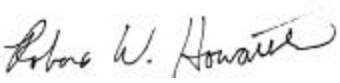

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