Comments on the *Integrated Assessment of Hypoxia in the Northern Gulf of Mexico* report

I found this report to be a substantial and impressive scholarly work. Unfortunately, a few questionable assumptions led to improbable (nonsensical and incorrect) conclusions regarding Nitrogen(N)-management results and their associated costs. Several statements were also made which were patently misleading and are refuted overwhelmingly by the scientific literature. The improbable conclusions are (1) the low level of N-loss reduction achieved by reductions of fertilizer and (2) the extremely high associated costs. The reason I feel these conclusions are improbable is that they do not agree with most published observations. More realistic assumptions would have led to the literature-supported conclusions that reducing Nitrogen application rates to corn to economically optimum levels would reduce N-losses greatly without appreciable loss of yield at considerable increased profits to farmers and with substantial benefit to rural communities and the general population.

Several types of questionable assumptions could have led to the aforementioned improbable conclusions. I obtained the EPIC program that was used to simulate yield and N-loss effects of various management strategies and ran a substantial number of simulations in order to ascertain if the model output closely matched that expected based on published literature. I found that its' simulation of average corn yield, corn yield response to reductions in fertilizer N, and estimates in L-loss was very realistic as long as realistic scenarios for average planting date and pest control were used for continuous corn (CC). Idealized scenarios gave much higher yields, greater estimated yield losses from fertilizer N reduction and substantially lower estimates of both initial and changed N-loss. Simulations of realistic corn/soybean (CS) rotational systems gave slightly less realistic for yield (slightly lower than CC) and yield loss estimates (slightly higher than CC) and very unrealistic estimates for N-loss (near zero). The use of idealized scenarios could account for much of the results reported. The lack of simulated N-loss in rotational systems was apparently from the assumption within the EPIC model that subsequent crops would use excess N unless precipitation was much above average between crops and moved the excess N beyond the rooting zone. In Report 4, page 37, it is pointed out that an evaluation of N-loss versus simulated N-loss showed a differential of 47,000 tonnes per year versus a simulated 7,000 tonnes of nitrate-N. The lack of a realistic tile drainage effect component was sited as the probable cause for this 6.7 fold discrepancy. A further assumption that fertilizer reductions would be applied capriciously to all crops and fields receiving nitrogen regardless of probability of response would greatly elevate simulated yield and economic losses beyond those associated with applying best management practices (BMPs). From page 39, Table 5.3, it is estimated that a 20% reduction in fertilizer N would result in a unit cost of $0.69/kg of N-loss and that a 45% reduction would result in a overall cost of $2.85/kg and a total cost of $2.93 billion. This would require a yield loss of 1.2 billion bushels of corn or @ 20 bushels per acre of corn grown within the MARB. It is doubtful if this level of loss would occur if the N reductions were applied maliciously, much less capriciously or by BMPs.

The predominance of literature indicates that N-loss from agroecosystems (AEs) is minimal as long as N uptake in increased yield approximately parallels N inputs. This occurs in N-limited AEs until yield becomes principally limited by factors other than N. Once other factors substantially limit yield, then additional N inputs increasingly are not taken up by the crops and become increasingly available to N-loss pathways. The vast majority of acreage that falls into the N-input much greater than N-uptake, is planted to corn. The phenomenon of applying Nitrogen to corn at rates that leave approximately half available to loss pathways is based on further questionable assumptions used in calculating economically optimum rates of N. Cerrato and Blackmer (1990) evaluated the impact of using various corn yield to N response models and pricing scenarios on estimated economic optimum N application rates. They found that at typical corn and N prices, their optimum model called for 18% less N than the typical model used. What they failed to account for was that their economics were based on a gross (not net) price structure and that inclusion of additional harvest, handling, drying, and P, K and Ca fertility replacement costs would have further reduced the optimum level by another 12%. An economic optimum that is 30% below university recommended levels is found consistently in peer-reviewed publications. The additional 15%, that this report identifies as N fertilization beyond university recommendations due to improper N credits by farmers for manure and cropping history, brings to 45% the estimated N fertilization to corn reduction to be at the economic optimum. This may only represent a 30% reduction overall but should also represent a >60% reduction in edge of field N-reduction. A similar analysis of the true costs and benefits (net, not gross) of P and K

fertilization, pesticide use and technology adoption would be of great benefit to farmer profitability and to environmental remediation.

Statements were included on pages 27 and 34 that are misleading and should not be included without clearly indicating how they are more representative of promotional material from the fertilizer industry than they are any sort of realistic data. On page 27, "According to comments from the Fertilizer Institute, farmers have also increased the amount of grain produced from 0.76 bushels per pound in the late 1970's to approximately 1.0 bushel per pound of nitrogen today – a 32% increase in efficiency" is stated. Although farmers have retreated from some of the excesses of the past, these changes are more a reduction in waste than an increase in use efficiency. Farmers could achieve an infinite % increase in fertilizer N use efficiency if they applied no fertilizer N. Such is the misleading silliness with these types of characterizations. On page 34, " "Insurance" application is an economic wager – in a good year, on a per acre basis, an extra 10-20 pounds of nitrogen fertilizer may result in 10-15 more bushels, worth $20-30." Is stated. While using the term "may" keeps this statement from being an outright lie, its' probability of representing an actual situation is laughably near zero except in a severely underfertilized, low organic fertility field. That this statement occurs in this report severely undermines its' credibility and calls into question the inherent biases of its' authors.

David McCartney
The Ohio State University
Mccartney.1@osu.edu