The USDA-ARS National Soil Tilth Laboratory (NSTL) lauds the effort put forth by the EPA SAB Hypoxia Advisory Panel in pulling together an update to the basin and gulf science on nutrient losses and hypoxia. We realize that the report put forth on 5-24-07 is a first draft and that the Panel is currently making revisions. To assist the Panel in putting together the most accurate and comprehensive review of the science, we have provided the following comments and suggestions for the Panelists to consider during their revision process. We would be glad to answer any panelist questions regarding these comments or to provide reprints of the articles cited.

Specific comments:

P35 l42. This period also coincides perfectly with the increase in soybean acres and the concomitant loss of perennials from the farm landscape. It is in fact the consensus of Midwest researchers (see the UMRSHNC papers) that switching from perennials to annual row-crops is the primary cause of nitrate losses to surface waters.

P74 l17. According to ERS statistics (http://www.ers.usda.gov/Data/ARMS/ app/Crop.aspx), fall N application has decreased over the period 1996 – 2005 as well as the rate of N applied in the fall. This would seem to be a better indicator of current trends in N fertilizer practices.

P93 l10. The % losses as N_2O do not agree with the IPCC estimates. From Mossier et al., 1998, (Assessing and mitigating N_20 emissions from agricultural soils. Climatic Change 40:7-38) the emission factor for N_2O for N applied to soil is 0.0125 kg N_2O-N/kg N input (range from 0.0025 – 0.0225), while for aquatic systems (stream to ocean) it is 0.025 (0.002 – 0.12) kg N_2O-N/kg N input. Thus, denitrification under aquatic ecosystems releases more N_2O as a fraction of N denitrified than under terrestrial ecosystems.

P113 l12. Is the 45% reduction in N for total N or NO_3? What basis is used for the 45% reduction? Elsewhere in the report the importance of spring (May) total N loads on determining the hypoxic zone size is stressed. Should the 45% be targeted at spring loads or annual loads? If spring loads are to be targeted, then does it matter if the loads during the rest of the year increase or decrease, i.e. would a strategy that delays the N loads arriving in the Gulf to fall or winter improve gulf hypoxia?

P116 l8. Are these reductions for total N and P? The % reduction is based on what initial level? No mention of seasonality for reductions is made although much was made of the importance of spring (May) N loads on hypoxic zone size.

P199 l1-14. These modeling studies have been contradicted by modeling studies by Dave Mulla, Univ of MN (see Gowda et al.,2007, J. Am. Water Resour. Assoc. 43:254-263) and do not agree with field measurements. Jaynes et al., 2001 and Lawlor et al., 2005 showed that a 33% reduction of N fertilizer to near the economic optimum N rate resulted in about a 28% reduction in NO3 losses from tile drains. Thus, the ratio is much closer to 1:1 and the water quality benefit from reducing N fertilizer is much smaller than portrayed here.

P127 l13. While we do not necessarily disagree with the limited benefits of purely voluntary programs, we believe that education and peer pressure can effect substantial change. N fertilizer rates have decreased over the past 10 yr primarily to continuous educational efforts by state University extension services etc. in educating farmers on proper N fertilizer rates. Corollaries can be found in the public sector where repeated public service messages resulted in reduced cigarette use and increased seatbelt use. While education can not be expected to result in 100% adoption in can be effective especially when reduced N rates are shown to be a sound economic practice.

P135 l32. Iowa is not the best state to use as an example for the applicability of drainage water management. The soils and landscape in IL, IN, and OH make these states much more conducive for this practice. Using STATSGO and NLCD data, we estimate that these states have twice as much area conducive to DWM than IA. Evans et al., J. Irrig Drain Eng., 1995, 141:271-276 surveyed state experts and estimated cropland suitable for DWM to be about 25% of all drained cropland in the top 21 drained states.

P135 l42. Denitrification walls have been found to be effective for "at least" 5 to 7 years. We recommend adding quoted phrase to clearly indicate DW effectiveness.

P136 l3. We have conducted research on installing denitrification walls around tile drains and the study write-up is in peer review with J Environ. Qual. We would be glad to provide a preprint.

P136 l9. It should be noted that installing tile drains at shallower depths but closer together will maintain drainage intensity and thus have little effect on increasing runoff while still reducing NO_3 losses in tile drainage by not over draining the soil. Increasing width between tiles may reduce drainage intensity and lead to less timely field management, yield loss, and economic loss for the farmer.

P141 l27. While we are aware of problems caused by regulatory barriers, no information is provided in the text previous to the Key Finding to substantiate this recommendation.

P146 l42. The lack of sustainability of a corn/soybean rotation on drained land from both soil and water quality perspectives was more forcibly stated in the Conclusions of Jaynes et al., 2001 already referenced in the Report.

P147 l12. While we agree with the strong endorsement of cover crops for nutrient reduction, no information was presented on these benefits in the narrative preceding these Findings. We recommend citing Kaspar et al. (Rye Cover Crop and Gamagrass Strip Effects on NO_3 Concentration and Load in Tile Drainage, JEQ. in press) and the references cited within. We can provide this preprint if desired.

P147 l14. While research on intercropping cover crops and leguminous cover crops should continue, it is the use of fall planted small grain cover crops that is most likely to be adopted as the short growing season after harvest and cold winters make leguminous crops poorly suited for the upper Midwest. Research needs to continue on fall planted rye and other small grains to help eliminate yield reductions in the following corn crop and in how best to establish these cover crops in the short fall growing season typical of the Midwest corn belt.

P151 l22. Your reference to “late May or June” is confusing and incorrect. If referring to application of fertilizer this is usually done in April or fall. If referring to rapid plant growth, this occurs in late June and July, not May.

P151 l38-43. Benefits of nitrification inhibitors continues to be controversial as numerous studies have shown either positive or no effects – studies have even found negative effects when applied in spring with N fertilizer. A more balanced and conservative recommendation for inhibitors is required. See Dinnes et al., 2002, Agron J. 94:153-171 for further discussion of this topic.

P153 l8. This statement could be made for any N management strategy that attempts to reduce N application to the economic optimum given the uncertainties as to what this optimum is before pre-harvest.

P153 l36. This statement is misleading as there have been few if any studies looking for SOC decreases at N fertilizer rates less than optimum. Typically, studies have looked at fully fertilized vs. no N fertilizer, and in those a loss of SOC has been found (Havlin etal. 1990, SSSAJ 54:448; Allmaras etal., 2003, SSSAJ 68:1366; Robinson etal., 1996, SSSAJ 60:264; Omay etal., 1997, SSSAJ 61:1672). Also as pointed out in the UMRSHNC report the losses of SOC computed from N balance studies are typically below our ability to detect SOC changes over short term (~10yr) studies. This conclusion also contradicts statements made on p73 l1-7 of this draft and the justification for the “revised” N inputs shown in Fig. 25 of the draft. Also the study by McIsaac and Hu (2004) cited on P83 l9-16 of the draft contradicts this conclusion.

P154 l4. Targeting N rate based on high and low yielding areas typically does not work with an unlimited supply of N because the N response or optimum N rate is very nearly the same in these areas even though final yields are not (see Derby et al., 2007, AJ99:405 for example).

P154 l16. This contradicts your statement on P154 l3.

P154 l20. While N sensing in wheat has shown to be profitable, this is not the usual case for corn unless it is irrigated and N can be applied with the irritation water. See discuss of limitations in Jaynes and Colvin, 2006, Agron J. 98:1479.

P154 l34. Remove “not” before “proceeded”.

P159 l32. These studies also illustrate the continuing need for farmer education through University extension services and other outlets about the need to optimize nutrient inputs.

P159 l36. As noted above, we feel that this statement does not reflect the state of the science in corn production. No mention of the other approaches (rate, timing, controlled release, etc.) discussed in this section are made under this Key Findings. Is it the finding of the SAB that only variable N rate approaches are viable for reducing nutrient losses?

P164 l30. Urban lands may comprise only 1% of the watershed area, but precipitation delivery for urban lands is close to 100% vs. maybe 20% for ag lands. This multiplies the urban impact by a factor of 5 making its influence not so trivial.

P169 l17. If these dairy cows were merely redistributed within the MARB than the overall impact would be much less than implied here. Impact would only be substantial if total dairy cow numbers within the MARB increase which is doubtful.

p171 l16. What is the “top 505 of the stover”?

Table 14. It is unlikely that P losses in runoff will decrease as indicated by changing from above recommended to recommended N application as we would not expect a yield increase and thus more P uptake.

Again, it is hard to imagine decreased in N in runoff by balancing P application with crop use vs. over application. This will not result in increase yield. P timing, rate, and method should not be shaded green for TN in runoff.

Following the convention used elsewhere in table, switching from drained to undrained will increase N and P in runoff not improve it, but markedly decrease losses to drainage for both. Perhaps you meant replacing undrained with drained.

P179 l12. Using leguminous cover crops have not been successful in the Midwest cornbelt due to an insufficient growing season after main crop harvest.

P191 l26. This statement contradicts the statement on l3 of same page.

P191 l37. N fixation can be estimated but probably no better than we can estimate denitrification.

P195 l31. Is the 45% reduction for total N or NO_3 and the 40% reduction for total P? To what baseline are % reductions compared to?

P198 l34. The impact of drain spacing is well known at the plot scale from field experiments and modeling. What is not known is how well these known changes in N and P losses scale up to watershed scales.

P260. While this section on Landscape Design is interesting, it is not integrated into how the MARB should be managed. We recommend deleting the entire section.

P263 l6. Actually the 1978 Census of Agriculture and the 1983 and 1993 NRI samplings were the last efforts to survey for the extent of farm drainage. The 1985 USDA effort was an estimate based on soil and crop data collected in the 1983 NRI sampling.

P263 ll28. A concerted research effort on novel drainage water management practices in the Midwest has been ongoing since 2002 (http://www.ag.ohio-state.edu/~usdasdru/adms/Admsindex.htm).

P271 l28. Although there is much uncertainty in the magnitude of N fixation by soybean, it has been well established in the literature that soybean removes more N in grain than it fixes. Jaynes and Karlen also point out that in their partial N balance approach, several potentially large outputs or losses of N were not considered (denitrification, volatilization of N fertilizer, and N emissions from senescing plants). Including any of these would increase the N imbalance they computed and lead to greater estimates of N mining from SOC. They also pointed out that the losses computed would not be detected in most short term SOC studies (~10's of years) due to our inability to detect small changes in the large SOC pool. However, studies by Havlin etal. 1990, SSSAJ 54:448; Allmaras etal., 2003, SSSAJ 68:1366; Robinson etal., 1996, SSSAJ 60:264; Omay etal., 1997, SSSAJ 61:1672 have all measured losses in SOC when going from high to 0N applications. Thus, applying N much below the optimum N rate may lead to longterm SOC depletions in a corn/soybean rotation.

P280 l2-7. If the feeding of DDG to dairy cows is merely a replacement of feeding them the corn directly, it is difficult to see how this practice will increase N and P loads to the MS river.