Missouri Department of Natural Resources

Notes from Nutrient Criteria Technical Subcommittee – April 5, 2012

In Attendance: Karen Bataille, MDC; Nick Bauer, St Louis MSD; Brandy Bergthold, MDNR-ESP; Robert Brundage, Norman, Comley & Ruth, PC; Suzanne Femmer – USGS; Ed Galbraith, Barr Engineering; Peter Goode, Washington U/MCE; John Hoke, MDNR-WPP; Leslie Holloway, MO Farm Bureau; John Madras, MDNR-WPP; Dave Michaelson, MDNR-ESP; Paul Michaletz, MDC; Rob Morrison, Barr Engineering; Rebecca O'Hearn, MDC; Dan Obrecht, UMC; Kevin Perry, Regform; Mark Osborn, MDNR-WPP; Steve Taylor, MO-AG; Tony Thorpe, UMC; Phil Walsack, MO Public Utility Alliance; Chris Zell, Geosyntec.

On Conference Line: Gary Welker and Jeff Robichaud, EPA Region VII.

Florida Ruling

Mark made a presentation on a recent Federal court ruling concerning promulgation of nutrient criteria by EPA in the State of Florida. The Florida Department of Environmental Protection (FDEP) had been working for a number of years to develop numeric nutrient criteria, in response to previous directives from EPA to all the states. The state had (and still has) a narrative criteria, which is widely regarded as a little vague and not sufficiently protective of the waters of the state. In 2008, several environmental groups sued EPA, with the demand that numeric nutrient be adopted. As a consequence of this lawsuit, in January, 2009, EPA wrote to FDEP, stating the intention for numeric criteria promulgation on the State by EPA (This is referred to as the 2009 Determination). This was accomplished in October, 2010 for the state's inland waters. A series of countersuits followed, initiated by the state's Department of Agriculture and Consumer Services, the South Florida Water Management District, and eleven trade associations. Judge Robert Hinkle, presiding over the US District Court of Northern Florida, consolidated all the cases and issued a ruling on February 18, 2012. Before describing the ruling, Mark presented the central characteristics of EPA's rule.

- **Lakes** are classified by color and alkalinity. "Colored" lakes are those with colorimetric data that indicate measurements of over 40 platinum cobalt units (PCU). The color is generally results from the decay of floating vegetation. They have the highest criteria for Total Nitrogen (TN) and Total Phosphorus (TP). "Clear" lakes are further classified by alkalinity, with a threshold of 20 mg/L $CaCO_3$ that separates those with high and low alkalinity. The low alkalinity lakes are the most oligotrophic, and thus have the most restrictive criteria for TN and TP. They also have a limit for chlorophyll-a (Chl-a) that is more restrictive than for the other two classifications. For TN and TP, lakes in each category have baseline criteria, as well as ranges for modified criteria. For an individual lake, the latter can be applied if there are sufficient data from three consecutive years that indicate that the Chl-a levels are consistently in compliance, and TN and/or TP levels are consistently within the range specified for each category. They also must not violate the criteria for any stream to which the lake discharges.

Scientific Rationale: The lake classification system was produced as a result of stronger relationships of chl-a response to TN and TP being calculated within each of the categories, as opposed to the stressor-response relationship of the lake population as a whole. The Chl-a criteria were based on the predicted trophic status associated with widely recognized standards developed by the Organization for Economic Co-operation and Development (OECD). The range of modified criteria was devised to accommodate the margin of error that was calculated in the stressor-response regression.

- **Streams** are classified geographically, with the state divided into six zones based on eco-regional characteristics. One of these zones, the South, is dominated by the Everglades, and has limited reaches of "normal" streams. It is excluded from stream criteria. The rest of the state has criteria that range from 0.67 to 1.87 mg/L for TN and 0.06 to 0.49 mg/L for TP.
  Scientific Rationale: Stressor-response relationships were difficult to identify in streams. Therefore the reference approach was employed. Reference streams (those with minimal disturbance) were identified through a combination of benchmark studies and Stream Condition Index (SCI) measurements. The benchmark studies involved a GIS analysis of anthropogenic disturbances within stream watersheds. SCI is a scored assessment of stream habitat and biological condition. Due to extensive development in the Tampa area, no reference streams could be identified in the West Central region using the benchmark approach. Therefore, the SCI method was used in that area. In all other regions outside the South, benchmarks, considered reliable were used. Criteria for each region were set at the 90th percentile of the TN and TP distributions in reference streams for those regions using benchmarks and at the 75th percentile in the West Central region.
- **Downstream protective values (DPVs)** are calculated for streams that discharge to lakes, using an equation that accounts for the lake criteria, the fraction of flow that a stream contributes to a lake, and the lake's hydraulic retention time. For any given stream, the effective numeric nutrient criterion is the lesser of the regular stream value or the DPV.
- **Springs** have a single criterion statewide, which is 0.35 mg/L nitrate-nitrite (NO_2 + NO_3]. This was developed following laboratory and field studies of two nuisance algae species which indicated this as an effective threshold value.
- **Site Specific Alternative Criteria (SSAC)** that are at variance with default criteria for a specific water body may be assigned if certain requirements are met. Any entity (government or private, institution or individual) may apply for a change to the nutrient criteria of said water body. The entity must provide data and analyses that meet quality assurance standards. Approval of the change will follow a public comment period and review by qualified personnel.

The Judge's Ruling: By consolidating the claims and counter- claims between EPA, FDEP, the environmental groups (the "Florida Wildlife parties" and the "Gulf Restoration Parties"), and their adversaries (the "State and Industry parties"), Judge Robert Hinkle was able to bring a comprehensive (though perhaps not final) resolution to the cross currents of litigation. Specific decision points are as follows:

- **The 2009 Determination:** The State and Industry parties moved to invalidate the 2009 Determination and the numeric criteria adopted by EPA. The judge pointed out that FDEP, a state entity, had acknowledged the need for numeric criteria, and furthermore that the Clean Water Act (CWA) calls for numeric criteria for all waters, whether impaired or not. Therefore, EPA's issuance of the rule is "not arbitrary or capricious."
- **Lakes:** The State and industry parties complained about the classification scheme and the parameter limits, noting that some lakes in northwest Florida are naturally high in TP but they were meeting their designated uses. The judge replied the adoption of water quality standards does not require showing that designated uses are not being met; they can be established in anticipation of future impairment. Also, if "natural" conditions include concentrations greater than the water quality standard allows, this can be addressed through the SSAC or TMDL processes. These parts of the rule were thus deemed "not arbitrary or capricious."
  The State and Industry parties also complained that the use of limits for all three parameters (TN, TP, and Chl-a) was unreasonable. The judge replied that the science used to develop criteria for all three parameters was defensible, and furthermore, Chl-a can be a lagging indicator, meaning that the use of standards for all three parameters is appropriate. Thus the requirement is "not arbitrary or capricious".
  The Gulf Restoration parties complained that the inclusion of modified criteria would allow FDEP to change criteria without EPA oversight. The judge replied that EPA had set up specific guidelines for using this option, and furthermore, it blunts some of the force of the State and Industry party complaints. Thus, inclusion of the modified criteria provision is "not arbitrary or capricious".
- **Springs:** The Gulf Restoration parties claimed that the criterion was too high, pointing out that laboratory studies indicated a lower response threshold by the nuisance algae species. The judge pointed out that field studies accounted for system complexities that were not replicated in the lab. The criterion for springs is "not arbitrary or capricious".
- **Streams:** Both sides of the litigation claimed, for different reasons, that the reference streams that were selected did not represent the appropriate target. The judge agreed, pointing out that the 90 percent (or 75 percent) thresholds did not necessarily demonstrate harmful increase in nutrient concentration. The stream criteria as currently calculated are "arbitrary or capricious".
- **Downstream Protective Values:** The state and industry parties claimed that DPVs are unnecessary and unprecedented; regular stream criteria are sufficient. The judge disagreed, stating "A better mousetrap is by definition unprecedented, but it is an improvement nonetheless." If a stream is contributing to the impairment of a lake, whether or not it is meeting stream criteria, it is part of the problem. Therefore, inclusion of DPVs is "not arbitrary or capricious".
  However, the judge agreed with the state and industry parties' position that EPA disregarded factors besides streams that lead to lake impairments. For lakes that are not impaired, as with streams, a harmful increase is not identified.

- **Canals:** The South Florida Water Management District challenged the inclusion of DPVs for canals, noting that canals simply transport water from one location to another, without increasing pollution, and are not subject to effluent regulations. The judge agreed on the latter point, but pointed out that canals are subject to water quality standards, and to exempt a canal from a downstream protective value provision would effectively exempt any water upstream from the canal that indirectly flows into a lake. Thus, the use of DPVs for canals is not "arbitrary or capricious".
- **Site Specific Alternative Criteria:** The environmental groups did not like this provision, worrying that it could allow changes to broad areas, such as entire watersheds. The judge found that such a scenario did not seem probable and was speculative. It was not "ripe" for judicial review. Therefore, the SSAC provision is "not arbitrary or capricious".

Follow-up: The judge ruled that the EPA rule, excepting the stream and DPV provisions, would be allowed to go into effect March 6, 2012. (This has now been postponed until July 6, 2012.) EPA is to submit new for streams and DPVs by May 21, 2012. (This deadline may be extended.)

Meanwhile: Florida has passed its own nutrient criteria, which has similarities and differences with the EPA rule. The numeric criteria are devised as a translator of narrative criteria. As such, the numbers mostly resemble the EPA numbers, with the glaring exception of the TP criteria for lakes in the West Central region. It is set at 0.49 mg/L. The environmental groups are not happy with the Florida rule, and they have submitted a legal challenge which is ongoing.

Nutrient Impacts on Lake Fish Communities

Paul Michaletz of MDC reported on analysis that he has done with fish communities and their relationships to an array of environmental variables including nutrient concentrations in lakes. From this he has written a paper, which is still in review. He studied 156 lakes, mostly between 20 and 200 acres in size, although there were a few larger ones, with areas up to just under 1,000 acres. TP concentrations in the lakes ranged from 7 to 324 µg/L and Chl-a concentrations ranged from 1 to 186 µg/L. Generally, he found that fish size structure and growth increased with higher nutrient concentrations, peaking at around 100 µg/L for TP and between 40 and 60 µg/L for Chl-a. Species that were studied included bass, bluegill, crappie and other sunfish. Most of the lakes studied were in northern Missouri.

Overall, there was no particular temporal trend observed in trophic status in the lakes that were studied. However, Dan Obrecht noted that there were specific lakes, such as Little Dixie Lake, that did have changes in trophic level that appeared to result from the introduction (and in a few cases removal) of grass carp. Carp tend to be very disruptive, stirring bottom sediments and consuming aquatic macrophytes, which results in the release of nutrients, particularly phosphorus, into the water column. These are not the same as grass carp, which used to be deliberately stocked for the control of aquatic vegetation.

Several native species, such as bass and bluegill, have been found to be self-sustaining in Missouri lakes. They are more sensitive to nutrient levels than channel catfish, which generally need to be periodically

restocked. The question was raised that if nutrient levels are significantly lowered in a lake, the sport fishing potential could be lost. Paul replied that this has happened in a few situations in the southeastern U.S. In Missouri, such a scenario is not likely. However, some lakes in the Ozarks are deliberately fertilized in order to support the sport fish population.

Some lakes have too many nutrients. Highly turbid, hyper-eutrophic environments appear to be detrimental to sport fish. Other species, such as carp, tend to take over. Higher nutrient levels can lead to problems with dissolved oxygen levels, reducing the volume of the epilimnion in which fish can live. Paul cited a study in Iowa which focused on eutrophic levels at which this occurs.

Mark asked Dan about the number of lakes in the data set that were owned or operated by MDC, pointing out the dilemma of the sport fishing use not aligning with the definition of warm water aquatic life protection that is currently in the Missouri water quality standard. Dan stated that out of 108 lakes listed in the data set that was previously distributed, 29 were owned by MDC and an additional 50 were managed by MDC for fisheries. Rebecca reminded the group that, while MDC generally manages the lakes for sport fishery, it is not the desire of the department to degrade these waters solely for this use.

Lines of Evidence

Mark handed out a table describing the current figures, and briefly described the rationale of each one. Not all figures came from the previously distributed data set. Some were from the data set previously collected by the RTAG group. The percentiles were from that group as were the data for the tri-section figures. Gary described the tri-section method as a determination of the best lakes in terms of chl-a, and the levels of TP and TN that are associated with it. It is somewhat more conservative than the use of the 25th percentile of the general population. Mark explained the figures from Nebraska. That state has just recently adopted its lake nutrient criteria, signed off by the Governor. The WCB refers to the Western Cornbelt Plains, of which Missouri shares a portion in the northwest part of the state. The High Plains refers to the western part of Nebraska and may be less relevant for Missouri. The list also includes RTAG reference figures specifically for Missouri as well as for the entire RTAG region (IA, KS, MO, NE). The EPA reference figures are based on publications from about ten years ago that are specific to the Omernik nutrient eco-regions. The regression figures are based on the MDNR data set. The change point analysis was described at the previous meeting. Mark also ran the Florida model (base line and range of alternate criteria). The ranges for the lines of evidence are in the following table.

	Chl-a (µg/L)	TN(µg/L)	TP(µg/L)
Plains	5.4 – 11.8	360 – 1000	15 – 50
Ozarks	1.8 – 8.7	201 – 750	8 – 35

Chris asked about the use of historical prairie as was submitted in the original rule that was previously in part disapproved by EPA. Jeff explained that the model that was used did a good job of predicting what the nutrient level of a given reservoir would be, but it did not predict what level would protect the aquatic life use. Mark added that if anyone wishes to see the disapproval letter, he can provide it.

The question was raised about what level of chl-a would be considered harmful. Dan pointed out that some amount is necessary for aquatic life. Mark referred to the Florida model, in which the criteria were determined from internationally recognized literature, but they also had considered other lines of evidence. There is ample literature which demonstrates that high levels chl-a are detrimental. Chl-a data are relatively abundant, unlike data for other response variables such as macro-invertebrate scores or fish community data.

Rob expressed interest in the Nebraska criteria, with the question raised about how those criteria were derived. Mark said he did not have that information on hand but would provide it when available. Jeff said that Nebraska has a good data set, and their analysis is likely to produce similar results in northern Missouri.

Robert expressed some skepticism about the proposed limits for chl-a, noting that the analyses that Mark had performed did not reveal any particular inflection point and that, as Paul had indicated, higher concentrations are fine for sport fishing. Mark replied that, while this is true, sport fishing is not the only desired use for Missouri lakes. Presently, they all are expected to meet the requirements of protection of aquatic life as well as other recreational uses. Protection of aquatic life, as currently defined by Missouri water quality standards, includes a component of biological diversity, to which high chl-a levels are demonstrably detrimental. A possible solution to this conundrum is the assignment of a new class of lakes, which would have a modified definition for aquatic life protection that would downgrade the diversity component and would include sport fishing as its primary use.

Dan pointed out that all the lakes that are affected by the nutrient rule are artificial, and there is no natural historic basis for aquatic diversity within them. He cited the example of clams, which rely on flowing water as a survival mechanism. The detriment of their populations is not so much a result of nutrient and chl-a levels as it is the existence of the reservoirs themselves.

There was further discussion of designated uses. L1 lakes are for drinking water, and they would necessarily have lower levels required than lakes used for sport fishing. Chris mentioned the Scenic River discussions going on with Oklahoma, citing the multiple studies of aquatic life response to nutrient concentration. He suggested that the group should be doing more research in this area, that is, a more intense literature review.

Robert wondered whether there were any examples of lakes that had been shown to suffer loss of diversity due to nutrient impairment. Mark replied that there is some literature concerning that, but it was from outside the state. Dan said that there was really not been any research done on aquatic diversity in lakes, the effort has focused primarily on support of the sport fishery.

An extended discussion followed concerning the desired use of lakes. Several participants repeatedly expressed the concern that if nutrient levels were forced too low, the fisheries would decline. Mark reiterated the option being considered, that an alternative use designation would be created for sport fisheries. Jeff confirmed that EPA could work with the approach, with the caveat that it may cause a ripple effect with other water quality issues. He suggested that the use of site specific alternative criteria and the modified criteria approach used in Florida would be viable.

Suzanne tried to pose the question from the other direction: Are the nutrient criteria numbers suggested in the lines of evidence actually detrimental to sport fishing? For example, the range in the Plains for TP is from 15 to 50 µg/L. Paul indicated that 15 is pretty low, but many of the lakes used for sport fishing are at around 50 µg/L, so that may be reasonable. Dan mentioned that in the Ozarks, some lakes that are fertilized are in the range of 8 to 12 µg/L.

Paul cited a study in Alabama, in which the desired threshold for chl-a with sport fish species was about 30 µg/L.[1] Mark indicated that that figure is probably too high for Missouri. Paul also pointed out that for some species in the Ozarks, such as trout and smallmouth bass, a lower nutrient threshold would make sense.

Jeff stepped in to defend the figures in the lines of evidence, noting that they were fully documented and peer reviewed. Robert acknowledged that the RTAG benchmarks would surely be protective of the uses, but maybe more than necessary, noting Tony's previous suggestion that in such a lake there may be happy fish, but perhaps only two of them. Mark offered an explanation of the RTAG process, pointing out that it was not intended as a final determination, but more as a starting point. The benchmark figures were arrived at after consideration of the issue from many angles.

John Hoke expressed an interest in seeing more specifics from the MDC study, so as to get a better idea of what particular quantities of nutrients and chl-a correlate with optimum conditions for sport fisheries. This would be useful in setting the parameters for an alternate designated use.

Chris expressed perplexity at the discussion of the higher numbers as desirable for sport fisheries and how to reconcile them with the lower numbers in the lines of evidence. He reiterated his suggested of further literature review. Dan pointed out that he had done a search after the last meeting, and found that there was not much in terms of specific aquatic life response. He mentioned mussels and crayfish as species for which not much is known in these terms.

Dan went on to present his own lines of evidence, including fish kill data and a 2007 assessment of lakes performed by EPA. For the period of 1995-2005, he reviewed data for the 40 lakes that his program monitors regularly. He found that fish kills occurred for a variety of reasons in lakes with TP concentrations across the whole range in the data set. There was no evident correlation of fish kills to nutrient concentration. Out of the 14 lakes that had fish kills, there was only one incident that was attributed to eutrophication. He cited the history of kills in several of the lakes.

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[1] Paul later reported that he misquoted the paper. They suggested that a chla concentration of about 10-15 mg per cubic meter may be a compromise to maintain desirable sport fisheries and still have reasonable water clarity. They did point out that anglers and fisheries managers may have to lower their expectations for sport fisheries at these levels. Maceina, M. J., D. R. Bayne, A. S. Hendricks, W. C. Reeves, W. P. Black, and V. J. DiCenzo. 1996. Compatibility between water clarity and quality black bass and crappie fisheries in Alabama. Pages 296-305 *in* L. E. Miranda and D. R. DeVries, editors. Multidimensional approaches to reservoir fisheries management. American Fisheries Society Symposium 16, Bethesda, Maryland.

Rebecca reported that when fish kills are reported, it largely depends on probability of being witnessed, therefore more likely to be reported from near urban areas. She also reported that she compared fish kill data to the nutrient data that Mark had provided and did not see any significant correlation.

Dan presented an interpretation of EPA's 2007 National Lake Assessment. Data were reviewed nationwide but also in terms of nutrient eco-regions. For each region, they set up categories of "good", "fair", and "poor" for each eco-region. The threshold between "good" and "fair" was set at the 75th percentile of the reference lakes for each region, and the threshold between "fair" and "poor" was at the 95th percentile. For the two eco-regions that encompass Missouri , he determined the percentage that were rated as "poor" for each parameter (TP, TN, and Chl). He then applied those percentiles to the data set that was distributed at the previous meeting. His findings are displayed in the following table.

	Ozark Highlands			Plains		
	TP	TN	Chl	TP	TN	Chl
% of lakes rated as POOR in NLA	13	12	22	30	40	29
Corresponding concentrations for MO	64	945	23.5	69	914	30.3

Dan indicated that the numbers for the Ozarks may be high, but that may be due to the lakes in the previously designated Ozark Border region being folded in with the Ozark Highlands. He felt that the numbers for the Plains were more representative.

Jeff said that there was struggle in EPA's definition of "poor", "fair" and "good". He said he could provide some data that would offer greater context to these figures.

Dan showed another table comparing nutrient criteria for states that share eco-regions with Missouri.

	Ozark Highland (Ecoregion XI – Central & Eastern Forested Uplands)			Plains (Ecoregion IX – Temperate Forested Plains & Hills)		
	TP (µg/L)	TN (mg/L)	Chl (µg/L)	TP (µg/L)	TN (mg/L)	Chl (µg/L)
Illinois				50		
Georgia		4	5-10		3-4	2-27
Minnesota				65/90		22/30
S. Carolina				60	1.5	40
Virginia	10-40		10-35	20-40		25-60
W. Virginia	40		20			

A few qualifiers: In Illinois, the criteria are statewide for lakes and reservoirs greater than 20 acres in surface area. In Georgia, the criteria are site specific for six reservoirs, two in Ecoregion XI and four in Ecoregion IX. The Minnesota criteria are actually for Ecoregion VI, the Corn Belt and Northern Great Plains, which covers the northwest corner of Missouri. The first number is region-wide for Minnesota,

and the second is for shallow lakes within the region. In Virginia, the ranges are site specific for 29 water bodies in Ecoregion XI and 72 water bodies in Ecoregion IX.

Question: These states do not have criteria for all three parameters. Is it the intention of EPA to get states to adopt criteria for all three? Jeff replied yes, and he referred to the "Stoner Memo", a letter to states from the EPA administrator which outlined EPA's current strategy to bring about nutrient reduction nationwide. The implementation of numeric nutrient criteria was a part of it, and criteria for stressor and response variables would be expected. Mark pointed out that, at least in Missouri, chl-a did not appear to be a reliable response variable in streams. Jeff agreed, and mentioned Maine, which has a wide array of biological data that they are using for that purpose.

Next Meeting: May 9, 2012

Straw man proposed rule

Mark distributed copies of a draft of the proposed rule that included portions of the original rule but also with revisions to adapt to the change in circumstances. Table L, which would list the actual numeric criteria, was left blank, and Mark intends to have it filled before the next meeting. He also will be adding sections that will address alternate criteria for eutrophic lakes designated specifically for sport fishing, as well as procedures for assigning site specific alternate criteria.

Next Meeting

May 9, 2012