Missouri Department of Natural Resources

Missouri Nutrient Reduction Strategy

Committee Meeting

Tuesday, April 30, 2013, 9:00a.m. – 3:00 p.m.
Bennett Springs and Roaring River Conference Rooms
Department of Natural Resources, 1730 E. Elm Street, Jefferson City, MO 65101

A. CALL TO ORDER

The meeting began at 9:00 a.m. on April 30, 2013, in the Bennett Springs/Roaring River conference rooms at the Missouri Department of Natural Resources Elm Street State Office Building located at 1730 E. Elm Street, Jefferson City, MO 65101. Meet Me call-in bridge and toll-free phone numbers were available from 10:30-3:00 p.m. for committee members who were unable to attend the meeting in person. Live streaming video was also available from 10:45-11:45 and 1:00-3:00 p.m. at www.dnr.mo.gov/videos/live.htm. The meeting was announced in accordance with the Missouri public meetings law.

B. ATTENDEES

The following committee members were in attendance:

Alan Freeman – Missouri Department of Natural Resources – Soil and Water Conservation Program
Bill Allen - Metropolitan St. Louis Sewer District
Bob Angelo – Environmental Protection Agency - Region 7
Bob Broz - University of Missouri Extension
Bryan Hopkins - Missouri Department of Natural Resources - Office of the Director
Claire Baffaut - U.S. Department of Agriculture – Agricultural Research Service
Chris Klenklen - Missouri Department of Agriculture
Cory Lindeman - University of Missouri Extension
Colleen Meredith - Missouri Department of Natural Resources **-** Soil and Water Conservation Program
Darrick Steen - Barr Engineering
David Carani - Geosyntec, Inc.
Doris Bender- City of Independence
Joe Boland- Environmental Improvement and Energy Resources Authority
Joe Engeln - Missouri Department of Natural Resources – Office of the Director
Joe Slater- University of Missouri – Agricultural Experiment Station
John Madras – Missouri Department of Natural Resources – Water Protection Program
John Christiansen - Geosyntec, Inc.
John Hoke -Missouri Department of Natural Resources - Water Protection Program

Judy Grundler - Missouri Department of Agriculture
Kat Logan Smith - Missouri Coalition for the Environment
Ken Struemph – Missouri Department of Natural Resources – Soil and Water Conservation Program
Kurt Boeckmann - Missouri Department of Natural Resources – Office of the Director
Lorin Crandall - Missouri Coalition for the Environment
Mark Osborn - Missouri Department of Natural Resources – Water Protection Program
Mark White – Missouri Corn Growers Association
Philip Walsack – Missouri Public Utility Alliance
Scott Totten – Missouri Department of Natural Resources
Steve Taylor - Missouri Agribusiness Association
Steve Walker- Missouri Department of Natural Resources – Soil and Water Conservation Program
Walter Fett - Missouri Department of Natural Resources – Water Protection Program

Committee Members Participating Via Phone:
Todd Blanc - Missouri Department of Natural Resources – Water Protection Program
Jeff Arnold – U.S. Department of Agriculture – Agricultural Research Service
Dale Robertson - U.S. Geological Survey
Charlie Stevens - City of Liberty

C. MEETING AGENDA

9:00 a.m. Welcome – Joe Engeln (Missouri Department of Natural Resources)

9:10 a.m. Announcements/Introductions – Steve Walker (Missouri Department of Natural Resources)

9:20 a.m. Summary of work tasks initiated and completed - EPA Gulf of Mexico Grant Employee Cory Lindeman (University of Missouri)

9:30 a.m Workgroup Breakout Sessions – Discuss ideas for indicators of progress for tracking success of nutrient reduction efforts

10:45 a.m. SWAT Model Presentation – Jeff Arnold (USDA-ARS)

12:00 p.m. Lunch

1:00 p.m. SPARROW Model Presentation – Dale Robertson (USGS)

2:00 p.m. Workgroup Progress Reports and Discussion

2:55 p.m. Next Steps/Next Meetings

3:00 p.m. Adjourn

D. WELCOME

Mr. Engeln welcomed everyone to the meeting and stated that he and John Hoke have been added to the team that will help develop the Missouri Nutrient Reduction Strategy. He stated that the goal is to reduce the nutrient loads and not just nutrient concentrations. He said this meeting will be looking at modeling efforts (SWAT and SPARROW) and committee members need to find reasonable approaches that are quantifiable, but not necessarily based on measuring nutrients. Mr. Engeln stated that EPA would like to see this Strategy completed by December 31, 2013, but it may not be finished by then. He said that committee members also need to make note of the successful program efforts and monetary backing of projects in the state of Missouri. He said that the progress made in Missouri during the last 10 years of our nutrient reduction efforts should be tabulated.

E. ANNOUNCEMENTS & UPDATES

Mr. Walker then briefly made announcements and updates. He explained that the development of a Missouri Nutrient Reduction Strategy was a commitment made by Missouri in the 2008 Gulf of Mexico Hypoxia Action Plan. The commitment of all 12 states that are on the Hypoxia Task Force was to complete and begin implementation of state-level nutrient reduction strategies by the end of 2013.

Mr. Walker listed progress to date:

- Forming this Committee
  - To date, 117 people from 43 different organizations have participated
- Vision Statement
- Guiding Principles
- Annotated Table of Contents
- Watershed Nutrient Loading Potential Spreadsheet (with assistance from Tetra Tech)
- Compiled numerous nutrient reduction ideas and strategies from Committee members
- Applied for and received an EPA Gulf of Mexico grant for $118,000
- EPA grant monies have been used to enter into cooperative agreements with MU and LU to hire two temporary full-time employees, Cory Lindeman at MU, and Nikita Mullings at LU, to assist with work tasks.

Mr. Walker then informed committee members that he had planned on the two temporary full-time employees, Cory Lindeman of University of Missouri – Columbia and Nikita Mullings of Lincoln University, Missouri providing a brief overview of their work tasks. Mr. Walker however, provided a brief summary of Nikita's works tasks as she was unable to be present at the meeting as she is visiting her family back home in The Bahamas. Mr. Walker describes Nikita's work tasks below:

- Compiled minutes for our previous seven Committee meetings
- Compiled information about nutrient articles in Missouri, background information on nutrient sources, and costs and effectiveness of BMPs
- Drafted several summaries including septic tank recommendations; things all Missouri citizens can do to reduce nutrient loads, including lawn care and pet wastes; nitrous oxide sources of air emissions; and wetland mitigation banking
- Conducted simulations using the SPARROW Decision Support Model

F. INTRODUCTIONS

The attendees and members participating on the phone then introduced themselves.

G. PRESENTATION - Cory Lindeman – Works Tasks & Accomplishments

A pdf of Mr. Lindeman's presentation is provided below:

Acrobat Document

H. PRESENTATION – SWAT Model Presentation- Jeff Arnold – (USDA – ARS)

A pdf of Mr. Arnold's presentation is provided below:

Acrobat Document

Mr. Arnold began by providing a brief introduction stating that he was going to talk about the CEAP project, (Conservation Effects Assessment Project). He works for the USDA for the Agricultural Research Service (ARS) which has a core group of ARS scientists that support the CEAP model team. He said they also have the NRCS team of about 5 engineers and scientists and USDA also works with Texas A&M university as they have an experiment station co-located with them.

Mr. Arnold then provided background information on CEAP. He explained that CEAP started after the 2002 farm bill when USDA went from a few hundred million dollars in conservation payments made to farmers to billions of dollars. He stated that when this happened, the Office of Management and Budget (OMB) wanted accountability so they questioned what the environmental impacts of farmers putting conservation practices in place were. Over time, there

was a blue ribbon panel that conducted reviews and said that everything was well and good, but it was determined that the real strength of CEAP should be in guiding policy and making scenarios to guide policies.

Components of CEAP

Mr. Arnold then discussed CEAP components and mentioned the first thing USDA thought they had to do was get a good idea of what practices are in the field right now. In order to determine this, he stated that USDA conducted a 3 year survey in the mid-2000s to obtain a good idea of the practices over a given time period. He stated they then took that information and fed it into an APEX model which is a field-scale model that he would explain further. He stated they then look at the edge of field effects of the conservation practices and then take that information, which is aggregated at the sub-basin level, and feed that into the SWAT watershed model. He explained that with SWAT they are able to look at off-site water quality estimates and source loadings as all the point and non-point sources are aggregated.

Statistical Design and CEAP Survey

Mr. Arnold explained that the survey data is a sub-sample of the NRI data points over 3 years. He said they had approximately 30,000 – 50,000 points across the country allowing for a complete dataset of everything needed to input into APEX about the cultivated areas such as crops grown, nutrient applications, timing, manure applications, pesticide, tillage, irrigation, and any structural conservation, practices such as buffers, grassed waterways, and tile drainage that might be in place on the landscape. He said this is then taken and directly entered into management files for APEX.

Estimation of On-Site Effects (APEX)

Mr. Arnold said that all management information is then taken and applied to a representative field where they not only model what is on that field, but they also model if there is any kind of buffer, grassed waterway or terrace system so there is a second land use to physically model the processes of that flow across the buffer.

SWAT Modeling Watershed Modeling System

Mr. Arnold explained that this information is taken and thought of as a watershed and within SWAT all the cultivated fields are then taken in order to aggregate the APEX output within the 8 digit HUCs. He explained that some of the heavier agriculture areas (Iowa and Mississippi) may have 30 or 40 different representations of APEX fields within that 8 digit, all the way down to some areas where we have less agriculture consisting of 1 or 2 points. He said USDA then aggregates the point sources with the SWAT model and simulate all the non-cultivated land (urban areas, forest, range) lastly aggregating those in SWAT allowing them to then be able to start routing through the channels and floodplains and reservoirs to the outlet of interest.

Field scale- Landscape Model Capabilities

Mr. Jeff Arnold stated that some of the processes in APEX and SWAT both operate on a daily time stub, therefore they update daily (weather, precipitation, maximum temperatures) and typically generate some of the other parameters: radiation, wind speed, water balance, hydrology, sedimentation, erosion, plant growth, nutrient cycling, pesticide dynamics, carbon dynamics and pathogen fate (he stated that pathogen fate was not looked at in CEAP). Mr. Arnold continued by informing committee members that some of the management looked at the different cropping rotations and they then modeled those inclusively (the harvesting of the residue, removal of the residue, tillage fertilizer grazing, pesticides, irrigation, tile drainage and impoundment).

He explained that when they get into channels they actually conduct the water balance and flood routing within the channels, sediment deposition and degradation and nutrient and pesticide reactions in the stream. He said that in a similar way they also look at ponds and reservoirs and wetlands and look at the water balance whereby the main difference in those is mainly the outflow and how it's controlled. Mr. Arnold stated that the major reservoirs have a human control whereby some use the target approach or the input of the operation rules; - the smaller ponds and PL-566 structures actually have different spillage controls and on the ponds and reservoirs it is assumed they are well mixed in both the nutrients and pesticides when the balance of those are computed.

CEAP Database

Mr. Arnold then went on to discuss the CEAP database and that they used databases uch as NRI and the CEAP sampling databases in addition to the USGS National Land Cover Database (NLCD). He stated that they have been updating the data recently to get different land uses and also the percent of cultivated agriculture within the basin (using the 8 digit HUCs). He mentioned that the USGS Hydrologic landscape Region (HLR) was also used as another one of the overlays and they then came up with the HRU table which is the overlay of the land use, soil and slope in SWAT in order to come up with the hydrologic response unit of the non-cultivated areas.

He said that the rainfall of all 11,000 COOP stations was also looked at and ran through the Prism model which generated daily precipitation and daily maximum and minimum temperatures for the country. He explained that for atmospheric deposition, all of the sites were analyzed with wet and dry and anti-deposition rates and the points were then collected and smoothed out to come up with a number for each 8 digit HUC watershed.

Nutrient Management Issues addresses by Models/Assessment

Mr. Arnold stated that they also included the point sources which were aggregated by 8 digit HUCs and at one point he stated they were using the same data as SPARROW. He said that as far as nutrient management issues, when going back to the survey data they have information on not only fertilizer amount but also on timing, cropping system, pasture and grazing; simulating

the pasture and grazing manure rates within SWAT. He explained that for the tillage impacts, there are tillage implements and with each implement there is a mixing efficiency and depth of mixing that tells the model how much residue is removed or incorporated within mixing of nutrients and pesticides.

Nutrient Management Issues Addressed Structural Practices

Mr. Arnold stated that some of the structural practices in place and simulated with APEX include contouring, terracing, filter strips buffers, waterways and tile drains. He said that at this point all basins have been completed and the results are reported out on a 4 digit scale where there are fourteen 4 digits within the Upper Mississippi. The 8 digits are the sub-basins where all the point sources are aggregated and all the APEX information is then routed. He said the routing reaches are the main routing reaches between the 8 digits and they take and route and down through the river basins until eventually routing to the Gulf of Mexico.

Calibration

Mr. Arnold advised that they did spend time trying to calibrating the models. He said the first step was to take all the USGS stream flow records and come up with a smooth map of runoff applying the base flow separation technique. He said they then come up with an interpolation of the base flow and total flow, total runoff for each of the 8 digit HUCs in the country and then calibrated the average water balance to those numbers for each 8 digit HUC and then they go back to a few select gages to make sure the monthly and annual values were good. He stated lastly, once the annual average is calibrated, the gages are then used to conduct a monthly and annual calibration for nutrient and sediment loads at those sites. Mr. Arnold said that at each 8 digit HUC, the observed average annual yield vs. the predicted average annual yield is compared. The predicted sediment and predicted nitrogen, total nitrogen and total phosphorus were also analyzed. He said using the CEAP calibration of the Mississippi River Basin they then looked at the monthly total nitrogen and phosphorus at the river gages. He explained that they tried to make sure that they were within the error bounds of the measured gages. He said they also did a SPARROW comparison, but they did not try to calibrate or validate the SPARROW model, just compare.

Significant Progress Made in Reducing Erosion and Sedimentation

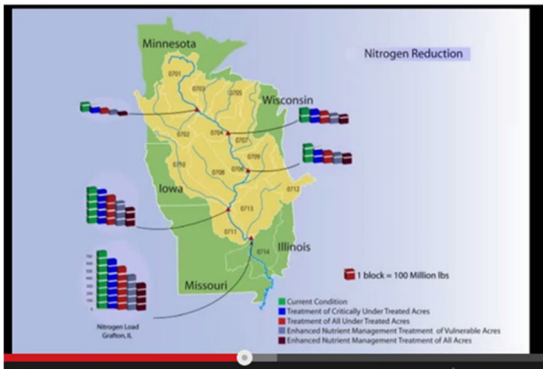
Mr. Arnold then discussed the results focusing on the Upper Mississippi. He state that what they found was 45% of the cropland and 72% of the HEL (highly erodible land) had structural practices on it and 95% of the cropland had reduced till and 71% of that had no-till or mulch till. He said just from the survey for erosion control from the initial runs, they found that the current conservation practices in place had reduced edge of field sediment loss by 70%, phosphorus by 45%, nitrogen by 18% and in-stream sediment reduced by more than 30% (37%).

Comprehensive Planning is Needed

Mr. Arnold stated that one of the things they found was without nutrient practices in place the erosion control practices can actually increase subsurface nitrogen losses especially where the majority of the nitrogen comes from the tile and tile drains fields, with most of that coming from nitrate.

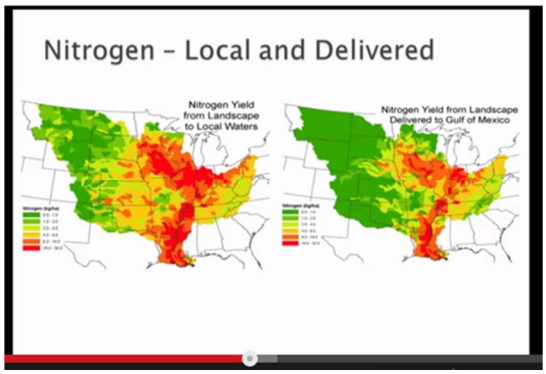
Targeting Conservation Increases its Impact

Mr. Arnold then went on to discuss putting bounds around what agriculture can do. He explained that if going from cultivated agriculture and comparing conservation practices versus no conservation practices, that was the estimate of putting error bounds around what agriculture can and can't do. He said the next thing they did is look at targeting and found areas deemed as under treated for sediment, nitrogen, or phosphorus in some way. He stated that of 36 million acres, treating those 36 million acres (62%) would cut nitrogen loss in subsurface flow by 48 % total nitrogen to 43% and phosphorus to 51% of just the cultivated land. He said that of 8.5 million acres deemed as critically under treated for sediment and treating that 8.5 million acres could get just 15% of the area reduction to 30-40% by just treating those critically undertreated areas.

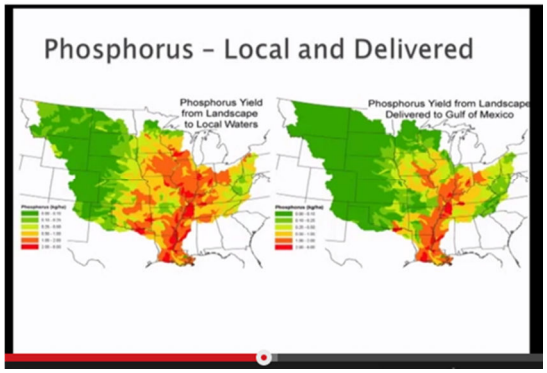


He discussed the graph on the right which shows that the nitrogen reduction on the mainstem of the Mississippi in the bottom left is the total nitrogen load graphed. The green line is current, the blue, red and grey are the treatment of some under treated areas. He said the grey and brown are enhanced nutrient management treatments of all vulnerable areas which got the nitrogen down from well over 700 million lbs. to 300 million lbs. at Grafton.

Nitrogen Local and Delivered

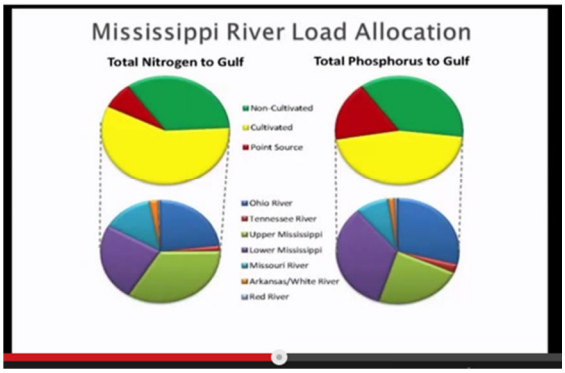


Mr. Arnold then talked about what was delivered to local water bodies and to the Gulf of Mexico and caused hypoxia. He said that the slide at the left is total nitrogen yield from the landscape from nonpoint and point sources to the local waters within each 8 digit. He said on the right is the actual amount originating in the 8 digit HUC watersheds that actually gets to the Gulf of Mexico. He stated that once you determine what's delivered, not only does it have a long travel time, but you can see there's major reservoirs in these basins. He mentioned that in the Upper Mississippi, Ohio and Tennessee, in addition to the Lower Mississippi, there is still a large amount of nitrogen delivered to the Gulf directly.



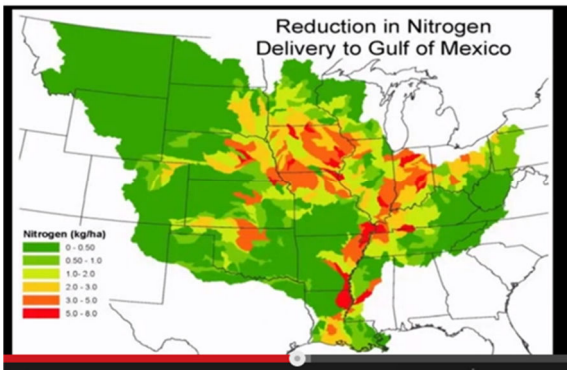
He explained that the same thing is occurring with phosphorus. He stated that this is total phosphorus and showing that not much phosphorus is being delivered from the west, and even in southern Missouri which is mostly green, there is not much phosphorus getting to the Gulf either. He said it's just the Northern part where we're estimating a significant load is being delivered to the Gulf.

Mississippi River Load Allocation

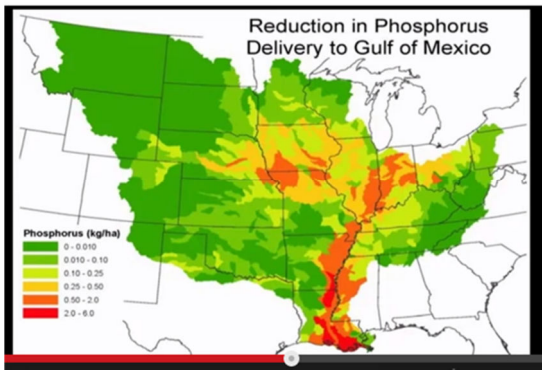


Mr. Arnold then discussed the Mississippi River Load Allocation and stated the green is non-cultivated, yellow is cultivated, and the red is the point sources which is a much higher relative contribution. He explained that the bottom two pie charts are contributions by major river basins within the basin and he said that for the Lower Mississippi, the phosphorus and its relative load is much higher in the Lower Mississippi, and nitrogen is higher in the Upper Mississippi as all the nitrates are coming out of the tile drains.

Reduction in Total Nitrogen to the Gulf



Mr. Arnold then displayed the actual reduction of total nitrogen to the Gulf. He said these slides represent the impact of current practices on what's actually being delivered to the Gulf in kg/hectare of total nitrogen delivered to the Gulf in addition to the total delivery of the reduction of phosphorus delivery to the Gulf in kg/hectare.



Mr. Arnold then explained that with the loading of all sources delivered to the Gulf, they report edge of field loadings, cultivated edge of field loadings, loads to 8 digit HUCs, and in-stream concentrations and loads going down the river basin. He said the record shows no conservation

practices and with current conservation practices allowing about 18-20% decrease in nitrogen and phosphorus loads from agriculture.

Mr. Arnold explained that one of the things in the process of trying to scale down the 8 digit HUC reports to get better spatial resolution and focus more on local issues and have a system for looking in more detail at local systems. He explained that the 8 digit HUCs (131 sub-basins) compared to 12 digit HUCs (5,729) sub-basins is a significant increase in spatial complexity and detail and there are some challenges that are posed with a more complex data intensive system model.

12-Digit Models Now Operational

Mr. Arnold stated that there were some 12 digit models that have been constructed in Ohio, Texas and the Gulf and initial un-calibrated simulations show the results are pretty good. He explained that they are still in the process of getting those calibrated.

Summary and Discussion Points

Mr. Arnold closed with summary and discussion points listed below:

- CEAP National Cropland Assessment has been completed at the 8-digit scale for all the watersheds east of the Rockies and Columbia basin. We are in the process of downscaling to 12 digit basins.
- Impact of Conservation Policy Scenarios
- Targeting Scenarios – In regard to under-treated acres with erosion control and nutrient management practices, additional scenario runs for hypoxia planning-would need to be coordinated with the CEAP team in Temple
- Currently developing SWAT 8 digit HUC simulations which could be transferred to states to conduct the analysis

Committee members then asked questions

Q: Do you have some idea as to how you identify the high risk areas and where they are located within the state?

A: You would need to talk to the NRCS team here Lee Norfly and Jay Aftwood. They have been on the CEAP team from day one. They can tell you exactly what assumptions they made to come up with those critical under treated areas or areas that we deemed needed treatment.

Q: Are the 8 digit HUC reports available for download?

A: The results are available, again you'd have to talk to NRCS. Some of the survey data

may be available at a larger scale, maybe a four digit scale potentially depending on how much agriculture is in the 4 digits. The results are available and all scenario outputs are available.

Q: What role did wetlands and slopes play in your model or how they were integrated?

A: Slopes we got from the actual farmers surveys, the SWAT we got from the DEMs GIS analysis on the slopes. As far as wetlands we had estimates of various drainage areas that contributed to ponds and wetlands. We also had some reservoir information so how we took that into account, the 8 digit was our sub-basin that where lumped, so if we had 20% of the area drained into farm ponds we would take everything in that 8 digit and drain it through a farm pond and the same with the wetlands and smaller reservoirs. We would do the lumping at the 8 digit scale, if it was actually on the Missouri reservoirs for example we are on the main routing reaches within the 8 digit so we model those implicitly and those were each modelled individually within the routing structure but within the 8 digit we lumped those by the fraction of area that we drain. When we get to the 12 digit scale we hope to not have to do the kind of lumping we did at the 8 digit scale.

Q: Have you talked about modeling wetland restoration?

A: No we have not that's something we can do;- we can increase or decrease that wetland area there's all kind of scenarios we could run that we haven't run the only ones we ran were the ones I showed you for our report. But we could run different tile drainage scenarios wetland scenarios climate scenarios, anything that needed to be done.

Q: How long does it take to run those scenarios?

A: We can run the model in a day we can run SWAT on a cluster with about 100 processes and we can run the entire country in about 10 or 15 minutes if we run them parallel. The APEX run are all run in batch mode and I think we did those in a couple hours. Just the actual run time we can turn around once or twice a day. Setting the scenarios and calibrating them, parameterizing the model and checking it is where it takes more time. Depending on the scenario I would say a week and if it's not something we did before it may take a couple weeks.

Q: You were showing your plots they looked like large sites are they true?

A: Yes they were all fairly large. We did have a significant effort within ARS CEAP watershed assessment study where we went in and did a detailed calibration at several research sites across the country. We collected data and did a detail study (e.g. in Iowa we looked at tile flow, in Mississippi we looked at sedimentation processes, In Missouri we looked at local watersheds) and validated SWAT and APEX at the smaller scale where we could look at the detailed impact of management and what was going there. In the national assessment we looked at fairly large river basins and the more detailed

calibration and validation what was done more as part of the ARS benchmark watershed assessment.

Q: When you're simulating the assessment management practices you have certain efficiency practices you apply through all your runs or where do you get those.

A: We get those straight from the surveys. We don't input any coefficients as far as the efficiency type coefficients we actually model. If it's no till or if it's a tillage operation we have database. If we know it's a field cultivator that database goes out and it says the depth of cultivation is 6 inches and the mixing efficiency is 0.3 and we actually simulate all those processes. So if we run a scenario with 10% reduction in fertilizer we go back to the management file and decrease the amount of fertilizer that's applied by 10% and then when the model runs and triggers that event then the amount of fertilizer put in the soil that day is lower. So we're just simulating the processes and practices we get from the field surveys.

Q: What do you think the difference would be if we went back to all grassland vs. what we are trying to accomplish now?

A: The NRCS team went through different scenarios and we looked at one where we had no input from cultivated areas and a grassland and a no input and such but it's just kind of a bound where we can look at to see how good we are really going to do as far as agriculture but as far as a sediment impact as far as edge of field it had a large impact but once we started routing it through the channels we had considerable stream power and it did pick up more sediment as far as nutrients go. We did see without taking the cultivated lands out of cultivation and not fertilized then the edge of field nutrients we'd see a big impact and we'd also see a big impact in the Mississippi River. I didn't have time to show all the graphs but those graphs I showed of the sediment we have similar ones with nitrogen and phosphorus in the no cultivated are way down even in the rivers because unlike sediment it's not going to pick those up as it goes downstream.

Q: If we put everything back to grassland in the whole Mississippi river basin would we still have a hypoxic zone.

A: I don't know. I'll tell you what people have done if you go with what the model says probably not. But the person who developed the hypoxic zone model is just the simple regression on the amount of spring nitrogen coming through the Mississippi and he related that spring as a simple regression on the spring nitrate coming down the Mississippi vs. the size of the hypoxic zone later in the summer and found taking hurricanes out of the equation found a pretty good fit. And what they're doing at Iowa State is linking some of the SWAT simulations directly to that hypoxic zone model. If we take our no cultivated agriculture and feed into the regression model and see what it came out with but from what I can imagine the hypoxic zone would go down just giving what

his regression looks like.

The group then went to lunch and came back and resumed at 1:00 p.m. with a presentation from Dale Robertson of USGS on the SPARROW model.

I. PRESENTATION

SPARROW Model Presentation- Dale Robertson – (USGS)

Mr. Robertson began by providing background information on SPARROW. He stated that most of what we know about nutrient problems really comes from small lakes. He stated in order to figure out a strategy to reduce the nutrient loading committee members can go through and model a lake and also model its watershed with something like SWAT or APEX and figure out what's going on.

Typical Goal of SPARROW Model

Mr. Robertson explained the main point of interest is the Gulf of Mexico. He stated the first goal is to model the entire watershed of the entire Mississippi River basin or the Great Lakes and figure out where those nutrients are coming from which leads into the typical goals of SPARROW modeling. He stated that SPARROW is not to simulate things at a really small scale but typically used to try to describe phosphorus and nitrogen loading over large spatial scale, therefore the Mississippi or Great Lakes falls into the range for SPARROW models. He stated that the second thing the SPARROW model is used for is not only describe the high loads but try to go through and try to rank the specific basins where the highest loads are coming from and where the lowest loads are coming from. He said the third SPARROW is used to do is also describe the relative importance of nutrient sources and then finally provide this information to various states and regions to try to support regional interpretations and guide local more in depth studies to use that to describe nutrient reduction strategies and so forth.

SPARROW Water Quality Model

Mr. Robertson then described some of the strength and some its weakness of SPARROW. He explained the SPARROW model is mass balance model that tries to take various nutrient sources and apply them to the river networks in such a way to match monitored loads as best as it possibly can. He stated that they have tried to have as many sites that throughout the landscape to describe all the different ways fertilizer and manure are spread out on the landscape. He said sometimes instead of using fertilizers and manure they have used corn or wheat. He explained that when SPARROW model is ran they don't have the various sources transported to the stream uniformly across the entire basin but the that various functions of GIS attributes and various things describing the environmental characteristics of the basin such as soils, tile drains those kind of are put into the model to predict the entire landscape. He stated that in this case a national model is created using sources from throughout the landscape allowing roughly 62,000 stream reaches across the country to be predicted.

Watershed Modelling Continuum

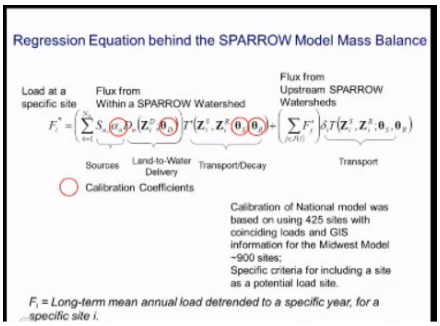
Mr. Robertson stated that SPARROW model is a bit more unique than other models as SPARROW models separate land and in stream processes and specifically try to address those different from SWAT. He stated that SPARROW is calibrated the same way as SWAT and predictions are made by looking at the long term mean annual flux throughout the landscape. He said that other various models may simulate daily kinds of variability but SPARROW model simulates annual fluxes and long term averages. He explained that once SPARROW is calibrated, they can interpret the coefficient and that's very important because it allows them to try to figure out the relative importance of fertilizer and manure throughout the basin. He said that SPARROW ranges from a complete statistical model like the artificial neuro-networks to something like SWAT or HSPF falling between those. He explained that SPARROW does have various mechanistic kind of processes but also various empirical kinds of things trying to describe how the processes occur across the landscape.

SPARROW'S Reach Scale Mass Balance

Mr. Robertson explained that what is done is the study area is divided into a series of small SPARROW catchments and then the nutrients are inputted to match the downstream nutrient loads as best as possibly can. Mr. Robertson stated that when looking at 5 SPARROW watersheds and one calibration site they would start off in the headwaters of that area and start off with a small SPARROW catchment and predict the loads there and then ultimately what try to match the downstream site as best as they can so they go through and simulate then add the lower reaches down below. He explained that the sources are then added to the landscape and transported to the river and the upstream fluxes from upstream added with a certain amount of transport and decay as you go down stream. Mr. Robertson stated that the complicated part of SPARROW is the calibration of the model development trying to put coefficients to each of those processes (e.g. fertilizer has one coefficients and manure has another) and then those coefficients are then interacted with this land-to-water delivery term ending up with each of those sources delivered to the stream differently and then transported downstream. Mr. Robertson stated that this is done in a way to try to match the monitored loads as best as they can and those are long term monitored average loads for approximately 1,000 sites throughout the basin, therefore the coefficient is set up because alpha and beta interact with each other allowing for differential transport to the stream.

Regression Equation behind SPARROW Model Mass Balance

Mr. Robertson informed the committee members that there was an equation behind the SPARROW model which can be shown below:



He explained that the F is the load at specific sites which is the calibration or model development sites and the way it's computed is to take the flux within the SPARROW watershed (the left part) and add the flux coming in from all the SPARROW watershed basins upstream of those. He said this then provides the F terms which is each of the sources the second one is the land-to-water delivery variable and finally the transport terms so those all interact and then we add that to what's coming in from the upstream basin;- so what the model has inside there is a series of calibration coefficients or model development sites so they want to try to match those through a regression approach by adjusting those coefficients until they match the flux at the 1,000 sites the best that they can so each of the terms will be reacting with a source term or a land-to-water delivery term.

Estimating Loads at the Monitoring Sites with Fluxmaster

He then went through each term in the equation to describe where they were coming from.

He said with the flux term, they go to each site and develop a regression model to try to predict concentration as a function of flow, seasonality and trend term.

Concentration = f (flow, seasonality, time trend)

Form of the Fluxmaster Load Model

Ln (Conc) = a ln (Q)+ b sin (jday/) + c cos (jday/) + d (decimal year) + e

Mr. Robertson stated that the equation is calibrated for each of the sites which allows them to predict concentrations on every day of the year for about 30 years and multiply that by flow ending up with a long term estimate of the flow at each of the calibration sites. He said that what they are trying to do is input all of the nutrient sources representing a specific year (2002) and try to come up with the long-term average estimate load for 2002 given all this variability from one

year to the next. He explained that they don't want to represent that high point in 2002 otherwise that's really not the long-term average loading and they don't want to just take the average of all those 30 years because if there' a trend in that the load may be underestimated. He stated that it would be preferred for a regression line to go through the graph. He explained that the regression through all those 30 years is taken at a point that intersects the 2002 line and this is the long-term average flux for that site. He explained that this is done for the 1,000 sites where they try to come up with a regression model sort then estimate the loads over 30 years de-trend it and come up with that estimate. He said this would then allow them to come up with loads through the entire landscape that does not represent a dry year or wet year.

SPARROW Sources and Transport Attributes

Mr. Robertson then explained that when trying to come up with all the input variables for SPARROW catchment for the Mississippi River basin (which has approximately 25,000 catchments) they want to estimate all of their sources for those as well as the land-to-water delivery variables. He explained that what this provides is a series of nutrient sources and that they try to quantify throughout the entire basin. He stated that the earlier models had population as a surrogate for point source values that was estimated; - now newer models have atmospheric deposition values, farm fertilizers coming from county estimates, estimates of fixation animal manure and various other natural kinds of things like forested inputs, forest shrubs and that kind of thing. He explained that it is important to come up with the nutrient sources because if not SPARROW can assign the inputs to other variables. He said that they then try to see how that varies across the landscape therefore looking at various kinds of possibilities such as climate variables, soils, topography, artificial drainage such as tiles and they will use that in the SPARROW models and then we have a certain amount of aquatic attenuation. Mr. Robertson stated the can then compute the travel time to streams and reservoirs and find out how much decay is occurring in SPARROW by having the source variable which is all the S terms, (25,000 sites), and having the various GIS attributes to be tested in addition to the in-stream velocities to estimate how much decay is occurring. He said that once all that is done, they now have a calibrated SPARROW model for a specific year to try to describe things.

Mr. Robertson then explained what committee members can get out of using SPARROW. He stated that first of all the total loading is described throughout the entire landscape which would be like having 25,000 estimates of loads coming off. He stated that one could also try to describe where the loads were coming from throughout the landscape and also figure out the incremental yield that describes where the highest part getting into the stream with no decay as it goes down the rivers. He stated that this therefore makes SPARROW very useful in terms of describing the water quality in the rivers themselves and stated this has been used to try to help with determining how much is coming in to affect their nutrient criteria. Mr. Robertson reminded committee members that not all that comes into the streams makes it down into the Gulf of Mexico as part of it is lost in the streams due to stream decay. He mentioned that nutrients going downstream and once in the reservoirs may be intercepted with approximately maybe 4kg going into the stream and only 1kg delivered to the Gulf therefore having about 75% decay going downstream.

Mr. Robertson stated that SPARROW models also provide the source terms that are the coefficients which can identify how important the various sources are. SPARROW is also used to determine where the greatest sources of nutrients are which Mr. Robertson stated is very important if trying to look at nutrient strategies trying and decipher where the highest loads are coming from to try to reduce those loads. He then explained the EPA exercise that tried to describe the ranking process. He stated that they first got the original model for the entire country and then broke it down into HUC 8s and looked at how much of the incremental yield was coming from each of the 818 different HUCs. He said one of the first they came up with was the top 150 ranking from the #1 all the way out to 150, looking at the statistics behind their SPARROW models and ranked them from 1-200. He stated that they put 90% confidence limits on every one of the predictions at the HUC 8 scale explaining that that they wanted to do was take advantage of that distribution to try to figure out how confident the prediction were. They went through a statistical approach and came up with how the ranking affects the ranking it self. He said the basin that was originally ranked 40 was ranked 8-227 when they put the statistical confidence on that with 90%.

Mr. Robertson stated that the USDA and NRCS came up with the Mississippi River Basin Healthy Watershed Initiative and identified areas in each of the states where they've put in a significant amount of time and money to reduce the loading which is how the original basins were partially chosen. So that's where we were with our original model which was a few years ago calibrating with about 450 sites and from that they could predict everywhere in the landscape in almost the entire US that had a HUC and basically a RF1 scale. Mr. Robertson stated that when you look at individual states some were over predicted or under predicted so they decided to develop regional models. He said that using regional models and looking at all the other basins in the entire SPARROW network and the median size;- there's about 500 square miles which is the scale they're looking at in terms of the SPARROW network but with monitoring networks they're up at about 10,000 sq. km. creating a real disconnect.

Mr. Robertson explained that with the NAWQA program they went through within the USGS and broke the country down into 8 major river basins and tried to develop SPARROW models for those. He said with the new models, they wanted to come up with more load calibration sites so they went out and started with all the sites that were in the national model and tried to open it up to add sites they could compute loads for. He said they took all the data that was in the USGS database that had nutrient data then went to each of the states to add in what was being sampled by the major sampling agencies leading to more reliable data. He said they also contacted individual states to get more data then looked at all the sites that had enough data from to compute good accurate loads. He said that they had to set criteria that had at least 25 samples, representing all the season and had a gauge next to it allowing them to end up with potential load sites. They then had a final map of sites with long term loading to be used to develop SPARROW model.

Mr. Robertson then talked about the Upper Midwest stating that they went out got all the sites and ended up with about 800 sites to compute loads for all those sites. He said they first updated

their point source coverage using actual point source estimates going from the MRB3 model to the Mississippi model. He stated they updated all of contributions from fertilizers, manure at a county wide scale and then allocated that to each of the SPARROW watersheds. When they were done they had all of the nutrient sources for fertilizers and manure in addition to a series of different USGS attributes thought to be important for describing transport to the stream like permeability, tile drain and so forth, in order to be applied the stream networks and do that in a way to match the loads as best possible. Once this was done Mr. Robertson explained that they could then go out and describe through the entire landscape where nutrients were coming from and an estimate for the various river basins.

He explained that committee members could also quantify the total delivered yield and describe the major sources. He said that from what was found the point sources and urban areas were much more important than thought. This information is then collected and put into nutrient reduction strategies trying to figure out where the higher loads are coming from. He explained that for each of the particular river basins they were ranked based on relative yields to the basins.

Mr. Robertson then described what was now being worked on and stated that they wanted to update the Mississippi model to take advantage of things like what they're looking at in the smaller basins using point sources instead of population estimates therefore coming up with more updated nutrient inputs and see how that affects sources and ranking. He stated that the other thing is if they developed this model instead using crop types they're actually using fertilizers and manure going back to the basic input terms therefore they'd rely on inputs from other MRBs from upper Missouri and put all the information that was assembled as part of these other parts but try to make one SPARROW model for the Mississippi river basin.

Mr. Robertson informed committee members of the sources in the new nitrogen model include point sources only from wastewater treatment plants, other inputs from urban areas, farm fertilizers, inputs from confined animal manure, fixation and other inputs associated with legume crops and atmospheric deposition. He explained that these sources get into the landscape or into the stream as a function of 6 different land-to-water delivery terms;- the drainage density of the streams, irrigation as a percent, tile drains as a percent, how much precipitation that drainage basin gets, the air temperature in and the soil organic matter content. He said each of these allow point sources and other nutrients to be delivered to the stream differently.

Mr. Robertson stated that the new Mississippi model compared with the national model (the old model-1992) was centered over Illinois, and Indiana and with the newer model its indicating the higher loads of nitrogen are coming from Iowa and Indiana. He stated that when comparing the phosphorus and nitrogen, nitrogen is from Iowa, Illinois and Indiana, and phosphorus is more spread out and the reasons for that is nitrogen is coming from different sources than the phosphorus. He said that of the inputs broken down by various sources nitrogen shows that waste treatment plants and urban areas account for 14% of the load and agriculture, fertilizers fixation manure represent about 60% of the load and 25% coming in from atmospheric. He stated that with phosphorus sewage treatment plant and urban areas are about 30% twice as much as important compared to nitrogen. Dale stated that agricultural areas are putting in about 50% of

the load instreams, soils and forest are putting in about 22%. Looking at variability across the entire basin in terms of major river basins, the Middle Mississippi is the highest contributor in terms of yield in terms of where they are coming from and looking in terms of where they are coming from for nitrogen most of it's coming from fertilizers and for phosphorus its more balanced between fertilizer and manure.

He then talked about looking at the sources stating that urban areas are higher in magnitude for phosphorus although they are coming from the same areas as nitrogen. He explained that nitrogen was found to be driven by fertilizers and phosphorus driven by a combination of fertilizers and manure throughout most of the basin except down by the Mississippi where there may have been different types of soil inputting more phosphorus than nitrogen. This input was then broken down by state, HUC 8 and major river basin to see how important these relative areas are. Mr. Robertson stated that starting off with states creates a new ranking schemes for nitrogen, illustrating that the major part of the nitrogen loads are coming from Iowa, Illinois and Indiana. He said that with the best estimates in terms nitrogen loading, Missouri is ranked #4 and if we go to phosphorus Missouri has become #1 in loading of phosphorus to the Gulf of Mexico. Dale stated that Missouri, Illinois and Iowa were the same in contribution to the Gulf of Mexico but ranks different as compared to nitrogen. He said that looking in terms of breaking down the importance of the sources for Missouri manure and fertilizer are most important for nitrogen and Illinois shows that phosphorus comes in much more from farm fertilizers which is the entire loading for states. He said looking in terms of yield there is a difference and an upper ranking scheme and the #1 contributor in terms of yield is Illinois then Mississippi therefore in terms of yield Missouri is penalized for its bigger size than Illinois and Missouri adjusts for that and Illinois now has a higher yield than Missouri. The original ranking was done by HUC 8. He said that the new results for the Mississippi model shows that nitrogen is more centered over Illinois and phosphorus is mostly driven by inputs from wastewater treatment plants. The old model and new model doesn't show any biasedness but a lot of variability which may be driven by better definition of sources and how the sources are delivered to the Gulf of Mexico. Mr. Robertson stated that looking at the inputs from fertilizer and all agricultural sources and comparing them on the new and old model shows that the old model had a lot more input down by the main river basin than the new models do and the biggest difference occur along the main river basins depicting a drop in the relative contributions from those areas. He said that those are made up for higher contributions higher in the basins and lower inputs lower in the basin therefore, there's redistribution and this is important because when trying to put BMPS in the basin they should be put throughout the basin and not concentrated on the lower basin areas.

Mr. Dale Robertson stated that in terms of delivery in SPARROW in the new model (Mississippi river model) there is more input from headwater areas than there is in the original model. He explained that they wanted to go to a smaller scale from RF1 scale to NHD so a finer scale closer to HUC 12 and maybe even smaller than that and update the input terms at the same time and have inputs similar to 2012. He said that information is released in methods below:

- SPARROW MAPPER – it's a way to go out there and link basins and see where the relative importance of these things are

- DSS- allows users to go through and change our source terms and see how it changes the loads through a river basin and possibly to the Gulf of Mexico.

Mr. Robertson explained the SPARROW mapper for the Upper Midwest as being designed to quickly show the relative contributions for phosphorus or nitrogen, being able to look at the accumulated load or yield. It also tells the specific area of interest, allowing the selection for a state, and to pick an area of interest and then one can group results by HUC, watersheds or different things. He explained an example stating that if a specific state was selected a catchment can then be added and a scale to figure out where it's coming from. He said an incremental yield can also be selected which tells you where it's coming from on the landscape correcting for the area of the basin and everything else and so that's the hotspots showing where the highest yields is coming from.

Mr. Robertson stated that there will also be a MARB SPARROW mapper to use for the same purposes. He stated that as soon as the publications come out they will be able to release this and from that they can go in there and rank all the individual states based on their contributions to the Gulf of Mexico. He mentioned that it is also possible to zoom into Missouri and look at all the HUC 8s based on its total delivered load to the Gulf of Mexico. He said the MARB SPARROW mapper allows you to go through and look at relative contributions to the stream by looking at accumulated yield and delivered accumulated yield and the difference is how much is getting to the stream and how much is getting to the Gulf of Mexico.

Mr. Robertson then talked about the Decision Support System (DSS) which allows committee members to go through and click on a state, pick a model and then show whether you're looking at the individual tributaries, all the reaches and what the total load is in each of them;- or you can click on catchments which will show you the entire area that the model handles;- or you can go through and zoom into a specific area and try to find out what's going on. He said this tools isn't good for ranking but is good for describing what's out in the models. He stated that this model was more importantly chosen to describe what the models were saying and get the model source inputs and predicted values. He said the DSS also allows committee members to zoom in and change things and try to find out how will the SPARROW model results will change or look at tables which will show how much the total load to the Gulf can be reduced. He stated that there were also plots that could be looked at allowing one to look at where original sources were coming from and what that change resulted in.

The committee members then asked questions as this was the end of Mr. Robertson's presentation.

Questions

Q: To clarify, your inputs for crop fertilizer is fertilizer sales and state application rates?

A: I wouldn't say state application rates. What they're based on is fertilizer sales and we

summarized those up on a statewide basis and then allocate it back to the county based on sales and expenditures so we use sort of a complicated way to take our county wide estimates and refine it to that specific county. We then allocate it to the watershed based on where the agriculture land is so we have a 30 meter land use coverage that we take all of our fertilizer sales and only put it on agricultural land.

Q: Last year we had a drought and we had a lot of fertilizer sales and a lot of fertilizer put down, but because of the drought there was low yields and the plants didn't utilize the fertilizer, so how do you account for that because another example would be the NRCS 590 practice promotes better plant usage of nitrogen or fertilizer, nitrogen and phosphorus, so it seems to me if you just use sales you're not accounting for factors like drought and other things that can affect the plant utilization of the product that was put down?

A: The way SPARROW works is it looks at what was put down in 2002, but what we're looking at in terms of loading is 30 years of data trying to come up with how much is being lost to the stream, so it takes droughts, flood and all of those together and come up with a typical amount that's being lost from the landscape so if the farmers really made that much of a difference in 2002 or 2003 in how much they put on the landscape, that could cause us a bit of a problem, but the farmers don't really change how much they put on the landscape because the drought or flood usually occur after they're done so I think we've compensated for that as best we can.

Q: Do you use actual soil sample data to determine the nutrient levels in the soil currently or samples taken after nutrients have been applied or anything like that?

A: No, that doesn't come into our model like that. What we're relying on is nutrient inputs probably the higher places where they're putting more nutrients into the landscape is going to have the higher ones so we indirectly do a little bit of that, so no it does not incorporate that at all

Q: Those data are nutrient concentrations from samples and then combined with flow to calculate the loads right?

A: Yes, for each of our sites so we've got about 1,000 sites in this latest model where we've estimated the load for those and for each of those sites we have about 25 samples and maybe 2,500 samples so some sites have a lot more data than other ones. From that we've developed regression models to predict a concentration on a daily basis based on those measured estimates of concentrations we come up with a model that we can predict the load on a daily basis some of them up to an annual basis and then compute sort of a long term trended load for that site so its heavily based on data that's collected out in the field.

Q: How does this data represent storm events compared to base flow or low flow

conditions?

A: We develop those regression estimates and plot those up as a functional flow so during low flow we're using this regression estimate to estimate the total load on every day of the year whether its base flow or high flow. We estimate the load for that particular day and then add them all together. So how well the regression estimates low flow versus high flow to get a little bit of certainty on our load estimates but we have an estimated load for everyday of the year and that varies as a functional flow and when we average those all together (so for a year we add up the 365 loads) and then average it over 30 years to come up with that long term; so our numbers do represent base flow and high flow all incorporated into one number

Q: What magnitude of change would have to occur for it to show up in your model? (e.g. as a result of the nutrient reduction strategies)

A: I don't think SPARROW model would be a good way to try to look for a change. I think if we were looking for a change we would be looking at individual sites. I don't think SPARROW would be a technique to look for a change. We could simulate what we think would happen if we go out there that's where DSS would come in;-where we could reduce a source input to tell you what we would think that would do to the load for Missouri.

Q: But it's not a good tool for tracking progress that we're making or getting an up to date perspective of what's going on?

A: I don't think SPARROW itself is I think, if we're looking for an actual tracking progress we can look and say what should we do so we can get a 10% reduction but to track it the better approach would be to looking at actual monitoring data. Taking a site whether you're looking at a headwater site for quick response or a downstream site looking at those and trying to see how that specific load has changed. We can use SPARROW to say what we expected to see but to quantify on an annual basis progress I would say the best way to do that is data itself. And that's the same for SWAT also.

Q: Would SPARROW be a good way to model changes and practices and see what effect that would have?

A: Yes and NO. Yes it's a good approach but if you remember how SPARROW is developed we don't have management strategies in there so that's a strength of SWAT and a weakness of SPARROW.

Q: Have you ever looked at plugging your model into some model that looks at coastal things to get a concept of what the dead zone might look like or having a model that doesn't look only at the watersheds but the whole?

A: No we haven't. Some of the stuff in SPARROW has been used to try to predict the size of the dead zone. I'm not sure you need SPARROW to do that though I think we would have the monitored load at the downstream gauge and then take that load and feed it into a downstream model. SPARROW model is a long-term annual average so it's good for allocating and describing things in the landscape but it's not going to give you that base flow load versus the high-flow load of daily variability that's out there. This is really good for prioritizing on the long-term average where the loads are coming from its not good for individual days.

Q: Your old model looked at population how did you do that is it by population density?

A: What we do in the old model is divide the entire country up into about 25,000 different catchments. For each of those catchments we came up with a total population estimate and then in our model we put in that number and came up with a coefficient that basically said this is how much we think is coming out per person throughout the entire basin and that's what we allocated it to so it wasn't really based on density;- indirectly it is but it was based on the total population in a catchment. The new model is an estimate of how much is coming in from wastewater treatment plants at specific locations so we could put it on a specific river at that location

Q: So if you have a regional treatment plant that covers 10 or 12 of these sub watersheds does that mean the sub watershed went to 0 and then your one piece of pipe in that major stream collected all those nutrients?

A: Right so if you had one wastewater treatment plant that was feeding in from 12 plants all of it would be going into the stream from one specific location and then we can track that down. Our point sources are how much the state gave to the EPA so that we could compute the loads. Some of the states are very good at giving those sources to the EPA some aren't so that's why we went out and worked with almost every state trying to update those. It really depends on what's available now if you look at that and say we're measuring phosphorus pretty close. Hopefully by the time we get out there people will be measuring nitrogen and we can get an estimate of nitrogen input by wastewater treatment plants. Right now we have a concentration of the type of wastewater treatment plant it is and that's the number we're using and a lot of that is our best estimate for nitrogen rather than a measured nitrogen at a point source. With our newer models we only have wastewater treatment plants we have no other point sources in the model but the wastewater treatment plants what we do is have a concentration of a few measurements that are made, it won't be your plant but somebody else's. We go into NIFTYS code we looked at what water quality is available for that NIFTYS code and then we assume that was the concentration coming out of that plant with the flows that we had in our models. So it's pretty weak for nitrogen but it's better than not including it.

Q: You had mentioned that the proximity to streams wasn't important as it was in the previous model can you explain that a little further.

A: If you looked at the original model there was a couple conclusions that said BMPs should concentrate on major rivers or farmsteads on major rivers or near where the major rivers or smaller rivers are draining into the bigger rivers. The newer models are saying that BMPS put up higher in the watershed are not that much different in terms of effectiveness than ones put on lower down in the landscape and I think people from USDA and NRCS knew for a long time in our original model and this is where a scale is important we didn't have many small sites and we can get to the answer a couple of ways now with more smaller sites to help develop the models. It said that small headwater areas are a lot more important than the original model was saying that they were. So I think that's important and something you can develop a model for. The big sites will come up with different conclusions when you have more headwater sites to your model in the model development phase so our original model was based on all big river sites and was sort of smudging things out but now that we have a lot more sites to look at high in the watershed. I think it's important that especially for BMPs to realize that putting a BMP up high in the watershed is almost as important as putting it down lower in the watershed.

Q: I'm just not sure how you draw that conclusion when SPARROW doesn't deal with BMPs and their effectiveness?

A: No it doesn't deal with BMPs and its effectiveness but if you look at the amount of fertilizer put on the landscape high and low on the landscape before in the original models what they were saying was if I have a lot of fertilizer up in the headwater area I would lose a lot of that due to in stream decay before it got downstream what the newer model is saying is that if it gets into the stream it's going to be transported downstream, so it's not looking at the BMP itself it's saying that it's where you put the BMP and how much in stream decay occurs and what we're saying is the newer model has less in stream decay at those smaller sites and a lot of it is being transported down. Rather than going up into these headwater areas we want to go down and look at fields right next to the Mississippi River Basin and use all our efforts there rather than going up to the headwaters.

Q: Since it's basically an optimization problem you have loads and a bunch of coefficients in your models which are adjusted so the model results match the measured or estimated loads how do you deal with multiple parameters that would give a good answer?

A: If we only had a few sites we could come up with that a number of different ways but having a wider range of sites allows us to have to try to come up a combination of those variables that will describe all 1,000 at the same time. The more variability you have on the landscape that's trying to capture this the better off you are, so without having the headwater sites we could have had a lot more input from those streams with a lot more decay and get the same answer downstream, but by having more sites up there to help

constrain what those coefficients are the better off we are so by having more sites we think we've done a better job. By having more sites you may say I can get to the same number by increasing my fertilizer or manure so we can do it 2 different ways if we have a combination throughout but by having more and more sites we have areas that have very little fertilizer with little manure and some sites that have a lot of manure and no fertilizer so we have both sides and by having more combinations out in the landscape it helps constrain our model. Likewise with point sources without having the right value there we would minimize that value between the measured and observed. So I think its lots of sites with a lot of spatial variability in terms of the relative importance of source which helps to constrain what we're talking about here

Q: From your knowledge of what other states are doing, how are they using the SPARROW model with their nutrient reduction strategies, can you give some descriptions of how they are using it?

A: They are using it more so for targeting. For targeting what we're trying to do is describe where things are coming in the landscape we've got a lot of sites that we're trying to minimize the difference between the measured and observed. We think we're doing a better job at describing where things are coming in from landscape and we can look at our residual and so forth and from that we can target the areas and that's what Wisconsin is using it for to target between a HUC 10 and HUC 11. They're looking at a combination of delivered to the Mississippi or Great Lakes and are using that in terms of downstream delivery and they're also looking at the overall what gets to the stream in terms of nutrient criteria saying we should prioritize where these actions are going to be placed based on downstream delivery but also what's important for the state of Missouri itself in terms of what to do in the landscape that's been sort of a little bit more out there In terms of nutrient reducing its more of a targeting thing it hasn't gone into what type of action to take but it could be used this way. For each of the catchments we have an allocation of how much is coming from agriculture and how much is coming from point sources. They're using that to try to identify areas for different types of projects so if we want to look at urban areas this would be a good place to do an urban or agriculture project by looking at those source allocations. So those are the ways they're using it now. I think in addition to just on a statewide basis we will see a huge TMDL for the entire Mississippi basin and we'll see if that plays out but if we do it I'd feel more comfortable with the newer models than older models. I went to Iowa I don't know how far they will use SPARROW. The data we've assembled to develop the SPARROW models have also been useful to people to develop their own models. Some of the stuff we're using we're now looking at in terms of trend analysis.

J. WORKGROUP PROGRESS REPORTS

Mr. Steve Walker then presented to committee members workgroup progress reports. The first thing the group talked about was the stream monitoring and using that as one of the indicators of progress. Mr. Walker stated the main parameters would be total nitrogen, total phosphorus and

total suspended solids. He said the group talked about areas like the Lower Grand , The North Fork Salt and South Fork Salt being areas where there's a lot of data that can be utilized and those are good areas to have pilot projects to really track what's going on in any progress in reducing loads. Mr. Walker said the group also talked about identifying representative watersheds versus just prioritizing watersheds and maybe targeting those watersheds that have unique characteristics such as clay pan soils in order to have indicators of progress specifically for those types of watersheds and looking at some of the national initiatives like MRBI, the national water quality initiative, and the air Missouri waters initiative locally and key in with those different processes that are going on with some of our activities. The group also looked at the amount of money spent on BMPS and tracking that into the future and come up with ways to increase those amounts (e.g. nutrient trading in the future). He stated that the group would recommend tracking where the practices have been implemented and the group discussed the fact that we'd like to have more information about the locations of practices and also farm management data and come up with some innovative ways to obtain that information from NRCS. He suggested that even if it was needed to maybe get MOUs in order to aggregate data and use it in useful way to track progress is better. Mr. Walker stated they also talked about making sure they were in close proximity to the USGS flow gauges when looking at water quality data within the streams which was very important because the flow is needed information to calculate loads. The group also talked about the about new climate atlas that's out now which will provide weather statistics to use. Mr. Walker said that they also discussed using LIDAR which will show up close what's going on in the different landscape within the states and if there was a way to pay for doing a computer program to identify all these areas that would be a way to come up with BMPs, where they're located potentially and also for targeting. The group also talked about the 4Rs of nutrient management and how to show progress in the future, nutrient management practices, tracking the rate, source and nitrogen inhibitors. He mentioned that there may be some other things about nutrient management that's not available therefore only certain things can be tracked. He said they also want to look at some conservation practices that may be effective with agricultural landscapes. He said that individual fertilizer companies have a lot of data for tracking that usage, and some of the handouts were passed out showing the fertilizer usage which can be used to track in the future. Mr. Walker stated that the ARS edge of field monitoring data and the MRBI edge of field monitoring data are very important and show the effectiveness of different practices. He said that they may need some MOUs with some of the monitoring contractors to get the data to see how effective practices are. Besides ARS, there are university studies going on within the Midwest, so that's a valuable source of information as well. It was suggested that we may want to measure negative actions such as farming up the stream actions to see if the perceived negative actions improve over time. Another suggestion was conducting soil tests which could be tracked by watershed and the University of Laboratory will track those by gardens fields' lawns and other sub categories. It was also suggested that maybe the percent of farms with BMPs would be one metric to track as well as the percent of acres that may have BMPs.

The Municipal and Industrial group then presented their progress report. The group talked about primarily domestics on the waste waterside for nutrients and ammonia both public and private as well as industrial storm water facilities that have nutrients in their processes and municipal storm

water as well. He stated the group ranked them as what the contribution from each of those sources to a watershed would be. It was stated that Geosyntec did some studies that and the top few major municipal discharges from wastewater treatment plants tend to have the largest load in a given watershed if you are looking at a certain scale. The group then talked about individual things that different facilities can do and everyone all agreed to using natural systems like wetlands - a real benefit all around. The efforts of different sources were ranked on the watersheds and detailed analysis at the watershed level using GIS and point source and inventories and things of the nature in addition to water quality data to get a picture of what happening in those watersheds. He stated that the group was determined at looking at what they know what they don't know, and what they think they can do is measure progress outside of water quality data. The group stated that the elimination of the number and volume in concentration of untreated discharges whether from SSO or CSOs those sorts of things to reduce those sources which contribute nutrients. The group stated that you may not see the change in the water quality data but you know you are reducing the nutrients. The group stated that additional water quality monitoring can only be biased towards chemical monitoring and biological monitoring creating a cause. Other measures of progress discussed included, reducing the number of outfalls, consolidating and expanding facilities to accommodate and remove non-point sources like from septic tanks. The group also thought it would be good to know that the monitoring of permitting outfalls to get an idea of the typical loading from a certain size facility or a certain type of facility into a watershed. Ways municipalities could reduce their contribution of nutrients from reduction in fertilizers on golf courses and green ways and stuff like that to composting their waste involving reusing and recycling was also discussed. These changes may not be seen right away with data but you know you're taking tonnage out of the system.

Committee members then asked questions:

> Q: Does Missouri have a method for monitoring blue green algae as opposed to other types of algae and whether or not there's cause or effect we could look at in those situations?
>
> A: Yes, some data is collected, but not a concerted effort to do that sort of thing. From a water quality standards perspective, algae is algae and when you start talking about the toxins associated with those blue green algae, we start talking drinking water supplies and also recreational uses. Right now our data and information is fairly limited.
>
> Comment: There is a new multi-agency group that's dealing with the blue green algae issue and setting up a method for whenever somebody finds it, to report it.
>
> Q: Can you do an aerial analysis to try to pull out nutrient-rich waters ponds and stuff in the summer and look for the ones that are bright green
>
> A: Yes with aerial photography and remote sensing

K. NEXT STEPS/NEXT MEETING

Mr. Walker then talked about the next steps for the next meeting. Mr. Walker stated that what he'd like to do is have the committee meeting every 2 months like we've been doing and have workgroup meetings more frequently. Mr. Walker suggested the meeting times of maybe every 2 weeks for an hour or two hours. The group thought that 1-2 hour meetings every 2 weeks may have been inconvenient due to the travel that many committee members do and that maybe fewer longer meetings may work best as compared to shorter meeting, unless the workgroup meeting could be done online via conference calls. Mr. Walker stated that he was suggesting conference calls where individuals could come in or call in, as he wanted to meet everyone's needs, but allow the committee members to have the work done in a reasonable time frame. He then suggested monthly workgroup meetings and the members agreed.

Q: What are the workgroups?

A: Right now we have an agricultural work group and a municipal industrial work group and I think there is a need for a watershed prioritization work group and probably an onsite wastewater treatment work group that's kind of more specialized.

Comment: Steve the watershed prioritization will be done through the Missouri our watersheds so that's not a workgroup you need.

Q: So would you suggest for our Missouri Spring River watershed that this group would integrate in with that for a while and then pull out or are you going to run that sort of group?

A: The way those watersheds plans are working, they're supposed to be on a 5 year cycle, so next year what we'll be selecting, and this is obviously going to be a big issue in the Grand River Basin and Spring River is a little bit different because there's a lot of other issue there as well as nutrients but what we're going to try to do is focus our resources effectively across programs over those 5 years, so starting next year we will try to get these all in sync. If we've selected half a dozen watersheds in the Our Missouri Watershed Initiative that's what we will look at in that first phase, then in the next year, watersheds will be added onto that second year 5 year cycle and we can tie in this as well because you want to talk about what do we know about the watershed, what's its quality is, what BMPs are already in place, those sorts of things, what's the status of the sources, who needs help, and then in that 5 year process you go through actions to where you come back and assess again.

Comment: I think the watershed prioritization when they were showing the nitrogen and phosphorus in those our Missouri watersheds didn't seem to pay much attention to where the significant loads appeared to be coming from in Missouri.

A: It depends on whether you're talking about the livestock sources too because remember some of that stuff was screened by delivery to the Gulf and to the Spring River

Q: But is the Bootheel in one of your watersheds?

A: Not in the pilots but again this is one of the things we will do and this will be part of our strategy is pointing out that this has to be part of the discussion as we prioritize watersheds

Q: When is the next watershed prioritization in the Our Missouri Waters coming? When are the next 3 watersheds being introduced?

A: We now have a watershed coordinator, and we've hired Jennifer Hoggatt who's going to be leading the Our Missouri Waters Initiative and her task is to get through the month of May because at the end of the month is the first summit and then after that we will look at what should be our next set of watersheds

Mr. Walker stated that if the Our Missouri Waters Initiative is looking for more detailed information on nutrient metrics, there have been hundreds of metrics that were put together by Tetra Tech so that information is available for use for any further watershed prioritization, in particular for nutrients. Mr. Walker stated that the other thing going on is DNR is putting together a project proposal for a nutrient trading project proposal through an NRCS Conservation Innovation Grant (CIG) grant and our internal deadline is May7th. He reminded committee members who received emails asking for letters of support, to please return those letters as soon as possible.

Mr. Walker stated that the next meeting is scheduled from 9:00 a.m. -3:00 p.m. on June 25th and once the workgroup conference meeting dates are decided, he will send out e-mails with a toll free call in line for everyone to use.

L. ADJOURNMENT

Mr. Walker then thanked everyone for coming and for their participation and informed committee members that he would see them at the next meeting. The meeting was then adjourned.