Agricultural Modeling Team (AMT) Meeting

November 8th
09:00 AM – 11:00 AM
Meeting Materials
Microsoft Teams: Join the meeting now
Meeting ID: 246 929 423 243
Passcode: z872qn
Dial-in by phone: +1 202-991-0477,,913721509# United States, Washington DC
This meeting will be recorded for internal use to assure the accuracy of meeting notes.

Summary of Actions and Decisions

Decision: The AMT approved the October 2024 minutes.
Action: Follow-up offline to determine a time for the AMT to revisit the discussion on crop yields at a subsequent meeting
Action: The AMT will revisit agricultural inorganic fertilizer data in CAST at the December meeting. Please come prepared with any feedback on preferred methodology.

Meeting Minutes

Statement of purpose:
   To evaluate the proposed crop yield prediction framework and begin discussions regarding agricultural inorganic fertilizer data for Phase 7.

Decision items:

1. Approve the October minutes
2. Vote on the proposed crop yield prediction framework.
    Decision: The AMT approved the October 2024 minutes

Announcements:
*   Chesapeake Bay Commission November 14-15 meeting.
    o   Manure in Southeastern, PA
*   The U.S. Department of Agriculture is seeking nominations to the Advisory Committee on Agriculture Statistics
*   Timeline update:
    o   *September 2025 end date* for new decisions

Introduction/Recap: 09:00-09:15 [15 min (Zach Easton, Virginia Tech)]
   Zach provided a quick recap of the AMT progress from last month's voting items.
   Discussion
   Ken Staver: In terms of the wording, we didn't reach consensus on the poultry industry data, right? It wasn't that we reached a consensus of no, we just didn't reach a consensus. Is that right?
   Zach Easton: Correct, there was no consensus.
   Dave Montali: If we can't reach consensus on change, then the rule is we keep doing things the way we are doing them.

Crop Yield trends 09:15- 09:35 [20 min (5 min presentation 15 min discussion) (Joseph Delesantro, ORISE, Tom Butler, EPA)]

The group discussed further questions regarding data scenarios provided to interested parties after last month's meeting. A final attempt at a vote was conducted on adopting a new statistical framework to predict crop expected yields. Decisional.

Discussion

Clint Gill: We're still reviewing the data. It's a lot of information, as you well know. On some of these, we have the uptake pounds being larger than the amount of the addition of manure, fertilizer, direct deposit, and fixation. Is that just a model thing that I am not quite understanding?

Jess Rigelman: In the model, these inputs are not related other than the fact that they are related through yield. So, we've been through the whole application process for manure and fertilizer in some detail. Nitrogen fixation is based on a nitrogen fix per yield unit, and then there's also an equation that goes along with that which takes into account how much is applied, but it's not necessarily a one to one. The uptake is purely the amount of uptake for yield unit, so it does not factor in what is applied. It is just here's the expected uptake per yield unit and then the yields that are being provided by Joseph.

Clint Gill: With the uptake being higher than the amount applied, would that indicate that there's more need there? In other words, we would be utilizing all of the nitrogen that went down? Vice versa, if it's less uptake than what we've applied, does that indicate that there's more nitrogen out there than the plant can use?

Jess Rigelman: We're not actually doing a crop growth model here. Like I said, those are two separate processes. We have the inputs. There are various methods for calculating those inputs. Uptake, like I said, is very simple, and then the load is calculated based on the change in input of this scenario versus the calibration average. The only thing that effects uptake, per se, is the crops, which are influenced by the ag census data, and the yield, which is ag census and annual surveys.

Bill Keeling (in chat): Maybe Dave Montali can answer this but this group is setting up how the p7 CAST will operate or is it providing how CalCAST will operate or both?

Joseph Delesantro: It might be helpful to mention, too, that the modeling workgroup is overseeing the uptake, but the uptake is being revisited as well.

Tom Butler: For some of these sheets, some are by crop and some are by land use. So, if you're looking at a land use sheet, there are more than just the crops being modified. That might also be adding to some of what you are seeing. So, if it's a land use sheet, there's more than just the crops modified by this in that land use. You might be seeing an uptake value that's aggregated and then a crop that might not be. So, just want to be sure we compare crop to crop and land use to land use. If you wanted to bring up specifics to us offline, maybe we can walk through some of those if that's helpful.

Joseph Delesantro: Happy to do that. I'm just looking at that for my own benefit, making sure I understand how that's happening. That might not be the case in the final Phase 7 just because how uptake is being calculated is being revisited in a different workgroup.

Ken Staver: Just from a nutrient management standpoint, the plants take up more than we apply. It's the removal, which is not in the spreadsheet, which is where you calculate your surpluses on removal not on uptake. That's another, separate, calculation you have to do. Overall, it struck me that if it's not a legume or it's not pasture or ag open space, generally the

inputs always exceed the removal. It gets squishy in those land uses that have legumes in them or where we don't fertilize, something like pasture. So there's plenty of uptake, but it's really the removal term that plays more into the loads than it is the uptake. I had a separate question, too. Is this methodology going to be sustainable in the future? How much work is it going to take to have this methodology be used?

Joseph Delesantro: I think whoever I hand this code off to is going to need to be able to program and run code, of course, but that's really the only requirement. So, I actually think that this will be easier to update than the Phase 6 method and that's because, with a model, you build the model and you have your various inputs, and it can be a rather simple procedure to update that model when more data becomes available. So, in this slide of code, you input your census data, you input the survey data, and when new data becomes available, then you just add that and hit run again. That is actually simpler than the previous method which relies a lot on these methods of outlier removal and filling with other averages. That to me is going to be more difficult to actually update than the model.

Ken Staver: Well that's good news. Almost nothing gets simpler moving forward. So that's good news, thanks.

Joseph Delesantro: I'll write up the methods, but then the code will also be available for review. I am happy to take comments on the code as well to make sure that you all are confident that it's in a point where people can understand what I've done and that it can be passed on to others with little complication.

Tom Butler: Thank you, Joseph. Were there other comments or questions on this topic before we brought it back up to see where people stand? Again, we did have a number of votes supporting this last time. We had a request that went out last time and we had Maryland, Pennsylvania, and Virginia who were at holds. So, I wanted to see if that had changed or if anyone else had. I will real quick start to run through this.

Ken Staver: Just a quick comment. Overall, uptake would be higher for most crops with this method. Is that right?

Tom Butler: The yield would be so, by association, probably yes. The big thing with this was our yields were wrong, so we wanted to get the yields right. This, I think, gets the yields more accurate.

Ken Staver: They're steadier. We don't have those odd dips from the five-year anomalies, and then we also have a bump up just based on expectations of a reasonable year. At the very beginning of this, that's where we wanted to be, is expectations that are a little more constant and a little higher.

Joseph Delesantro: That's right, Ken, and thanks for bringing that point up. I failed to mention that consistency is also a big thing that this method addresses over the Phase 6 method.

Tom Butler: Thank you, everyone. We're going to run through this and see where we can get. Clint, you were at a four. You're looking through data, so I just wanted to check back in with you and Delaware.

Clint Gill: I think we're still reviewing. This happened to coincide with our Chesapeake Bay annual reporting. A lot of times, there's kind of the same people doing both, so it narrows our bandwidth quite a bit.

Tom Butler: Ok, so would you like me to move you to review? Let's run through the rest, first, and see if we've had any substantive changes. If we have Maryland, PA, and Virginia represented, if we can get those and see how they fell, we can address other people's concerns with still reviewing the data. Do we have Alisha or Elizabeth?

Alisha Mulkey: Maryland is going to stay at a hold on this one. Like Delaware, we are in a crunch time with staff capacity, so we are a little further along in the analysis, but I am seeing some questions that aren't making me comfortable to agree yet. I'll propose to reach out to Joseph by email individually and I'll cc you, Tom, because I am seeing some yield changes and applications that I just need some clarity on. So we'll stay at a hold for now and try to get some time on the calendar with him in short order.

Joseph Delesantro: If you could cc Jess, as well, I'd appreciate that. She knows the application process better than I do.

Alisha Mulkey: Absolutely, because I also have questions about the uptake and removal and how that is factoring into this conversation both here and in a parallel effort at the modeling workgroup that may be outside of us.

Tom Butler: Awesome, thank you. Kate?

Kate Bresaw: Thanks, Tom, and thanks for providing that data. After reviewing the spreadsheets that you sent, we are going to move to stand aside.

Tom Butler: Ok, great. Tim in Virginia?

Tim Larson: We haven't been able to come to a consensus to move forward on this in our group. Thank you for all the data. I've noted which counties we need to evaluate for which will have county level data versus the regional model. I know James and Bill have been talking to you, but we're going to have to group here in Virginia and just review the trends that you sent us for the counties it will affect. It looks like it effects about 20% of our counties that will have county level yields versus regional county level yields. So if you just give us a little bit of time, October has been a reporting period for us as well, so it's been a time crunch trying to get that done. Hopefully we can get this data out today and have a meeting of heads in Virginia early next week.

Dave Montali (in chat): In response to Bill, generally this group is to determine inputs to the watershed model. CalCAST is used by the MWG to determine sensitivity to inputs, which is the purview of the MWG.

Bill Keeling (in chat): Sensitivity at the catchment scale? For statewide or county scale inputs? More specifically will CalCAST be used to modify any processes this group determines should be used in CAST?

Tom Butler: Thanks, Tim, I appreciate that. Having heard a similar thing for a few jurisdictions here, I'm not going to run through everyone else on this list right now. I think what we're going to do is put this on ice, follow up offline, and determine a good time to come back with this, whether its December or January next year, and try to knock it out there. Is that something everyone here is amenable to? We'll determine when to bring this back after we have some discussions offline. Joseph, thank you for your work. Dave and Bill are having a conversation in the chat about the lines between CalCAST and the modeling group sensitivities, so follow along for that one if that is an area you're interested in.

Dave Montali: I want to jump in here, Bill, I'm not the guy to talk about this. You need to talk with Isabella and Gary and Joseph more to get into the details of CalCAST and we can do that, we can set up some time to talk. I'm just not well versed. Joseph, can you help me here in any way, or should we move this offline to a different meeting?

Joseph Delesantro: Can Dave summarize the question really quickly?

Bill Keeling: I'm just not clear on whether CalCAST will modify any of the processes this group is agreeing on and, if so, shouldn't they understand that what they recommend may be modified?

Joseph Delesantro: I don't think that there are any of these inputs will be modified by CalCAST. I think CalCAST will parameterize land to water factors and sensitivities within practical ranges

informed by the literature. But, these inputs of yields and fertilizer, these are not parameters, they are inputs, and CalCAST modifies parameters.

Jess Rigelman: I provide the inputs to Isabella for CalCAST. So, right now, she's working on a data set that I provided her a few months ago based on CAST-19 just so we can get the logistics worked out. But, it goes the opposite direction. Our recommendations will provide the inputs that will go into CalCAST.

Tom Butler: Great. If we have further questions about that, let's try and take that offline. I want to keep us on track here for the fertilizer discussion.

Ken Staver: Since everybody's kind of been saying this is a lot of work, sorting it all out, one thing I think would be interesting is just to see the sort of average county change in crop uptake as a result of updating the yields. It was something I was taking a run at, but I didn't get to it. I think it would be useful for a lot of people because that's one of the reasons we're interested in this is this difference between what we're applying and what we're taking up. So, we're presuming that this method is going to reduce that different sum by being more realistic. I can see that graph, and I don't know if I can get it done, but it would be a good one to see how much our crop removal/uptake is changed by this.

Joseph Delesantro: Ok. Thanks, Ken. I will think about that and talk to Jess and Tom about it. Again, because the uptake method is changing for Phase 7 potentially as well, we just want to make sure we're strategizing how we're looking at that and comparing it so you're not comparing the Phase 7 yield and application to the Phase 6 uptake, so I think that's a good idea and we'll just need to strategize a little bit on how best to make that comparison.

Action: Follow-up offline to determine a time for the AMT to revisit the discussion on crop yields at a subsequent meeting.

Inorganic Fertilizer in CAST 09:35-10:55 [80 min (30 min presentation 50 min discussion) (AMT State Representatives)]

Each state took five minutes to provide concerns/comments pertaining to the current agricultural inorganic fertilizer data in CAST. This feedback will be used to create a path towards improving inorganic fertilizer in Phase 7.

Discussion

Clint Gill: In Delaware, we are pretty comfortable with our fertilizer numbers. Our nutrient management commission gets a report every year from our state chemist. He is able to break out fertilizer sales by county, farm and non-farm, and bag, bulk, liquid. He could probably do more if we asked him, but for us, we feel fairly comfortable about our state numbers. Pretty confident that there is not a double counting issue. So, for our numbers, we feel pretty good.

Tom Butler: Thank you, Clint. For everyone's reference here, that's data that they're able to provide given the sales data that they have. So, they're saying that they're comfortable with that. We are going to move on to Maryland.

Alisha Mulkey: We are the opposite of Delaware. We don't have tight control or influence of how the fertilizer sales data is collected and QAQC through the department do not foresee that that there's a lot of opportunity to influence that. We are also aware from both these conversations and others we're a part of, plus the fertilizer expert group, that there are other methods beyond the AAFPCO data. We're advocating that this group explore data beyond AAFPCO or at least other data sets that could be supplemental to AAFPCO as well as what some of those distribution methods to state levels become, recognizing that I think there's some QAQC with the sales data. So, we've tried to normalize that in Phase 6, but maybe there are

different ways to consider that for Phase 7. Second, we are losing confidence in Maryland in the watershed bucket method, what we call the waterbed, so there's a bucket that's getting distributed across all the states. What Maryland's not confident is that, because we have such high levels of nutrient management acreage and compliance in our state relative to some others, we're having a real hard time trying to tease out the answer between nutrient management effectiveness as a BMP and fertilizer where we're seeing applications that exceed crop need or application when we know we have nutrient management compliance, because that bucket has to be spread. It's been hard for us to discern how that play is happening. We want to make sure that as this group proceeds in figuring out fertilizer data, it very much ties to how nutrient management BMPs get applied against that. At the end of the day, the tool that the state has for addressing fertilizer loads is primarily through nutrient management. So those two are pretty coupled in our mind. I know that that might not be clean, reopening the conversation of nutrient management BMPs, but Maryland is going to very particular about how we want to think about that either as a state separately, versus a whole watershed bucket. If we can't mitigate with a BMP, then we've got nowhere to go from here. Last is the data. Leaning into Jess and Joseph and folks like that who are going to be able to help us visualize some of these distinctions that we would be looking to get at when it comes time to testing and making consensus recommendations towards Phase 7. This is Bay Program data, this isn't Maryland's data, so essentially showing we're already well exceeding our Phase three WIP goal for nutrient management. We've got a little way to go with some of our precision nutrient management BMPs. Maryland is very saturated with BMPs, so we're going to be very thoughtful and particular about how we think about Phase 7, because there's not much left on the table for us to pick from in terms of tools in our toolbox. So this is not a small decision for us.

Tom Butler: Thank you, Alisha. Cassie couldn't be here from New York. She did provide a slide, so I'm sharing that now. Her comments are essentially that New York doesn't report to AAPFCO and they don't have a statewide fertilizer summary report. So, again, the opposite of what Delaware has, so she's advocating for potentially examining other data sets. She's actually provided one. It's a USGS Falcone report. It's essentially fertilizer usage from 1950-2017, linked here. She also did make a call to look at potentially using state specific fertilizer stocks versus the watershed. So, some similarities here to what Maryland has suggested. Any questions, you'll have to follow-up offline with her. The next party will be Pennsylvania.

Kate Bresaw: Thanks, Tom. As it was discussed earlier, we're interested in what it would look like if we revert back to the no bounds bucket. That being said, Pennsylvania is in a good place with our state data. But this data, through the conversations we had last year, we understand this data was not intended for the purpose it's being used in the model. Much like other states, we are interested in exploring other data sets and if there is not something that can appropriately put that boundary on the bucket, what would we need? What resources would we need to actually get an answer to the question that we are actually after which is our fertilizer loads. That's the question that we want answered. We don't necessarily want fertilizer purchased because we do have concerns about stocking that happens. We know that that's happening on the ground when fertilizer is purchased at low prices and what have you. We are interested in exploring other data sets and also looking at what would be required to actually develop a data set that is addressing the actual question we are trying to answer here.

Tom Butler: Thank you, Kate. With that, I am going to move forward here. Tim in Virginia, what do you have for us?

Tim Larson: We've discussed internally that the fertilizer distribution methodology, overall, should really be reconsidered. We want to consider factors that might account for fertilizer sold

in one state but not applied in states and eliminate or cut the ability to ship fertilizer into a state in excess of that individual state's sales data. So, I think we're concurring with Maryland that the watershed/waterbed/bucket method is problematic. We have problems with the application rates of both organic and inorganic fertilizer on land classes. We have, in Virginia, a million/a million and a half acres of pasture total. Most of that is in the Bay. We're dealing with a situation where we have a fixed rate of fertilizer applied to pasture. We'd like to consider how we could propose a change in the land classification for managed pasture. This would affect the distribution of both organic and inorganic fertilizer, but it would allow us to apply a lot more to those classes. So, those are concerns that we have right now. I won't speak for Bill, but I think if Bill Keeling wants to chime in at all, this would be the time, but those are some of the concerns we've talked about internally.

Bill Keeling (in chat): Nothing to add Tim stated it well.

Tom Butler: Thank you, Tim. I think with that we will move it on to our last state here. Dave, what do you have for West Virginia?

Dave Montali: Building off some of the things the other folks said, there is the potential to reduce latency by getting the data from the states, but it's the same data they ultimately send to AAPFCO. There's not a double counting issue. There does not appear to be a farm versus non-farm issue. The data is not good at the county scale, because they don't really care, and we can't influence what they do. Their mission is not for watershed modeling, it is more to get their tax money on the amount that's sold and make sure that the product labels are accurate. Although they did take time with me to tell me what they do and how they do it, they really didn't follow through and try to help us when we asked them to give us their data directly for the years data post 2016. The bottom line is there's not an opportunity to influence. I brought up the idea of what's the bottomless bucket say for today. If we could go back to Phase 5 approach and have folks be more comfortable with that, that would sure be a heck of a lot easier than what we have been doing. The risk is that we're maybe not accurately understanding the trends. But, maybe there are some more simple statistics within AAPFCO stuff that we could bound ourselves by as we move into the future. I did hear something yesterday on the urban nutrient management panel that made me scratch my head, and the question was where do the commercial landscapers and lawn maintenance companies get their fertilizer? My understanding is that when they classify whether it's farm or non-farm, it's done by material type. If there's some nuance that the landscaping companies and commercial places purchase their fertilizers on things that are counted as farms, there might be something there. With regard to alternative data sets, lots of folks have looked at that over the years, and they always conclude AAPFCO isn't great but there's nothing else that we've got for the whole watershed. So, that is what it is. I don't have a real problem with what we've done now. I think on the Ag side, the way we do it, smooths out the issues of county to county and smooths out the issues of stuff between states, but I'd certainly be interested in simplification if possible.

Tom Butler: Thank you, Dave. Are there any other comments from any states now that we've heard every state go through? I want to try and get at bigger themes.

Chris Brosch: I appreciate all the perspectives I've heard. One thing I think we haven't really grappled with is the old method, which I think some people have more comfort with, the current method, which definitely made things more complicated but attempted mass balance-had its own merits. I am just really struck as we grapple with this question that nobody is really talking about a more complicated method, except for what Tom described for the one state that doesn't contribute data. New York uses that Falcone set and it takes into account other data sets, to your point, Dave, and I've reviewed the paper several times. I think some of those data

sets are useful, and the way they've used it is novel, and I think it's also got its own merits that we should also be considering.

Tom Butler: Thank you, Chris. Ken, I see your hand is up. I know we have a USGS person online. I don't know their full familiarity with that data set. So, Alex, I am going to let Ken talk first and then I am going to ask you about Falcone, if you are ok with that.

Ken Staver: I just have one comment about pasture. Since we seem to have this problem of more N than we think should be going onto our row crop acres, is there a general sense from the folks with a lot of pasture that there is a long-term trend of more intense management and more N use on pasture? Does anybody have a sense of that. That maybe our old approach was really underestimating how much of our bucket we are using on grass production.

Bill Keeling (in chat): Ken, I have been seeing increasing use of rotational grazing systems and alternative watering systems on pasture in the BMP reporting. Also, when I was not called modeler and was permitting for land application, I saw lots of what CBP would classify as pasture that had at least 1 cutting of hay off of it. And sometimes some of those acres were fertilized using commercial fertilizer. So yes it does appear to me that there are increases to acres of pasture being managed to intensively managed.

Tom Butler: Great question, Ken. If I could hold that now, I'd like to keep the Falcone thing fresh. Alex, can you talk a little bit about Falcone?

Alex Soroka: I remember doing a thorough look at Falcone, and one thing that struck me was just how much higher the Falcone data was estimating nitrogen applications in comparison to CAST. That might have been because they were estimating total nitrogen and not a plant available nitrogen application. Here is a plot in Kilograms, and this would be for the state of Delaware, for example. If you take the Falcone data set, the blue points here, and you use it for the state of Delaware, this would be your result. However, if you were to take Delaware's yield data as reported in NASS and assume that there is one pound of nitrogen applied

Anticipated nitrogen application rate for corn in kilograms per year. Estimate based on a 1lb nitrogen/ 1 bushel of corn yield using USDA annual survey data for corn yields in bushels.

USGS (Falcone 2021) estimated nitrogen application from "Estimates of county-level nitrogen and phosphorus from fertilizer and manure from 1950 through 2017 in the conterminous united states" in kilograms

per one bushel of corn, that would give you this estimate in red. This is only using corn, and corn is a dominant receiver of nitrogen fertilizer in Delaware. I looked at those two numbers and I was somewhat shocked at the differences between them. When I did all of the nitrogen applied as estimated in CAST versus Falcone, it looked to be that the Falcone data set was almost twice as much. I'm not saying that Falcone is wrong, but I was kind of surprised by how high the numbers were.
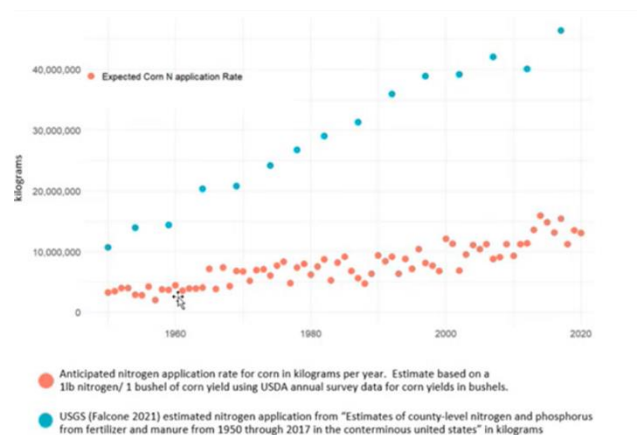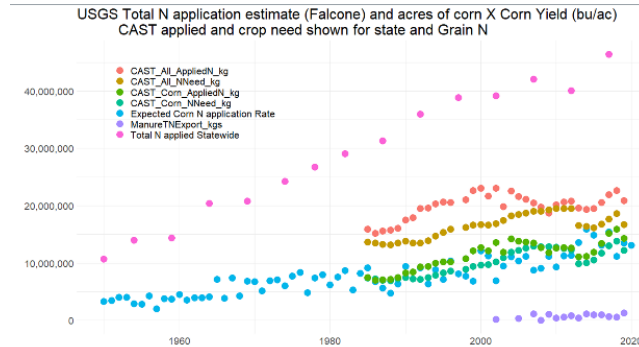
Tom Butler: That's interesting. Thank you, Alex. This might take some diving in offline to try and get a good feel for that. I think Joseph has a question related to that, though.

Joseph Delesantro: I just wanted to mention that there are a couple of ways to think about that Falcone work. One is in terms of the actual values that it's producing, and the other is in terms of the methods that it's using. So, we can think about different ways to model and constrain the output of the model. So, both of those are valid things to consider. I think, because the application of the Falcone model yielded values that are maybe too high for certain regions, it doesn't necessarily mean that a similar method applied under the guidance of this group would not be able to constrain those values to a more appropriate level.

Alex Soroka: I agree with that, actually. But the point I wanted to make was I don't think it's a bad method, but if we wanted to apply it to the Chesapeake Bay, we would need to tune what they were doing. I found the other figure and will drop it in the chat. The multicolor bars are the CAST values for all applied nitrogen for the state of Delaware, and Falcone is on top.

Alex Soroka (in chat):

USGS Total N application estimate (Falcone) and acres of corn X Corn Yield (bu/ac)
CAST applied and crop need shown for state and Grain N

Chris Brosch: Alex gets all the credit for first bringing this paper to me a while ago. I appreciate the context that both folks contributed to teeing this up. It is staggering how different Falcone is compared to the other data sets. So if you are at home surprised that I like it, I will tell you why. That is because of the rate at which Falcone moves. It moves at a rate that outpaces the yield increase, and I think that's important because we need to make sure that our models capture the increased nutrient use efficiency of our most widely planted crops.

Alex Soroka: When you say that, Chris, do you mean that Falcone is overestimating or underestimating the nutrient use efficiency?

Chris Brosch: I think I did misspeak. The rate that it increases better approximates what we see in the yield data, and that's an advantage. I also think that there are a couple of parameters, because currently our model used three parameters to distribute the nutrients. Falcone uses 6 or 7. The most recent had the most parameters, and I think we could improve them and that would probably result in the amplitude being closer to what we would tacitly expect, but would probably protect the slope.

Tom Butler: I am curious about what other people might think of this. If this is a model that is applicable at say a state scale, with AAPFCO and maybe some additional state data or trends from state data, how is that sitting with other people as a gut reaction?

Ken Staver: I feel like if we are going to move to something new, I think we really ought to think about with all we've invested in nutrient management in all the states, that we sort of move to using what we are attaining from our nutrient management planning efforts as opposed to picking out these data sources and trying to estimate what we are working with farmers directly to do. This is another proxy, when it feels like, to me, we should get as close as we can to on the ground reported data. If we are going to change it feels like we are starting to dive around now because we aren't happy with where we are. I'd like to share a slide with the group so we are clear about where we are now.

Robert Sabo (in chat): Whether you use Falcone and NuGIS fertilizer estimates, nationwide increases in NUE and declines in surplus are captured.

Ken Staver: This is CAST 23. This is all the state averages, and it's applied N per bushel of grain yield. Whatever was going on from 1990 down to 2009, every state was the same and it reached a minimum in 2009, which is kind of the start date of all the analysis in the CESR report. Since then, despite all the nutrient management efforts, every state has basically had a 30% increase

or more in the amount of N applied per bushel of harvested grain. This is what's offsetting all our BMP efforts and why our N loads in CAST are not going down, because the baseload related to the N surplus is increasing. This is what we're dealing with with our current approach and, if this is real, then the effort out on the land has to be revisiting nutrient management efforts because, despite all the nutrient management efforts, everything is going in the wrong direction. I feel like there's some aberration here in the way data is being collected because I grow corn and my nutrient management plan hasn't changed what I am allowed to do in Maryland.
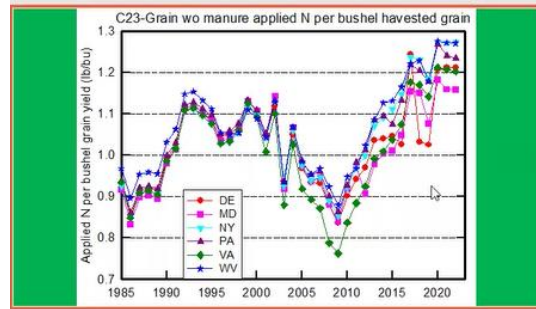
Alex Soroka: What was the source of data here?

Ken Staver: This is just CAST. This is what CAST 23 is doing now. The progress report that went public earlier this year was not CAST 23. This is where we are now. This is why progress went backwards when we switched over to CAST 23, and this is the new fertilizer sales data that got brought into this. That's my understanding of what this is. So when we get over to that delivered loads category, that's why we're going to struggle moving forward. It's odd to me that the exact same pattern shows up in every state. If yields go up, this will look a little better, so that maybe will change things. But this is what it's doing right now as we speak.

Jess Rigelman: I did want to remind people that in CAST 19, we were missing a large portion of the fertilizer. So, yes, while there is an increase in fertilizer because of the new sales data between 19 and 23, we're also missing all of Virginia's portion in CAST 19. So, it's not as bad as we're saying. In general, we should be measuring progress from year to year, and I understand that people are measuring it from model to model, but we should looking at progress from 22, to 23, to 24, not from CAST 19 to CAST 23. That being said, I do understand the concerns and that there is a large discrepancy in the model, and I don't want to dismiss that.

Tom Butler: Just to kind of hit on this point a little more. I think it is important to realize that there's a large force of fertilizer. This is the nitrogen by nutrient source and year in CAST. Looking at those versus 2025, they're reasonably consistent. I think the thing that jumps out is that inorganic fertilizer, this top orange bar, is high. I think the thing we need to grapple with in this group is, is that right? Even if it's not the overall
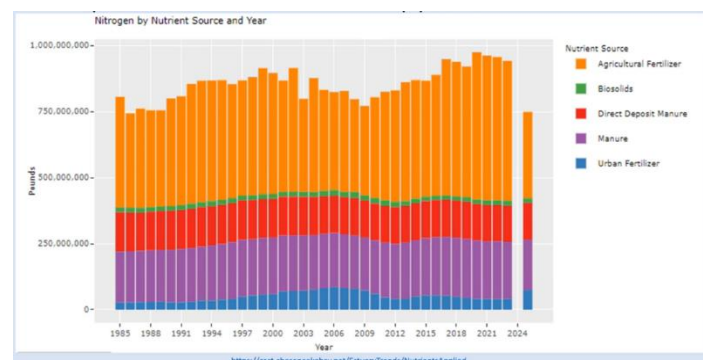
number being right, is the magnitude and direction of change right? What we need to get at is, is the fertilizer real, and is it accurately depicting what's happening? Whatever way we can move in that direction I think is going to be a win.

Dave Montali: First off, Ken's presentation graph was interesting to me. But, my eye went back initially to 1993-1995 and then compared recent times to that, because that's generally consistent with what we're trying to do with this model. Things to consider- if you drew a line from 93/95 out there and looked at how does the compare to what you might expect from increased yields. Instead of looking at 2009 to now, what if we looked at 93-95 to now, and maybe if we had some explanation about why our model was dropping down so much from 93-95 to 2009, and then coming back up, it might help understanding what's going on there. I think it would be helpful if we all understood why we have that dip. If that dip isn't real, then maybe there's something else going on to say that the way we were modeling in 2009 is not accurate. Yeah, there's a dip, but the slope from 93-95 is much flatter and may line up when you compare that to what we might expect from increased yields over time.

Robert Sabo (in chat): the receipts reveal what farmers have likely purchased and these receipts are consistent with farmer reported application rates in corn

Bill Keeling (in chat): Is Ken suggesting using NM plan information on planned application rates to set model application rates?

Tim Larson (in chat): Would like to see this against a plot of landcover changes, and total yield

Alex Soroka (in chat): 2008 recession?

Bill Keeling (in chat): What about non-compliance?

Robert Sabo: One thing I just wanted to point out in terms of the increase in fertilizer application in CAST, of course it's consistent with the increase sales, and that's just because of cheaper fertilizer prices. Also, when you actually just go to ERS surveys specifically for the state of Pennsylvania, in the 2000's, Pennsylvania farmers were reporting that they were applying 75-90 pounds per acre on average for their corn acres. But in 2017 and 2018, they're reporting 120 pounds per acre. So, I don't really see a very large inconsistency between fertilizer sales receipts and what farmers are reporting to USDA and what they're applying. Of course, that increased input is being offset by increased yields, but some of the skepticism about that increase, the receipts don't lie, and also the farmers in Pennsylvania are reporting similar increases in application to their corn crop.

Tom Butler: Thanks, Robert. Kate, you are from PA. Do you have any insight into that?

Kate Bresaw: Pennsylvania, the way our regulatory programs work, is that we regulate manure application. We don't regulate synthetic fertilizer application. If there is an operation out there that is not applying manure, we would not see a nutrient management plan from them. The way that we teach folks to write nutrient management plans is to plan for your expected yield. So, we would apply your manure at whatever rate you are going to apply manure, and then apply supplemental fertilizer in sufficient amounts to meet the yield. So that's the data that we have readily available. The actual records are kept on site, and it's been a very long time since I've actually been on site and reviewed records. We can say that folks are following their plans and are applying at or less than what they had planned to, but that's going to get us our expected yields. Long story short, I can tell you from the data that I'm seeing, on operations where manure is being applied, if they're applying less than or equal to their planned application rate. I can't tell you to what amount they are applying less.

Robert Sabo (in chat): https://www.ers.usda.gov/data-products/fertilizer-use-and-price/ I would like to emphasize that NUE and surplus has largely improved in many of these areas, especially in PA. Increased inputs does not have to necessarily result in increased pollution to waterways

Tom Butler: Thanks, Kate. I don't know if Candiss is on. Do you have any insights, Candiss? If not, Tamie I know you do a lot of modeling, so I am wondering if you've seen similar trends to this, or if you had a different way to deal with fertilizer than what we have here?

Tamie Veith: I think that was a really nice summary we just heard about how Pennsylvania works. We just kind of go with that same method when I am doing modeling or try to assess what people do, and also, we have some surveys from them. We assume that they're doing their best to use whatever manure they have and need to use in an appropriate manner, as they would for a nutrient management plan, and then applying the chemical fertilizer to meet their expected yields.

Tom Butler: For any inorganic fertilizer applications that you might see, do you tend to use the sales data source? How does it work with your efforts? Is it substantially different?

Tamie Veith. I typically assume that they will use what they need to for what's typical for certain regions or crop types, more than using a sales source. I don't know how much different it would honestly be, but if I use the sales source and people are buying some of that chemical fertilizer for vegetable cropping, or residential, or other things besides the main foraged crops and all, I am going to over apply to the wrong places anyways. If I am trying to match with CAST or I have the sales data, I use this data. But I don't go hunting for it because it's not at a level of detail that's super helpful once it is all aggregated out.

Tom Butler: So you're working maybe at finer scales than county that we're operating on.

Tamie Veith: If all else fails, if I have to work at the county level, I might use it. In the past, we've kind of just assumed that people are going to buy what they need to. We don't assume they over apply, and then we see what would happen if we could get them to apply less. As we get information that the current status quo has changed, we make the accounting, and then adjust that as our status quo.

Mark Dubin: I know in some of the work I did in Phase 6, we were looking at the USDA use of the natural resource inventory data which documented fertilizer and organic nutrient use by producers. Tamie, is that something you have used or not?

Tamie Veith: I haven't really used that in the past, no.

Mark Dubin: I know that's something that was being used out at Temple with the NRCS modeling work they were doing nationally.

Tamie Veith: I think at the big inventory level, yes.

Mark Dubin: Yeah, for CEAP modeling they were using it.

Ken Staver: I see Robert stepped away, but he has a comment in the chat, and he emphasizes that nutrient use efficiency has largely improved in many of these areas, especially in PA. So that statement is very counter to what CAST is showing. I'm not sure what the basis for that statement is but, basically, he's saying that it's more efficient even if the inputs are going up. The problem we have in CAST is we're showing reduced efficiency. The only quick follow-up I would have is maybe these adjustments to yield will really change the trajectory of that curve a little bit. Let's take, for instance, where we're headed with yields and plug some of that in and see what it does. Is that something that could be done near term? Then maybe we aren't as unhappy with this fertilizer data as much as we think we are, if the yield stuff makes it look more like what we think is going on.

Tom Butler: Just to clarify, the scenarios we're providing with different yields, that massive set of 6 spreadsheets, that was with those updated yields. The other one was with those specific crops updated within the land use, and that was showing the applications there. Loads are going to change no matter what we do, because everything else is changing around us.

Ken Staver: I meant to have it done by now, and I didn't have it done. So, I was sort of thinking more about the spreadsheets didn't have edge of field loads. So I thought, maybe if we ran it through CAST, we'd have edge of field loads. But we don't even need to go that step, yet. We'll

just look at making the same graph that I presented with the regional yield data and see how that looks. Maybe that will look a lot better.

Tom Butler: I would caution when we're doing loads right now, there's a lot changing. So, it wouldn't necessarily be that ours are the only thing. The model would be kind of recalibrated, put through it's recalibration period. So, a lot is going to change no matter what we do.

Ken Staver: You said somebody else is working on the uptake values. So, where is that happening? They're going to change the crop uptake factors? Who's doing that?

Tom Butler: I know that we have uptake as a value here. It's a value for each of the crops, so that would be applied based on the crop yield.

Ken Staver: So, no one is working on the coefficients right now?

Joseph Delesantro: The coefficients are a sensitivity, and the sensitivities are under the modeling workgroup. So there is an effort to revisit these values, and I will be presenting them to the modeling workgroup. That has included looking at the literature for uptake and removal coefficients, and, for corn, it might also include temporally varying coefficients. So, uptake would vary in time as we've seen dramatic increases in the nutrient content of corn, in particular.

Tim Larson (in chat): What is the stacked bar on the far right? A forecast?

Robert Sabo (in chat): Using CAST data, AG surplus is declining.... these estimates will improve with Delasantro updates
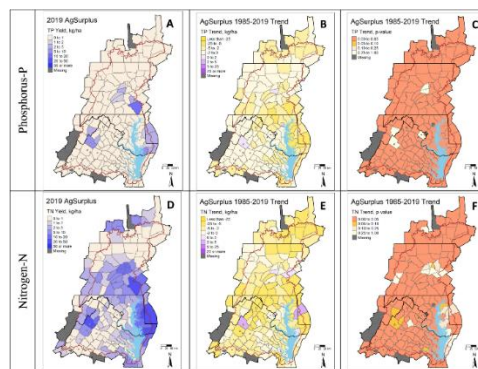
Alex Soroka (in chat): Because the total amount of yield is going up, we can have higher inputs AND higher nue at the same time. However, it doesn't necessarily mean an improvement to N loading to rivers because the overall mass balance is going up.

Robert Sabo (in chat): long term surplus is going down, though it has stalled in the 2010s with current CAST crop yield rates.

Alex Soroka: I was just curious about Joseph's comment that we've seen increases in nutrient content of corn. What I've read is we've focused quite a bit on yield and improving overall yield numbers and that, actually, the protein content of individual corn, has gone down. So actual nitrogen per gram in corn per gram has gone down, but the overall yield has gone up. So you are removing more N. But, for every pound of corn, you remove less nitrogen, but you remove more pounds of corn.

Figure 1. Applicable NUE component changes in maize hybrids over time. Schematic of the relationship between NUE, NIE, and NRE (A) and effects of maize hybrid YOC on grain yield (B), NUE (C), NRE (D), NIE (E), grain N concentration (F), and NHI (G). Bars represent standard error. Means denoted with different letters are significantly different from each other at p < 0.05. All means are presented as the average of two years and five N treatments.

Joseph Delesantro: Thanks, Alex. I'll need to spend more time with those values because there is some difficulty in distinguishing the uptake and removal to get at exactly what it is we really want, which is removal. I appreciate that input, and I'll make sure I am paying attention and thinking about that as I am reviewing those numbers from the literature.
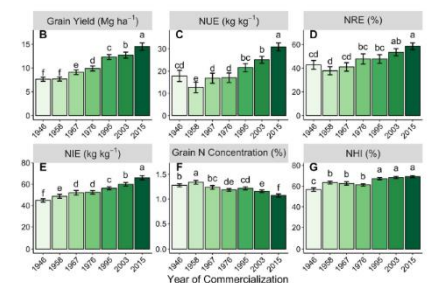
Robert Sabo: My comment is maybe a little dated now, but I just wanted to emphasize that these increased inputs do not result in increased surplus or decreased NUE in CAST. When you actually look at the mass balance information, it's matching up overall with national level trends, if you look at the national nutrient inventory, the NUGIS database as well. I think these estimates will only get better with some of the Delesantro updates to the crop yield time series as well. I'd just like to encourage the group to not be scared of that increase input, it might lead to some ephemeral increases in estimated pollution loads. But, overall, the increase in crop yields will be likely offsetting these increased inputs.

Ken Staver: Currently CAST is showing an increased surplus in corn per acre. We're not talking about inputs going up, we're talking about surplus, the difference between removal and applied going up, and NUE going down in the last decade.

Robert Sabo: That's partly due to the crop yields being underestimated in the 2010's. When you look at the national level inventory, corn yields have almost doubled since the 1980's, and that's essentially a linear trend through time.

Tom Butler: Thanks, Robert. I want to kind of bring us back. Overall, we kind of heard that yes, applied does not equal load, various factors impact that. For the raw data we're looking at, we need to start thinking about if we want to look at different sets. We know AAPFCO has kind of been the default there. We've heard of maybe a modeling approach that is a little different that is based on that data but isn't the sales data itself, talking about breaking things up so that we are in state fertilizer stocks rather than the watershed, and kind of looking at what we did in the past. Are these the kind of things we can look at doing? Is this the direction we want to head? I just want to get a feel for what people are thinking. I want to try and get more actionable things in place, and it seems like fertilizer is going to be a big one. What are other things that we would look at? We heard of Falcone and looking at that, and that's a little bit different. Maybe if it were possible to re-parameterize that for the watershed, we could see something similar. Alex, do you have a feel for that? Is Falcone retired? Is someone still running that? Is it you?

Robert Sabo (in chat): Just to show Ken's concern: Pink shows increased ag surplus in the 2010s due to increased fertilizer use and stabilizing crop yields. But crop yields should be still increasing in the 2010s.

Alex Soroka: No, sorry, it's not me. We can find someone to talk about this for sure.

Tom Butler: So, is this something the group supports looking into? I just want to make sure we aren't going down rabbit holes without broader support. Sounds like New York is on that train, maybe Delaware is as well.

Ken Staver: I feel like we ought to run this yield thing all the way through and see where that is before we jump in and start putting a lot of effort in. So, we have something we're working with, maybe we'll end up with CAST supporting the idea that NUE is getting better. Then we will say, ok, maybe it's not the fertilizer sales data that is so far off, but it's our yield and maybe we're under applying on pasture and a couple other things, and we get it to where it looks pretty reasonable. All I know is these big switches take a lot of work.

Tom Butler: Thanks, Ken. My comments are on the yield. We've been working on this for over a year. It is very possible that we stay with what we have for Phase 6, and that's a decision. If we make that, that's totally fine, we just need to own it. As of now, the yields have not passed. We need to do more work, so I think we have to work with what we've got now. Our time is now
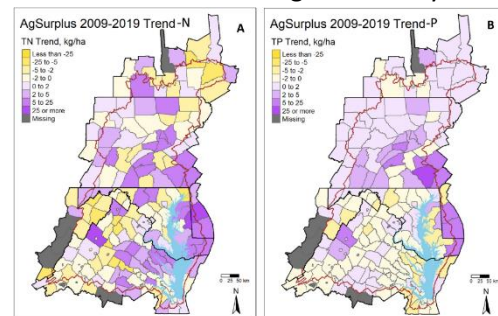
until September and, if we push things further and further, we are not necessarily on track to make a lot of decisions. We have a finite time until September 2025, so we've got a few months, and when we go to test these things, we need to test them with what we have. The data I sent you is the result of an iterative process, and it's so confusing because there are multiple different versions of CAST, and that does lead to some confusion in articulating results. The yields have been provided now, so I think people have see the effect of the yields on the applications. The loads, I would really strongly caution against doing that because if you do that, then the sensitivities change, you've been working on the previous sensitivity, and we don't know what happens until the whole model is run. So, we're going to have a review period where we can say this is terrible, it needs to go to something else. If we are basing things off the loads now, I would caution against that. I do encourage us to keep looking at the fertilizer and asking if this is real. There are clearly uses with the actual raw data. Independent of anything else we are doing with other things, people are concerned with the sales data. If that's true, is there an alternative approach? Is it an AIR report? This is the type of discussion I want to have.

Jess Rigelman: I just wanted to say we can't do loads now. The loads are based on the inputs of calibrated for Phase 6, and we'd have to do a recalibration to even get our base loads. We had to do something similar to that when we changed the application timing function for CAST 23, and that's weeks worth of work. So, loads are off the table until we actually get a calibrated model. But, inputs are on the table, and I think you said it correctly. A lot of things can be shown, but it gets confusing, and I know that on the table is yields. We've finally made a decision on grain splits. It looks like the curves are off the table, and now we are talking about fertilizer and/or other things, but each one gets into a matrix and gets bigger and bigger. So, I'd be happy to tackle a few, but I can only have so many versions of CAST before I start making mistakes, which doesn't help anybody.

Tom Butler: Thanks, Jess. I want to try and push this conversation again. This fertilizer topic is a big one. People weren't happy when it was fixed in Phase 6. They're not happy with it as it sits, and I want to make sure that when we look at this, we have a good feel for what we want to do moving forward. We need to make sure we are all comfortable with the input data for this.

Dave Montali: I'm in agreement with all the issues about the timing. We may not get to a point where, by September, we can actually see the combined effect of all the things that we've done. But we do have a year of review to say we had good intentions, but this didn't work right, and we need to change something. But, looking at this graph that is right in front of us right now, it looks to me like if we would have seen those orange bars going on a nice linear trend from the 80's up until the 20's, and then we didn't have a big dip in the middle, folks would feel a lot more comfortable with the nutrients that are being applied for fertilizer. To Ken's point, before we jump off and do something completely different, if building in our suggestions for the yields can somehow be applied to this type of graph and we can see the effect of that, it might change our whole way of thinking. I think there is some value in the idea that, if we can look at all the different changes we started proposing using CAST 23, is there anything that we can do to incorporate the yield changes to mesh with this display?

Tom Butler: Jess, you are going to have to jump in here with me on this one because the data we just sent out has the different yields under three scenarios. It's got the ones we have plus the first which has regional, and county and regional, and I believe that the applications are there for those crops. Maybe that's what people are trying to look at?

Jess Rigelman: That's definitely it. We have the Phase 6 method, and everything else was kept the same in the latest version I put out. I think they are all with the new grain split, since that one passed, and it should be pretty clear what version of the curves was used, but it was the

Phase 6 yields versus the regional only yields, versus the regional and county yields. Other than Joseph making a change to his method and giving me more data, we have nothing more really to display on yields for those 13 crops. The next decision would be to decide whether or not we are going to go with the new method and whether it's the regional or regional and county. We want to get it as good as possible, and I 100 percent am behind that, but we also need to think is either one of the new methods better than what we have for Phase 6? If it is, go from there and start with at least a method that's better than Phase 6 and then move on. We can come back and continue to discuss and revisit and then it would be what else we wanted to test once we have a decision on yields, or I can run two different versions of fertilizer with two different versions of yields. What I don't want is three or four different versions of fertilizer, plus different curves, plus different versions of yields, because it's a big multiplicative factor and there ends up being too many versions and we can't keep it straight.

Robert Sabo (in chat): fundamentally we need to know the extent increased crop yields are offsetting increased inputs

Tom Butler: I think the takeaway is that those data sheets are going to give us this type of information already.

Ken Staver: I agree. I think it's just a matter of getting it done and looking at it a certain way. I think there's work to be done with what you've already done, and we can do that and sort of see where we are.

Robert Sabo: I know there's been some discussion about exploring some other fertilizer and agricultural mass balance data sets. That's something my ORD team can probably generate pretty quick if there's interest for the AMT call next month. We can provide some slides for you guys to review. But I think, at the end of the day, if we just recalculate NUE surplus values with some of these updated numbers from Joseph, we will fundamentally be able to answer is this increased orange bar being offset by increased crop yields. I think that will probably be the most useful information for the group.

Joseph Delesantro: I echo what Dave said which is I agree with all of this. To your point, Tom, I think that maybe it's useful to pursue these two things in parallel. So, if we can get some sort of an idea of what people are interested in in terms of other methods for fertilizer and what that might look like in the watershed, in addition to looking at how the proposed changes to yields are effecting the NUE, that gives us something to compare, and it also gives us a start for down two paths so we aren't behind switching paths in a couple of months.

Tim Larson (in chat): crop yield and acreage/landcover changes

Robert Sabo (in chat): we can compile 2 or 3 sales-based methods and a survey-based method

Robert Sabo: I'd be happy to do that, but one thing I want to emphasize to the group is that these two or three different sales-based approaches that we are talking about today, as well as the survey-based approaches that are nationally done, they are going to be biased towards individual states. It's state level sales data. It's state level survey data. You're set up here in the Chesapeake Bay to aggregate everything to the entire watershed. So, I just wanted to point that out that any comparison you do there's going to be a state specific bias because they're not aggregating all the sales data to a larger region, they're keeping it within a state. I just wanted to point that out to the group if you guys want to pursue those comparisons. It's not going to be an apples-to-apples comparison because you all do this unique aggregation step which these other methodologies do not do.

Tom Butler: I want to try and get a feel for if that's something people are interested in, seeing those compared methods and anything else like that that we've talked about.

Ken Staver: It depends on how much work it is to take a quick look, that would be my only comment on that.

Robert Sabo: If there's a desire from the group, I'd be happy to help out. We can compile that pretty quickly.

Action: The AMT will revisit agricultural inorganic fertilizer data in CAST at the December meeting. Please come prepared with any feedback on preferred methodology.

Recap/Closing 10:55-11:00 [5 min (Zach Easton, VT)]
Action Items:
• Discuss agricultural inorganic fertilizer data for Phase 7.

Adjourn – 11:00
Up Next:

Office Hours: Friday, December 13th, 2024, from 8:00 - 9:00 am.
AMT Meeting: Friday, December 13th, 2024, from 9:00 - 11:00 am.

Participants

Zach Easton, VT
Tom Butler, EPA
Caroline Kleis, CRC
Tyler Trostle, PA DEP
Tim Larson, VA DCR
Eric Hughes, EPA
Clint Gill, DDA
Joseph Delesantro, ORISE Fellow, EPA
Kate Bresaw, PA DEP
Bill Keeling, VA DEQ
Alex Soroka, USGS
Auston Smith, EPA
Nick Moody, VA-DCR
Pat Thompson, EnergyWorks

Dave Montali, WV/Tetra Tech/MWG
Jessica Rigelman, CBPO Contractor
Ken Staver, UMD Wye
Chris Brosch, DE
Ruth Cassilly, UMD CBPO
Elizabeth Hoffman, MDA
Helen Golimowski, Devereux Consulting
Ashley Hullinger, PA DEP
Arianna Johns, VA DEQ
Bill Keeling, VA DEQ
Dave Montali, Tetratech
Seth Mullins, VA DCR
Tamie Veith, USDA-ARS
Mark Dubin, UME/CBPO
Curt Dell, USDA-ARS

**Common Acronyms
AgWG- Agriculture Workgroup
AMT- Agricultural Modeling Team (Phase 7)
BMP- Best Management Practice
CAST- Chesapeake Assessment Scenario Tool (user interface for the CBP Watershed Model)
CBP- Chesapeake Bay Program
CBPO- Chesapeake Bay Program Office (houses EPA, federal partners, and various contractors and grantees working towards CBP goals)
CBW-Chesapeake Bay Watershed
CRC- Chesapeake Research Consortium
EPA- [United States] Environmental Protection Agency
PSC – Principals' Advisory Committee (CBP)
STAC- Scientific & Technical Advisory Committee
TMDL- Total Maximum Daily Load
WQGIT- Water Quality Goal Implementation Team