Agricultural Modeling Team

October 10, 2025
9:00-11:00AM

Visit the meeting webpage for meeting materials and additional information.

Purpose: To discuss inorganic fertilizer data, processing, and application for Phase 7.

Summary of Actions and Decisions

Action: The September meeting minutes will be approved at a subsequent AMT meeting, once all federal partners are back to work and able to review.
Action: At a future meeting, the AMT will discuss renaming the original hay and pasture classes to hay low and pasture low, once all federal partners are back to work.
Action: Time permitting, the group will discuss soil phosphorus and manure nutrient concentration data at a future meeting, at the request of VA DCR.
Action: Joseph Delesantro will work on projection methods of fertilizer trends for comparison at future meeting. These projections include state trends for nonreporting, crop need trends for non-reporting, and averaging the last three year trends and three to five year trends for non-reporting.
Action: The AMT will work with Robert Sabo to create a table highlighting fertilizer consumption trends across national data sets as an additional line of evidence for the fertilizer projection method.

Minutes

I. Introduction/ Recap

Lead: Tom Butler, EPA

The group was asked to review the September meeting minutes. A quick recap of the AMT progress to date, as well as the groups timeline was provided.

Actions:

1. The September meeting minutes will be approved at a subsequent AMT meeting, once all federal partners are back to work and able to review.
2. At a future meeting, the AMT will discuss renaming the original hay and pasture classes to hay low and pasture low, once all federal partners are back to work.
3. Time permitting, the group will discuss soil phosphorus and manure nutrient concentration data at a future meeting, at the request of VA DCR.

Discussion Notes:

Jess Rigelman (in chat): We have specialty high and low. Should the original hay and pasture be renamed to hay low and pasture low?

Jess Rigelman: We currently have specialty high and specialty low, which indicates which specialty crops have high application rates and which have low application rates. I was wondering whether or not we should rename the original hay and pasture to be "hay low" and "pasture low" to be in sync with "hay high" and "pasture high".

Tom Butler: Thanks, Jess. That's a good point to bring up. We can put that on an agenda once we get everyone back to be able to make a formal decision. If you guys have any input that you'd like to provide on that, please email me offline or if you'd like to discuss that now, drop it into the chat and we can certainly discuss that.

Auston Smith (in chat): I am in general agreement with this renaming suggestion, but open to other nomenclature from partners.

James Martin: My team has provided updated manure concentration data as well as some additional soil phosphorous data. Now is our chance to try and get that data in the model for Phase 7. So, I would really like to be able to get those items considered as well.

Tom Butler: I appreciate that, James. I recognize your team has sent that information to us, so that is certainly something we can discuss here as the group. I imagine other people might have information and will want to deal with that in whatever way we as a group feel it should be dealt with. So, I definitely want to be receptive to that and appreciate your efforts and your team's efforts. We will register that, and then we will try and work things in as best we can. James, there is a comment from Andrew, so I am sure you can answer that in the chat if you'd like.

Andrew Leight (in chat): James - what were those two data types?

James Martin (in chat): Soil Phosphorus and manure nutrient concentration for all animal types.

II. Inorganic Fertilizer Discussion

Lead: Tom Butler, EPA

Tom Butler, EPA, went over major fertilizer related topics that have been brought up and outlined a plan of action to address these. Topics include efforts to collect more up to date data, solicit feedback on new possible data sources, and additional data processing topics.

Actions:

1. Joseph Delesantro will work on projection methods of fertilizer trends for comparison at future meeting. These projections include state trends for nonreporting, crop need trends for non reporting, and averaging the last three year trends and three to five year trends for non reporting.
2. The AMT will work with Robert Sabo to create a table highlighting fertilizer consumption trends across national data sets as an additional line of evidence for the fertilizer projection method.

Discussion Notes:

James Martin: Do we understand the sources of the state data? Obviously, we know they come from the state, but how are they collected, etc.? What are they collected for? I understand Virginia's is because our Department of Agriculture, not really in their agriculture section but

kind of in their regulatory section, regulates fertilizer labeling and taxes fertilizer. So, that's the source of the data in Virginia. Is that the same for all the states?

Tom Butler: They're similar in what they're doing in terms of consumer protection for fertilizer labeling. They are getting it as taxes. So, they're taxing based off that, and that does create some concerns that we've discussed with several of the state chemists or equivalent personnel. So, it's not completely the same everywhere. Generally speaking, that is the trend that we've seen amongst the states, and that is that it's information used for taxes and protection of consumers. You are going to buy fertilizer, you want to know what's in it. We did discuss the process of blending and mixing fertilizers and the potential of that to have implications for double counting fertilizers, etc. We've kind of gotten the feel from some of these people that that is not inherently going to be a large issue. They did not have necessary analysis to back that up, but those would be the people who get it, and this would be from companies who produce it. Not inherently mixing it and then reselling it, but the companies actually making the product would report that at the time they sell it. So, the companies are reporting to jurisdictions the county of sale, pounds, fertilizer grade, and that would be the information we'd be seeing. So, great question.

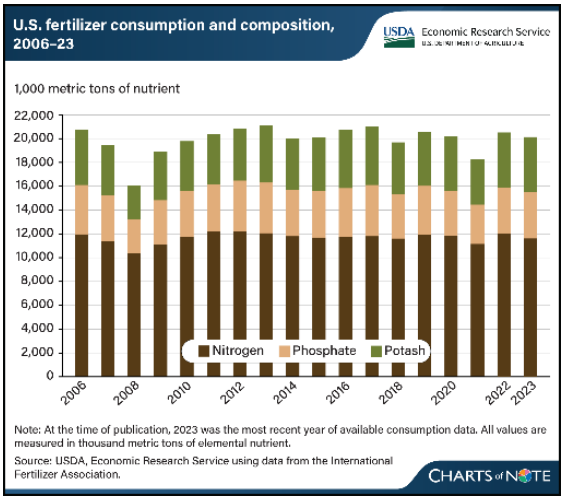
Jess Rigelman: I just wanted to say that the data is projected forward using the rules that the fertilizer group formed for CAST 23. It was important that we did project so that we could use state data to a certain time period because, at that point, we had a watershed wide bucket, so we needed all the states in there. So, we had a method for estimating the data for West Virginia and New York who didn't have data up through 2020 like the other states. Now that we have state buckets, it could be discussed that we wouldn't project state data. We could just use Maryland's data through 2022, as opposed to having to project it forward to 2024 just because other states have reported to 2024. So, I just want to put that out there that the way you will be seeing results later on in this presentation is based on the projection rules that the fertilizer group had done, or at least my interpretation of how they wanted that stuff done. So, the projection forward doesn't have to happen for Phase 7, since we have agreed to state buckets.

Auston Smith (in chat): The Fertilizer Expert Group's work: https://www.chesapeakebay.net/who/group/fertilizer-expert-group

James Martin (in chat): If we agree to the process for adding additional years of fertilizer, can we continue to add additional years of data up until the start of Model Calibration?

Jess Rigelman (in chat): Fertilizer Year= CBP Progress Year

Robert Sabo (in chat): Just to put Chesapeake Bay nitrogen fertilizer consumption increase into context, American fertilizer consumption has hovered around 12,000 metric tons of nitrogen since 2010 (despite increased yields and production across CONUS). I believe P fertilizer consumption trends in the Bay watershed is roughly consistent with national developments (stable to slightly declining).



Tom Butler: Thanks for that clarification, Jess. I do appreciate that because that is kind of the crux of our discussion today. I think a lot of what we want to deal with is how to talk about areas where we might not have information or if we have information but want to deal with it in a different way than we currently do. James, that's a good question. Because it's 2025 now, it would be 2024 for this data we've got here. I believe the question James is asking is as we get closer to the actual calibration, would we be able to put in 2025/2026/2027

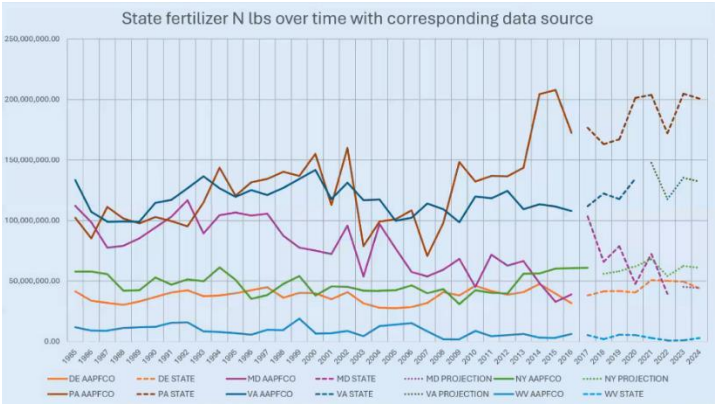
information? I feel like the answer should be yes. James, am I misconstruing what you are talking about?
James Martin: No, Tom, that's kind of what I was getting at. It just seems like it would be unfortunate for us to start using a model in 2029 that only has fertilizer data that is already five years old.
Auston Smith: Agreed, James, it would be unfortunate. Do you know generally when updated annua data sets, at least for Virginia, might be available? Would they be available in a batch of years, or are they frequently available annually at some point?
James Martin: It's annually at some point, but I think what we're talking about here is leaving in place a two-year lag intentionally because of the QAQC, as Tom referred to earlier. So, I think there may be debate as to whether 2024 is a year that we use now or not. By the end of next year, 2024 will definitely be in. By the end of next year, we should be able to add in 2025. I've seen references to a fertilizer year. We need one more year, right? We've got state fiscal, federal fiscal, water years, model progress years, and now we've got a fertilizer year, but I am not sure when that year ends.
Auston Smith: That's a good point. I guess I was just asking because I didn't know as model calibration went on, what Virginia might be able to provide as far as an updated year versus what other jurisdictions might be able to.
Andrew Leight: I just want a clarification of what Jess said. It sounded to me like, Jess, you were suggesting that different states might have different numbers of years involved when we get to the model calibration. Am I understanding that correctly?
Jess Rigelman: Right now, we have data from four states through 2024 and then Maryland through 2022 and New York through 2017. So, the Fertilizer Expert Panel basically said if you have three or more states with data, use the trends of those states to project the amounts for the other states. So, in Maryland's case, we're projecting '23 and '24 from your 2022 data, based on the other four states that have data. But, that was because, in Phase 6, we had a watershed wide fertilizer bucket that was used in our nutrient spread for Phase 7. We've agreed to use state buckets so, therefore, we could just use Maryland's data through 2022 and not project it forward because we don't have a watershed wide bucket. The way that this is processed now is based on logic that was agreed upon a couple of years ago, and part of that logic could be discussed and changed because we had agreed to a state bucket.
Andrew Leight: Thank you for that explanation, Jess. It's still a little confusing to me what the implications of that would be if, for example, Maryland doesn't include data past 2022, and we're going with the new system where it's a statewide bucket, so there's not a need for projecting out. I'm really curious what the implications of that would be for the model. Presumably you are going to build scenarios overtime for particular years, right? So, it's a little fuzzy to me what that would mean.
Jess Rigelman: What we do is we take the last year that we have fertilizer data, and we basically say what was the fraction of your application goal that was met? For 2023, we would say, for this crop on this land use, you met 80% of your crop goal. So, we're going to apply manure. We're going to apply biosolids, and then we're going to apply enough fertilizer to meet 80% of that goal, absent of an actual bucket of fertilizer. That is the way it would be done for all states past 2024. Again, that is something that this group can discuss, but those are the current processing rules. The way that this would affect Maryland differently is that we would go from 2022 for you if that decision was made, and you wouldn't be affected by the other states fertilizer trends for '23 and '24. So, let's say that fertilizer went up for those four states. Maryland's '22 number would go up or go up from 2022. If all those other states went down, then Maryland's fertilizer would go down based on the trend of those other four states. So, you wouldn't be beholden to the trend of those other four states that have data. It could be a good thing if they go down. It could

be a bad thing if they go up. So, that is how the model would use that data. We would use your 2022 fraction, and, for the other states, we would use their 2024 fraction. For New York, we would use their 2017 fraction.

Joseph Delesantro: To update the calibration, we need not just the updated fertilizer data, although that is a really big component, but we also need to be able to update all the data across sectors and, particularly, the monitoring data that we are calibrating, too. Certain data sets we can project. Other data sets we really shouldn't project. So, I just wanted to make sure that we're keeping that in the context that there might be other limitations on our ability to rapidly update the model. Certainly, of course, if we can keep fertilizer from being the bottleneck, that would be great.

James Martin: Joseph's comment made me think about yield data and the correlation. We know yields have been increasing over time and fertilizer has been increasing over time, recognizing that fertilizer is increasing faster than yield. I guess what I want to make sure is that we're careful not to use one data set that's much more current than the other one. So, if we only have yield data through 2022, maybe we should only be using fertilizer sales through 2022, so that the fertilizer sales align with those yields that are being realized at that time. Does that make sense?

Joesph Delesantro: Yes. Thank you for articulating that so clearly, but those are the sort of concerns and considerations that we would want to keep in mind when deciding when and how to update the model or to update the calibration.



Ken Staver: I don't know that I've seen this graph before broken out by state, but when we had the watershed wide bucket, everything was going up since 2009, but we were mixing the whole watershed together. When you look at this, most of the states are pretty flat since 2009, except for Pennsylvania. So, when we had the watershed wide bucket, was the whole thing being driven up for every state because of the doubling in Pennsylvania? So, are the states going to really look different now on the N applied for bushel of production when we break it out by states? Have we looked at that yet or not?

Tom Butler: Preliminarily, we've started to look at that, but I don't have it for discussion today.

Ken Staver: With the old watershed wide bucket, every state looked exactly almost the same in terms of their N use efficiency. They all had that upward trend from 2009 to 2020. When we look at this graph, you are like, wow, it doesn't look the same in all the states. So, it just sort of jumps out.

Tom Butler: That's a great point, and I suspect what we'll see are differences. So, if you look at Maryland, their's has gone down from 2020. If you look at Pennsylvania, it's kind of level from 2020. But, you are right, that 2009 inflection point you could certainly see there are changes there, and that could be more reflective of what's happening there and what they're doing. This is just what the data is showing. I would rely on people from those areas to kind of weigh in on what this would look like. We've already gone to states. So, we've said, essentially, fertilizer is more independent from the states. Maryland's is going to be different than Pennsylvania than Virginia, etc. If we were to use those fertilizer trends from Pennsylvania, West Virginia, Delaware, for Maryland from 2022-2024, maybe that isn't representative of what's actually

happening. As you said, Ken, maybe Pennsylvania's jumped up here, and maybe that would influence Maryland.

Ken Staver: Yeah, I'm not even talking that much about since 2020. This was the CESR report that everybody got so wound up about with everything starting at 2009. There's N imbalance, everybody is talking about the nutrient budgets, and we're looking at this saying, well, this doesn't really look like that's the case everywhere when you look at this. If you look at these other states and the yields went up since 2009, then the N use efficiency didn't get any worse at all. I haven't seen it all, but it looks like it's kind of being driven by one major state with a huge uptrend from 2007, 2008, up through 2015. It doubles in the biggest state in the watershed. That really needs a closer look. I don't really mean to take the discussion backwards. It's just, a week doesn't go by that I'm not in a discussion where I hear about CESR or N budgets, so I am kind of sensitized to that issue. So, that's just a thought. I'll be anxious to look at that and see what that looks like.

Tom Butler: Thanks, Ken. That's a good point, and we will certainly follow up and look into that more ourselves and definitely get everyone involved on that one.

James Martin: I wanted to circle back to something Jess said earlier about moving to state limited buckets of fertilizer for Phase 7. Do we replace this forecast methodology with the currently standard model approach on a state-by-state basis? Rather than trying to forecast fertilizer, we just hold the percent applied, or percent of goal, or whatever it is?

Tom Butler: Jess, are you able to speak to James about the impacts on holding crop need or fraction of crop need met, moving forward?

Jess Rigelman: I guess I'd ask James to clarify. I don't quite understand the question he's asking.

James Martin: What I am thinking is, with state buckets, couldn't we, instead of using state reported data to forecast for states that didn't report data, just simply use that percent of goal met to forecast forward from whatever the last data point is we have for any of the states?

Jess Rigelman: Yeah, that was kind of what I was suggesting as a possibility. So, like I said, Pennsylvania, Delaware, Virginia, and West Virginia would 2024. Maryland would be 2022, and New York's would be 2017. So, we would just use the fraction of crop goal met from those years, so each state would be independent. There's no need to project Maryland. There's no need to project New York, but it doesn't mean that we can't project them all forward to 2024. That's a decision the group can make.

James Martin: Do you have a sense for what the difference would be? I don't even know how to measure it. Maybe the pounds of fertilizer per state difference between the forecasting methodology and the percent of need met methodology?

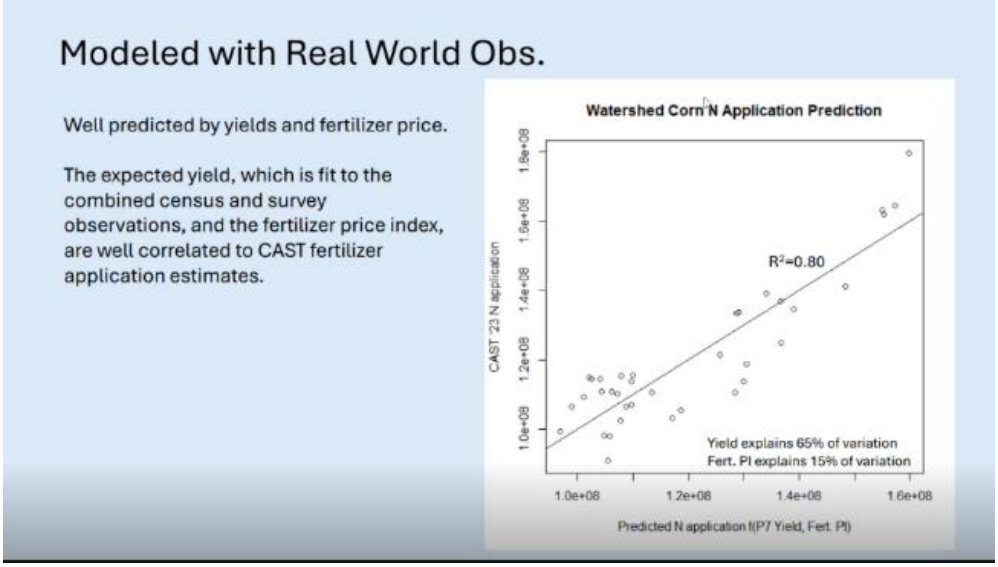
Jess Rigelman: I don't have the data in front of me. Tom, this is just the fertilizer versus crop yield met. I haven't actually run scenarios where I left Maryland. I haven't run scenarios past 2020, so I haven't incorporated any of the 2020-24 data yet, because I don't have this version of Phase 7 or the Phase Six/Phase 7 hybrid set up past 2020, but that's something I could work on going forward.

Joseph Delesantro: Not wanting to complicate this but, in the Spring, we had basically just made an attempt to work backwards and predicted fertilizer sales based on yield, which is essentially used to derive crop need times a factor and fertilizer price index. We found that there was a very good fit there. We could explain about 80% of the fertilizer sales with that crop need and the fertilizer price index. So, that might be another predictor variable we might consider using to enhance these projections.

James Martin: Joseph, the crop need that you are referring to is something that you calculated based on yield data, right, not the crop need that we have set in the model?

Joseph Delesantro: That's correct. Based on yield data.

Tom Butler: I think, Joseph, this might be the figure you are referring to.



Joseph Delesantro: That's correct. This was presented back in June.
Tom Butler (in chat): June materials referenced https://www.chesapeakebay.net/files/documents/final_Fertilizer-Data-6.25_JDel_TWB_0625.pdf
James Martin: The methodology that Jess implements based on partnership decisions of holding percent of crop need for forecasted years, that uses the model's crop need not the yield-based crop need?
Joseph Delesantro: The model's crop need is based on the yield. Jess, if you can elaborate or correct me, please do.
Jess Rigelman: No, that's correct. The model is based on yield data. What I am talking about is the percentage of that that was met in the last year that we had fertilizer using the existing manure, biosolid, and fertilizer buckets.
Joseph Delesantro: So, we could maintain that percentage of the crop yield, or the crop need met, and that crop need would be changing over time based on the yield and the past formulas for that.
James Martin: I thought we established crop need for each crop, just like we did with the new hay and pasture, right? Isn't that what the change from 120 pounds from 60 was all about? Changing and resetting the crop need not based on yield, but based on recommendation?
Joseph Delesantro: The yield provides us with a mass per unit space, so bushels per acre. Then that number of bushels per acre has a need which is going to be in terms of nitrogen and phosphorous per bushel. So, those two things combined give us the crop need. Essentially, we are converting from our yield (bushels, pounds) of a crop, to the need of nitrogen and phosphorous.
James Martin: But, that is only for a very small subset of all of our crops, right?
Joseph Delesantro: A small subset in terms of the total number of crops because we have 100 crops, but it accounts for the majority of N and P application and the majority of actual acres. It's 11 crops that we are currently doing what we refer to as true yield calculations on. But, yes, you are very much correct that there are crops, very notably hay, for which we do not have yield data. Instead, we use acres as the yield unit and, therefore, the crop need is defined by that number that you are referring to. That's right.
Jess Rigelman: Application rate is on a per yield unit for 13 of the crops and per acre for the other crops which we just covered but, crop need, which we are supposed to be calling crop application goal, can be affected by nutrient management. So, there is a slight difference between crop application and crop need or crop application goal, and that can be increased by not using

nutrient management from what's in those tables. So, there is one other factor that can affect what we're calling crop need or expected application goal.

Tom Butler: To summarize, we are currently using a source of data pretty uniformly through 2016. There is already a concern or discussion point raised about one of the jurisdictions and the trends there. But, leaving that aside for now, we're talking about how to carry forward when perhaps everyone is not reporting. So, when the states do report data, that seems pretty cut and dry that that data is reliable, and the way we use that in relation to the yields is set in CAST. Then we have other jurisdictions who do not have that information. So, for those areas we, perhaps, want to look at how it would affect them if we did not use the trends from those who had reported. So, I might lean a little bit on Andrew and Cassie to see how you guys might be perceiving the conversation. Not trying to single anyone out, but I think that's particularly relevant in your cases, because I think the implications for this are if we use the trends going from the other states, we've moved to the state scale stock, but then we would be tying a projection of your state scale stock to how other jurisdictions are behaving. So, does that seem like a reasonable thing to be doing? Is that not realistic? I certainly want to make sure this is clear, because this is a topic that I think has big implications, simply because when we are adding fertilizer, adding fertilizer, adding fertilizer, that has a big implication for what's happening across the watershed, as we've already heard today.

Cassie Davis: At this time, we don't have a method for reporting to AAPFCO, so I think leaning in on the other state trends would probably be more accurate than using our existing data and trending that into the future. That's just my gut assumption, though. It's hard to know without having the data.

Andrew Leight: My gut reaction is that I agree with some of the comments made earlier. It inherently seems to make more sense if we are going to have state specific inorganic fertilizer buckets that state specific trends make more sense. How that gets implemented, what that means for the model, what it means if we don't have new data, and what gets incorporated into the calibration, all of that I am learning in today's discussion. So, certainly not prepared to make a definitive assessment here but I think our preference would be, if we do decide to implement some trend over time, that it would be state specific. That just seems to make more sense.

Joseph Delesantro: It's going to be sufficiently easy for us to do the proposed projection, possibly even to do it in a couple of different ways. So, I'm happy to hear there's some interest. I am happy to volunteer to spend a couple of hours doing that. We can see what it looks like next time.

Tom Butler: Joseph, if you are going to be doing that, we could get some input on what people might be interested to see. So, I think James and AK indicated potentially looking at, for Maryland and New York, what happens if we stop using fertilizer data trends from the other states. So, Maryland would freeze in 2020. New York would freeze in 2017, and then we would base things off the crop yield. That is one thing I heard. The other would be to continue doing projections based on the other states who have reported. Those are two of the things I am hearing people might want to see. I do see a comment in the chat. So, I'll pause to read that and see if other hands come up.

Robert Sabo (in chat): proposed projection, to the extent possible, should be constrained by national consumption values. Joseph may you and I please touch base?

Joseph Delesantro (in chat): Sure, looking forward to hearing what you're thinking.

James Martin: For comparisons sake, I think there's value in continuing to use the currently approved projection approach for states that have gaps in their data. But, I agree with A.K. If we are moving to state specific source buckets, my gut is the same. It probably makes more sense to look at alternative approaches to projecting that missing data. Whether it's just extending the New York trend through 2017 on into 2024 or comparing that with what would happen from

2024 forward, which was the approach Jess was talking about, where the percent of crop need is held constant through those years, I think those are a couple of good approaches to look at.
Andrew Leight (in chat): When is the drop-dead date for states to provide sales data before calibration occurs?
Tom Butler: Jess and Joseph, I will lean on you more for that solid date. I have been told for us to get in information, we are talking about our February meeting. Obviously, that is not the end of when everything happens, so I will lean on those two here for some of that expertise.
Jess Rigelman: It is my understanding it would be the end of February. Obviously, that's when all the other data for fertilizer methodology and whatever is due. It doesn't mean we are going to start the calibration March 1st. I don't actually know when we would start the calibration. Joseph can maybe speak more to that, but it's not like all of it starts at once. We're going to be starting some of that probably even prior to February for some of the other inputs. So, I don't know when the fertilizer data would be due.
Auston Smith: I am less familiar with what goes into the data that we're seeing depicted right here. For jurisdictions like New York and Maryland that maybe have decisions to make, I was just wondering if, in this data set that's just representing a full state, is the data able to be broken out by counties within that state? Or is it not broken out that way? I guess the reason I am asking is because maybe in New York's case, maybe northern PA counties might be an interesting trend to look at rather than PA as a whole just to look at it from a latitudinal perspective.
Tom Butler: That's a great point, Auston, and Cassie seems to be receptive to that. When I've looked at this, and Jess has looked at this probably significantly more than I have, we have county information. I think we actually have several of the people who provide this information on the call. I think I saw Denise. I think we have the counties. Denise, I just wanted to see what your input might be on that.
Denise Uzupis: We provide state data by county. If New York would like county data, like northern Pennsylvania county data, we could probably break that out for them if that's what you are looking for. I am happy to get you whatever you need.
Tom Butler: Thank you very much. We might have already been given it. I am sure we could break it out, but if there was something specific, Cassie, that you might be interested in looking at that Denise can help with, that could be useful.
Denise Uzupis: Yeah, Tom, you should have all that data based by county. But, again, it might be easier sometimes for me to pull it.
James Martin (in chat): VA data is by County as well.
Clinton Gill (in chat): DE is the same.
Jess Rigelman (in chat): All states provide by county.
Tom Butler: Great point, thank you. Jess has clarified everyone provides by county. James and Clint have corroborated that. So, that could be a track there for New York. A.K., I don't know if that would be helpful for you in Maryland to look at Southern Pennsylvania Counties or Northern Virginia counties. Obviously, things are different. We recognized crossing state lines is a different thing, but just a possibility that I think would be a good discussion to have.
Joseph Delesantro: Going back to when that data should be provided, I think that Jess is right in terms of a true drop-dead date would be the end of February. She would be able to process that data and pass it on to myself and Gopal to do the calibration over the next few months. But I do want to bring everybody back to the points that Tom brought up earlier. The fertilizer here is really important. So, if this data is coming in last minute and it represents a significant change, it's not leaving us much time to potentially make changes to how we're processing, incorporating, and interpreting that data because fertilizer is such a large component of our nutrient balance. It isn't one of those incremental changes. This is a change to the model that has

the potential to break it. I am all for breaking models and putting them back together better again, but if we break it the last day of February, there's going to be a lot of work to do to fix it before we need the final model ready. So, just wanted to throw those considerations out as well.
James Martin: So, Joseph, I guess what we need to do is agree to some forecast methodology and, should MD or NY be able to produce additional data, as long as we have methodology it's just a matter of replacing the data set, right? It's not that cumbersome, is it?
Joseph Delesantro: Yeah, I think you are right in terms of it not being cumbersome to simply replace that data with a set methodology, maybe rerun if any additional projection is needed based on that last available data. My thoughts would be how does that change the results, and does it make us rethink any of our other decisions or processing? If that happened right at the end, we really wouldn't have the time to have those conversations or to make additional changes. Maybe if we've got Virginia and Pennsylvania right, maybe we're not too worried about Maryland and New York. I'm not sure, but I just wanted people to keep that in mind.
Tom Butler: I appreciate that, Joseph, and I definitely want to give people as much runway as we can for this. We're not saying that one state is less important than another. Everyone has their effort and their goals and objectives. That's definitely not what we are implying. It's just, for some of these bigger players, the implications have been huge across the watershed. As you know, we heard from Ken earlier, and I think when we look at some of these trends, that's noticeable. We want to make sure that that's as right as it can be and that we're doing something better than what we have in Phase 6. We've discussed a little bit about the approaches for some of these things and how to deal with that. I think the other implication for that is if we were to get information from some of the states in some years but not in every year, we currently have a protocol in place where if at least three of them report, we would be able to project that. Say, theoretically, not everyone had a refresh at the same time of their data. We might have new information from Pennsylvania, Delaware, and Virginia, not West Virginia. We would want to make sure that we would be able to still deal with that. So, it could have an implication for any one of the jurisdictions should they miss a year, or they just didn't have that ready at the time. So, I just wanted to highlight that as well. Fertilizer is a big one. I think the implications for this are pretty big across the watershed for everyone's goals, and getting this right is kind of important. I think we have some good feedback on state trends as we have them now with the other jurisdictions, versus the crop need being met, recognizing we need to figure out that process for forecasting. Once we have some scenarios, I think we would be better positioned to do that.
James Martin: One more thought of another projection method. It is related to the percent of crop need met but, instead of holding the last year steady through the projection period, we could look at the last three-year trend or last five-year trend of percent of crop need and move that forward through the years when we don't have data. Anyways, just trying to come up with alternatives that, if Joseph has time to run them, we can compare against the status quo.
Joseph Delesantro: That sounds reasonable. I've written it down, and we will just see what there is time for before the next meeting.
Cassie Davis (in chat): I'm interested in seeing the Northern PA trends. I agree, that seems like a more accurate representation for NY than the entire watershed trends.
Tom Butler: Well, if we can get some of these down, I definitely want to keep the conversations flowing about that. But, I also wanted to kind of come back a little bit to the data sources we've got. Recognizing the time we have, I'd like to get other people's perspectives, because we know we have this drop-dead data in February. We know what we have here right now, and there might be increases. We are going to get Virginia's data incorporated. We're going to look and see if we can do information gathering from the counties in Northern Pennsylvania and potentially Southern Pennsylvania and see if that would be something that other jurisdictions were interested in seeing. But, this is kind of a data set that we've got that's an amalgamation of states. There's

always the discussion in the back of our minds that keeps coming forward about the raw data and, given the time frame that we are working with, I've hinted already today at the processing and focusing on that. I want to get a quick gauge on peoples' perspectives on the actual source. I think this goes to a point that Ken made earlier about looking at that 2009 forward trend. We have looked for data sources. Caitlin Grady presented, and the Fertilizer Expert Group was actually meant to inform this group prior to kind of being switched up a little bit and taking over for Phase 6. We've looked at a lot of different things from the Fertilizer Institute, the International National Plant Nutrition Institute in Canada. We've looked at scientific research articles. In June, we had a discussion about some of that. So, in terms of focusing on raw data, I'd like to kind of get people's perspectives on what they might feel. If this is the best we are going to get and we can focus on really getting the processing down for this, if that's the direction the group wants to go, then I think we should kind of get on the same page about that. If people still wanted to look at raw data and potentially different sources for simultaneously dealing with this, that's also something we can do. It will just take more time. So, really quickly, I'd like to gauge and see if people had comments about that- whether we want to focus more on the processing here or if people had suggestions for different sources of data. If we don't have any suggestions at this point, I am not saying I am skeptical that we could get it done in time, but I am wary that if we put out an effort to get fertilizer data from a brand new source, it might not leave us with the time to adequately address the processing of it and get things in position.

James Martin: I think the state source data is as good as we are going to find in terms of the raw data. I do think we should pay attention to some of the other data reporting and trends, like what Robert Sabo has reference in the chat. If we see significant deviation from some of those other national trends, we need to use it as another line of evidence to support or maybe look deeper into our state data sources if there is significant disagreement.

Tom Butler: Thanks, James, that's really good insight there. Robert, I will kind of call on you a little bit here because I know you are really plugged into the national scale on things and, obviously, you've already said you will work with Joseph on planning some of this. I wanted to see your input as well.

Robert Sabo: I think it is in the best interest of partnership to stick with the state level/county level sales data. There's a power to having receipts and being able to work with your farmers to influence their fertilizer decisions and to help them optimize their nutrient management. Any other path forward, whether you're making an assumption about how much nitrogen is going to be applied or crop need based on extension recommendations, that's sort of like you are baking assumptions into the model, and it's not going to be empirically driven and data driven. So, I think the sales data is sort of your best friend. The receipts don't lie. It's a great way to constrain the mass of nitrogen and phosphorous likely being applied within your state. To second James' point, you can use the national trends data sets like from the International Fertilizer Association as a laugh test. If I was in Pennsylvania's shoes, I might double check if what's going on in 2013-2014 was a conversion issue, just to make sure that big spike is a real thing. So, that's just the power of being able to reference these alternative data sets just to double check and make sure everything is checking out properly.

Tom Butler: Thanks, Robert, I do appreciate that. I just wanted to highlight as well that as we look at those, again, that AAPFCO data is what many of the states have indicated is their historic record. So, if we had other sources to look at, I think that wouldn't necessarily be a bad idea.

Hunter Landis: I have maybe a question about the data or the sources of data versus any kind of recommendation. I apologize I am not an expert on the Virginia data. Do we know the capability or the possibility that some of the fertilizer that we have in this data set was actually applied outside of the Bay?

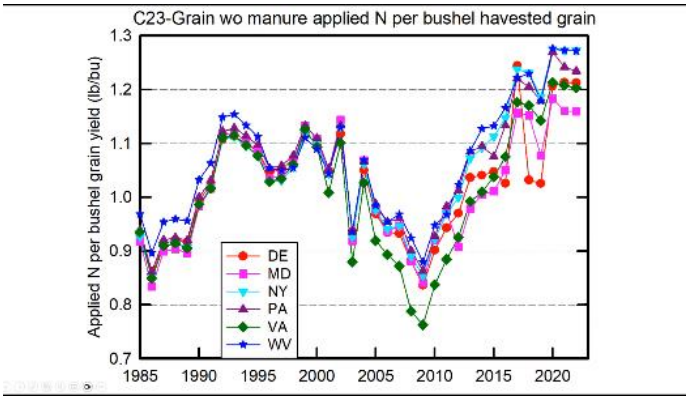
Tom Butler: That's a great question. The way that we deal with this now is that we use the USDA Census of Agriculture expenditures information so that we calculate the fertilizer that is purchased within the watershed versus outside. So, that helps account for that, at least in part. I don't know if that gets at your question or if you had more in-depth things you wanted to know.
Hunter Landis: Maybe I will just repeat what I think I heard. So, we are accounting for it being purchased inside of the Bay. Is that correct?
Tom Butler: Yes.
Hunter Landis: We've got border counties in Virginia and other states, too. So, even without the county being a border, if the whole county is on a border, someone could have purchased it in a Bay County and applied all of it potentially in a neighboring out-of-Bay county?
Tom Butler: Yes. We recognize purchase does not equal application. This is where we get into Phase 7 versus Phase 6. So, we now have state scale where we separate out based on the price or the sales where the fertilizer is purchased and then make that available, and that becomes applied based on the organic portions and the inorganic portions and that crop's expected application goal. So, that is what really drives where things are applied. We do simulate a whole county if it's on the border, but then we use the part that is in the watershed. So, that's kind of how we deal with the applications. For more on that, I would lean on Jess. I'm talking about the application process that we have and how we account for inside versus outside of the watershed.
Jess Rigelman: The application is done at the county scale. All manure and fertilizer is done for the full county. Loads are calculated for the part that is in or out of the watershed, based on Land River Segment. But, regarding Hunter's question, we take the whole state and then we use the expenditures data for only the counties that are in or partially in the state. It is a concern that you could buy it in county A and apply it in a county that's out of the watershed, but the same argument could be made that you bought it out of the watershed and applied it in the watershed. We don't have detailed data. The only detailed data we have is where it was bought and sold, so that is just what we use.
Ken Staver: The only thing I am thinking about is how this is going to look. We've done three different things with fertilizer. We've done the putting more N on grassland, which is going to make a difference in a couple of states. We've gone to the state bucket, and now we are sort of looking at this projection method. What makes sense, if you are thinking from an ag production standpoint is what the application rates are on crops. I think Robert used the word laugh test or something. If you look at corn and say, ok, what are people doing for corn, that's where you can take it back to the nutrient management, plants, and things like that. So, if you want to do a closer check, you can look at state information where they have plans that farmers are doing or where they do audits. In Maryland, you get audited. How does it look? What are farmers actually doing? To really sort of have a feel for it, you have to put it on the crops and see what the application rates look like on the crops and the pounds per N bushel of corn. I am just looking at this graph, and the state bucket is the big thing, I think. Of all the things we're talking about, that's a big thing. For a state like Virginia that has a fair amount of grassland, and now we are going to put more N on grassland, that's a big thing, too. The last five years are a little choppy but, overall, it's pretty flat there. Nothing really jumps out. It shouldn't be too bad for the last five or ten years, unless you really go to some crazy method. It's going to kind of all just work out. But, the other things are the big things. So, that's my guess. I could be wrong, but I got to see this relative to pounds of N. Corn is a big hitter, and that's the benchmark. If you don't get corn right, you don't get it right for N in the watershed.
Tom Butler: Quick question, Ken, pounds of nitrogen per bushel of corn, in your experience, is it like .8 to 1.2? Do you have a feel for where that is?
Ken Staver: Because we had the watershed wide bucket, the trend was exactly the same from 2009-2020, and it went from about .75 to 1-1.1. That was corn without manure. This was the

cleanest case we have for N use on a crop. Corn without manure, that's pounds of N relative to crop need. N applied per crop need went from about .75 to 1.1. So, that's big, right? That means that's all excess.

James Martin: That's where you are making sure you are accounting for changes in yield. If you are holding your yields or your need constant through those years, it doesn't surprise me that N applied per acre is going up because yield per acre is going up, right?

Ken Staver: The yield is going up for this, too, so this is based on the increases in yield.

Tom Butler: Is this the right version of the figure you are referring to, Ken?



Ken Staver: I've done a bunch of versions, but it's the same basic thing. We had a low point in 2009. This one is a little different because I have one with some Phase 7 yield iterations. But, yes, there you go. This is in pounds per bushel. But, this is yield based, James. It is tied to yield.

James Martin: I thought you said it was on crop need. I didn't realize it was the yield version. I was still focused on the model version of the crop need.

Ken Staver: This is all CAST 23 data. There's nothing that I have independent of CAST 23. So, it's just based on the yields that are in CAST 23 and the amount of N that is applied. So, I am saying the state patterns are all very similar because we had a watershed wide bucket. So, as the N excess went up in the watershed, then it went up in every state kind of the same way. So, for nutrient management in Maryland, what you are held to as a farmer is 1 pound per bushel. That's what you are supposed to be applying of yield goal. So, obviously in dry/bad years, you don't hit it. In good years, you do better. I'm thinking based on that graph you have and how the differences in the states are, the states are going to look very different when this graph gets redone with a state bucket. They are going to look really different, I think, unless Pennsylvania has grown a lot more corn since 2007. Maybe they doubled their corn acreage, I don't know. So, you need to look at it based on the crops that are being grown in that same period. Maybe it makes perfect sense when you see that, and Pennsylvania's N use efficiency could be better than everybody else if they are all the sudden growing a lot more corn. But, you'd have to see that first to sort of give it the common sense test.

Tom Butler: Corn for grain and, in our case, without manure, is the easiest/biggest one to do that with.

Ken Staver: That's the one that's kind of like the signature. It sort of tells you what is going on in general, and that's where most of the focus is with nutrient management. It's the poster child, nationwide, for N use and water quality. So, that's kind of the benchmark. That's our "1.0". That's our linchpin in the middle of everything- corn without manure- because we have a lot of data, and everybody in the whole country looks at that crop. So, anyway, that's what we need to look at next, I think. I think the state bucket is going to change something big. That's my guess.

James Martin: My comment was spurred again by one of Jess' comments about the fertilizer spread and that we use the Ag Census data to determine how much of the state bucket goes into

each county. It occurs to me that since we have sales data at the county scale, we should be doing a sniff test there as well. If the Ag Census is telling us this county needs three times what the fertilizer sales for that county says, we need to just ask ourselves does that make sense? It would be unfortunate to have county scale data on the sales, and all we do with the county scale data is roll it up to the state and then ignore it forever thereafter. So, let's use the data we've got to check our other assumptions and processes.

Tom Butler: James, I don't know if I misspoke on the way that is processed now. Jess, can you clarify the expenditures and how they're related to the state scale that we did? They are aggregated to the state at this point, right? We don't keep them at the county, right?

Jess Rigelman: We take all the fertilizer data and aggregate it to the state scale. Then the expenditure data is basically just how much of that was sold in the counties in the state divided by the whole state. Then we just take the statewide bucket of the fertilizer data and multiply it by that fraction to say that 2/3 of it was sold in the counties that are in the watershed or partially in the watershed, and 1/3 wasn't. So, in both cases, we aggregate it up to the state or counties within the state. We don't actually use the individual county level data for everything.

James Martin: I think it's important to recognize that what the Ag Census is asking for is not fertilizer expenditures. It is soil amendment expenditure. So, think about differences in soils. If you have regions of your state that have much more acidic soils, they are going to end up getting more lime. That's an expenditure that shows up in that report. So, we may be skewing how we distribute fertilizer to the county scale, which is why I think we should set up some allowable tolerance around the county scale fertilizer sales data. Obviously, I don't expect if we use the Ag Census expenditures as the method to distribute it, that it is going to end up exactly right and a perfect match, but I don't know what the variance allowance should be. Maybe it's outside of 20% or 25%. I am just throwing out a gut number.

Robert Sabo (in chat): NuGIS does a county level interpolation from cropland centers, so they can retain the county sales info.

Andrew Leight (in chat): I wonder if county-scale sales data is even more prone to the issue of application outside of county of sales, than at the state level

Jess Rigelman: We don't ever use that county scale stuff at the county level. I get what you are saying as far as expenditure, but it's the model and our crop application goal that determines how it gets to individual counties. So, the expenditure data is just what portion of it is in the watershed and what portion of it is out of the watershed. It's never county scale data. The way fertilizer gets to counties is wholly dependent on our fertilizer spread, which is based on crop need yields and application or nutrient management and those curves.

James Martin: Ok, I gotcha. So, the expenditure data is only for in the Bay/out of the Bay determination and then the crops and crop need are what drive the actual distribution from the state bucket out to the counties. That makes more sense, but it is still an opportunity to run a check. We do have that fertilizer sales data at the county, so I think it's a good check for us to run, since we've got the more spatially explicit data.

Jess Rigelman: Ok.

Andrew Leight: I am new to all of this discussion, so I don't have a great handle on this, but my understanding is that the sales data is based on point of sale. So, I suspect many of the companies that are selling fertilizer are not evenly distributed across our counties. So, I'm wondering if that would then create some bias. It would be interesting to look at, that's all I'm saying.

Robert Sabo (in chat): Does soil test P soil levels influence crop need based allocations across a state?

Jess Rigelman: We don't take soil P levels into account in applying the fertilizer. It may somehow be baked into the application rates that were provided, but that's another thing. Soil phosphorous

effects loads in that the phosphorous is determined to be at a certain level 25 years in the future, based on current management actions. So, soil P is not used directly in application of fertilizer or manure, but it is factored into the load calculation.

Robert Sabo: For nitrogen, I am extremely comfortable with the overall methodology but, for phosphorous, it might be just a different story. The soil phosphorous test levels would likely highly influence a farmer's phosphorous application rates. So, we're kind of averaging out the potential deviations in NUE across the state of Virginia or state of Maryland where you have particular hot spots of high soil test P. But, in other parts of the states, they need to apply a lot more phosphorous because they don't have those legacy phosphorus pools. So, I don't think there's a particular action item. That's just something I want to point out. Maybe we can reflect on if there's any solutions to try to account for that.

Joseph Delesantro: I was just going to say it's an interesting idea. That's something I will personally be giving some thought, but we are limited in terms of the coverage we have of the soil P test data. So, incorporating something like that, since we don't have perfect representation of it, it would perhaps require a whole other set of interpolations, extrapolation, projections, etc.

Robert Sabo (in chat): Yes, its a big challenge for PHASE 8

James Martin (in chat): Denise, do you know if the state has data on the location of the points of sale for the fertilizer? Wondering if we can look to reduce that potential county sales bias.

Denise Uzupis: I was wondering what James means by location?

James Martin: We were just talking about using that county's sales data as a potential check when we re-spread this state fertilizer buckets across our counties. Somebody raised the point that I do think is real that it is not uncommon for fertilizer to be sold in county A and spread in the surrounding counties B, C, and D. So, if we knew where those locations were, we could make some assumptions about reasonable commute, reasonable transport distances, that kind of thing, and say, ok, we need to lump all the sales in this kind of area if we had the actual point locations where major fertilizer sales hubs exist.

Denise Uzupis: Unfortunately, that's been a point of contention for a while. The sales data is just what is being sold in that county. We have no way of tracking where that fertilizer actually goes and, of course, we don't know if it's even been applied and where it may have been applied. So, it could have been bought in Bradford County, but maybe it went across the line into the next county. So, unfortunately, that is a limitation of our data sets. So, we can only report where the sales occurred, and that's it, unfortunately.

James Martin: And only with county level precision?

Denis Uzupis: Correct, yes.

Robert Sabo (in chat): NuGIS, IDs the cropland center within a county and then interpolates the sales tonnage across the counties. NuGIS could be a rough check.

Tom Butler: That's helpful. Robert has mentioned NuGIS operates kind of in a way to deal with that transfer distance in that they use a geographic center in the county of cropland. So, that could potentially be something that could be looked at as a check. Again, they do things differently than we have. We have talked with them in the past, though, and discussed their methods, so that is certainly something that is different. Ours is just crop need. Theirs is off of that geographic center in the county. Thank you, Robert. That is a useful comment there. I don't think we have any other people working on the fertilizer data themselves on this call. So, I don't know if there might be a difference. I suspect it would be similar to the instances Pennsylvania has where it's maybe a privacy thing where they don't know the point of sales. I don't know if anyone here could speak to that who has been in contact with their state fertilizer personnel. But, I think it's similar.

Denis Uzupis: Tom, for us, we have semi annual tonnage reporting. So, we actually get our sales data from the guarantors, so whoever's guaranteeing that product. They fill out a form, and that form and they have to state how many tons per county they have distributed. So, it's fairly limited. It doesn't provide them that option, and some of that's because of the system that we use. I think a lot of states use PA plants or USA plants. That data is limited to that. I don't know if that's helpful.
Tom Butler: I think so, because I don't know of at least one other jurisdiction in our watershed who uses that. So, that's helpful. Ken?
Ken Staver: My only comment is, for what we're trying to deal with and the timeline and everything, if we try and start burrowing down to these fine scales, I think we just have to be careful. Certainly, if somebody in a state wants to check something out and say, hey, this doesn't look right, and I want to look at it like this, that's fine. But, as a group, it seems like we have a huge expanse and huge datasets and all this stuff to deal with. I feel like if the burrowing down is going to be done, and I've said this a bunch of times, we just have to get the states to go get nutrient management plans and look at what the farmers are actually doing. Even all the point of sales, whatever you do, it's all proxy data for what's actually going in fields in the county. So, just go to the source and look there if you are going to do extra fine scale effort. So, that's my only thought. I'm just kind of shuddering thinking about trying to decide about point of sales within a county, within the whole watershed of the Bay.
Tom Butler: I hear that point and definitely appreciate it. Jess, your hand is up.
Jess Rigelman: I wasn't super involved in the fertilizer discussions for the beginning of Phase 6, but I do believe that county scale data was looked into and even state scale data was looked into, but it was dismissed because of this whole point of sale thing, which is why this watershed wide bucket was done. So, I'm not disagreeing that we should or shouldn't use state buckets now for Phase 7, but I think county scale might be a bridge too far. I think that we can certainly look into it for points of comparison. I guess I am agreeing with what Ken said, based on past attempts to use this data.
Tom Butler: I think it's always important to stay grounded in that we know we have our timeline, and we know what we have now and the level of effort that might require. So, I would definitely encourage jurisdictions to look at that if they had the ability and the time. We could definitely discuss that in our main meetings here but, perhaps people are right in that we want to focus more on some of these bigger things, like the testing that we've talked about today and coming back with some projection methods so we could make decisions on stuff like that. I think that is definitely a valuable direction. I just want to gauge if people are on board with that. If you are quiet, I will just assume you are, and we will keep running around until someone says something contrary. So, I think we have kind of a plan for at least three scenarios to test: state trends for non-reporting, crop need trends for non-reporting, and then varying or getting an average of the last three years trend, and 3-5 years for non-reporting. So, I think that gives us kind of a plan to at least move forward. That, I think, Joseph has indicated he's willing wo work with Robert on some of these things and that we'll focus a little bit more on some of the processing rather than the raw data. Although, if we can find things from national scale, we definitely want to try and use those as checks. That's kind of our main summary from the takeaways that I have for today. If there's anything people would like to add to that, I would certainly be open to hearing that now.
Robert Sabo: Tom, even if we don't operationalize these alternative data sources, I think maybe just a rough summary table could be helpful for this group and for the partnership in general about what the directions of fertilizer consumption are, like which way are they pointing? Are they going up? Are they going down? Are they remaining stable through time? There's a variety of data sources. Just to give everyone confidence. I am an advocate for what's been proposed

today. I am very excited. You guys have set up a good model maybe for the National Nutrient Inventory, but I just think having some additional lines of evidence to put everyone at ease that this generally pointing to what reality truly is.

Tom Butler: We will definitely work with you, Robert, on this, given your exposure nationally, and I am sure you have access to a lot of these things. So, we will look forward to that.

Robert Sabo: Well, I appreciate you guys coming up with this and working directly with the states. It is a fantastic model going forward. So, hopefully we can get other states that could get on board and do it too.

Tom Butler: Well, I like to think we've got the best partners. Everyone's efforts are certainly appreciated on this one.

Robert Sabo: Tom, one more thing. I had mentioned this earlier about QAQC. What's nice about not working directly through AAPFCO, like getting directly from the states, is that the states have more control of the quality assurance and control. So, if there is something you want to revisit with this state level time series, a state can go back and just double check their numbers. It could just take one or two county sales data to throw things off by 20-30% for the state level total because a distributor miscalculated in tons of ammonia when there should have been tons of nitrogen, and they got taxed too much. Also, that mass of nitrogen and phosphorous is now too high for the state level total. So, what's nice about this approach you all have developed is that it allows states to go back. If a state had this 200% increase in nitrogen fertilizer, you can say is that right? Is that true? Let me call the distributor really quick and see if the numbers converted correctly. So, I just want to emphasize you guys have much more control of QAQC now, too, in terms of state level fertilizer data you are providing to the Bay Program.

Elizabeth Hoffman (in chat): To that point, Robert. Don't need to speak to this and maybe not important as we've decided this is the best available source of data but -- is there any sense of varying response rates across years and states? AAPFCO is not regulatory, as seen by states not always reporting, and is done in good faith. We don't get the sense they did the same QAQC. don't need to speak to that, Tom. Just registering the question.

Ken Staver: Somebody's looked at this state data and said pounds of ammonia, pounds of urea, this is all getting converted. I don't want to insult anybody by asking a question that seems like they wouldn't possibly be doing that. I think Mark Dubin hinted around a couple of times that, in fact, maybe they were doing that in some cases where we have these blends and we change from one form to another. Are we confident that is getting done? The changes in forms that people use are changing for farmers. Farmers around here are using more urea than they have in a long time because it's cheaper. Do we know that's all handled in a sensible way?

Robert Sabo: Sometimes little tabular calculations get messed up but, yeah, we can go back and fix it. So, if there's a mistake, it needs to be corrected. Also, it could be the distributor misreported as well, not even necessarily state level personnel, like a distributor who is reporting their tonnage sales to the state also might have miscalculated something as well. So, it could be multiple lines where the miscalculation/misreporting occurred. But, what's nice is that we have more control. It's not going to be that this is AAPFCO, and we have to go back through AAPFCO. You can go back to the states and double check calculations if you feel like you need to.

Tom Butler: I appreciate those comments there. I think we've gotten feedback that we are reliably using nitrogen pounds and that that's being translated correctly. Definitely, if there are those concerns, we can see that, and hopefully people can address them.

Ken Staver: I assumed that was the case but thank you for the confirmation. Somebody that seems to know says don't worry about that. So, good, happy to hear it.

Tom Butler: Thank you, everyone, for your time. I appreciate it. We will work on some of these things for November. We are scheduled for the 14th, and we are planning on that and holding to it.

III. Wrap-Up

Lead: Tom Butler, EPA

IV. Adjourn

Next Meeting:

AMT Meeting: Friday, November 14th, 2025, from 08:00 - 11:00 am.

Attendees:

Tom Butler, EPA
Caroline Kleis, CRC
Anne Coates, TJSWCD
Krista Crone, PA DEP
Tim Larson, VA DCR
Andrew Leight, MDA
Tyler Trostle, PA DEP
James Martin, VA DCR
George Doumit, DNREC
Nicholas Moody, VA DCR
Jess Rigelman, J7 Consulting/CBPO
Joseph Delesantro, EPA
Emily Dekar, USC
Denise Uzupis, PDA
Chris Brosch, DDA
Elizabeth Hoffman, MDA
Joseph Schell, DNREC
Auston Smith, EPA
Ashley Hullinger, PA DEP
Hunter Landis, VA DCR
Jennifer Nelson, AAC Coordinator
Cassie Davis, NYSDEC
Clint Gill, DDA
Robert Sabo, EPA
Seth Mullins, VA DCR
Ken Staver, UMD Wye
Scott Heidel, PA DEP
Clint Gill, DDA