Agricultural Modeling Team (AMT) Meeting

April 14th, 2023
09:00 AM – 11:00 AM
Meeting Materials

Decision:

- The AMT approved the March meeting minutes.
- The AMT informally agreed to remove timing and eligibility requirements for subsequent CAST testing runs.

Action:

Tom Butler will work to provide:

1. Documentation for the yield goal calculation used by the CBPO.
2. A graphical depiction of the different data sets before and after data processing for the yield goal calculation.
3. For specialty crop low and high percentage of
    a. Load contributed relative to the overall watershed loads.
    b. Land covered over the watershed.
4. A visualization across the entire watershed of where fertilizer shifts.
5. Any analyses or perspectives on which topics may have more weight in terms of importance to CAST.
6. A background presentation discussing the groups next focus topic, Re-evaluating Land Uses.

Meeting Minutes

Announcements:

- Fertilizer Expert Group meeting Monday April 3rd. Discussion of Phase 6 inorganic fertilizer data sets.
    - Tentative recommendations here.

Introduction – 09:00-09:10 [10 min (Tom Butler, EPA)]

Recap of previous CAST discussions.

Scenario Discussions: Crop Nutrient Application 09:20-10:55 [95min (20 min presentation 75 min discussion) (Tom Butler, EPA)]

We will discuss and reevaluate Crop Nutrient Applications. Today's item will consist of a brief informational presentation on several scenarios altering the timing and eligibility of manure applications to crops. These scenarios include:

1. Making all manure eligible crops on manure eligible land uses 100% eligible for manure applications and remove the timing component to create a single annual average application.
2. Making all grains and silage land uses eligible to receive manure applications

The group will follow this up with a discussion about whether to change how applications occur.

Discussion:

- Alex Soroka asks where he can read more about the documentation for Crop Yield Goals?
    - Tom Butler says he will get this and circulate it to the entire group.
- Ken Staver wants to see a graph of the raw data and a comparison to the data after is it processed for both the annual surveys as well as the ag census. He would like to see the yield that we end up using and see what this process does. He also asks if this process is mostly used for the smaller crops or the larger ones such as corn?
    - Tom Butler says that this is mainly for the smaller volume crops which we lack data on. We get roughly 80% of our data on the larger crops such as Corn and these have a good data record. The intent is to smooth the data and fill in gaps in the datasets.
- Lisa Duriancik says it would be good to see the data before and after for different crops. She was wondering what scenario builder max yields looked like. Using max from literature values and UDSA values would likely skew the data. If its less significant crops its not a big deal but she would like to see the impacts.
    - Tom Butler will get specific graphic examples of this as well as documentation.
- CHAT
    - Alisha Mulkey and Alex Soroka would like to see specific examples of these calculations for various crop types as well.
- Chris Brosch clarifies that the yield goals manipulations on USDA yields are for ag census or annual surveys.
    - Tom Butler says that it happens after the combination of the annual surveys and ag census data.
    - Chris Brosch asks if we are pulling five crops from annual surveys and over one hundred from the ag census?
        - Tom Butler says yes.
- Chris Brosch would like to see a depiction of the calculations since he doubts if there will be many outliers.
- CHAT
    - Dave Montali: Is there any way to simplify by grouping nonsignificant crops?
    - Tom Butler says he thinks there should be. He suggests that if we wanted to create some test groups for nonsignificant crops, he can reach out offline.
    - Dave Montali thinks we should decide what crop types to use in the model. Is there a way to do this assessment for 10 things vs 100? Maybe we need to combine crops and make assumptions but that this is an important question to ask.
        - Tom Butler says there are probably several ways to do this. He suggests that the land use topic is going to directly address that.
        - Ken Staver says that we combine several crops into groups now.
        - Dave Montali asks if we can make simplified assumptions for specialty high and low crop groups?
        - Tom Butler says that for yield goals the groupings it might be different. He clarifies that we would be aggregating them for the yields goals?

        - Dave Montali says that we should simplify wherever we can. Perhaps we can make a single yield goal that is unchanging for a large grouping of crops.
- CHAT
    - Chris Brosch states: I agree with Dave, we should roll around that idea of combining smaller acreage crops into a yield/management group, but we will always wrestle with nay sayers that the model "can't simulate what I am doing on my 40."
- Dave Montali says that this can be done since in the real world no one is reporting what happens at high detail so this combination is already taking place in terms of the averages used in the model.
    - Ken Staver adds that folks who grow vegetables need NM plans. At that level someone is approving nutrient inputs and yield goals they're based on. its not like the info isn't available. The question is if in the watershed level its accurate to lump things together on a large scale. He says its hard to mix a lot of vegetables that are different from each other.
        - Tom Butler asks if we suspected there would be large differences and we need to get to the watershed scale can we get the data for each of these crops across the entire scale necessary? He probes other states if this information is available?
- CHAT
    - Alisha Mulkey Yes there are LGU recs for specialty crops. I'm sure its not the whole list in Census.
        - Ken Staver wonders what role the smaller categories play?
        - Chris Brosch adds this has been what Dave Montali has been getting at. What is the sensitivity of these smaller crops to the entire watershed? Can we see what impact these crop groups have?
        - Ken Staver says those land uses have a specific load it should be easy to see what the load is.
        - Chris Brosch says that only the land uses have a load not specific crops and the crops are aggregated.
        - Ken thinks the land use loads are aggregated but wants to see what percentage these crops contribute as aggregated land uses. Ken Staver says we need to see an answer to that.
            - Tom Butler will work with this and get the information out of the model.
- Ken Staver asks if the only two land uses that are manure eligible where crops are not is the two specialty groups, high and low?
    - Tom Butler says that is pointing us where we want to go.
- Ken Staver is asking if Tom is talking about the county level?
    - Tom Butler says that this is referring to crops and so you would end up at a county scale.
    - Ken Staver asks if for the manure eligibility we are talking about the county?
        - Tom Butler says that the manure is at the county scale but the fertilizer is at the watershed wide scale.

        - Chris Brosch says since the manure eligibility of land uses is at the watershed scale it would be useful to split this up and see specific examples. If they are crop eligible that is a statewide rule. The actual percentage is dependent on the county scale.
- Ken Staver asks if manure comes out month by month in terms of availability?
    - Tom Butler says CAST operates on an annual average. So even if you put in timing it is averaged very quickly and becomes a single value. This is not to be confused with the timing that a BMP can impart, that timing is still something that can be counted.
    - Ken Staver questions why the amount available doesn't go down prior to planting when there is a pre plant application? Why wouldn't you do applications before planting?
        - Tom Butler says that we are given the timing and it artificially forces you to apply manure or fertilizer at different times. You cannot take this away form the need later since we are often linking N and P together. So you can apply N and hit your real world P need but the model will still ask for a P application.
    - Ken Staver asks other states where there are any row crops that need to have these split manure applications after planting? Ken adds that we consistently have higher P where we use manure to meet N requirements.
        - Mark Dubin answers Ken, there are acreages where manure applications happen after planting. That does happen just not everywhere.
        - Olivia Devereux says that in the model since manure is applied first you meet crop need and then have specifications for additional fertilizer to be applied. That also needs to get applied even if manure meets all crop nutrient needs. By specifying timings you remove models ability to balance nutrients applied by over specifying these parameters. There is a real world which is more closely simulated with BMPs in the model. In the current version this timing component creates an overapplication of nutrients compared to what is likely happening in real life.
        - Alex Soroka clarifies that we need these timings in order to apply the full bucket?
            - Olivia Devereux says this is incorrect. The timings are in place to attempt to match real world applications. This ends up putting down more nutrients then are likely happening in real life. She specifies that the loads coming off the land are an average annual amount so this timing doesn't change the details of what is coming out of the model.
            - Ken Staver asks Olivia if the manure and fertilizer are constrained by the animal populations and watershed wide bucket? He doesn't see how timing affects the fill amounts applied.
            - Olivia says it is constrained by animal populations but NOT the fertilizer bucket.
            - Ken Staver asks if watershed wide the fertilizer is constrained?
        - Jessica Rigelman says that in a county you have a certain amount of manure and biosolids that are applied regardless. If you have 25% of

corn need that is only manure eligible and 75% of need that is only fertilizer eligible that is what you would apply. If you have more manure then the 25% of need then it will go on the manure application. That means that 75% of crop need is NOT met even though you overapply the manure. That can lead to large overapplications of manure since you must put it down and then an application later of fertilizer. This leads to timing having a potential excess application in some situations.

- Dave Montali asks if in the real world if a producer has enough manure to meet crop needs is there a real world need to add fertilizer after the first planting? Does that really happen?
- Chris Brosch says yes. The issue is that few people want to manage that way since its wasteful. That scenario might be important since it was likely big in 1985 but this is not how it is done anymore. This leads to a huge waste in P and that P has a value off the farm.
- Dave Montali says that they would use inorganic N as a sidedress often?
- Chris Brosch says yes to balance the crop need with the nutrient supply.
- Ken Staver says that they didn't apply whole crop need. Chris' scenario is half application then side dressing.
- Gary Shenk clarifies that Chris meant that in 1985 its likely a producer would apply all the manure they had pre plant and that currently they are selling it so it moves all over the county. The model assumes manure moves freely around the county and has since 1985. We are not seeing a behavioral change where a producer used to use all the manure they had and that now it moves across the county. Is this correct?
- Chris Brosch says yes. That is why it is difficult to talk about farmer decisions at a county scale.
- Gary Shenk says this is a factor that can change loads. He isn't sure how to deal with that and thanks Chris for bringing it up.
- Chris Brosch says it was probably common before 1985 since NM wasn't widely used.
- Gary Shenk says that we are deciding about big tweaks or little tweaks. If we are thinking about little tweaks we can show an actual application at a county where this timing is driving large manure applications relative to crop need.
- Chris Brosch agrees and says that there are only 12 or so counties that approach and exceed 1x on those acres. More often then not counties are at a nutrient deficit.
    - Gary Shenk says that this timing issue is the only thing causing this right?
    - Chris Brosch isn't sure if turning off the timing will put all the counties over 1x application under 1x. you still need BMPs to move manure. You might take it from 12 to 3.
    - Gary Shenk says that its more in a county where the application is under 1x has applications over 1x since applications don't allow manure.
    - Curtis Dell says that timing has a reality for N since adding N to meet crop need with pre plant manure will cause a lot of loss

leading ot side dress applications mid-season that supplement the N but that leads to increased P applications as well.
    - Mark Dubin says that perspectives are different across the watershed and that there are differences. Liquid manure isn't moved compared to solid and that there isn't necessarily a management style that uses all the manure generated. This is likely becoming less and less since smaller operations are going out of business. That condition does still exist though even if it is at a lower percentage then in the past.
- Dave Montali says that there are t many graphs to understand and asks for clarification. It jumps out to him that there is an increase in N fertilizer which doesn't make sense.
    - Chris Brosch says that he sees an overall increase in manure consumption by grain with manure. That allows manure that exists to not be spread on full season soybeans so the fertilizer fills the crop need differently. This applied a smaller amount of fertilizer. For pasture as well we can see a reduced manure application in terms of disposal. The balance is that the excess nutrients are from the right source, fertilizer, and it goes on acres that is like crop need.
    - Dave Montali asks if a excess manure county should have sexcess manure on pasture.
    - Chris Brosch says that in the county shown there isn't excess manure, its excess fertilizer.
    - Dave Montali says that excess manure from poultry send them over in WV.
    - Tom Butler says that by removing timing you might allow the model to perform in a way that is more consistent with the real world.
- Chris Brosch adds that CAST 21 made DE anxious in that it has a timeline running through 2012. These graphs show that 2012 behaved differently from subsequent years. There was a shift in DE since 2012 in the way nutrients were distributed in an unexpected way. It didn't seem to be working right. This shows a shift in lower application to land uses that reach a disposal application and that is critical. Neither scenario shows what probably happens on the average acre but the disposal to land uses must be dealt with more accurately. He thinks we need to spread nutrients out more thinly rather.
- CHAT
    - Cassandra Davis: Tom, it would be helpful if you included where we are in the model documentation. It is difficult to follow along.
    - Tom Butler: Cassie we are in section 3.3 of the documentation https://cast-content.chesapeakebay.net/documents/P6ModelDocumentation%2F3TerrestrialInputs.pdf
- Chris Brosch asks if all the data are from CAST 21?
    - Tom Butler says yes.
- CHAT
    - Alisha Mulkey: It makes sense. I agree with trends, the rate and source in NT column look more appropriate to MD
- CHAT
    - Lisa Duriancik-NRCS: Just seems odd that pasture is not receiving manure in the NT scenario?

- Chris Brosch agrees and thinks its an issue of logic and sequence. Manure must be spread prior to manure. So if all the acres of a county have a prescribed need and manure goes out to grain crops the grains soak it all up. The fertilizer then makes up the difference. In all counties you reach excess once fertilizer enters the equation. So you would never get manure in the disposal since manure is spread first sequentially.
- Dave Montali thinks this conversation showed a manure excess county to display the differences. In the past he has seen counties that have so much manure from chickens and low crop land so they get excesses from manure.
    - Chris Brosch shows that manure enters equation in disposal for full season soybeans in the current scenario. Due to the sequential logic spreading we lose the manure signature for loads until 2015 when the manure load is so high that we get manure in a disposal phase. The sequence of nutrient spread makes the source of disposal N is improved when timing is removed and reduces the disposal amount across disposal land uses.
- CHAT
    - Alisha Mulkey: But that's collected manure, correct? Not direct deposition.
    - Jessica Rigelman : Yes, not direct deposit
    - Lisa Duriancik-NRCS So do you adjust the fertilizer application to reduce it for direct application?
    - Alisha Mulkey: Lisa, direct deposition does not count toward crop N need. And we set crop need for pasture at 15 lbs N based on largely under managed pasture in many states. Should be revisited for P7.

- Dave Montali asks if the only N form fertilizer for legumes is the inorganic product applied for P ahs N with it?
    - Jessica Rigelman says they are not coupled
    - Chris Brosch says they are only coupled, N and P when it comes to manure. So the manure applied for N contributes P but the fertilizer applied for N does not.
    - Dave Montali says he recalls there should not be inorganic N on soybeans.
    - Ken Staver says that is remembering correctly. Some N comes when you put inorganic P with any fertilizer. The numbers shown look correct in demonstrating this.
- Mark Dubin says that if you are not following a NM plan anything is a go but that these numbers look indicative of core N NM.
- CHAT
    - Jessica Rigelman says that in the model inorganic N and P are not coupled in the model.
- Kate Bresaw asks about collected vs non collected manure. She understands that the quantity of manure is based on the animal population s in the county or the amount of manure transported. Is uncollected manure not a part of this discussion?
    - Tom Butler says it is bound by the animal numbers. We then go through several categories and direct deposition goes onto pasture. This does not go towards crop need. This deposition cant be stored and used later, the only manure we can apply are collected from confined areas. We then put stored manure through losses via BMPs and loss terms until we get to an amount that can be applied.
    - Kate Bresaw asks how the amount of direct deposited manure is calculated?

    - Tom Butler says that states directly supply these timing elements and locations.
    - Mark Dubin says that the direct deposit makes an indirect influence in the crop need applications. We did not used to have direct deposits in the past but if we did the pasture would have a higher rate then what we have now.
    - Alisha Mulkey says that the states must define by animal type and month the location of animals. Those are state specific animal specific and monthly. They help generate the amounts of manure in each of these buckets.
    - Dave Montali agrees.
    - Alisha Mulkey says we can revisit these but they were done based off what was reasonable at the time.
    - Tom Butler pulls up an example sheet in page 12 of section three of the documentation.
- CHAT
    - Jessica Rigelman: The CAST detailed animal source data have the numbers Alishia I referring to - https://cast.chesapeakebay.net/Home/SourceData
    - Cassandra Davis: I'm also interested in more information on the timing of manure applications in the model.
- Tom Butler suggests that we move forward with some type of direction moving forward and that if no agreement is made, we stay with Phase 6. He suggests that we run a specific version of CAST where we make a change and run different scenarios.
- Ken Staver asks where fall manure applications fall in with the timing approach?
- Tom Butler asks if he means in terms of the days after planting.
- Ken Staver asks where it could fall in general. For example in dairy operations do they apply fall nutrients? There should be fall manure applications that impact cover crop discussions. Does any of this manure get applied in the fall?
- Jess Rigelman says that its solely defined by when the plant date is and the number of days after planting. If an application can get manure then it is possible to spread manure on all applications. We do not go through the year we spread all applications based on the curves at the same time based on eligibility.
    - Ken Staver needs to defer to someone who knows dairy country but that we should get the timing as close to crop need as much as possible. He wasn't aware of storage for 365 days. Dairy's often seem to apply in the fall. Its part of the cover crop and green forage systems in the fall to take up fall applied nutrients. Ken takes away that Jess said no.
    - Jess Rigelman says the answer is yes. If it is a fall crop that can received manure then it will get manure it is based on the days after planting. It is 100% defined by the days after or prior to planting.
    - Ken Staver says this must have been an AgWG discussion since he discussed if winter cereals were cover crops or crops. He is asking if there is a winter cereal plant date that gets manure application. He is curious about how that is handled.
    - Mark Dubin says that for liquid manure storages they empty these in the fall to prevent overfilling. The model ties this into the cropping system so fall applications to fields are represented as applications and can be shown as a fall cropping system.
    - Chris Brosch says that this is still an oversimplification that works well. For spring or fall there is a relative sequence that hides how nutrients in the

sequence are split. They can be split by crop type by county. For a fall forage the -30 days could be 100% of N and P. other applications could be 0%. This can be played with in the same way that we see animals spending time in different places. That specificity applied for each of the timings.

- Tom Butler asks if anyone has the experience in dairy on how these fall nutrients are applied in the real world?
- Tad Williams works with small diaries in VA. The usual process is that diary's apply fall prior to planting a small grain in the fall and can come back with additional winter application to the small grain. It varies by operation. Larger dairies would do spring and fall applications. They can do an application after corps emerge it depends on when they get the crop planted and the storage available.
- Kate Bresaw asks if incorporating timing is adding anything or does it complicate things? It seems to not help the model much.

- CHAT
    - Tamie Veith: Won't they still do a fall clean out if they don't have a cover crop planned if they have enough crop residue?
    - Kate Bresaw: good thought
    - Kate Bresaw answers that often they will do a fall cleanout if they have crop residue.
    - Tad Williams says there are exceptions if they have storage issues they will spread to fields that are fallow but would still have crop residue.
    - Kate Bresaw says that they don't inhibit winter spreading in PA.
    - Mark Dubin says that there needed to be residue for winter applications
        - Kate Bresaw says yes.
    - Mark Dubin says these applications would not be well represented.
- Chris Brosch agrees and has struggled with this. He comes back to application timing being sold to farmers as a BMP. If we need to model a non-BMP and a BMP condition to assign credit for these practices it's a tough thing to model. Turing off specificity in the model seems more like a non-BMP condition which we should be simulating. Then again, we have three timing events that we could program and no one in history has had the timing vary through simulation period over time which has probably changed greatly. the outcomes of today's scenarios are more appropriate for real life then what the previous version shows.
- Mark Dubin says that when the timing BMP aspect of NM is shown that can represent timing and effects the edge of stream losses, so we still have an ability to represent this here. He says that when we apply everything at once time pre plant it caused losses. It is good to look at this simplification since were making more generalized educated guesses. He suggests that we might see issues in the future if we do this.
- Dave Montali says that regardless of when we put things down we have an annual load and an efficiency BMP for timing that reduces loads by X%. Back to Chris's comment there is a creditable thing that isn't dependent on the month in the model that manure is put down. Is that correct?
- Mark Dubin says that correct.
- Dave Montali says that he's for simplification and that a new algorithm for putting down manure doesn't matter for water quality purposes.

- Ken staver says you mean water quality purposes in the model right?
    - Dave Montali says yes.
- Ken Staver says we want to get the model to give us a real result but for an agricultural production system when it comes to nutrient loses and ways to reduce things we have to break it down to the management level. Ken Staver says we want to point to the model in such a way as to foster giving credit to producers.
- Dave Montali says that the existing system gives them credit, with a timing BMP.
- Ken Staver asks if there is a way to give us more credit. He asks what we can do to make the system lose less N and get the credit they deserve. He asks how much dairy manure is applied in the spring vs the fall in the model and what is it applied to? We need to translate this down to the field and how it is representing what we are actually doing and thinks we don't have a good feel for this.
- CHAT
    - Jessica Rigelman: Crop timing data is here under detailed crop data - https://cast.chesapeakebay.net/Home/SourceData
    - Cassandra Davis: Thanks, Jess, this is what I was missing
- Mark Dubin examined the NM timing BMP, and it has a 5-1-% edge of stream reduction value. This was likely in light of the timing issue that was being addressed for the timing of applications so we might want to revisit the BMP efficiency if we simplify the timing.
- Chris Brosch shares his screen to help navigate to the link Jess gave. He went to the crop nutrient application timing and shows three crops, Full season soybeans, Double cropped soybeans, corn for grain with and without manure. On both soybean types 100% of nutrient need is applied on day 0. There is no timing fraction. It all goes on the day it is planted. It is manure eligible. The corn for grain has 2 timings 20 before and 40 after. After planting 75% of total crop need is only fertilizer eligible. Grain with manure in DE has 25% of need manure eligible. This is important since it is not a good representation of what's going on in the world.
- Ken Staver says its not the timing that's wrong it's the eligibility of manure N applications.
- Chris Brosch asks if its better to turn off timing or drill down into the timing of each and look at the fractions provided for each of the crops? He thinks it is unnecessary to have the timing and that we are better off without it.
- Alisha Mulkey adds that these values are state, county and crop specific, but that they tried to make consistency across states when these were mad ethe last time. The rules should be consistent when looking at this sheet. She agrees that turning this off would help.
- CHAT
    - Lisa Duriancik-NRCS: There are other aspects of managing nutrients that are not really represented well in this model (if you are talking what happens in the 'real world'), including the nutrient buckets and application based on N. This is not a process-based model, and there are other process-based models better suited to helping understand implications of management options, correct? Will tweaking timing help significantly address things or are there bigger issues that have more weight on outcomes?
    - Olivia Devereux: Lisa, excellent point. Removing timing is more consistent with the rest of the model assumptions and parameterization. CAST is not and was never intended to serve as a process based model. The 4 Rs including nutrient

application timing is already modeled as a percent reduction in the annual average load.
    - Tamie Veith: Olivia and Lisa, these are important points to document for users I think so that they understand that these items were considered appropriately at the scale level of the model.
- Tom Butler seeks a recommendation for the test version of CAST in terms of implementing no timing. He outlines that we are not making a formal decision but that we are making a test version of CAST only for the AMT and that we will test many ideas in it. He asks if the group has any issues moving forward without using a formal timing scheme for nutrient applications?
- Dave Montali thinks that is a good thing to do. Seeing how it works everywhere would be good to see. Dave would like to see where the fertilizer goes.
    - Tom Butler will talk offline to get this visualization right.
- CHAT
    - Lisa Duriancik: Just to capture one thought while it is fresh, is there some kind of sensitivity analysis that has been done to evaluate how much each of these different factors really affects loads so that we can better understand relative importance of some of these different factors coming before this group? E.g., yield goal, nutrient application timing, N-based application assumptions...? Thank you.
    - Chris Brosch: Looking at Lanc, PA, it's better for corn. 80% 15d prior is manure eligible. then 10% @ 0d and 10% @ 45d - fert only. This helps explain why Lanc has less timing effect in the comparison.
    - Tamie Veith: It sounds like the impacts of the timing are currently incorporated in the" remove timing" version.
    - Scott Heidel: Can we be more mindful of the timing of the meeting. I must leave again while conversations are ongoing
    - Lisa Duriancik-NRCS: Yes. understood. Maybe Gary and Olivia have a good sense, if there is not an analysis, of which ones have more weight? That would be a good place to start next time perhaps.
- Lisa Duriancik says that topics were prioritized based on expert opinion and evaluated as if they were independent. She thinks this is not the case and asks if there has been any analysis to weight the impact of the factors this group is being asked to consider. For example, we have looked at timing. But wonders if yield goal is more importation to the overall model process. She wonders how we can look at the most impactful topics over others.
- Chris Brosch says that he agrees and says that many people won't know what the differences one change will make over another. Chris thought this was a higher priority since it was wrong but isn't sure if it will impact the loads. He takes the questions seriously and says that the model should be fairer an accurate.
- Tom Butler doesn't think we have this analysis but wants to ensure the group is ok moving forward with no timing in future CAST testing.

MEETING ADJOURNS

Attendees:

Kate Bresaw, PA DEP

Zach Easton VT

Tad Williams Virginia Tech

Jeff Sweeney, EPA

Olivia Devereux, Devereux Consulting

Scott Heidel PA DEP

Becky Barlow, DCR

Dave Montali, Tetra Tech, WV

Gary Shenk USGS@CBPO

Karl Blankenship, Bay Journal

Alisha Mulkey, MD Dept. Ag

Curt Dell, USDA-ARS, University Park, PA

Jessica Rigelman, J7 Consulting, contractor to the CBP

Ruth Cassilly, UMD CBP

Cassie Davis, NYS DEC

Alex Soroka, USGS

Tamie Veith, USDA-ARS

Elizabeth Hoffman, MDA

Clint Gill, DDA

Hunter Landis, VA DCR

Mark Dubin, UME/CBPO

Tom Butler, EPA-CBPO

Clare Gooch, DE

Chris Brosch, DE

Lisa Duriancik, NRCS

Ken Staver, UMD

Patrick Thompson Energy Works Inc.

Tim Larson, VA

Candiss Williams, NRCS