

Compilation of Comments on CAST-21 with responses

Summary of communications

Below is a summary of the communications that were held regarding the transition from the current version of CAST, CAST-19, to the next version, CAST-21. Additional communication occurred on an ad hoc basis at the request of many partners and interested parties.

- CAST-21 was released for review on October 1, 2021 with comments due November 1, 2021.
- Missing and erroneous data were identified. An announcement that there was missing data and errors was made at the Watershed Technical Workgroup ([December 2, 2021](#)) and the Water Quality Goal Implementation Team (WQGIT) meeting ([December 13, 2021](#)).
- One-on-one meetings with jurisdictional representatives on the WQGIT were held during February of 2022.
- A special webinar was scheduled with the WQGIT on [February 14, 2022](#) to address missing and erroneous data.
- The agriculture and urban fertilizer concerns were discussed at the [March 28th 2022 WQGIT meeting](#).
- The differences between the CAST-19 and CAST-21 versions were presented at the [March 10, 2022 Management Board meeting](#)
- The next version of CAST, CAST-21, was re-released [February 18, 2022](#) for review, with additional feedback requested by April 15. Note: This document includes comments provided during both periods (October – November 2021 and February – April 2022).
- Urban fertilizer data processing were discussed at the [January 18, 2022](#) and [March 15, 2022 Urban Stormwater Workgroup \(USWG\) meeting](#).

Chesapeake Bay Program Office (CBPO) staff and the CAST support team have been available for questions on an ongoing basis. Additional documents and resources about CAST-21 can be found on CAST's Model Documentation page:

<https://cast.chesapeakebay.net/Documentation/ModelDocumentation>

Note: Comments are sometimes edited for clarity, but are mostly verbatim based on emailed comments on the given dates from the referenced individual(s).

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Delaware

1. Comment-Fertilizer Data and Timing

Delaware expressed concerns regarding the use of CAST-21 as proposed. First, regarding the use of the AAPFCO non-farm fertilizer sales data for turfgrass, Delaware requested the removal of the turf fertilization revision from CAST-21 and subsequent review for future incorporation once it has been discussed further at the WQGIT. They believe that the revised application rates and the corresponding load effects are not representative of the real-on-the-ground change in the watershed. They noted that the recent presentation to the Urban Stormwater Workgroup raised new concerns among staff. For example, replacing placeholder numbers with non-farm fertilizer data in some jurisdictions and mixing data with zero placeholders on other jurisdictions is not consistent with using the best available data. They requested more time to review Delaware's raw data.

Delaware commented that the implications of the previously omitted farm fertilizer AAPFCO data from 2013-2014 in Virginia has implications for all states as a result of the CAST nutrient spread algorithm. They stated that because CAST was presumed to be working and giving reliable results without the inclusion of the 2013-2014 AAPFCO data in Virginia, including the data in CAST-21 would require partnership review on par with the full Phase 6 Watershed Model review. For this reason, Delaware suggested that this correction be deferred.

In addition, Delaware raised the concern that staff were simultaneously compiling and preparing annual BMP progress submissions and QAPP/Verification plan updates, while reviewing and preparing for the next round of milestones. These commitments make it difficult to adequately conduct the outreach needed to complete a thorough review.

Comment provided by: Jennifer Walls—DNREC on 12/1/2021

A) CBP Office Response

The Chesapeake Bay Program (CBP) partnership agreed to take several extra months to fully review the fertilizer and other data. A summary of the presentations and communications provided to the partnership is at the beginning of this document in the "Summary of Communications" section. In addition, the Agriculture Workgroup also plans to continue the discussion on fertilizer data to inform future versions of CAST.

For urban turfgrass fertilizer application rates, alternative methods were devised to lessen annual swings in AAPFCO fertilizer use data. The issue was the subject of the [January 18, 2022](#) and [March 15, 2022 Urban Stormwater Workgroup \(USWG\) meetings](#). Ultimately, USWG members did not reach a consensus, so the existing method remains in place.

For agricultural fertilizer, CAST-19 did not reflect accurate trends in fertilizer use and was corrected with CAST-21, following data sources and methods established by the CBP partnership. Fertilizer use estimations for years after 2016 changed because of incorporation of 2015 and 2016 AAPFCO data, not because of corrections to 2013 and 2014 data. Nutrient loads were under-estimated in CAST-19 because the fertilizer use was underestimated in the 2013 and 2014 data. For CAST-21, 2015, 2016 and projections are influenced primarily by the inclusion of 2015 and 2016 data. If we were to continue to omit the missing 2013 and 2014 data, estimates of historic change over time would be inaccurate. It is not scientifically justifiable, nor consistent with partnership methods, to keep an error in the new

version of CAST or to rely on 2012 fertilizer data to determine application rates through the 2023 progress year. Currently, many partners are expressing that the 2016 data is too old, and 2012 is even older.

It is understood that releasing updated versions of CAST biannually while the annual progress review is underway is difficult for staff. As such, the CBP is scheduling future releases of new CAST versions for the period after the progress submittals are finalized. This has the added benefit of allowing the most up-to-date BMP history to be used in the CAST update. This schedule was presented at the [April 25, 2022 WQGIT](#) and is posted on the [Phase 7 model development page](#).

2. Comment CAST-19 vs CAST-21

Delaware has observed the following impacts to its nutrient loads as a result of changes and assumptions between CAST-19 and CAST-21.

- Increase in nitrogen loads by 842,095 pounds.
- Increase in phosphorus loads by 57,673 pounds.
- The 2017 agriculture acres in the CBWS shows a decrease of 11,315 acres.
- 2018 full Season soybean projections from the Ag Census from 2012 to 2017 shows an increase of 98,247 acres. The implication on nutrient loads due to fixation of the increase in full season soybean acres is much higher in Delaware than other states, and the impact of the change in the model has a drastic impact on our loads. Unfortunately, there are no tools to manage these load changes when shifting between soybean cropping cycles occurs. It also raises the question of whether this issue is cyclical due to normal cropping practices or an anomaly due to other factors. The increase in loads here does not appear to be consistent with on the ground farming practices. Further analysis should be considered to address this issue. We acknowledge it is not likely an issue that can be resolved during this review process but should be considered for future versions such as CAST-23 or Phase 7.
- The increase in phosphorus load projections between versions due to turf management assumptions is also of concern and not indicative of the reality on the ground.

Delaware Agriculture Sector	CAST 19	CAST 21	Difference
TN Applied for DE CBWS in 2017	38,935,275	42,864,505	3,929,230
TP applied for DE CBWS in 2017	11,302,564	14,478,225	3,175,661
			-
Ag Acres CBWS in 2017 (CAST)	192,514	181,199	(11,315)
Land Use Correction (acres)	59,708	46,381	(13,327)
	2012 Census	2017 Census	Difference
Ag Acres - Ag Census (STATEWIDE)*	396,724	416,244	19,520
Full Season Soybeans Acres (2018)	37,738	135,985	98,247

Comment provided by: Jennifer Walls—DNREC on 12/1/2021

A) CBP Office Response

The higher agricultural loads in CAST-21 compared to CAST-19 are primarily due to increasing amounts of fertilizer use (nitrogen) in the 2015 and 2016 period. Decreasing agricultural acres would increase nutrient application rates if nutrient inputs remained the same, which they did not. For changes between the 2017 Census of Agriculture and the year 2025, the acres in agriculture are determined by the crop and pastureland from the 2013 land use change product. Inputs to the land for CAST-21 followed the direction provided by the WQGIT and its workgroups.

The soybean acres increase over time, following the Census of Agriculture trends. The CBP office suggests that full-season soybean acres be evaluated in the upcoming 2022 Census of Agriculture, annual Census surveys, and alternative data sets provided by jurisdictions and vetted for quality and consistency. Such data sets could provide support for the submitted statement, “The increase in loads here does not appear to be consistent with on the ground farming practices.” and would improve CBP estimations of agricultural management over time.

As was announced at the April 21, 2022, Agriculture Workgroup, a Phase 7 agricultural modeling group is being formed to address agricultural inputs in the Phase 7 watershed model. This group will prioritize and tackle agricultural modeling items as charged by the WQGIT and the Agriculture Workgroup. The Phase 7 model will undergo extensive reviews by the CBP partnership and the independent Scientific Technical Advisory Committee (STAC). The groups formed for the Phase 7 model and its input data are intended to provide the forum to evaluate sources of data and methodology for the models. With every version of the Watershed Model, improved agreement with the monitoring sites has occurred (<https://cast.chesapeakebay.net/documentation/NonTidalWaterQualityDashboard>). We look forward to the involvement of Delaware experts in the development of the Phase 7 model to ensure that the model reflects farming practices occurring on the ground.

Maryland

2) Comment-Communication

Maryland Department of the Environment (MDE) inquired whether there will be any official announcement in the WQGIT, Management Board, or throughout the partnership regarding the changes from CAST-19 to CAST-21, and the expectations going forward regarding nutrient load changes due to the AAPFCO issue.

Comment provided by: Gregorio Sandi—MDE on 11/16/2021

A) CBP Office Response

Maryland was informed that the CAST team met the week of November 16, 2022 to develop messaging around the agricultural fertilizer correction. This information was provided in the one-on-one meetings, the February WQGIT, and in the presentation to the Maryland Bay Cabinet.

In addition to the communications around the correction, the messaging referenced a tighter internal CBP office review of the processing of the input data before it is incorporated into the model. Ms. Lucinda Power conveyed this information at the partnership meetings (Watershed Technical Workgroup ([December 2, 2021](#)) and the Water Quality Goal Implementation Team (WQGIT) meeting ([December 13, 2021](#)).

3) Comment-Urban fertilizer data

Maryland Department of Agriculture (MDA) asked the CBPO to explain a little more about the changes to urban fertilizer data.

Comment provided by: Elizabeth Hoffman—MDA on 11/19/2021

A) CBP Office Response

For CAST-21, two additional years of non-farm fertilizer data from AAPFCO were included with CAST-21, 2015 and 2016. The methods were approved by the Urban Stormwater Workgroup in June 2016. For information about how turfgrass application rates were calculated, see the following presentations made by Mr. Jeff Sweeney to the Urban Stormwater workgroup:

- November 16, 2021 –
https://www.chesapeakebay.net/channel_files/42055/sweeney_uswg_urbanfertilizer_111621.pdf
- January 18, 2022 –
https://www.chesapeakebay.net/channel_files/44156/sweeney_uswg_urbanfertilizer_011822.pdf
- March 15, 2022 –
https://www.chesapeakebay.net/channel_files/44158/sweeney_uswg_urbanfertilizer_031522.pdf

There were new years of fertilizer data from AAPFCO. The methods were approved by the Urban Stormwater Workgroup in June 2016, and data were revised in September 2019.

- CAST-19: Agriculture has two new years of data. Urban had no new data.
- CAST-21: Agriculture has two new years and corrections to the prior two. New=2015 and 2016. Corrected=2013 and 2014. Urban has four new years of data.

Comparison graphs were provided to MDE and MDA to show the load over time between the CAST-19 and CAST-21 versions for TN, TP, TSS pounds at edge-of-tide.

4) Comment-Correction timing

Maryland expressed concern about the last-minute correction to the AAPFCO data and its impact on agricultural and urban sectors. Maryland suggested pushing back changes that could impact jurisdiction loads to a CAST-23 version or Phase 7.

Maryland also expressed concern about land use changes and requested to meet with the CAST team prior to releasing the CAST-21 model and the 2021 progress and verification assessment.

Comment provided by: Gregorio Sandi—MDE on 11/30/2021

A) CBP Office Response

Procedures agreed to by the Urban Stormwater in June 2016 for processing the urban fertilizer data were followed. Nevertheless, an alternate method for calculating application rates was developed to reduce annual swings in non-farm AAPFCO fertilizer use data. This new method was proposed at the

USWG meeting in [March 2022](#). Ultimately, USWG members did not reach consensus on using the alternate method, so the existing method remains in place.

For agricultural fertilizer, CAST-19 did not reflect accurate trends in fertilizer use and was corrected with CAST-21, following data sources and processing methods established by CBP partners. Fertilizer use for years after 2016 changed because of new 2015 and 2016 AAPFCO data that was incorporated into CAST-21. This increase in the amount of fertilizer estimated to be applied would have occurred regardless of corrections to the 2013 and 2014 data, since the increased use was in the 2015 and 2016 data. Thus, the overall progress in nutrient reductions was over-estimated in CAST-19 because we underestimated fertilizer use. If we were to continue to omit the missing 2013 and 2014 AAPFCO data, our estimates of historic change over time would be less accurate. It is not scientifically justifiable, nor consistent with partnership procedures, to keep an error in the new version of CAST or rely on 2012 fertilizer data to determine application rates through 2023 progress. Currently, many partners are expressing that the 2016 data is too old, and 2012 is even older.

It was confirmed at the Watershed Technical Workgroup call on December 12, 2021 that CAST-21 was not going to be used to formally assess 2021 progress. As described at the top of this document, the CBP met one-on-one with all jurisdictions to discuss changes to the updated model and the WQGIT held a February 14, 2022 webinar, among other discussions and briefings about CAST-21.

5) Comment - Nutrient Application Sequences

Nutrient distribution sequences are controlled by application curves developed during the Phase 6 modeling process that prioritize manure applications before fertilizer applications, as well as application sequences based on crop priority (e.g., non-legumes versus legume crops). When evaluating animal numbers between CAST-19 and CAST-21 in Maryland, MDA observes animal units and pounds of manure remain unchanged or declining depending on animal type, yet manure nitrogen applications have increased on some load sources. **Please explain the increased manure nitrogen applications to Pasture and Leguminous Hay load sources from 2012 through 2020?** Additionally, MDA observes irregular patterns between the *Double Crop* load source and *Small Grains* load source based on our understanding of nutrient application methods. **We request the calculated acres of the Double Crop load source by crop type, crop nitrogen need by crop type, and nutrient application details for the Double Crop load source for 2012, 2017, 2018 and 2020 for further comparison to the Small Grains load source.**

Comment provided by: Alisha Mulkey—MDA and Gregorio Sandi—MDE on 4/14/2022

A) CBP Office Response

Manure applied to leguminous hay and pasture in the entire state of Maryland increased slightly compared to inorganic fertilizer in 2020 when compared between the two versions of CAST. This slight increase is due to the difference in BMPs applied to manure and manure-receiving land uses rather than changes in animal population counts. The more substantial difference that resulted in the load increase between CAST-19 and CAST-21 versions is in the fertilizer data. The inclusion of more recent AAPFCO fertilizer data is the primary cause of the increase in nutrients applied and loads delivered to streams and the Bay in CAST-21.

Land Use	Nitrogen source	CAST-19 (current)	CAST-21 (future)	Increase	Pct Change
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Leguminous hay	Manure	16,412	17,618	1,206	7%
	Fertilizer	30,406	72,031	41,625	137%
Pasture	Manure	908,853	1,002,804	93,951	10%
	Fertilizer	1,177,003	2,026,506	849,503	72%

The data requested that show the nutrient applications by crop type for double crop and small grains land uses are provided via email.

6) Comment – Fertilizer Methodology

MDA was closely involved in the review and development of fertilizer data during the Phase 6 model development, and understands why and how AAPFCO data was determined, at the time, to be the most appropriate data source. However, more recently acquired AAPFCO data brings up major concerns about data integrity relative to the MDA’s knowledge of fertilizer applications. The assumption, based on AAPFCO-based methods, that excess fertilizer is being land applied is entirely contrary to reality. This is especially relevant in Maryland with the strictest nutrient management regulations in the Chesapeake Bay, in addition to the highest adoption of enhanced nutrient management BMPs. Maryland farm fertilizer inputs for 2016 (last year of available AAPFCO data) are assumed at more than two times the raw data suggests. While AAPFCO data is recognized as variable, the downward trend in Maryland farm fertilizer inputs suggests a re-evaluation of methodology. **MDA supports the WQGIT recommendation to further investigate AAPFCO data, and MDA would recommend the development of a CBP workgroup to engage with the State Chemist offices directly within each jurisdiction to discern the common available data for improved uses in the Phase 6 model.** This option retains the use of fertilizer sales data but could improve data quality and lag time into the model.

Comment provided by: Alisha Mulkey—MDA and Gregorio Sandi—MDE on 4/14/2022

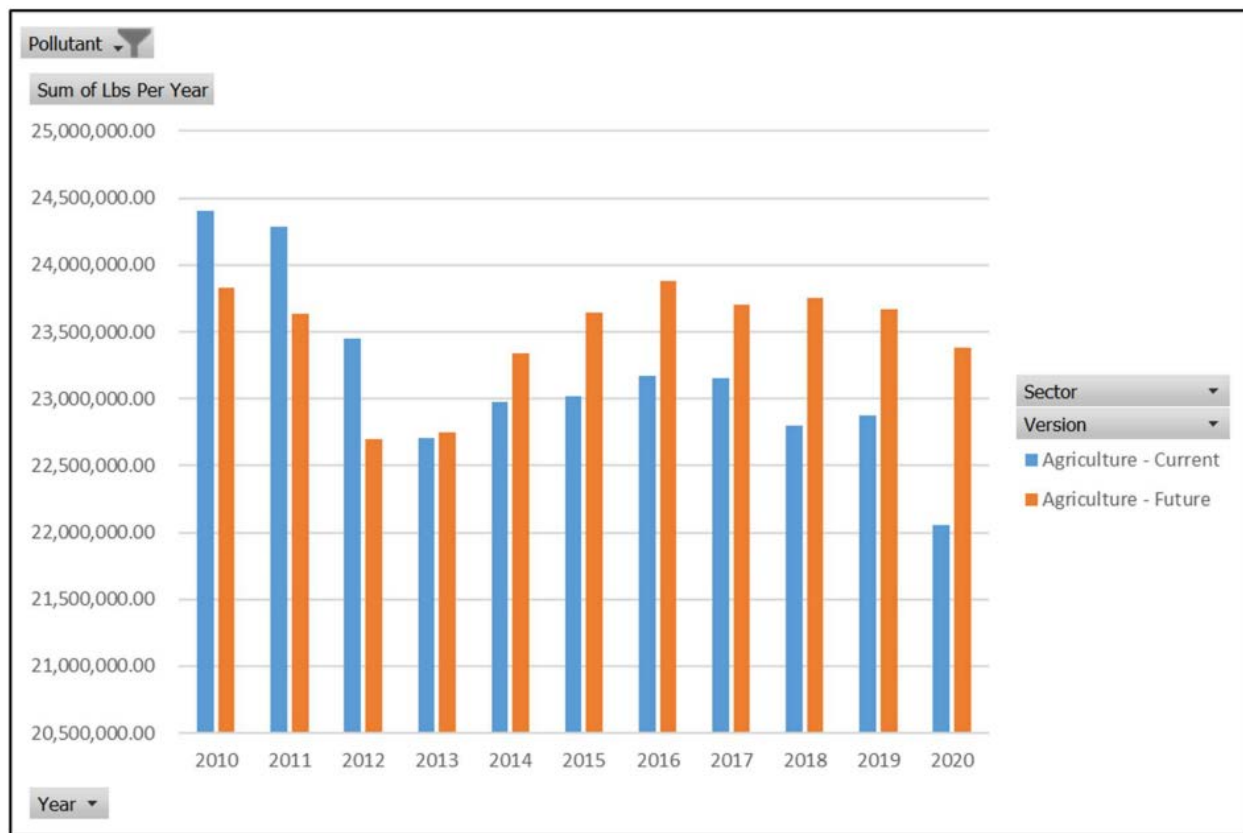
A) CBP Office Response

An evaluation of fertilizer sales data is an action item of the Agriculture Workgroup at the request of Maryland, Pennsylvania, Virginia, and New York during CAST-21 workplan discussions and is itemized in the Agriculture Workgroup [CAST Issue Tracker](#). The task is to seek updates from states on fertilizer data collected and reported to AAPFCO by state chemists. According to the work plan, Lindsay Thompson and Janelle Eck/MDA are organizing a review with state chemists (Maryland) to be followed by Pennsylvania and other Bay states. Delaware has engaged in clean-up of these data in recent years. The plan is to create a template in Maryland and apply the same template to other states. There may be redundancy in reporting by registrants. This request is appropriate to make through the Chesapeake Bay partnership process to the Agriculture Workgroup via the WQGIT, as you indicated.

7) Comment – Edge-of-Tide (EOT) Loads

A comparison of nitrogen loads between CAST-21 (future) and CAST-19 (current) is deeply concerning to MDA as depicted in the image below. Under CAST-21, the nitrogen edge-of-tide (EOT) loads for the agricultural sector remain nearly constant for 2010 through 2020 annual progress, with the exception of unexplained dips in 2012 and 2013. Maryland farmers pride themselves as leaders in agricultural conservation, and are supported by robust programs available through MDA and other conservation partners. As such, Maryland is the highest achieving state for on-farm conservation as demonstrated by CBP summary reports in CAST-19. **Yet, despite the high level of conservation, CAST-21 depicts minimal**

progress. This is an outcome and message that should be untenable to the CBP. The adoption of CAST-21 will raise questions about the legitimacy of the CBP modeling tools and lessen confidence in our Phase 3 WIP efforts at a critical time for the agricultural sector across all Bay jurisdictions.



MDA encourages the CBP to continue engaging with the Bay jurisdictions on the data assumptions to be included in CAST-21, and welcomes an opportunity for additional collaboration on fertilizer data, crop yields, and nutrient management.

Comment provided by: Alisha Mulkey—MDA and Gregorio Sandi—MDE on 4/14/2022

A) CBP Office Response

One of the expectations in the *2010 Chesapeake Bay TMDL for Nitrogen, Phosphorus, and Sediment* (Bay TMDL) is that there is accounting for and management of new and increased loadings of nitrogen, phosphorus, and sediment ([Section 10. Implementation and Adaptive Management](#)). The section states that new and increased sources must be offset. Maryland has continued to implement BMPs to control existing loads and has seen a decrease in loads as a result. As crop yields have increased (according to USDA-NASS) and fertilizer usage has increased across the Bay watershed (according to AAPFCO and particularly for the period 2012-2016 when fertilizer prices decreased, per the NASS data), there is an increased load from agriculture. The Natural Resources Conservation Service (NRCS) Conservation Effects Assessment Project (CEAP) [Cropland Assessment](#) showed similar findings in fertilizer usage. CEAP uses farmer surveys for 2013 to 2016, which is an independent and separate data source from AAPFCO. Managing future growth is a specific expectation of the TMDL and one for which EPA has oversight under the Bay TMDL's accountability framework and as part of its evaluation of progress.

The CBP office communications document is posted to CAST under [Model Documentation](#) to help explain the load changes between CAST-19 and CAST-21, and the CBP office can work with Maryland on tailoring specific messaging to its agricultural communities.

8) Comment - General Nitrogen Levels

MDE has observed that the differences in loading rates between the two models seems to be aligned throughout most of the previous years with nitrogen differences being off by roughly 400-600 thousand pounds when nitrogen loads from the two models are compared, but then in 2020 the difference spikes to approximately 1.2 million pounds of difference. What is driving this change from historic norms?

2020 has seemed off when compared to historic trends in several ways as described below.

Developed Sector Nitrogen (MDE)

The amount of nitrogen applied in the Developed sector has decreased by over 6,000,000 pounds when you compare the 2020 number for CAST-19 and CAST-21. However, our developed sector loads only show a 125K pounds decrease. Shouldn't a decrease in TN applied equate to a lower load, especially if it is a 6,000,000 pound decrease?

In CAST-21, septic loads decrease significantly in previous years but increases in 2020. Whereas in CAST-19 it suggested another year of reduction in 2020. Why the increase only in 2020?

Why would CAST-21 increase our WWTP loads only in 2020? It's only 2K pounds, but that seems odd when there was no change in previous years.

Comment provided by: Alisha Mulkey—MDA and Gregorio Sandi—MDE on 4/14/2022

A) CBP Office Response

For the agriculture sector, there is an estimated net increase of 22 million pounds of nitrogen applied to agricultural lands over the 2012 to 2020 period comparing CAST-19 to CAST-21. This accounts for animal manure nutrients, inorganic fertilizer, biosolids, and natural legume fixation. Approximately 95% of the increase is from fertilizer and can be attributed to AAPFCO fertilizer use trends from 2012 to 2016, as well as changes in crop types and the associated application ratio post-2016. The 2016 ratio of actual crop application to typical crop applications are used to determine nutrient application rates for post-2016 years when there is no direct fertilizer use data according to partnership-defined protocols.

The increase in fertilizer use for the Chesapeake Bay watershed as a whole is verified using changes in fertilizer prices from the Census of Agriculture through the same time period. Generally, fertilizer use aligns closely with fertilizer costs to farmers. Fertilizer costs were depressed during that time period, and we expect to see increases in costs in the next Census of Agriculture.

For the developed sector, the BMPs and the nutrients applied influence loads. The record of BMPs in the developed sector changed between the two model versions, accounting for some of the difference in delivered loads. There is a 29,342 decrease in acres treated by urban stormwater practices in 2020 progress between CAST versions. In addition, the acres in each sector can change. Lastly, the factor that keeps the model true to calibration is applied based on the 1995 year. This factor can have an effect on the loads between versions, since it changes with each version and change in 1995 loads. This factor was

explained at the October 25-26 WQGIT meeting in the presentation [Model Updates presentation](#) given by Ms. Olivia Devereux.

The number of septic connections and the amount of septic pumping in the 2020 progress scenario decreased between the versions. This decrease affected the septic loads.

There are two West Virginia facilities with Maryland land-river segments, WV0105384, WVG551450. The facilities' wastewater loads were updated by West Virginia in their 2020 wastewater data that is used in CAST-21.

9) Comment – Developed Sector Phosphorus

There was a significant decrease of about two million pounds applied in the developed sector in the new model starting in 2013 due to a partnership decision that assigns zero phosphorus to Maryland's developed sector from our adoption of a P ban law in urban fertilizers. Is this a correct statement?

Comment provided by: Alisha Mulkey—MDA and Gregorio Sandi—MDE on 4/14/2022

A) CBP Office Response

This is a correct understanding of the phosphorus ban law in urban fertilizer, although the two-million-pound difference also could be partially attributed to a change in BMPs or total acres. Trends in non-farm AAPFCO phosphorus fertilizer showed a sharp decline over the period 2012-2016. Maryland's lawn fertilizer law took effect October 1, 2013. It seems there would be a connection between the two, but the CBP office cannot definitively show causality between the AAPFCO data reduction and the effective date of the law. Additional years of data could verify the cause-and-effect with more certainty, particularly since the raw AAPFCO data can be highly variable over time.

New York

1) Comment

New York expressed concern that if the Phase III Planning Targets do not change with CAST-21 or future versions of CAST, in 2025, the Phase III WIP scenarios will be deficient due to the 2013-2014 fertilizer error. New York requested that a 2025 progress scenario be run on CAST-19 (or CAST-17 for the other jurisdictions), the scenario in which their Phase III WIPs were developed.

New York believes the 2013 and 2014 missing fertilizer correction to the model was completed without being vetted more thoroughly through the workgroups and WQGIT. New York is concerned that their current WIP is no longer sufficient, as it does not consider this increased, unexpected load. New York requested that this update be held until a future model update so that the proper outreach can be conducted to their stakeholders, or an alternative partnership decision is reached regarding this model error correction.

New York noted that it is shown as having an urban fertilizer application rate of zero in CAST-21 for 2016-2020 and Maryland has zero application rate from 2013-2020. New York stated that an urban fertilizer application rate of zero is not accurate and adversely shifts this load onto other jurisdictions. They requested that this update be held until a future model update so that a partnership decision can be reached.

New York requested that the model documentation be updated and finalized when CAST-21 is approved. New York stated that the current documentation is labeled as “draft” and did not include updates made for CAST-19. This created issues with partner outreach related to model updates. New York would like to know if the changes to CAST-19 and CAST-21 will be incorporated into CAST-17 documentation or kept as separate documents. New York suggested amending the original document to make it less confusing.

New York expressed concern that the decision to include 500,000 broilers for New York [due to not having annual NASS poultry survey] is not documented in the model documentation, where the method used for all other jurisdictions is documented.

Comment provided by: Lauren Townley—NY-DEC; Cassandra Davis—NY-DEC on 11/30/2021

A) CBP Office Response

The change in agricultural loads between the two versions of CAST is due to increased fertilizer usage in 2015 and 2016. The correction to the 2013 and 2014 fertilizer data did not change the load for future years.

In July 2018, the Principals’ Staff Committee made the decision to approve the 2025 Phase III WIP planning targets for nutrient and sediment loads, using the Phase 6 Watershed Model, and stated that these targets would not change between that time and 2025, even with the addition of new science, data and information. Keeping the 2025 planning targets constant is intended to provide stability to state and local jurisdictions, while also allowing for the incorporation of the best available science, data and information into CAST.

It is up to each jurisdiction to determine how they will reflect changes in pollutant loads in their WIPs and two-year milestones, as these are state-led efforts and official documents. However, it is an EPA expectation that any changes in loads are accounted for and addressed.

According to partnership-established protocols, when an updated version of CAST is ready for use, EPA will use the new version to assess annual progress and evaluate future two-year milestones. It is recommended that users either re-run or create new scenarios in the updated version of CAST to be consistent with the latest science and data, but it is up to each jurisdiction to determine if they will revise their WIP. It is likely that re-running a scenario in an updated version of CAST could result in different numbers, as noted in the comment.

The latest data and BMP history are used in each update of CAST. These updates allow users to manage the evolving changes in land use, BMP implementation, fertilizer use, manure nutrient generation, and other management actions. One of the expectations in the *2010 Chesapeake Bay TMDL for Nitrogen, Phosphorus, and Sediment* (Bay TMDL) is that there is accounting for and management of new and increased loadings of nitrogen, phosphorus, and sediment ([Section 10. Implementation and Adaptive Management](#)). The section states that new and increased sources must be offset.

As crop yields have increased (according to USDA-NASS) and fertilizer usage has increased across the Bay watershed (according to AAPFCO and particularly for the period 2012-2016 when fertilizer prices decreased, per the NASS data), there is an increased load from agriculture. The Natural Resources Conservation Service (NRCS) Conservation Effects Assessment Project (CEAP) [Cropland Assessment](#) showed similar findings in fertilizer usage. CEAP uses farmer surveys for 2013 to 2016, which is an

independent and separate data source. Managing future growth is a specific expectation of the Bay TMDL and one for which EPA has oversight under the Bay TMDL's accountability framework and as part of its evaluations of progress.

The release of the updated version of CAST, CAST-21, was held until late spring 2022 to allow for additional time for communication and analysis. These communication and review actions are summarized at the beginning of this document.

Regarding New York's request "that a 2025 progress scenario be run on CAST-19 (or CAST-17 for the other jurisdictions), the scenario in which their Phase III WIPs were developed", it is unclear if the request is to put current levels of reported BMPs (e.g., 2021) on 2025 conditions. A 2025 progress scenario typically refers to 2025 BMPs on 2025 land use, but we do not yet know the BMPs that will be implemented in 2025. The planned BMPs from the WIP are run on the current version of CAST as well as the version in which the WIP was originally developed. The CBP office is available to assist in running a scenario but needs clarification on the scenario parameters.

The urban fertilizer has been further reviewed since New York's initial comment. The issue was the subject of the [January 18, 2022](#) and [March 15, 2022 USWG meetings](#). Alternative methods were proposed at the March 2022 USWG. Ultimately, USWG members did not reach a consensus, so the existing method, approved by the USWG in June 2016, continues to be used. The non-farm fertilizer load is not zero for any jurisdiction, but is lower for states where the law bans phosphorus in urban fertilizer products.

The CAST documentation is updated with each new release. Documentation of every upgrade is at <https://cast.chesapeakebay.net/About/UpgradeHistory>. Comprehensive documentation of all CAST components is at <https://cast.chesapeakebay.net/Documentation/ModelDocumentation>. The Phase 6 calibration documentation is final, except for the land use section. The subsequent versions include separate, technical documentation of the changes along with comparison tools. The suggestion of incorporating the biannual upgrade information into the calibration documentation will be considered for Phase 7 of the model.

The decision to use the 500,000 asymptotic value for broilers was an oversight in the documentation, and was inconsistent with other methods. This has since been corrected. Communication regarding the new approach met with New York's approval. The new method is documented in the technical documentation.

Note: No further comments submitted from New York after the initial, November review period.

Pennsylvania

1) Comments

Pennsylvania observed that, from a projection aspect, CAST-21 appears to work well with expected load behaviors in forecasted scenarios.

Pennsylvania expressed concern that the fertilizer sales data corrections are adversely shifting loads in the CAST output. They believe that this load should be adjusted by the CBP partnership approval process and other needed adjustments such as the number of known animals in a county as delegated to "partnership decisions" should be more consistently handled. Pennsylvania said that changes or

corrections to the model that are this large should be vetted more thoroughly through the CBP workgroups and WQGIT. They did not support the inclusion of the [previously] omitted [2013 and 2014 VA AAPFCO] fertilizer sales data in CAST-21.

They noted some other suggestions that include:

- Update and expand the BMP Quick Reference Guide for BMPs to be a more complete technical reference inclusive of all the Chesapeake Bay creditable BMPs.
- Better upfront directions for using the Stream Restoration Calculator – the desired input guidance information is only available after executing the primary questionnaire. They appreciate not wanting the calculator to be misused but said that happens best when instructions and guidance are offered directly to the user upfront in simple language.
- While not directly a CAST issue, they said it would be desirable to reduce the number of BMP names in NEIEN and by extension CAST. They said the cross-walking is onerous. They would welcome any simplification that allows a more direct and consistent reporting of BMP titles and units between CAST and NEIEN.
- Suggested that CAST might consider a Land River Segment Data and Mapping Information Interface within CAST that could help facilitate local planning and BMP implementation tracking using these units.

Comment provided by: Jill Whitcomb—PA on 11/30/2021

A) CBP Office Response

The change in agricultural loads between the two versions of CAST is due to increased fertilizer usage in 2015 and 2016. The correction to the 2013 and 2014 fertilizer data did not change the load for future years. Fertilizer use for years after 2016 changed because of new 2015 and 2016 AAPFCO data that is accommodated with CAST-21. This increase in the amount of fertilizer estimated to be applied would have occurred regardless of corrections to the 2013 and 2014 data, since the increased use was in the 2015 and 2016 data. Thus, the overall progress in nutrient reductions was over-estimated in CAST-19 because we underestimated fertilizer use. For CAST-21, 2015, 2016, and projections into the future are influenced primarily by the inclusion of 2015 and 2016 data. If we were to continue to omit the missing 2013 and 2014 AAPFCO data, our estimates of historic change over time would be less accurate. It is not scientifically justifiable, nor consistent with partnership procedures, to keep an error in the new version of CAST or rely on 2012 fertilizer data to determine application rates through 2023 Progress. Currently, many partners are expressing that the 2016 data is too old, and 2012 is even older. The shift to increased loads is of concern because it shows growth in the agricultural sector.

One of the expectations in the *2010 Chesapeake Bay TMDL for Nitrogen, Phosphorus, and Sediment* (Bay TMDL) is that there is accounting for and management of new and increased loadings of nitrogen, phosphorus, and sediment ([Section 10. Implementation and Adaptive Management](#)). The section states that new and increased sources must be offset. As crop yields have increased (according to USDA-NASS) and fertilizer usage has increased across the Bay watershed (according to AAPFCO and particularly for the period 2012-2016 when fertilizer prices decreased, per the NASS data), there is an increased load from agriculture. The Natural Resources Conservation Service (NRCS) Conservation Effects Assessment Project (CEAP) [Cropland Assessment](#) showed similar findings in fertilizer usage. CEAP conducted farmer surveys for 2013 to 2016, which is an independent and separate data source. Managing future growth is

a specific expectation of the TMDL and one for which EPA has oversight under the Bay TMDL's accountability framework and as part of its evaluations of progress.

As crop yields have increased (according to USDA-NASS) and fertilizer usage has increased across the Bay watershed (according to AAPFCO and particularly for the period 2012-2016 when fertilizer prices were depressed), there is an increased load from agriculture. This increased load is expected to be addressed through additional BMP implementation.

An investigation of fertilizer sales data is an action item of the Agriculture Workgroup at the request of Maryland, Pennsylvania, Virginia, and New York during CAST-21 Workplan discussions and is itemized in the Agriculture Workgroup's [CAST Issue Tracker](#). The task is to seek updates from states on fertilizer data collected and reported to AAPFCO by state chemists. According to the work plan, Lindsay Thompson and Janelle Eck/MDA are organizing a review with state chemists (Maryland) to be followed by Pennsylvania and other Bay states. Delaware has engaged in clean-up of these data in recent years. The plan is to create a template in Maryland and use it for the other states.

The use of the AAPFCO fertilizer sales data was recommended by the Agricultural Modeling Subcommittee and approved by the CBP partnership. The entire Phase 6 modeling framework was reviewed by STAC as part of the Chesapeake Bay TMDL's Midpoint Assessment update process. The updates to data were planned and expected. In [December 2015](#) and [January 2016](#), the Water Quality GIT and the Management Board, respectively, reached consensus on the recommendations from the Modeling Workgroup. It was decided that with the development of each jurisdiction's 2016-2017 milestones, the partnership would hold the assumptions set at the beginning of the milestone period constant over the following two years. Any changes to the decision to update CAST every two years requires formal review and approval by the partnership.

The process for updating CAST and transitioning to new versions is approved and directed by the partnership. By holding assumptions constant for the milestone period and updating with new data and information every two years, CAST more accurately reflects what is happening on the ground. Changing conditions in the watershed can have as much, if not more, of an effect on nutrient and sediment pollutant loads than BMP implementation.

The specific bulleted recommendations are addressed in order, below.

- The first version of *BMP Quick Reference Guide* was developed for a selection of the BMPs available in CAST. It serves as a summary of the complete data already available in the CAST source data and in the Expert Panel reports, both of which are available on CAST (<https://cast.chesapeakebay.net/Home/SourceData> and <https://cast.chesapeakebay.net/Documentation/BMPs>). Nonetheless, the *BMP Quick Reference Guide* is being updated to include all approved BMPs and is expected to be made available summer of 2022. The *Guide* will remain organized in a way that sometimes combines multiple creditable BMPs into summarized reference sheets when it is logical to bundle these practices.
- The stream restoration calculator was developed because a number of users were having trouble with the project calculations. In addition to the examples in the Expert Panel report and the guided calculation in the tool, a webinar was held on February 17, 2022 and the recording is available on CAST, <https://cast.chesapeakebay.net/Learning/FreeTrainingVideos#>).

- It is acknowledged that the NEIEN/CAST annual reporting needs to be simplified. Decreasing the number of practice names and units would remove options for crediting practices. However, there are other ways to make the process more streamlined. The CAST Development Team is developing options for simplifying this process. A timeline of this, and other CAST improvements, is available on the Phase 7 Model Development site (https://www.chesapeakebay.net/what/programs/modeling/phase_7_model_development).
- CAST has a land-river segment mapping tool. This is already available on CAST under [Map Tools and Spatial Data](#). The direct link is <https://gis.chesapeakebay.net/mpa/scenarioviewer/>.

2) Comment - Fertilizer Sales Data

Pennsylvania shares concerns voiced by other jurisdictions in how the fertilizer sales data correction is adversely shifting loads in the CAST output. This load adjustment by program discretion and other needed corrections such as the number of known animals in a county (delegated to “partnership decisions”) should be more consistently handled. Changes or corrections to the model this large should be vetted more thoroughly through the CBP workgroups (including the source-sector, Watershed Technical, and Modeling workgroups) and the WQGIT. It appears this process was bypassed.

Pennsylvania is discouraged that, due to omitted data, there were missed opportunities for the partnership to fully review the methodology contrived by the Ag Modeling Subcommittee and the Ag Workgroup for modeled fertilizer application in the Phase 6 calibration and carried forward with the two-year CAST update. Pennsylvania will not support the projection of the “smoothed” and redistributed 2015-16 AAPFCO-provided fertilizer sales data.

The level of impact that an input has on the modeled loads should be equal to the level of scientific and partnership review. The methodology regarding the sourcing and preparation of fertilizer data, shared during the March 17, 2022 Agriculture Workgroup meeting, does not provide the requisite level of confidence that the 2015-16 fertilizer sales data and thus, the projection of 2015-16 fertilizer sales data, is the “best available” data for the CAST-21 iteration of the modeling tools.

Further, reviewing the AMS and Ag Workgroup Decisions on Phase 6 Model 2015-2017, it is unclear if the outcome of the fertilizer application in the model reflects the recommendations and decisions made by the Ag Modeling Subcommittee or the Ag Workgroup. Specifically:

July 20, 2016 – Agriculture Workgroup Decision Watershed-wide fertilizer is distributed to counties based upon each county’s share of the total watershed’s remaining crop application goal after manure is applied. Applications are prioritized to row and commodity crops over pasture and hay, and all crops do not receive 100% of application goal.

January 28, 2015 – Ag Modeling Subcommittee DECISION: The distribution of inorganic fertilizer will be done after accounting for all BMPs.

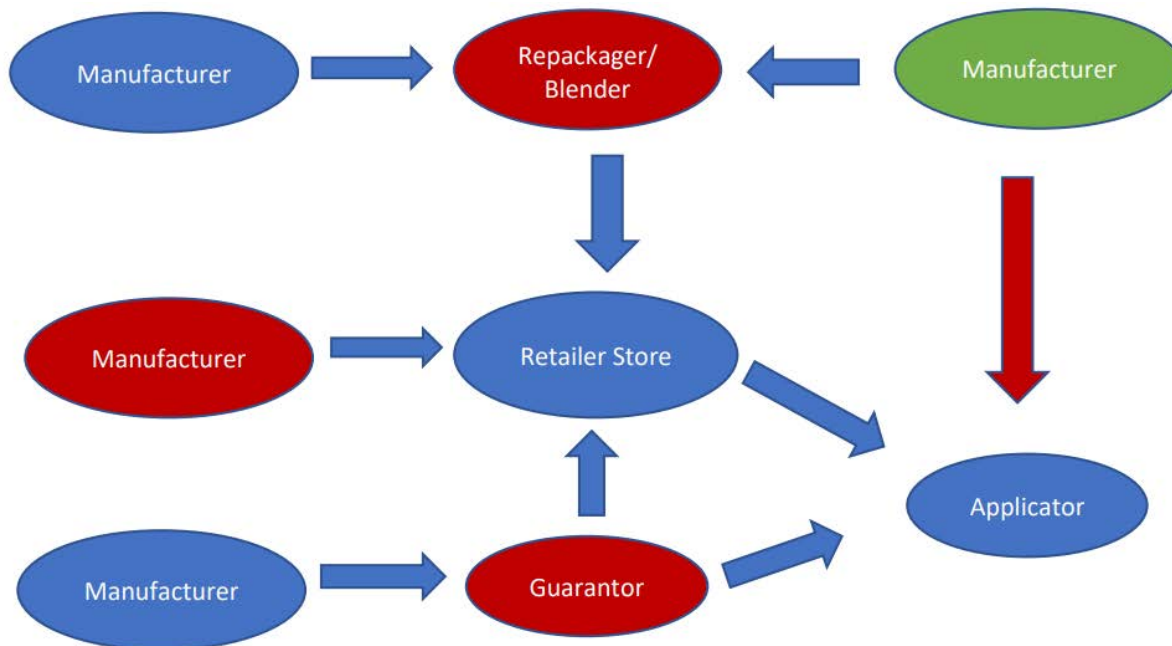
The decision made by the AMS on January 28, 2015 does not seem to be reflected in the fertilizer application methodology presented to the Ag Workgroup on March 17, 2022. Regarding Pennsylvania’s AAPFCO data source reporting, fertilizer tonnage reporting was incorporated into the Pennsylvania Fertilizer Act to generate revenue for enforcing the provisions of the Act, which is largely related to ensuring the quality and labeling of the material. The fertilizer tonnage reporting was not intended to be used to measure applications, nutrient loads and/or runoff. As the CBP staff have shared with

Pennsylvania regarding other data types, such as water quality monitoring data reported to EPA through the biennial Integrated Water Quality Monitoring Report, the purpose and intent of the data needs to be considered prior to use in a suite of modeling tools. Additionally, the levels of uncertainty and confidence of every input to the model, including but not limited to fertilizer and animal data, should be provided to the Partnership and stakeholders. Those with greatest impact to the potential nutrient loads deserve greater review and analysis.

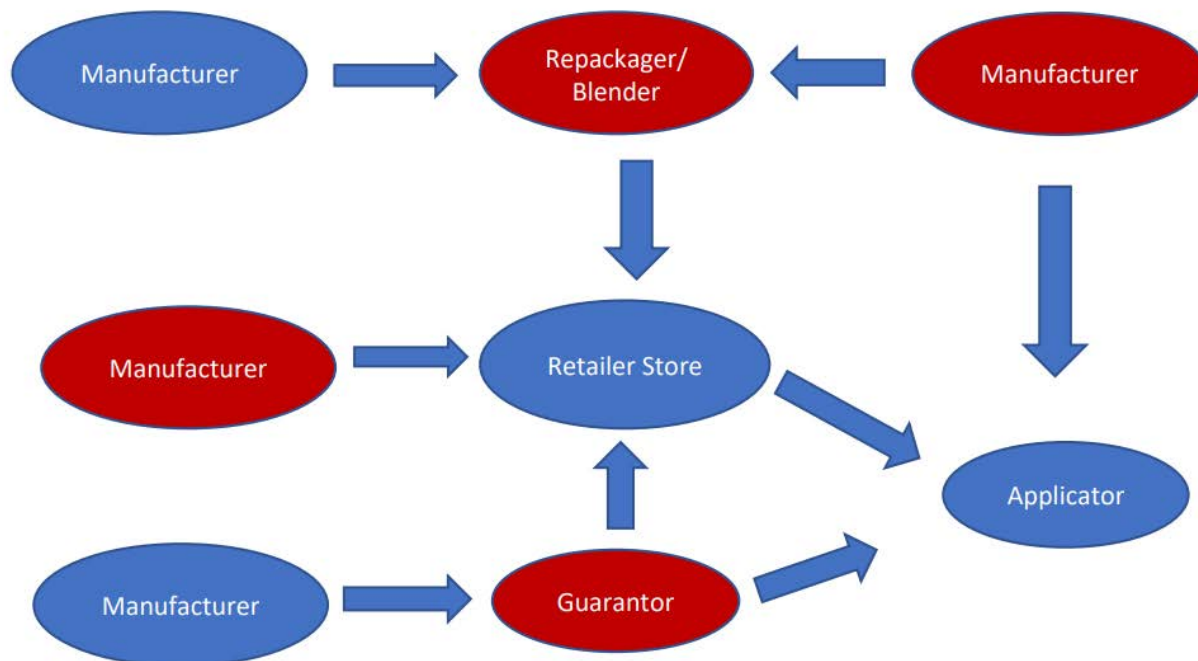
There are several points to consider when reviewing fertilizer tonnage data.

- Guarantors of fertilizer are only required to report the fertilizer distributed in Pennsylvania.
 - This type of data does not capture use.
 - Buyers could stockpile fertilizer to get better rates (e.g., wholesale versus retail), planning for future years of cost increases, etc. Fertilizer purchased in one year might not be applied until the following year(s) (this could be for farm and non-farm)
- There are some “Non-Farm Fertilizers” that should be excluded from the modeling tools.
 - Products intended only for house plants and interior plantscapes would still be captured under Non-Farm data.
- There is risk of duplicate reported tonnage, and, therefore, double-counting of fertilizer data in the modeling tools.

In an ideal scenario, all the businesses highlighted in red within this distribution tree would be responsible for reporting tonnage. For the manufacturer on the right (in green), only the tonnage shown in the red arrow should be reported.



However, in reality, some fertilizer companies report everything, and tonnage is then double reported. For example, the manufacturer on the right has reported tonnage sold to the repackager/blender as well as tonnage sold to the applicator. In this scenario, the manufacturer and the repackager/blender are reporting the same fertilizer twice.



Comment provided by: Jill Whitcomb—PA on 4/15/2022

A) CBP Office Response

CAST-21 updates and data corrections follow partnership approved methods and were handled with full transparency. CBP staff engaged in direct communication with jurisdictions and the public, documented meetings of the Watershed Technical Workgroup, Agriculture Workgroup, USWG, the WQGIT, and the Management Board. A summary of communications is at the beginning of this document.

If possible, model input data is presented and considered by workgroups prior to release of a draft version of CAST. However, other input data is reviewed after the release of a beta CAST because their availability may not align with the CAST schedule. Some data sources, like AAPFCO, may not release information on a regular predictable schedule.

The increase in usage reflected in the AAPFCO sales data indicates there is an increased load that will likely make reaching our Chesapeake Bay TMDL goals even more challenging. As noted previously, the increase in fertilizer use over the 2012 to 2016 period for the Chesapeake Bay watershed as a whole is verified using changes in fertilizer prices from the Census of Agriculture through the same time period. Generally, fertilizer use aligns closely with fertilizer costs to farmers. We expect that the next Census of Agriculture will show an increase in fertilizer costs, and that may align with a decrease in fertilizer sales. However, we will not know until the data are available for the next round of data updates to CAST.

An investigation of fertilizer sales data is an action item of the Agriculture Workgroup at the request of Maryland, Pennsylvania, Virginia, and New York during CAST-21 Workplan discussions and is itemized in the Agriculture Workgroup's [CAST Issue Tracker](#). The task is to seek updates from states on fertilizer data collected and reported to AAPFCO by state chemists. According to the work plan, Lindsay Thompson and Janelle Eck/MDA are organizing a review with state chemists (Maryland) to be followed by Pennsylvania and other Bay states. Delaware has engaged in clean-up of these data in recent years.

The plan is to create a template in Maryland and use it in all other states. There may be redundancy in reporting by registrants.

During June and July 2017, a fatal flaw review was conducted based on the draft Phase 6 version of the documentation with the potential for changes to be made during this time. All fatal flaws identified through the partnership review were resolved through documented procedures. The Modeling Workgroup and the WQGIT met in late summer for final approval of the CBP partnership's suite of Phase 6 models to be used for the Phase III WIPs. The Modeling Workgroup scheduled and conducted a series of webinars to provide partners and stakeholders with a summary of the draft Phase 6 Watershed Model in considerable detail.

A STAC review of the nutrient inputs was requested by the CBP in 2016. The review panel was charged with reviewing the appropriateness of methods used to estimate total manure and fertilizer application for each county in the Chesapeake watershed. In keeping with STAC protocol, the reviewers were asked to comment on the sufficiency of the documentation and to make suggestions for future work. Comments about AAPFCO data are included in STAC's many detailed recommendations. STAC did not identify better sources for fertilizer use or sales data but recommended using the information to calculate the actual ratio of ammonia and nitrate nitrogen in the fertilizer sold as a baseline and/or as a check against the 75:25 assumption in the model. The analysis was completed and validated the assumed split.

The 2013 to 2016 fertilizer data updates were not part of the calibration but extend the time period where actual sales or use data can be used rather than estimated based on past fractions of application goal. It is this newer data (2015-2016) that indicates an increase in usage in the Bay watershed that is concerning.

Pennsylvania noted that data was not reviewed in the Phase 6 calibration. All data used in the calibration, including the AAPFCO data through 2012, was reviewed by the partnership as well as STAC, an independent scientific body. The WQGIT met on October 22 and 23, 2012 to prioritize workplans for the partnership's development of the Phase 6 Watershed Model. During the period of 2012 to 2017, review and direction of the Phase 6 Watershed Model occurred in the hundreds of meetings where different aspects of the modeling were discussed and decided upon. The 2013 to 2016 data updates were not part of the calibration, but extend the time period where actual sales data can be used rather than estimated based on past usage. It is the 2015 and 2016 data that indicates an increase in usage in the Bay watershed. The correction to the 2013 and 2014 fertilizer data is impacting only the loads in 2013 and 2014, not the future loads.

Two rules are followed, (1) distribution to counties and prioritization to row and commodity crops, and (2) the distribution after accounting for BMPs. The Phase 6 model documentation Section 3 available on CAST at <https://cast.chesapeakebay.net/Documentation/ModelDocumentation> describes the methods in detail on pages 3-26 through 3-39.

Please clarify, "Pennsylvania will not support the projection of the "smoothed" and redistributed 2015-16 AAPFCO-provided fertilizer sales data." Does this refer to farm or non-farm data? The proposed method for determining turf grass application rates that included smoothing and removing outliers, was not approved by the USWG. For agricultural fertilizer, there are partnership-approved techniques for

smoothing and redistribution of data that apply until the partnership proposes and agrees to an alternative method.

Regarding, “The methodology regarding the sourcing and preparation of fertilizer data, shared during the March 17, 2022 Agriculture Workgroup meeting, does not provide the requisite level of confidence that the 2015-16 fertilizer sales data and thus, the projection of 2015-16 fertilizer sales data, is the “best available” data for the CAST-21 iteration of the modeling tools.” Please specify what is needed from the CBP staff to increase your level of confidence. CBP staff can provide spreadsheets with results for each step in the process and provide guidance on understanding the calculations. The method to determine post-2016 application rates is not a projection of 2015-2016 fertilizer sales data. Post-2016 application rates are assumed to be the same fraction of the application goal in 2016 for any given crop in any given county – following partnership-approved direction.

It is understood that the primary purpose of AAPFCO data is not to “measure applications, nutrient loads and/or runoff.” The partnership agreed to use the information according to the rules they established as the best source of data available for CBP modeling purposes. After considering the “purpose and intent of the data” over the past 25 years, the CBP staff have not discovered an alternative nor has a state, locality, academic, partner, or the like suggested a better source. AAPFCO fertilizer data is used by a host of organizations including The Fertilizer Institute’s Nutrient Use Geographic Information System (NuGIS), the USGS’ SPARROW Surface Water-Quality Model, and National Water-Quality Assessment (NAWQA).

Regarding the comment, “the levels of uncertainty and confidence of every input to the model, including but not limited to fertilizer and animal data, should be provided to the Partnership and stakeholders,” is a recurrent request of STAC and the WQGIT, and is a long-standing goal of the Modeling Workgroup. For responses, see the STAC review at http://www.chesapeake.org/pubs/379_Easton2017.pdf and Phase 6 Dynamic Watershed Model and CAST-17 documentation at <https://cast-content.chesapeakebay.net/documents/P6ModelDocumentation%2F13%20Reviews.pdf>.

It is very helpful to see the information presented on how Pennsylvania reports to AAPFCO. This information should be considered in any future decision the partnership makes regarding fertilizer data usage. The Agriculture Workgroup is accommodating a request from the WQGIT to determine sources and use of inorganic fertilizer data. It is likely that changes to current data sources and methods will require considerable effort by state agencies and their partners involved in tracking fertilizer data that ultimately is published by AAPFCO.

3) Comment - CAST-19 to CAST-21

In 2021, PADEP’s Chesapeake Bay Office (CBO) collaborated with CBP’s Land Use Workgroup (LUWG) to review Chesapeake Conservancy’s 2017 – 2018 high resolution mapping for land cover, land use and land use change. The LUWG selected 14 “prototype” counties bay-wide based on geography, agriculture, and developed land cover and land use to establish the geospatial relationship algorithm that was applied to all counties across the watershed. In Pennsylvania, Bradford, Clearfield, Cumberland, and Lancaster were selected as “prototype” counties that provided feedback for land cover, land use and land use change. All Pennsylvania Chesapeake Bay counties completed a local review for 2017- 18 land cover and gave comments except for Somerset, Carbon, and Lackawanna counties.

Below are observations and areas that would require re-evaluation in the next land use (LU) release and/or the development of Phase 7. Overall, there is a disconnect between the updated 2020 amounts

and the 2025 projections. In most cases, the 2020 data is adjusted, but the inputs into the 2025 projection were not changed. These changes in modeled future scenarios will create a disconnect between estimated future conditions between CAST versions which will make future WIP assessments and future planning more challenging.

To that end, Pennsylvania suggests that CBP staff work to address the messaging needed to communicate these changes and more systematically address revisions to 2025 case condition changes to preempt confusion in differing 2025 conditions. From our findings below, Pennsylvania suggests a wall-to-wall land use review for CAST-23.

Key for Tables 1-3 below:

- Yellow highlight is CAST-19;
- Blue highlight is CAST-21;
- Brown text in 2020; and
- Blue text in 2025

Table 1: Double Cropped Acres

- Acres generally increased. A few counties had large increases in 2020 from CAST-19 to CAST-21; these increases were not always proportional to changes in the 2025 data.
 - Lackawanna, Luzerne, and Potter (Counties with red text)

Table 2: Regulated Construction Acres (All Construction Acres in Pennsylvania are regulated; most are permitted)

- In general, these acres decrease from 2020 to 2025 in both versions of CAST. There is a larger decrease in acres in CAST-21 than CAST-19. There are only minor differences in 2020 acres between the CAST-19 and CAST-21, but larger difference in the 2025 amounts.
 - Six counties that had construction in 2025 with CAST-19 have zero acres of construction in 2025 in CAST-21. (Counties with purple text)
 - Pennsylvania reports disturbed acres related to construction activities as model inputs. These acres are reported by the county conservation districts, as they hold NPDES Construction Stormwater delegation from Pennsylvania DEP.
 - It is unclear how there are counties with zero construction acres in 2025 in CAST21. This will ultimately lead to an imbalance of estimated load in 2025 and the potential for cutoff of E&S Level 2 best management practices.
- Cumberland, Franklin, Tioga, and Snyder Counties follow the pattern of fewer acres in construction in 2025 than 2020, but in 2025 there are more construction acres in CAST-21 than CAST-19. (Counties with red text)

Table 3: CSS Acres

- Columbia: Based on PADEP data there are no CSOs in Columbia County. In CAST-19s' 2020 LU there are about 1,394.3 CSS acres. CAST-21's 2020 LU data has 0 CSS acres. Both CAST-19 and CAST-21 have 1,394.3 CSS acres in 2025 with minor differences in the specific load source.

- Perry County has a decrease in CSS acres with an increase in MS4 acres when comparing 2020 LU between CAST-19 and CAST-21. The distribution of CSS to MS4 acres is similar in 2025 when comparing CAST-19 and CAST-21 and this distribution is similar to CAST-19's 2020 distributions.
- Lycoming and Potter Counties have CSOs in Pennsylvania DEP's update table but not in CAST.

Other Observations

- Cameron County: The Pasture acres in 2020 changes from 266 in CAST-19 to 561 in CAST-21 but in 2025 there is less than 1 acre in both CAST-19 and CAST-21.
- One acre of Pasture in 2025 is not realistic for the number of animals CAST predicts in the county in either CAST-19 or CAST-21.

Table 1: Double Cropped Acres

Geography	Unit	2020 CAST-19	2020 CAST-21	2020 delta	2025 CAST-19	2025 CAST-21	2025 delta	CAST-19	CAST 2021
Cambria, PA (CBWS Portion Only)	Acres	566.40	1,021.31	454.909	940.60	1,392.57	451.972	374.20	371.27
Clinton, PA (CBWS Portion Only)	Acres	812.56	1,331.51	518.950	1,238.08	1,839.41	601.325	425.53	507.90
Columbia, PA (CBWS Portion Only)	Acres	-	1,248.59	1248.588	-	1,684.47	1684.465	-	435.88
Elk, PA (CBWS Portion Only)	Acres	-	10.38	10.378	-	3.36	3.359	-	(7.02)
Indiana, PA (CBWS Portion Only)	Acres	44.62	96.20	51.577	59.03	112.66	53.635	14.40	16.46
Lackawanna, PA (CBWS Portion Only)	Acres	304.23	643.12	338.887	702.45	1,053.89	351.437	398.22	410.77
Luzerne, PA (CBWS Portion Only)	Acres	176.77	1,998.78	1822.009	1,132.64	2,487.66	1355.019	955.87	488.88
Lycoming, PA (CBWS Portion Only)	Acres	276.50	1,194.30	917.804	871.69	1,888.79	1017.106	595.19	694.50
Northumberland, PA (CBWS Portion Only)	Acres	1,988.45	3,206.60	1218.145	2,541.21	3,822.77	1281.561	552.76	616.17
Potter, PA (CBWS Portion Only)	Acres	-	571.14	571.139	190.55	913.44	722.890	190.55	342.31
Schuylkill, PA (CBWS Portion Only)	Acres	161.51	1,035.81	874.298	413.52	1,363.16	949.644	252.01	327.35
Wayne, PA (CBWS Portion Only)	Acres	143.06	105.89	-37.176	106.42	80.45	-25.968	(36.65)	(25.44)

Table 2: "Regulated" Construction Acres

Geography	Unit	2020 CAST-19	2020 CAST-21	2020 delta	2025 CAST-19	2025 CAST-21	2025 delta
Adams, PA (CBWS Portion Only)	acres	1,434	1,434	0.0	289	64	(225)
Bedford, PA (CBWS Portion Only)	acres	80	80	0.0	0	0	(0)
Blair, PA (CBWS Portion Only)	acres	298	298	-0.1	23	0	(23)
Bradford, PA (CBWS Portion Only)	acres	293	293	0.0	125	20	(105)
Cambria, PA (CBWS Portion Only)	acres	74	73	-0.7	10	0	(10)
Carbon, PA (CBWS Portion Only)	acres	4	4	0.1	-	0	0
Clearfield, PA (CBWS Portion Only)	acres	127	127	0.1	0	0	(0)
Columbia, PA (CBWS Portion Only)	acres	150	156	6.2	32	0	(32)
Cumberland, PA (CBWS Portion Only)	acres	1,249	1,249	0.0	49	659	611
Elk, PA (CBWS Portion Only)	acres	14	14	0.2	0	0	0
Franklin, PA (CBWS Portion Only)	acres	1,699	1,699	0.0	1	236	235
Huntingdon, PA (CBWS Portion Only)	acres	99	99	-0.1	190	47	(143)
Indiana, PA (CBWS Portion Only)	acres	9	9	0.1	15	2	(13)
Jefferson, PA (CBWS Portion Only)	acres	1	1	0.0	0	0	0
Lackawanna, PA (CBWS Portion Only)	acres	194	194	-0.7	168	30	(138)
Luzerne, PA (CBWS Portion Only)	acres	1,750	1,739	-11.6	257	41	(216)
Lycoming, PA (CBWS Portion Only)	acres	474	474	0.0	145	19	(126)
Northumberland, PA (CBWS Portion Only)	acres	388	388	0.3	0	0	(0)
Potter, PA (CBWS Portion Only)	acres	252	254	1.8	18	0	(18)
Schuylkill, PA (CBWS Portion Only)	acres	331	332	0.9	81	11	(70)
Snyder, PA (CBWS Portion Only)	acres	316	316	0.0	0	8	8
Somerset, PA (CBWS Portion Only)	acres	25	25	0.1	0	0	0
Susquehanna, PA (CBWS Portion Only)	acres	103	103	-0.1	147	0	(147)
Tioga, PA (CBWS Portion Only)	acres	30	30	0.0	0	27	27
Wayne, PA (CBWS Portion Only)	acres	7	7	0.1	6	0	(6)
Wyoming, PA (CBWS Portion Only)	acres	80	80	0.0	51	2	(49)

Table 3: CSS Acres

Geography	Load Source	Unit	2020 CAST-19	2020 CAST-21	Difference in 2020	2025 CAST-19	2025 CAST-21	Difference in 2025	CAST-19 2025-2020	CAST-21 2025-2020
Columbia, PA (CBWS Portion Only)	CSS Buildings and Other	acres	558	-	(558)	560	566	6	2	566
Columbia, PA (CBWS Portion Only)	CSS Construction	acres	6	-	(6)	1	-	(1)	(5)	-
Columbia, PA (CBWS Portion Only)	CSS Roads	acres	167	-	(167)	168	168	0	1	168
Columbia, PA (CBWS Portion Only)	CSS Tree Canopy over Impervious	acres	78	-	(78)	79	78	(0)	0	78
Columbia, PA (CBWS Portion Only)	CSS Tree Canopy over Turf Grass	acres	159	-	(159)	160	152	(8)	1	152
Columbia, PA (CBWS Portion Only)	CSS Turf Grass	acres	369	-	(369)	371	377	6	1	377
Columbia, PA (CBWS Portion Only)	CSS Forest	acres	32	-	(32)	32	32	(0)	-	32
Columbia, PA (CBWS Portion Only)	CSS Mixed Open	acres	25	-	(25)	25	22	(3)	-	22
Perry, PA (CBWS Portion Only)	CSS Buildings and Other	acres	262	47	(215)	263	263	(0)	1	216
Perry, PA (CBWS Portion Only)	CSS Construction	acres	6	1	(5)	5	3	(2)	(0)	2
Perry, PA (CBWS Portion Only)	CSS Roads	acres	44	10	(34)	44	44	(0)	0	34
Perry, PA (CBWS Portion Only)	CSS Tree Canopy over Impervious	acres	38	6	(32)	38	36	(2)	0	30
Perry, PA (CBWS Portion Only)	CSS Tree Canopy over Turf Grass	acres	163	20	(143)	164	158	(6)	1	138
Perry, PA (CBWS Portion Only)	CSS Turf Grass	acres	196	42	(154)	198	201	3	2	159
Perry, PA (CBWS Portion Only)	CSS Forest	acres	141	19	(122)	137	143	6	(4)	124
Perry, PA (CBWS Portion Only)	CSS Mixed Open	acres	15	2	(13)	14	15	1	(0)	14

Comment provided by: Jill Whitcomb—PA on 4/15/2022

A) CBP Office Response

Regarding Pennsylvania's concern over the forecasted areas of agricultural land use, the Agriculture Workgroup considered several options for forecasting animal populations and land use acres for CAST-21 during 2020 and 2021. At the March 2021 meeting, the Agriculture Workgroup achieved consensus to continue using the current projection method (double exponential smoothing: $\alpha=0.8$). The crop and pastureland areas are determined using the partnership-approved land use change product and the crops are fit to those acres using the Census of Agriculture's proportion of crops. Double cropped acres are determined by the amount of harvested cropland that is excess of the cropped area. For changes between the 2017 Census of Agriculture and 2025, the acres are a reflection of the crop and pasture land from the 2013 change product.

The construction acres were reported by Pennsylvania for the years 1985 through 2021. The 2022 through 2025 acres were not provided, so the default calculation is used. The default is calculated as: 2021 Construction = $1.29 \times (2022 \text{ developed acre} - 2021 \text{ developed acres})$. This is documented in the Model Documentation (<https://cast.chesapeakebay.net/Documentation/ModelDocumentation>) as well as the CAST Data Update Frequency table on CAST (<https://cast.chesapeakebay.net/Home/TMDLTracking#progressReportingSection>). Pennsylvania can provide acres of construction for future years by the August 31 deadline of each year.

The CSO connections were updated in 2020 and those were carried forward by Pennsylvania for 2021. These CSO connections are part of Pennsylvania's point source/wastewater data submission. These updates affect the CSS acres. There is a separate point source dataset that was provided for the WIP3.

4) Comment - CAST-21: Program and Policy Implications

The data that is used to inform the load projections through time in CAST-21 should not be perceived as meeting the scientific rigor that would be required to justify the investment of additional annual dollars to meet a modeled outcome. In the coming two-year iteration of CAST, there should be a priority placed on:

- Research on load inputs, with a focus on fertilizer and animal data,
- Identification of uncertainty of the load inputs, both separately and as a whole, and
- Re-evaluation of the current methodology related to AAPFCO data use.

According to CAST-21, Pennsylvania has an assumed additional load of approximately 2.7 million pounds of nitrogen. The Chesapeake Bay watershed, as a whole, has an assumed additional load of approximately 6 million pounds of nitrogen. These loads were identified in November 1, 2021, with the initial release of CAST-21 for beta testing.

In comparison, the Chesapeake Bay Program Partnership identified an additional 6 million pounds of nitrogen from the Conowingo Dam, after having been provided data and research from the USGS report, ["Sediment Transport and Capacity Change in Three Reservoirs, Lower Susquehanna River Basin, Pennsylvania and Maryland 1900-2012."](#)

As a result of this report, published in 2015, the Lower Susquehanna River Watershed Assessment (LSRWA) team released the results of their study related to sediment management options of the Conowingo Dam. In 2017, the Principles Staff Committee (PSC) agreed to work collaboratively on a multi-jurisdictional Watershed Implementation Plan (CWIP) and in 2018, the Conowingo WIP Steering

Committee was formed. Multiple iterations of the draft CWIP were developed, communicated to the Bay Partnership at multiple levels, including the PSC, as well as stakeholders at-large across the partnering jurisdictions. In September 2021, the final CWIP was submitted to EPA for evaluation. Based on CAST cost estimates, the best management scenario that was developed for the demonstration of meeting the target with cost-effective practices showed that it would cost at least \$53 million a year, in addition to the estimates for implementing jurisdictional Phase 3 WIPs.

Conclusion

The data that is used to inform the load projections through time in the biennial CAST model updates should be held to a consistent standard and rigor as all other inputs. As stated previously, the levels of uncertainty and confidence of every input to the model, including but not limited to fertilizer and animal data, should be provided to the Partnership and stakeholders. Those with greatest impact to the potential nutrient loads deserve greater review and analysis.

Comment provided by: Jill Whitcomb—PA on 4/15/2022

A) CBP Office Response

EPA and the CBP office will continue to provide resources (e.g., staffing, financial) and technical assistance to support WIP and two-year milestone planning and implementation efforts – including organizing a prioritized, thorough review of potential changes to methods and data used in the model.

As was announced at the April 21, 2022 Agriculture Workgroup meeting, the Phase 7 agricultural modeling group is being formed. That group will prioritize and tackle agricultural modeling items as charged by the WQGIT and the Agriculture Workgroup. The Phase 7 model will undergo extensive reviews by the CBP partnership and the independent STAC, as was done during the development of the Phase 6 suite of modeling tools. This process is designed to meet the scientific rigor Pennsylvania describes.

The *2010 Chesapeake Bay TMDL* (Bay TMDL) establishes outcomes that are to be met by water quality monitoring data. Monitoring data is used to inform the calibration of the modeling tools, which are then used to assess progress towards the Bay TMDL goals. It was the monitoring data that led to the listing of waterways, and is monitoring that will lead to delisting. The TMDL does not link modeled data to investment strategies. Instead, load reductions are expected to be met in the way that the jurisdictions plan to do so in their implementation plans.

As aforementioned, the increased application of fertilizer is concerning given the rate of progress with BMP implementation. The increase in fertilizer use reported through AAPFCO is validated through alternative source of information including fertilizer expenditures in the Census of Agriculture and, generally, the latest USDA NRCS CEAP cropland assessment [*Conservation Practices on Cultivated Cropland, A Comparison of CEAP I and CEAP II Survey Data and Modeling*](#). Model estimates indicate that BMPs have not been implemented at a rate that offsets increased nutrient applications. It is the expectation that additional new practices, projects, and control technologies are implemented and those already in place are maintained.

CAST was developed to facilitate transparency, and the data review period, individual meetings with jurisdictions, presentations and explanations to the Watershed Technical Workgroup, WQGIT, Management Board, and source sector workgroups – are some of the ways that data and methods are

communicated. The actions that were taken to convey the information are summarized at the beginning of this document.

Virginia

1) Comment-Load and acre changes

Virginia noted that they have observed the percentage change in the numbers increasing as one goes from Virginia statewide scale to basin scale and then county scale. They also noted disproportional loadings impacts as compared to acreage increases and decreases. They were confused how some load sources can go down in acreage slightly but have significant increases or decreases.

Virginia noted that statewide, the roads load source went down over 17,000 acres (18%) but non-regulated roads load source increases less than 15,000 acres and it is not clear where those roughly 3,000 acres of formerly regulated roads are now attributed.

Virginia noted that neither of the WIP 3 (Official and CAST 21) versions available in CAST 21 have any Animal BMPs in the BMP Input text files. Virginia did see these BMPs in the submitted versus credited report but could not export the text file used by CAST 21 that showed the BMPs.

Virginia said it would be informative to get a CAST 21 scenario with a 2025 no action scenario before final approval.

Virginia found that when they compared the 2020 progress scenario from CAST 19 and CAST 21 statewide unit area loads by load source, they saw 9 load sources with significant changes ($\geq 5\%$). All were agricultural load sources.

Comment provided by: William Keeling—VA-DEQ on 12/1/2021

A) CBP Office Response

The BMP input text files were not showing the credited animal BMPs. This error was corrected the day that Virginia brought it to the attention of the CBP office.

A CAST-21 no action (no BMP) scenario on 2025 land uses was created and shared with Virginia.

The differences in absolute and unit (pounds per acre) loads between CAST-19 and CAST-21 are primarily due to updated data for 1) farm fertilizer (2015-2016), 2) crop yields (2017-2020 for six major crop types, resulting in updates to yields for 2013 forward), and 3) Virginia's reported BMP history.

For nutrient inputs to agricultural land over the 2012 to 2016 period, manure nitrogen increased 2.12M pounds (6%) and inorganic fertilizer increased 7.20M pounds (10%). Increases in soybean production increased fixation by an estimated 2.06M pounds (6%). Biosolid nitrogen applications decreased over the 2012-2016 period by 2.17M pounds, as well as manure nitrogen directly applied to pastureland (1.58M pounds, 3%) when comparing between versions. Overall, nitrogen inputs/fixation of 10.63M pounds (4%) is estimated to increase between CAST-19 and CAST-21.

Virginia also noted disproportional loadings impacts as compared to acreage increases and decreases. The BMP history is updated for each new CAST version. When a CAST version is not being updated, the BMPs submitted are only updated for the year of progress. The annual BMPs are those that must be implemented annually to have an effect, like street sweeping or cover crops. The cumulative BMPs are

those that carry an effect forward in time assuming they continue to be inspected to prolong model credit. Cumulative BMPs typically are structures, such as stormwater ponds and animal waste management structures. Cumulative BMPs implemented in any year are credited in that year's progress, assuming the inspections are up to date. Annual BMPs are only credited in that one year. When CAST is updated to a new version, the entire BMP history that was submitted via NEIEN is updated. The annual BMPs in every year are credited in the new version, whereas they were not if submitted or updated after the progress period in the older version. This has been the process the CBP office has used for more than a decade, since NEIEN was brought online. The crediting of these BMPs, along with the updates to the land use, change the loads.

2) Comment-Review timing and wastewater

Virginia commented that they have excessive time demands with annual reporting and QAPP revisions and therefore have not been able to give proper attention to the CAST21 review.

Virginia noticed some increases in industrial wastewater (flow and TSS) that they sent to Allen Brokenbrough. They were also looking at applied nutrients information and thought some of it looked strange. For example, TN needs going down and applications going up and large increases of applied N to full season soybeans.

Comment provided by: William Keeling—VA-DEQ on 12/2/2021

A) CBP Office Response

The CBP office understands that releasing updated versions of CAST while the annual progress review is underway is difficult for staff. As such, the CBP is scheduling future release of new CAST versions for the time period after the progress submittals are concluded. This has the added benefit of allowing the most up-to-date BMP history to be used.

Nutrient applications do increase as the new datasets show increased fertilizer sales. The increase in usage reflected in the AAPFCO sales data indicates there is an increased load that will likely make reaching our Chesapeake Bay TMDL goals even more challenging.

Virginia updated all wastewater insignificant facilities from 2014 to 2020.

3) Comment-application rate changes

Virginia indicated they have continued to examine CAST 21 and wanted to make sure to add their concerns over what appears to be a reduction in crop need when comparing the 2020 progress scenario between versions at the county scale. Couple this with the increases in fertilizer and it is no surprise Ag loads are significantly higher. To their understanding, crop needs should not change between scenarios or versions of CAST.

Comment provided by: William Keeling—VA-DEQ on 1/2/2022

A) CBP Office Response

The typical crop application goal does not change. The actual rates do change based on updates to the inorganic fertilizer data, animal manure, and NASS crop yields. The AAPFCO data was corrected for 2013 and 2014, and updated to include 2015 and 2016. The previous data through 2014 was lower than the updated data for 2013 through 2016. These new data inputs resulted in more fertilizer available to be applied to agricultural land. In addition, the crop yield data for six major crop types over the 2017-2020

period were updated, resulting in changes in crop yields for years after 2012. The yields for crops increased, which also affects the nutrient applications. The formula used in Phase 6 uses the typical rate applied for a typical yield per acre. These typical rates per yield were established by the Agricultural Modeling Subcommittee. These rates per yield per acre are then modified by multiplying by the NASS yield per acre. $(\text{TN Lbs.} / \text{typical crop yield} / \text{acre}) * (\text{NASS yield} / \text{acre})$. This formula is used for all years where we have AAPFCO data, which is through 2016. After 2016, the model applies nutrients at the same level that was met in 2016. This is calculated as the ratio of 2016 nutrients applied to the typical rate.

The methods and data sources were established by the Agricultural Modeling Subcommittee and approved by the Agriculture Workgroup. All Phase 6 model changes were evaluated through a public process of fatal flaw review as well as a STAC review of Phase 6 model inputs.

4) Comment-Fertilizer Sales Data

Regarding the use of the AAPFCO non-farm fertilizer sales data for turf grass, we respectfully request the removal of the turf fertilization revision from CAST 2021 and that it be reviewed for future incorporation once it has been further vetted through the WQGIT. The revised application rates and their load effects do not appear to be representative of the real-on-the-ground change in the watershed. The lack of consensus on this issue at the March 2022 Urban Stormwater Workgroup was concerning as is the lost opportunities to vet significant load changes resulting from corrections and data omissions that have occurred with CAST 21 more thoroughly through the Partnership process.

Furthermore, the implications of the previously omitted farm fertilizer AAPFCO data from 2013-2014, reported in Virginia, has implications in all states as a result of the CAST nutrient spread algorithm. It should be noted that the approval of this algorithm was in the first version of CAST (-15) sanctioned as the Bay Model during a time when the omitted data was missing during the partnership review. Therefore, CAST was presumed to be working and giving reliable results without this data so including it in CAST-21 would require partnership review on-par with the full Phase 6 Watershed Model review. Given the late discovery of these concerns, we recommend these revisions be deferred.

Comment provided by: Bryant Thomas—VA-DEQ on 1/2/2022

A) CBP Office Response

The urban fertilizer was the subject of the [January 18, 2022](#) and [March 15, 2022 USWG meetings](#). Alternative methods were proposed at the March 2022 USWG. Ultimately, USWG members did not reach a consensus, so the existing method, approved by the USWG in June 2016, continues to be used. This follows CBP partnership protocols for decisions.

To date, the CBP office has not received any different data sets from jurisdictional partners. The CBP office is using the information and methodology approved by the partnership. The USWG plans to address urban nutrient management issues in future model updates, i.e. the plans presented by David Wood at the March 28 WQGIT:

https://www.chesapeakebay.net/what/event/water_quality_goal_implementation_team_conference_c_all_march_28_2022.

The review of the calibrated Watershed Model/CAST had no omitted or erroneous AAPFCO fertilizer sales data. The calibration used data through 2012. The 2013 to 2016 AAPFCO data updates were not part of the calibration, but extend the time period where actual sales data can be used rather than

estimated based on past usage. It is this newer data that indicates an increase in usage in the Bay watershed that is concerning.

5) Comment

We first point out in our review that the loading numbers have changed significantly between CAST 19 and CAST 21. While EPA staff have identified errors and omissions (addition of Ag fertilizer, broiler/turkey populations, and crop yield data) which account for some of the changes in predicted loadings, we confirmed that two different BMP histories were applied between CAST versions 19 and 21. This greatly confounded our efforts in understanding land use and loading changes. Therefore, we do not attempt to explain the basis for changes in predicted loadings; rather, we identify where there are apparent anomalies in the results which cause concern.

As in the past we have examined CAST 21 at various scales and like in the past see the percentage change in the numbers increasing as one goes from Virginia statewide scale to basin scale to county scale and down to land-river segment (LRseg) scale. For many of the issues we identified in our preliminary review done at the end of 2021 we see some shifting of the numbers but essentially the same issues exist, these being large and unbelievable shifts in load source acres and associated loading impacts. This supports our position that we should recognize the benefits and limitations of the modeling tools we have and not rely on the accuracy of the predicted loading numbers as much as utilizing CAST to track BMP implementation and reporting over time.

The analyses presented below are based on a comparison of CAST 19 and CAST 21 using the 2020 water year, and focus on total nitrogen (TN) as the primary pollutant of concern. Our analysis highlights the variability of the CAST models as well as inconsistencies when comparing observed water quality conditions over time against CAST predictions. Quite simply, the CAST loading predictions simply do not correlate with on-the-ground observations. This is not to suggest the models do not serve an important function in identifying relative loadings across the landscape and tracking BMP implementation progress over time. But they are not good tools for predicting actual nutrient loadings.

Table 1. Select Land Use and Associated TN Load Changes of Concern Comparing CAST 19 and CAST 21

Geography	Load Source	Unit	CAST 19	CAST 21	Δ 21-19	Δ %	TN EOT %
VA Bay	Double Cropped Land	Acre	83,818	96,170	12,352	14.7	27.0
Eastern Shore	Double Cropped Land	Acre	4,227	10,161	5,933	140.4	164.2
Accomack County	Double Cropped Land	Acre	3,004	4,458	1,454	48.4	52.6
Northampton County	Double Cropped Land	Acre	532	2,869	2,337	438.9	515.3
VA Bay	Sm Grains and Grains	Acre	63,627	50,704	-12,923	-20.3	-23.1
Eastern Shore	Sm Grains and Grains	Acre	6,816	2,291	-4,525	-66.4	-63.8
Accomack County	Sm Grains and Grains	Acre	1,645	446	-1,199	-72.9	-72.5
Northampton County	Sm Grains and Grains	Acre	2,701	969	-1,732	-64.1	-61.1
VA Bay	MS4 Roads	Acre	105,193	87,520	-17,673	-16.8	-14.1
Potomac River	MS4 Roads	Acre	46,649	29,873	-16,777	-36.0	-7.6
Fairfax County	MS4 Roads	Acre	18,198	4,002	-14,196	-78.0	-77.7
VA Bay	Non-Regulated Roads	Acre	173,524	186,834	13,310	7.7	6.2
Potomac River	Non-Regulated Roads	Acre	45,354	60,794	15,440	34.0	25.0
Fairfax County	Non-Regulated Roads	Acre	3,206	17,413	14,207	443.1	424.7

VA Bay	Mixed Open	Acre	336,412	332,408	-4,004	-1.2	-2.8
Eastern Shore	Mixed Open	Acre	4,376	3,742	-634	-14.5	-13.4
James River	Mixed Open	Acre	109,682	105,579	-4,103	-3.7	-2.9
Potomac River	Mixed Open	Acre	97,664	100,746	3,082	3.2	2.5
Rappahannock River	Mixed Open	Acre	32,328	27,855	-4,473	-13.8	-16.8
York River	Mixed Open	Acre	40,855	44,361	3,506	8.6	1.6
Louisa County	Mixed Open	Acre	8,300	11,321	3,021	36.4	28.2
Spotsylvania County	Mixed Open	Acre	4,419	7,288	2,869	64.9	19.1
Fluvanna County	Mixed Open	Acre	2,436	5,390	2,954	121.2	110.5
Amelia County	Mixed Open	Acre	2,200	108	-2,092	-95.1	-91.7

We find it troubling when changes in a single county accounts for a very large to a majority percentage of the entire change in the Commonwealth. For example, as presented in Table 1 above, double cropped land area changes are dominated by Northampton County or the MS4 roads and unregulated roads changes in Fairfax County dominate these statewide load source area changes between CAST versions. We are still seeing a disproportionate load increase as compared to area increase on the double cropped land load source and still wonder if the NASS data regarding the load source (cropland rotation) is being misinterpreted by the CBP. We could not determine a logical pattern for mixed open other than there were differences in both positive and negative directions.

Table 2. Changes to 2020 Progress Edge of Tide (EOT) TN Loadings by Basin and Sector in CAST 19 and CAST 21

Geography	Sector	CAST 19 EOT TN (lbs/yr)	CAST 21 EOT TN (lbs/yr)	Δ 21-19 EOT TN (lbs/yr)	Δ %	% total Δ
Eastern Shore	Agriculture	1,436,918	1,675,573	238,655	16.6	51.4
James River	Agriculture	4,221,601	4,249,188	27,587	0.7	5.9
Potomac River	Agriculture	7,680,735	7,721,182	40,448	0.5	8.7
Rappahannock River	Agriculture	4,004,055	4,109,728	105,673	2.6	22.8
York River	Agriculture	2,182,008	2,293,163	111,155	5.1	23.9
Eastern Shore	Developed	251,665	255,505	3,840	1.5	0.8
James River	Developed	4,653,581	4,607,871	-45,710	-1.0	-9.8
Potomac River	Developed	3,673,418	3,657,544	-15,874	-0.4	-3.4
Rappahannock River	Developed	1,179,430	1,152,399	-27,031	-2.3	-5.8
York River	Developed	1,152,866	1,141,261	-11,605	-1.0	-2.5
Eastern Shore	Natural	330,122	341,132	11,010	3.3	2.4
James River	Natural	5,484,519	5,493,712	9,193	0.2	2.0
Potomac River	Natural	3,144,003	3,156,566	12,564	0.4	2.7
Rappahannock River	Natural	2,009,297	2,019,320	10,024	0.5	2.2
York River	Natural	1,775,670	1,793,474	17,804	1.0	3.8
Eastern Shore	Septic	58,380	56,729	-1,651	-2.8	-0.4
James River	Septic	679,415	661,825	-17,590	-2.6	-3.8
Potomac River	Septic	827,416	815,951	-11,465	-1.4	-2.5
Rappahannock River	Septic	336,764	328,081	-8,683	-2.6	-1.9
York River	Septic	256,029	252,530	-3,499	-1.4	-0.8

Eastern Shore	Wastewater	41,037	21,883	-19,154	-46.7	-4.3
James River	Wastewater	8,916,724	8,969,720	52,996	0.6	11.4
Potomac River	Wastewater	2,525,829	2,610,435	84,606	3.4	18.2
Rappahannock River	Wastewater	438,368	364,776	-73,593	-16.8	-15.9
York River	Wastewater	744,653	719,265	-25,388	-3.4	-5.5
All Basins	All Sectors	58,004,502	58,468,813	464,311	0.8	100

Table 3. Changes to 2020 Progress Year TN Loadings for All Sectors Combined by Basin

Geography	Sector	CAST 19 TN (lbs/yr)	CAST 21 TN (lbs/yr)	Δ 21-19 TN (lbs)	Δ %	% total Δ
Eastern Shore	All	2,118,122	2,350,822	232,700	11.0	50.1
James River	All	23,955,840	23,982,316	26,476	0.1	5.7
Potomac River	All	17,851,401	17,961,679	110,278	0.6	23.8
Rappahannock River	All	7,967,914	7,974,304	6,390	0.1	1.4
York River	All	6,111,225	6,199,692	88,467	1.5	19.1
All Basins	All	58,004,502	58,468,813	464,311	0.8	100

Figure 1. Bay Watershed Geographic Distribution of TN Loadings for by Land-River Segments (LRSegs) using 2020 Progress Year

CAST 19 Absolute Pounds of Nitrogen Delivered to Edge of Tide 2020 Progress **CAST 21 Absolute Pounds of Nitrogen Delivered to Edge of Tide 2020 Progress**

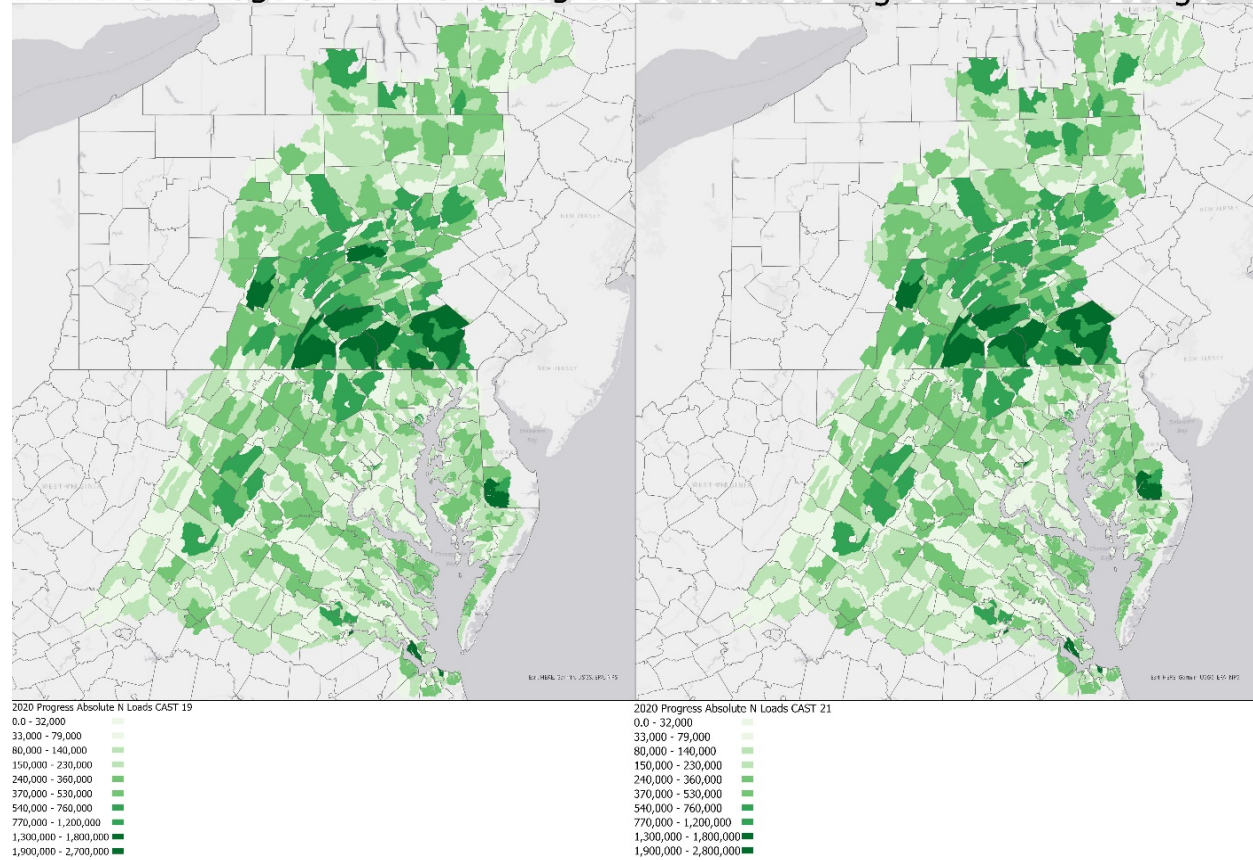


Figure 2. Change in VA TN Loadings by LRSegs using CAST 19 and CAST 21 for 2020 Progress Year.

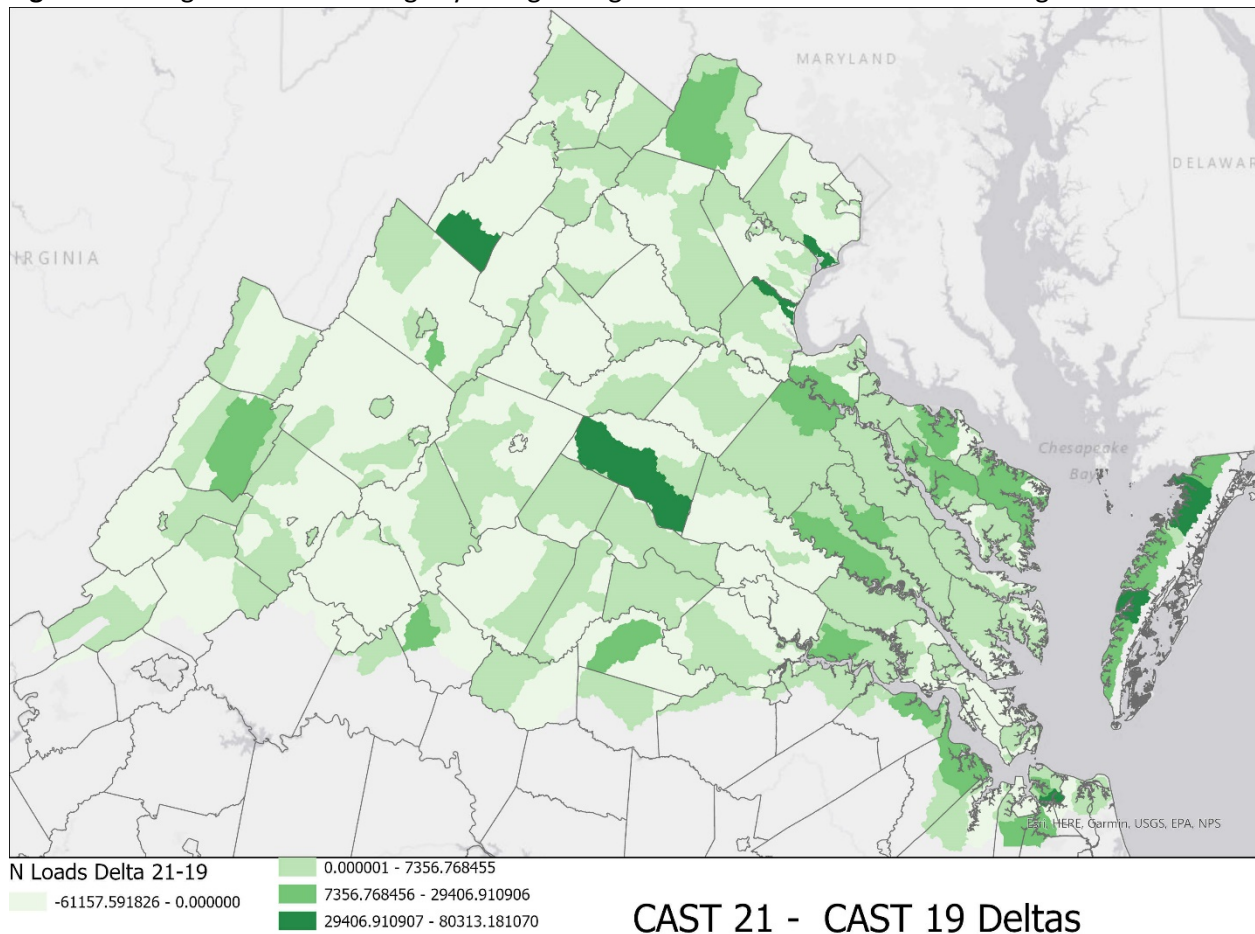
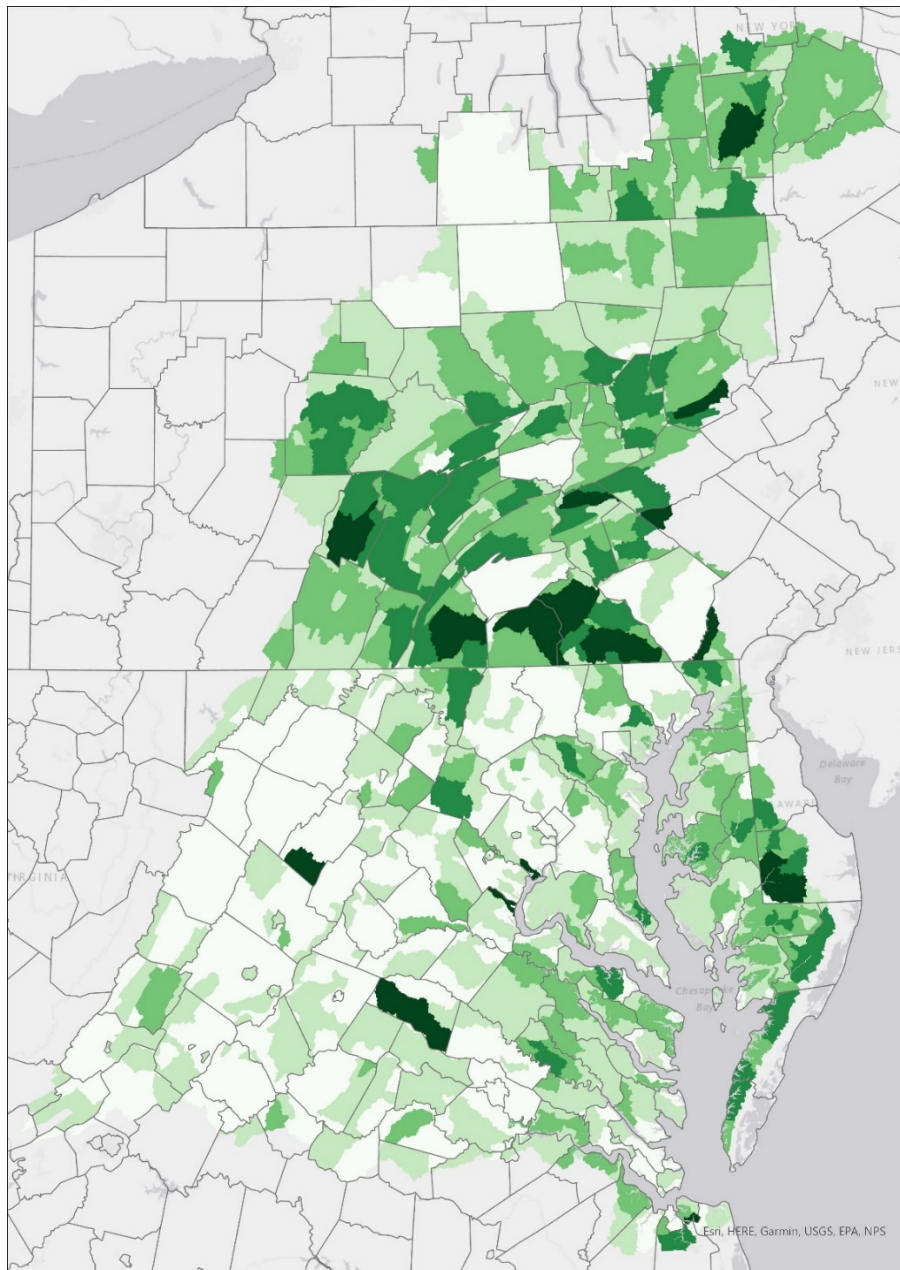
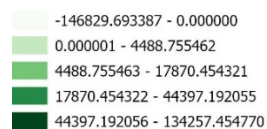


Figure 3. Change in Bay Watershed TN Loadings by LRSegs using CAST 19 and CAST 21 for 2020 Progress Year



CAST 21 - CAST 19 Deltas



As detailed in Tables 2 and 3 and the maps above, there is a general shift in delivered loadings from south to north and from west to east. In Virginia, we see a definite shift in EOT TN from western parts of the state to eastern parts with the extreme eastern end of the state's Bay draining segments (Eastern

Shore) having the largest increase. Half of all TN increased loadings in Virginia under CAST 21 are attributed to agriculture on the VA Eastern Shore. This does not appear to match the observed trends from the monitoring data. Specifically, the short-term flow-adjusted change in total nitrogen from 2011-2020 produced in partnership between MDDNR, VADEQ, ODU and the Chesapeake Bay Program suggest that TN levels in the vicinity of the Eastern Shore of Virginia are decreasing with statistically significant trends. However, the CAST 21 nitrogen loadings for this area of Virginia show an increasing trend over the same time period for delivered TN loadings. There seems to be a discrepancy in the observed, empirical data and what CAST 21 is reporting. Interestingly, we note that the nitrogen loadings produced by CAST 19 over this time period predicted decreasing loadings consistent with the empirical observations in this area. See Figure 4 below for graphical representation of the water quality trend analysis information, and Figures 5 and 6 for the CAST 19 and CAST 21 total TN loadings for the Eastern Shore over of the 2011-2020 time period, respectively. Additionally, we note that both versions of CAST indicate increasing loadings from the Potomac Basin and declining loadings from the Rappahannock Basin. However, the observed trend data from these basins show opposite trends than what either version of CAST indicate. While not confirmative, these comparisons of the CAST loadings against observed data suggest that CAST loadings are best considered as relative loadings and not necessarily reflective of actual conditions.

Figure 4. Monitoring Trend Analysis Illustrating Decreasing TN Trends in VA Eastern Shore Tidal Waters

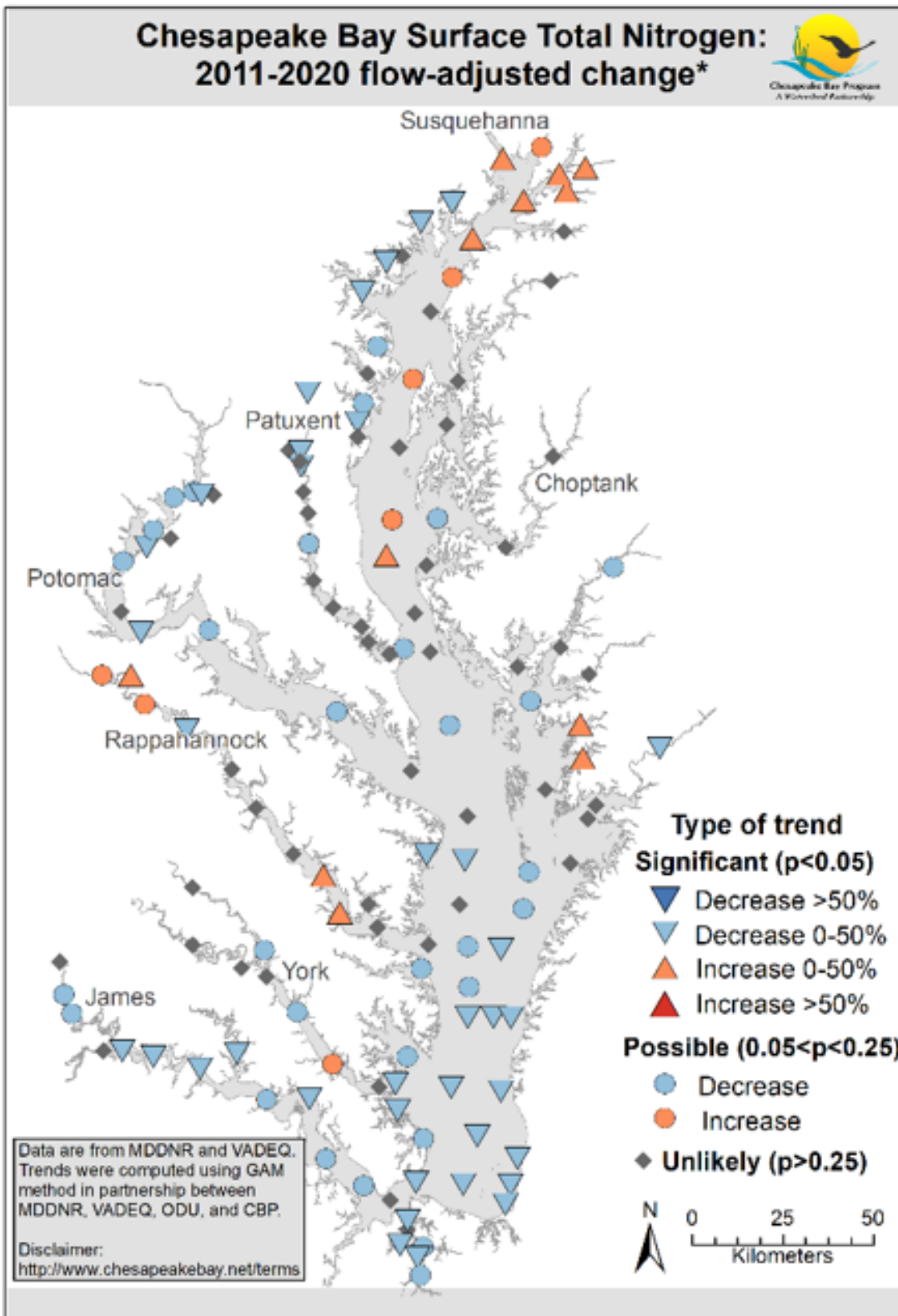


Figure 5. VA Eastern Shore EOT TN Loadings from CAST 19 for 2020 Progress Year

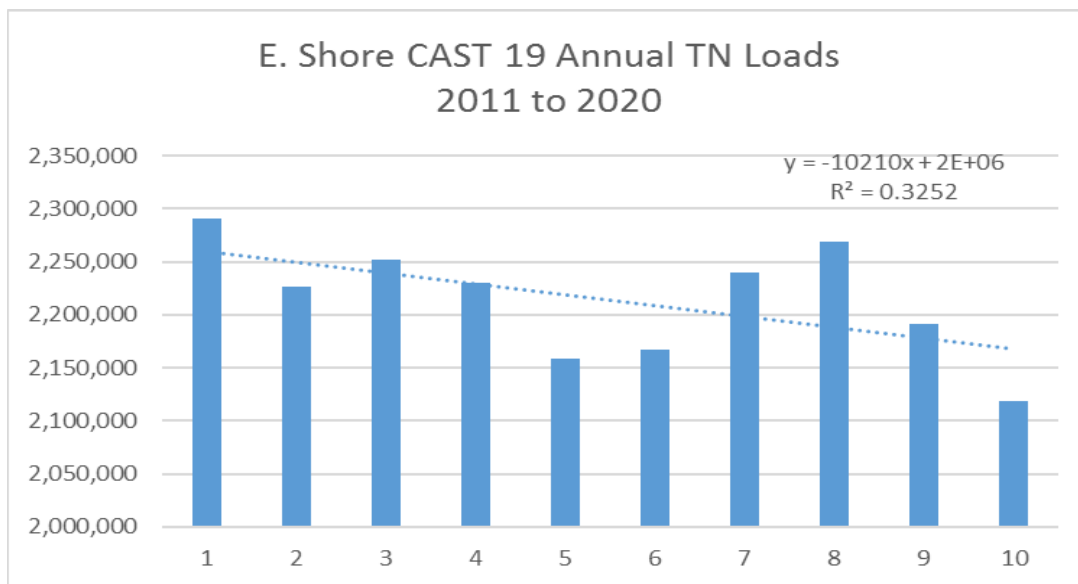
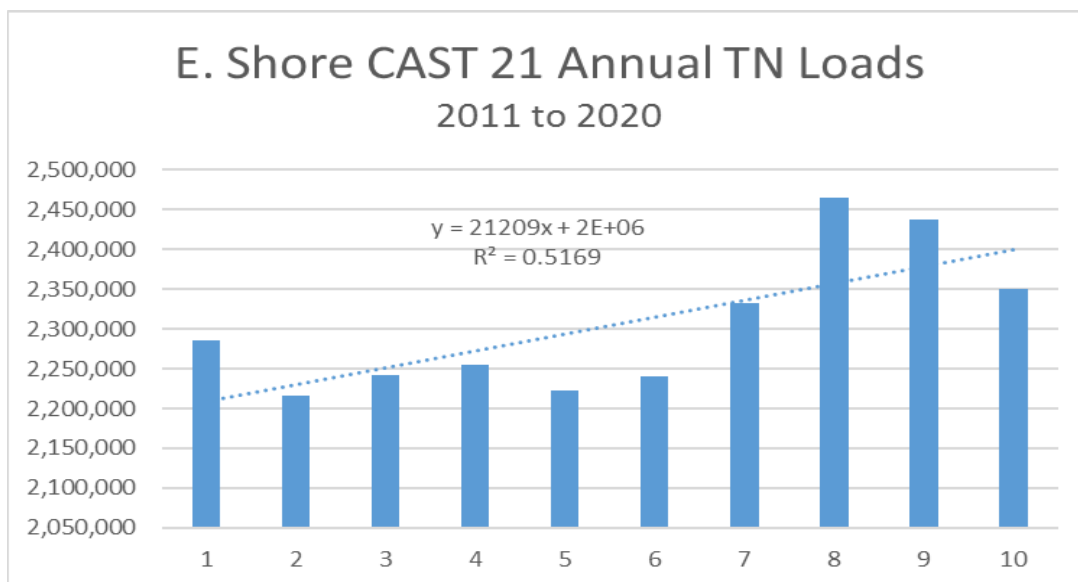


Figure 6. VA Eastern Shore EOT TN Loadings from CAST 21 for 2020 Progress Year



We have serious concern over our ability to achieve the needed reductions from Virginia's Eastern Shore considering the shift eastward in delivered loadings and the very significant increase to the Agricultural sector in a basin with only the western half of two counties within which to increase implementation efforts. Using the period 2011 to 2020, we experienced approximately a 20,000 pound EOT TN reduction on average per year on the VA Eastern Shore in CAST 19. This same analysis using CAST 21 indicates on average Virginia's Eastern Shore EOT TN increases on average by over 7,000 pounds annually. Again this does not match the available monitoring trend data for that portion of the Chesapeake Bay watershed.

With these predictions, Virginia may need a decade of additional implementation on the Eastern Shore just to get back to where CAST 19 indicated EOT TN loadings. Alternatively, it could be said we have added a decade or more to attainment for that Virginia basin. We also have concerns over the impact this may have on trading credits existing or in the future.

Comment provided by: Bryant Thomas—VA-DEQ on April 15, 2022

A) CBP Office Response

Thank you for making the time to do these detailed analyses and provide responses.

For the explanation of differences in Virginia manure and fertilizer inputs to the land, legume fixation, and BMP data used in CAST versions, please see the response to Virginia's comment number 1. The data updates and any changes to methods are part of the two-year milestones cycle where the partnership has agreed to incorporate new data so estimates of where we are with respect to goals reflects the best information.

The agricultural fertilizer data and NASS crop yield data were the most significant changes between CAST versions, and responsible for most of the load difference between versions. There was less of a shift of nutrients from one part of the state to another part, than an increase in load from agricultural land. The Virginia Eastern Shore counties of Northampton and Accomack are predominantly comprised of agricultural land and have about 200,000 lbs. of TN delivered to the edge-of-tide. Inorganic fertilizer accounts for about half of that amount. The manure and directly excreted manure have not changed substantially. The amount of USDA-NASS-reported crop yield increased, therefore nutrient applications per acre increased. The per acre rate in CAST-19 was approximately 65 pounds and in CAST-21 is about 85 lbs. The Eastern part of Virginia also has substantial agricultural land, which is why the changes to loads are more substantial in those areas. Double cropped land is seeing this increase as well.

One of the expectations in the *2010 Chesapeake Bay TMDL for Nitrogen, Phosphorus, and Sediment* (Bay TMDL) is that there is accounting for and management of new and increased loadings of nitrogen, phosphorus, and sediment ([Section 10. Implementation and Adaptive Management](#)). The section states that new and increased sources must be offset. Virginia has continued to implement BMPs to control existing loads and has seen a decrease in loads as a result. As crop yields have increased (according to USDA-NASS) and fertilizer usage has increased across the Bay watershed (according to AAPFCO and particularly for the period 2012-2016 when fertilizer prices decreased, per the NASS data), there is an increased load from agriculture. The Natural Resources Conservation Service (NRCS) Conservation Effects Assessment Project (CEAP) [Cropland Assessment](#) showed similar findings in fertilizer usage. CEAP uses farmer surveys for 2013 to 2016, which is an independent and separate data source. Managing future growth is a specific expectation of the Bay TMDL and one for which EPA has oversight under the Bay TMDL's accountability framework and as part of its evaluation of progress.

CAST was developed to facilitate transparency, and the data review period, individual meetings with jurisdictions, presentations and explanations to the Watershed Technical Workgroup, WQGIT, Management Board, and source sector workgroups are some of the ways that data and the tools the data inform are communicated. The actions that convey this information are summarized at the beginning of this document.

When comparing loads between CAST-19 and CAST-21, CBP staff communicate if the comparisons are between absolute loads for a point in time (a year) or between how loads changed through time. When comparing CAST-19 to CAST-21 for a single year (e.g., the 2020 Progress scenario), CBP staff find using the term “higher” loads rather than “increasing” loads avoids confusion. Looking at nitrogen load changes through time, all five state-basins show decreasing loads for the period 2009 (the starting point for the Bay TMDL) to 2020, including the Eastern Shore – for both CAST-19 and CAST-21.

CBP staff agree with Virginia’s statement that CAST loadings are better considered as relative loadings and not necessarily reflective of actual conditions for a point in time. Monitoring data is used to inform the calibration of the modeling tools, which are then used to assess progress towards the Bay TMDL goals. It was the monitoring data that led to the listing of impaired waterways, and is monitoring that will lead to delisting.

West Virginia

1) Comment

West Virginia stated that it was not in support of the use of CAST-21 due to the artificial and significant load effects that have resulted from the incorporation of recent AAPFCO non-farm fertilizer sales data. West Virginia proposed removing the turf fertilization revision from CAST-21 and instead pursue it in the next phase of the watershed model. West Virginia stated that it has long been recognized that AAPFCO data is unsuitable for representation of nitrogen and phosphorus application test rates on turfgrass, and that past representations to the USWG have documented extreme variability in the data and recognized that the data is not generated for watershed loading purposes.

West Virginia said that not enough time was afforded to pursue data quality reviews or method evaluations that might provide more realistic results across the watershed (they initially received the raw data on November 17, 2021, with the deadline for CAST-21 approval being November 30th). West Virginia proposed that the revision be deferred and evaluated in detail in the time afforded for the next model update.

Comment provided by: Teresa Koon—WV-DEP on 11/19/2021

a) CBP Office Response

CBP acknowledges West Virginia’s concern with the incorporation of the AAPFCO non-farm fertilizer data. CBP agrees that issues previously identified by both the USWG and the Urban Nutrient Management Expert Panel still exist. To date, the CBP office has not received any different data sets from jurisdictional partners, nor have there been any recommendations for alternative data sources or new methods. The CBP office is using the information and methodology approved by the partnership. The USWG plans to address urban nutrient management issues in future model updates, i.e. the plans presented by David Wood at the March 28 WQGIT: https://www.chesapeakebay.net/what/event/water_quality_goal_implementation_team_conference_c_all_march_28_2022.

2. Comment

West Virginia stated it stands by its previous objections to implementing the nonfarm fertilizer update in CAST-21. West Virginia stated that it had not had the opportunity to review the raw AAPFCO data used in the revision and said that they saw an apparent issue with the sales-based loads for the West Virginia

counties that are only partially within the Chesapeake Bay watershed, and that may be the cause of unrealistic effects of the revision in West Virginia. They assumed that the revisions are disproportionately and artificially influencing the West Virginia state-wide turf application rate and recommended removing the partial county data from the process.

Comment provided by: Teresa Koon—WV-DEP on 12/13/2021

A) CBP Office Response

Procedures agreed to by the Urban Stormwater in June 2016 for processing the urban fertilizer data were followed. CBP staff provided the raw data and an alternative methodology at a meeting with West Virginia representatives on February 8, 2022. An alternate method for calculating application rates was developed to reduce annual swings in non-farm AAPFCO fertilizer use data. This new method was proposed at the [March 15, 2022 USWG](#) meeting. Ultimately, USWG members did not reach consensus on using the alternate method, so the existing method remains in place.

Note: No further comments submitted by West Virginia after the initial, November review period.

Ken Staver

1) Comment

When looking at Maryland, grains without manure, applied TN diverges in 2012 to 2020 to reach a difference of approximately 10,000 lb./year by 2020 for CAST-2019 versus CAST-2021. What is the reason for this? Also, Dr. Staver believes crop N removal should be shown rather than calculated TN application which is back calculated and confusing as it does not describe anything that actually happened. TN is applied based on yield expectation but removed based on actual yield. Showing TN removal based on actual yields would be more relatable to what is going on.

On the comparison of loads, Mr. Staver could not see a way to see the loads for the land use types that are in later applied TN and TP figures. It shows loads for ag all together. It would be helpful to see the loads for the separate land uses.

The complete narrative for why loads are going up with the new version of CAST is still lacking.

Comment provided by: Ken Staver—UMD on 4/12/2022

A) CBP Office Response

The divergence between the two versions of CAST is primarily due to the difference in inorganic fertilizer inputs. The AAPFCO data was corrected for 2013 and 2014, and updated to include 2015 and 2016. The previous data through 2014 was lower than the updated data for 2013 through 2016. These new data inputs resulted in more fertilizer available to be applied to agricultural land. In addition, six major crop types were not updated by CBP staff from the most recent crop yield data from annual NASS surveys (2017 to 2020). This resulted in adjustments for all years after 2012. Nutrient applications change as the yields for crops increase. The formula used in Phase 6 begins with the typical rate applied for a typical yield per acre, as established by the Agricultural Modeling Subcommittee. These typical rates are then modified by multiplying by the NASS yield per acre. $(\text{TN Lbs.} / \text{typical crop yield} / \text{acre}) * (\text{NASS yield} / \text{acre})$. This formula is used for all years where we have AAPFCO data, which is through 2016. After 2016, the model applies nutrients at the same level that was met in 2016. This is calculated as the ratio of

2016 nutrients applied to the typical rate. The methods and data sources were established by the Agricultural Modeling Subcommittee and approved by the Agriculture Workgroup. All Phase 6 model changes were evaluated by a public, fatal flaw review as well as a STAC review of Phase 6 model inputs.

The loads data by land use can be downloaded from both versions of CAST. The CBP staff can provide guidance through the process for downloading reports for further analysis.

The technical documentation and this response to comments, along with the Fact Sheet, Understanding the Bay Model Tools, and the Comparison of Loads Tool, are resources available to understand differences in the model versions. They are all accessible on [CAST](#). We also can provide a one-on-one tutorial if those materials do not meet your needs for communicating the differences.

The crop uptake data you requested are provided via email.