

Appendix A. Technical Requirements for the Reporting and Crediting of Manure Treatment Technologies in Scenario Builder and the Phase 6.0 Watershed Model

Presented to the WTWG for Review and Approval:

Background: In accordance with the *Protocol for the Development, Review, and Approval of Loading and Effectiveness Estimates for Nutrient and Sediment Controls in the Chesapeake Bay Watershed Model* (WQGIT, 2015) each BMP expert panel must work with CBPO staff and the Watershed Technical Workgroup (WTWG) to develop a technical appendix for each expert panel report. The purpose of this technical appendix is to describe how the Manure Treatment Technology Expert Panel's recommendations will be integrated into the Chesapeake Bay Program's modeling tools including NEIEN, Scenario Builder and the Watershed Model.

Part 1: Technical Requirements for Reporting and Crediting Manure Treatment BMPs without Monitoring Data

Q1. How are Manure Treatment BMPs defined in the Chesapeake Bay Watershed Model?

A1. Manure Treatment BMPs are defined by the expert panel as technologies designed to alter manure characteristics to achieve one or more of the following goals: separate waste streams into a high and a low solids stream; alter manure organic matter; extract energy from manure organic matter; alter the form or concentration of plant-available nutrients; or concentrate nutrients and stabilize organic matter. Manure Treatment is broken into 19 distinct BMPs based upon the type of treatment technology that can be reported for nitrogen reductions.

- *Thermochemical Slow Pyrolysis (MTT1):* Conversion of organic matter in the absence of oxygen at temperatures between 575 and 1,475 F (300 to 800°C). Has longer residence times (hours to days) and lower temperatures and is used to produce char.
- *Thermochemical Fast Pyrolysis (MTT2):* Conversion of organic matter in the absence of oxygen at temperatures between 575 and 1,475 F (300 to 800°C). Has a short residence time (seconds) and moderate temperatures, and is primarily used to produce bio-oil.
- *Thermochemical Low Heat Gasification (MTT3):* Thermochemical reformation of biomass at temperatures less than 1,500°F in a low oxygen or starved oxygen environment, using air or steam as reaction medium.
- *Thermochemical High Heat Gasification (MTT4):* Thermochemical reformation of biomass at temperatures between 1,500 and 2,730°F in a low oxygen or starved oxygen environment, using air or steam as reaction medium.
- *Thermochemical Combustion (MTT5):* Direct consumption of dry manure to produce heat without generating intermediate fuel gases or liquids. Combustion temperature is not known.
- *Thermochemical High Heat Combustion (MTT6):* Direct consumption of dry manure to produce heat without generating intermediate fuel gases or liquids. Combustion temperatures range between 1,500 and 3,000 F (820 to 1,650°C).

- *Standard, In-Vessel and Rotating Bin Composter (MTT7)*: Performed in an insulated silo, channel, or bin using a high-rate, controlled aeration system designed to provide optimal conditions. C:N is unknown.
- *High Carbon, In-Vessel and Rotating Bin Composter (MTT8)*: Performed in an insulated silo, channel, or bin using a high-rate, controlled aeration system designed to provide optimal conditions. C:N > 100.
- *Low Carbon, In-Vessel and Rotating Bin Composter (MTT9)*: Performed in an insulated silo, channel, or bin using a high-rate, controlled aeration system designed to provide optimal conditions. C:N < 100.
- *Standard, Forced Aeration Composter (MTT10)*: Uses mechanical ventilation to push air into or draw air through the pile or windrow. C:N is unknown.
- *High Carbon, Forced Aeration Composter (MTT11)*: Uses mechanical ventilation to push air into or draw air through the pile or windrow. C:N > 100.
- *Low Carbon, Forced Aeration Composter (MTT12)*: Uses mechanical ventilation to push air into or draw air through the pile or windrow. C:N < 100.
- *Standard, Turned Pile and Windrow Composter (MTT13)*: Relies on frequent turning, usually with specialized machinery, to aerate the compost. C:N is unknown.
- *High Carbon, Turned Pile and Windrow Composter (MTT14)*: Relies on frequent turning, usually with specialized machinery, to aerate the compost. C:N > 100.
- *Low Carbon, Turned Pile and Windrow Composter (MTT 15)*: Relies on frequent turning, usually with specialized machinery, to aerate the compost. C:N < 100.
- *Standard, Static Pile and Windrow Composter (MTT16)*: Relies on natural aeration. Heat generated during composting rises and pulls air into the pile. Piles are turned or mixed occasionally. C:N is unknown.
- *High Carbon, Static Pile and Windrow Composter (MTT17)*: Relies on natural aeration. Heat generated during composting rises and pulls air into the pile. Piles are turned or mixed occasionally. C:N > 100
- *Low Carbon, Static Pile and Windrow Composter (MTT18)*: Relies on natural aeration. Heat generated during composting rises and pulls air into the pile. Piles are turned or mixed occasionally. C:N < 100
- *Directly Monitored Manure Treatment Technology (MTT19)*: Any manure treatment system that utilizes one or more manure treatment technologies described in the Manure Treatment Technology Expert Panel's report that has monitoring data to determine the nitrogen load that will be eliminated from the primary manure stream.

Q2. What types of Manure Treatment Technologies can be reported for credit in the Phase 6.0 Watershed Model?

A2. Only technologies that remove nutrients from manure can receive a reduction efficiency in the Phase 6.0 Watershed Model. The panel evaluated six broad categories of technology and further investigated individual technologies within each category, however, only a subset of those practices are shown to remove nutrients from the primary manure stream through the volatilization of nitrogen, as described in the panel's report. The following manure treatment

practices may be reported to NEIEN for credit in a Phase 6 progress scenario or used in a planning scenario:

Table A.1. Manure Treatment BMPs eligible for crediting in the Phase 6.0 Watershed Model

Practice Number	Practice Category	Technology Specifications*
MTT1	Thermochemical	Slow Pyrolysis
MTT2	Thermochemical	Fast Pyrolysis**
MTT3	Thermochemical	Gasification-Low Heat
MTT4	Thermochemical	Gasification-High Heat**
MTT5	Thermochemical	Combustion
MTT6	Thermochemical	Combustion-High Heat**
MTT7	Composting	In-Vessel and Rotating Bin- Standard
MTT8	Composting	In-Vessel and Rotating Bin- C:N>100**
MTT9	Composting	In-Vessel and Rotating Bin- C:N<100**
MTT10	Composting	Forced Aeration- Standard
MTT11	Composting	Forced Aeration- C:N>100**
MTT12	Composting	Forced Aeration- C:N<100**
MTT13	Composting	Turned Pile and Windrow- Standard
MTT14	Composting	Turned Pile and Windrow- C:N>100**
MTT15	Composting	Turned Pile and Windrow- C:N<100**
MTT16	Composting	Static Pile and Windrow- Standard
MTT17	Composting	Static Pile and Windrow- C:N>100**
MTT18	Composting	Static Pile and Windrow- C:N<100**
MTT19	Directly Monitored	

* Definitions for specific thermochemical and composting technologies can be found in the report in Sections 4 and 5, respectively.

**Information about process factors, as described in Section 4, pages 29 - 32, and Section 5, pages 43-47, is needed to report these BMPs

Q3. Can a jurisdiction receive nutrient reduction credit for a manure treatment technology that is not included in Table A.1.

A3. As discussed in the panel’s report, some manure treatment technologies do not remove nutrients from the manure, but alter the moisture content of the manure, making it easier to transport. “Removal” in this case means that the nitrogen is no longer present in the treated manure that is available for field application or transport according to model procedures that occur post-treatment. In the Phase 6.0 Watershed Model, jurisdictions will have the ability to directly report the moisture content of manure being transported (using the Manure Transport BMP). Manure with a lower moisture content has higher concentrations of nutrients, thus the benefits of these manure treatment technologies would be captured by the manure transport BMP.

In order to measure the manure moisture content, weigh a representative subsample of the manure, and then dry to at 103-105°C for 24 hours and record the new, dry weight. The difference between these two sample weights is moisture content (Standard Method for Examination of Water and Wastewater 2540 D).

Q4. Which land use categories are eligible to receive nutrient reduction credit from manure treatment BMPs in the Phase 6.0 Watershed Model?

A4. In the Phase 6.0 Watershed Model, nutrient reductions from manure treatment BMPs could be applied to the following land uses:

- Permitted feed operations
- Non-permitted feed operations

If neither land use is provided, the credit will be applied to the default category, “feed operations”, and the reduction credit would be distributed proportionally between permitted and non-permitted feed operation land uses.

In addition, to land uses Manure Treatment Technologies apply to animal types. The animal types in the Phase 6 Model are:

- Hogs and pigs for breeding
- Beef
- Dairy
- Hogs for slaughter
- Horses
- Other cattle
- Sheep and lambs
- Goats
- Broilers
- Pullets
- Turkeys
- Layers

Q5. How much nitrogen, phosphorus and sediment reduction credit are associated with each of the manure treatment practices?

A5. The nutrient and sediment reduction efficiencies are outlined in Table A.2:

Practice #	TN Removal (%)	TP Removal (%)	TSS Removal (%)
MTT1*	25	0	0
MTT2	75	0	0
MTT3	25	0	0

MTT4	85	0	0
MTT5	85	0	0
MTT6	95	0	0
MTT7*	10	0	0
MTT8	11	0	0
MTT9	13	0	0
MTT10	25	0	0
MTT11	28	0	0
MTT12	32	0	0
MTT13	25	0	0
MTT14	28	0	0
MTT15	32	0	0
MTT16	26	0	0
MTT17	29	0	0
MTT18	33	0	0
MTT19	Monitored	0	0
*MTT1 represents the default practice Thermochemical treatment systems, and MTT7 represents the default for composting treatment systems.			

Q6. What do jurisdictions need to report to NEIEN in order to receive manure treatment BMP credit?

A6. For manure treatment credit, jurisdictions will need to report the following to NEIEN:

- *BMP Name:* Practice name (e.g. MTT1)
- *Measurement Names:*
 - Animal Type - the unit for this will be tons, similar to manure transport, but you will be asked to report the measurement name as an animal type (e.g., “Broilers”)
 - County From – FIPs code associated with the county in which the manure was generated
 - County To – FIPs code associated with the county to which manure was transported after treatment by the technology
- *Geographic Location:* Qualifying NEIEN geographies including: Latitude/Longitude; or County; or Hydrologic Unit Code (HUC12, HUC10, HUC8, HUC6, HUC4); or State in which the facility is located
- *Date of Implementation:* Year the manure treatment was done
- *Land Uses:* Permitted feeding operation, non-permitted feeding operation, feeding operation

Q7. How will the Phase 6 Watershed Model credit the total nitrogen reductions listed in the table above?

A6. The manure will be removed from the County From, reductions will be applied to manure nitrogen concentrations after feed BMPs, if any, have been applied for the specified animal type and the specified county of origin, and then the manure will be placed back in the County To.

For example, let's say New York were to report the following information:

Practice Name: MTT6

Animal Type: 1 ton Dairy

County From: Chenango

County To: Otsego

The Phase 6 Watershed Model may estimate that a NY dairy cow produces about 84 lbs of total nitrogen for every ton of dry manure. With this example, 84 lbs of total nitrogen will be removed from Chenango County. If no feed BMPs are reported, the total nitrogen content of that ton of manure would be reduced 95 percent or down to about 4 lbs of total nitrogen. The resulting 4 lbs of nitrogen after credit will then be made available for land application in the county which receives the treated manure, in this case, Otsego.

Q8. Should jurisdictions report manure transport into and out of the facility separately using the manure transport BMP?

A8. No. Any manure being transported to a manure treatment facility should be reported ONLY using the appropriate manure treatment BMP names and associated measurement names. Additionally, to avoid double-counting manure transport from other jurisdictions to a regional facility, it will be the responsibility of the facility's home jurisdiction to report all tons that are transported into and out of the facility using the appropriate manure treatment BMP names and associated measurement names.

Q9. If a jurisdiction does not know which of the defined manure treatment practices they qualify for, which practice should they submit as a default?

A9. Jurisdictions are expected to know whether the treatment practice is thermochemical or composting treatment. If the practice is a thermochemical technology, jurisdictions should report MTT1 as the default. If the practice is composting technology, the jurisdictions should report MTT7 as the default. A generic manure treatment "system" cannot be reported if at least the basic type is unknown, because the system could be one of the other types described in this report and therefore not provide the nitrogen removal associated with composting or thermochemical practices. If the type of composting system is known, but the C:N ratio is unknown, the default is the practice with the lowest TN reduction efficiency that uses the same

technology. For example, a forced aeration composting system with no additional information would be reported as MTT10.

Q10. Are manure treatment practices cumulative or annual BMPs?

A10. All manure treatment BMPs are annual practices and must be reported each year in order to receive nutrient reduction credit in the CBP modeling tools. The treatment systems themselves may have long engineered lifespans, but the amount of manure treated may vary each year according to livestock production or system operations and maintenance. Therefore the BMPs must be reported annually.

Q11. What should a jurisdiction report as “County To” if the manure is NOT reapplied to agricultural land, or is landfilled, or resold as feed, bagged fertilizer or soil amendments?

A11. In these situations, the “County To” should be left blank in the same way jurisdictions currently report manure that is, for example, resold as soil amendments at home improvement stores.

Q12. Are reported Manure Treatment Technologies assumed to have an Animal Waste Storage Facility on the property?

A12. No. Animal Waste Storage BMPs must be reported separately in order to receive credit for those practices.

Q13. How do Manure Treatment Technology practices relate to other barnyard practices in the Phase 6 Model, such as Animal Waste Management Systems, Barnyard Runoff Controls and Loafing Lot Management?

A13: These practices should be tracked and reported separately. It is likely that many facilities with an MTT practice will also have a combination of other barnyard practices employed on-site to control runoff from feeding and loafing lot areas. States may report multiple barnyard practices and MTT for the same site if applicable.

Part 2: Technical Requirements for Reporting and Crediting Manure Treatment BMPs with available monitoring data

Q14. What is the definition for Data Driven (Level III) Manure Treatment BMPs?

A14. Systems reported under this category will have unique reductions calculated from reported sampling or monitoring data that accurately summarizes the performance of the system. The reported performance data will include the mass of nitrogen volatilized as gaseous emissions. If they do not monitor or directly measure the mass of nitrogen lost through emissions, then a quantifiable mass balance of the system’s nitrogen inputs and outputs is needed to calculate the volatilized portion lost to the atmosphere.

Systems without adequate annual performance data should be reported under the appropriate Level 1 or Level 2 categories for Manure Treatment, if available for the system's predominant treatment technology.

Q15. What do jurisdictions need to report to NEIEN to receive credit for manure treatment BMPs with direct monitoring data?

A15. To receive directly monitored manure treatment BMP credit, jurisdictions must report the following to NEIEN:

- *BMP Name*: Practice name (MTT19)
- *Measurement Names*:
 - Animal Type - the unit for this will be lbs of TN, but you will be asked to report the measurement name as an animal type (e.g., "Broilers")
 - County From – FIPs code associated with the county in which the manure was generated
 - County To – FIPs code associated with the county to which manure was transported after treatment by the technology
- *Geographic Location*: Qualifying NEIEN geographies including: Latitude/Longitude; or County; or Hydrologic Unit Code (HUC12, HUC10, HUC8, HUC6, HUC4); or State
- *Date of Implementation*: Year the manure treatment was done
- *Land Uses*: Permitted feeding operation, non-permitted feeding operation, feeding operation

Q16. Are there additional verification requirements for reporting Level III Manure Treatment BMPs (MTT19)?

A16. Any jurisdiction reporting a manure treatment system under Level 3 must document its data collection and reporting requirements for that system in its Quality Assurance Project Plan (QAPP) submitted to and reviewed by EPA. If there are variations in requirements or data collection between individual systems reported under Level 3, the jurisdiction will need to clarify those differences in its QAPP.

In all cases, the collected and reported data will need to meet the expectations described in the CBP partnership's BMP Verification Framework.

Q17. If the operator does not directly measure the amount of nitrogen removed from the treated manure in the form of gaseous emissions, can the operator still report the MTT19 practice?

A17. Yes. The operator can alternatively make a mass balance calculation to determine their load reduction, using the following equation:

Nitrogen lost as gaseous emissions = (lbs-N of all inputs) – (sum of lbs-N remaining in all solid and liquid outputs)