# Land Use Loading Rate Ratios

Hunter Landis, VA DCR; Tom Butler, EPA 8/8/2025

## Background

- February 2025
  - Created two new Land Uses:
    - Managed Pasture
    - Managed Hay
  - Designed to represent high application Land Uses
  - Require a factor that describes how N loads off the land
- July 2025
  - Loading Rate Ratio subgroup recommendation
  - Proposal vote
  - NO CONSENSUS

## Unless we get feedback, we will use the following:

Jurisdiction	Method to determine Managed acres	Method to allocate NM	Application rate	Managed Hay Phosphorus Application rate (lbs./acre)	Managed Pasture Nitrogen Application rate (lbs./acre)		Source
DE	To be reported like construction acres (state provided in advance of progress runs)	Reported Core N NM on specific land use	120	40	60	30	Low end of VT LGU recommendation
MD	To be reported like construction acres (state provided in advance of progress runs)	Reported Core N NM on specific land use	120	40	60	30	Low end of VT LGU recommendation
NY	To be reported like construction acres (state provided in advance of progress runs)	Based on reported Core N NM acres		0-50 Dependent on Morgan Soil Test P	50		Cornell Nitrogen Guidelines for Field Crops in NY for Native and improved grasses (Pasture) and Grasses in a 1-2 cut system (Hay) Cornell Phosphorus Guidelines for Field Crops in NY for Native and improved grasses (Pasture) and Grasses in a 1-2 cut system (Hay)
PA	No managed acres	No NM acres	120	40	60	30	Low end of VT LGU recommendation
VA	To be reported like construction acres (state provided in advance of progress runs)	Reported Core N NM on specific land use	120	40	60	30	Low end of VT LGU recommendation
WV	Based on reported Core N NM acres	Based on reported Core N NM acres	120	40	60	30	TEST DATA (Provided by VA DCR)

*Phase 7* CAST Ag Land Uses

- Two new Land Uses
  - Managed Hay
  - Managed Pasture
- Need to think about differences between new Land Uses and existing ones.

Chesapeake Bay Average				
Land class	Land Use	Loading Rate Ratio	Loading Rate (pounds per acre per year)	
	Double Cropped Land	0.79	30.9	
	Full Season Soybeans	0.71	27.7	
	Grain with Manure	1.4	54.7	
	Grain without Manure: Reference land use	1	39.1	
Cropland	Other Agronomic Crops	0.45	17.6	
Cropland	Silage with Manure	1.62	63.3	
	Silage without Manure	1.16	45.3	
	Small Grains and Grains	0.84	32.8	
	Specialty Crop High	1.34	52.4	
	Specialty Crop Low	0.31	12.1	
	Ag Open Space	0.43	5.1	
	Legume Hay	0.74	8.7	
Dacture	Other Hay	1.04	12.3	
Pasture	Managed Hay	;		
	Pasture: <b>Reference Land Use</b>	1	11.8	
	Managed Pasture	?		

### Literature Review

- Long-Term Leachate Water Quality Trends from a Broiler-Litter-Amended Udult in a Karst Region R.L.
   McMullen, K.R. Brye,\* A.L. Daigh, D.M. Miller, E.E. Gbur, A.L. Pirani, M.A. Evans-White, and R.E. Mason
   2014
- The impacts of nitrogen fertilisation and increased stocking rate on pasture yield, soil physical condition and nutrient losses in drainage from a cattle-grazed pasture, Monoghan et al 2005
- Field-Scale Nitrogen and Phosphorus Losses from Hayfields Receiving Fresh and Composted Broiler Litter R. W. Vervoort,\* D. E. Radcliffe, M. L. Cabrera, and M. Latimore, Jr. 1998
- Nutrient Losses from Fertilized Grassed Watersheds in Western North Carolina V. J. Kilmer, 2 J. W. Gilliam, a J. F. Lutz, a R. T. Joyce, 4 a4nd C. D. Eklund 1974"

### Additional information:

- Perennial vs annual crops:
  - In general perennial crops retain nutrients at a greater rate than annual crops due to many factors (biomass, root structure and extent, continuous cover, etc).
- Timing of nutrient applications:
  - The majority of nutrients applied to annual crops, especially manured crops, are applied prior to planting, and therefore subject to increased loss. Perennial grass systems are more likely to have nutrient applications spread out over the growing season, and there is always a crop available for uptake.
- Loss pathways:
  - Different (subsurface vs surface), lower erosion and P losses from perennial crops.
- A few reference papers that support these points.
  - Jungers, J. M., Sheaffer, C. C., & Lamb, J. A. (2019). The nitrate leaching potential of perennial and annual crops in the Upper Midwest, USA. *Agrosystems, Geosciences & Environment, 2*(1), 1–7. <a href="https://doi.org/10.2134/age2019.01.0003">https://doi.org/10.2134/age2019.01.0003</a>
  - Kleinman, P. J. A., Sharpley, A. N., Withers, P. J. A., Bergström, L., Johnson, L. T., & Doody, D. G. (2015). Implementing agricultural phosphorus science and management to combat eutrophication. *Ambio, 44*(S1), 297–310. <a href="https://doi.org/10.1007/s13280-015-0631-2">https://doi.org/10.1007/s13280-015-0631-2</a>
  - Lamba, J., Kladivko, E. J., & Brown, L. C. (2015). Nutrient and sediment loss from simulated storm runoff in grazed pastures and row crop fields. *Journal of Soil and Water Conservation*, 70(5), 293–302. <a href="https://doi.org/10.2489/jswc.70.5.293">https://doi.org/10.2489/jswc.70.5.293</a>
  - Syswerda, S. P., Basso, B., Hamilton, S. K., Tausig, J. B., & Robertson, G. P. (2012). Long-term nitrate loss along an agricultural intensity gradient in the Upper Midwest USA. *Agriculture, Ecosystems & Environment, 149*, 10–19. <a href="https://doi.org/10.1016/j.agee.2011.12.007">https://doi.org/10.1016/j.agee.2011.12.007</a>

## A concern: Perennial Grass ratio

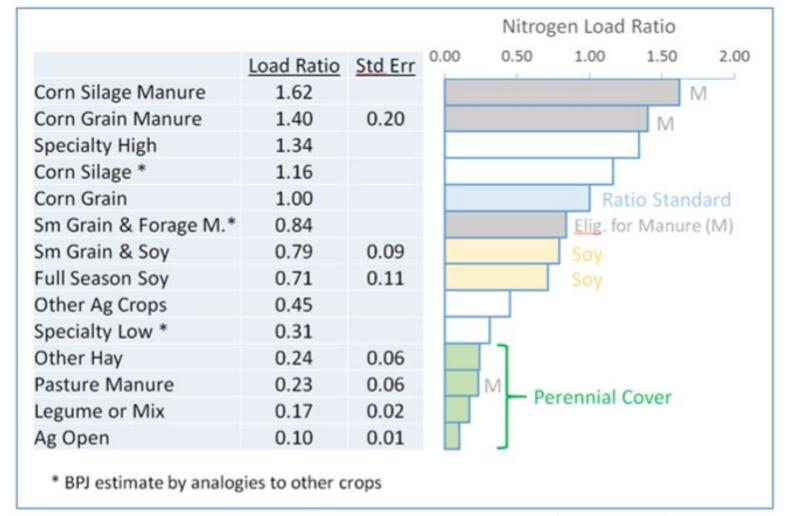


Figure 2. Nitrogen Load Ratio Relative to Corn (or Sorghum) Grain Without Manure

## Additional rates from Chapter 2 table 2.7:

- Ag
- Full Season Soybean 27.7
- Other Agronomic 17.6
- Specialty Low 12.1
- Other Hay 12.3
- Pasture 11.8
- Non Ag
- MS4 Construction 26.80
- MS4 Tree Canopy over Turfgrass 8.53
- Non-Regulated Turf Grass 11.19
- Harvested Forest 11.88

## A new proposal

- We should have Loading Ratios for managed hay/pasture that result in lower Loading Rates then traditional row crops
  - Other Agronomic Crops
  - Specialty Low Crops

## How can we get there?

Applications will not always equal high end of Land Grant University (LGU) Recommendations (some studies cited used **above** LGU recommend rate)

Most states will probably apply to 80% of this rate

We can take 80% of the high application values from the study and calculate the ratio

## VT Recommendations for Pasture and Hay

Other Hay - 120-200 lbs N

Pasture - 60-75 lbs N

• Other Hay: 120/200 = 60 %

• Pasture: 60/75 = 80%

Bound to Pasture as a reference

	ennial ( <i>Festuca arundinacea</i> )	
Description	Long-lived, tufted, deep-rooted; noted for early spring and late fall growth; leaves are dark green, shiny, and barbed along the edges, making them feel rough; leaves rolled in bud; very short ligule; sheath reddish pink belowground. Most existing tall fescue stands are infected with a fungal endophyte that induces fescue toxicosis in cattle.	
Varieties  Endophyte-free varieties are somewhat less hardy than endophyte-infecte fescue, requiring more careful management. Modern endophyte-free variet are stronger than earlier varieties. Endophyte-enhanced varieties have potential for greater adoption.		
Uses	Pasture, hay, and turf. Excellent when seeded at high rates for turf. Widely used for winter grazing.	
Weight per bushel	24 lbs	
Seeds per pound	220,000	
Germinating time	14 days	
Fertilizer	Establishment: 40 lbs N, 120-140 lbs $P_2O_5$ , and 120-140 lbs $K_2O$ at medium soil test levels. Pasture topdressing 30 lbs $P_2O_5$ and 30-60 lbs $K_2O$ annually, or 40-125 lbs $P_2O_5$ and $K_2O$ every 3-4 years. (For winter grazing, apply 60-75 lbs N in mid-August. Hay topdressing: 120-200 lbs N, 40-90 lbs $P_2O_5$ , and 85-185 lbs $K_2O$ . For turf, see Tursection.	
pH range	5.6-6.2	
Soil adaptation	Adapted to practically all tillable soils. Tolerant to both dry and wet soils.	
Time of planting	Early fall or spring at 15-25 lbs when seeded alone, and 6-12 lbs in mixtures for pasture; 4-6 lbs per 1,000 sq ft for turf.	
Harvesting (hay)	First cut when heads begin to emerge. Stems and seedheads of endophyte-infected fescue are highly toxic. Approximate yields 2-6 tons hay/A.	
Harvesting (seed)	When the field takes on a yellowish-brown cast and heads droop.	
Harvesting (pasture)	Tolerant of continuous stocking. With rotational stocking, turn in at 8 inches; remove cattle at 2-3 inches. Keep vegetative to reduce potential problems with endophyte. Remove pregnant mares from endophyte-infected fescue during last 3 months of gestation.	

Current Progress

- We should adopt the following Loading Rate Ratios:
  - Managed Pasture =1.52
  - Managed Hay = 1.56
    - 1.52+0.04
    - existing Hay rate is 0.04 higher than existing pasture

Chesapeake Bay Average					
Land class	Land Use	Loading Rate Ratio	Loading Rate (pounds per acre per year)		
	Double Cropped Land	0.79	30.9		
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	Ag Open Space	0.43	5.1		
	Legume Hay	0.74	8.7		
Dacture	Other Hay	1.04	12.3		
Pasture	Managed Hay	1.56	-		
	Pasture: <b>Reference Land Use</b>	1	11.8		
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Example Calculations:

- Managed Hay example math:
- 11.8lbs./acre/yr \* 1.56 = 18.4 lbs./acre/yr

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Example Calculations:

- Managed Pasture example math:
- 11.8lbs./acre/yr \* 1.52\* = 17.9 lbs./acre/yr

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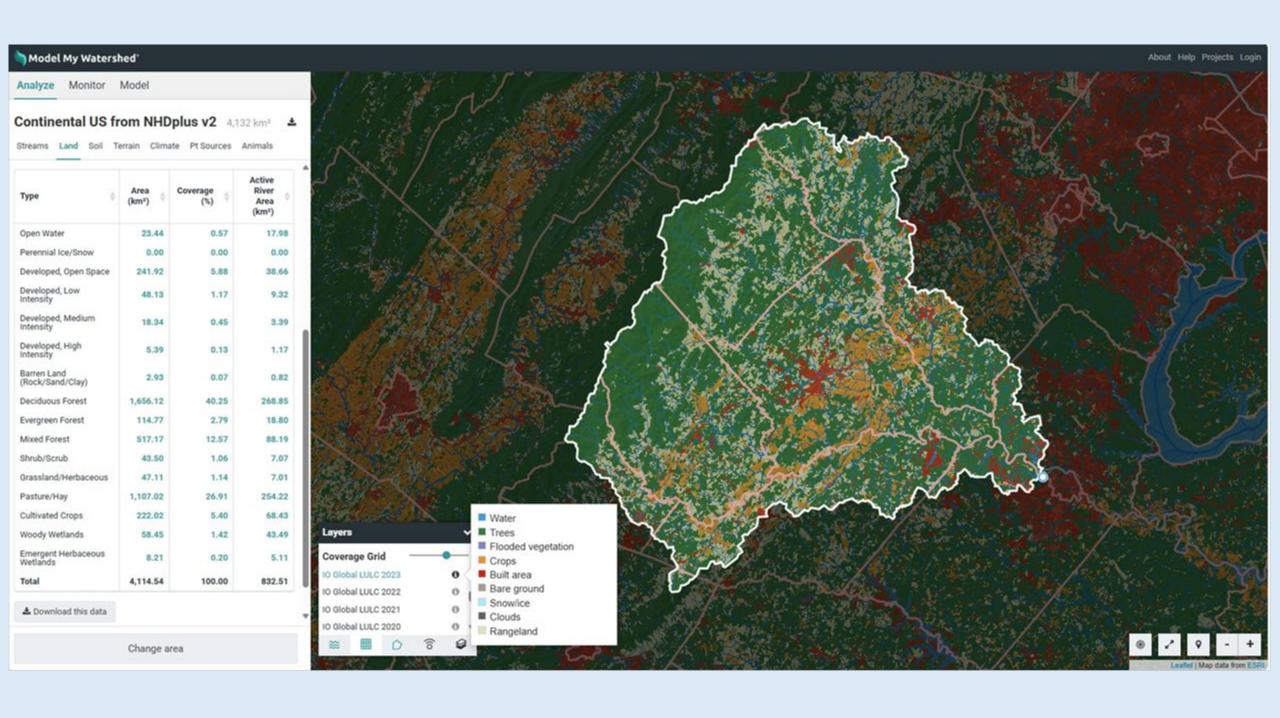
We should adopt the following Land Use Loading Rate Ratios:

Managed Pasture (High Application) = 1.52

Managed Hay (High Application) =1.56

Votes as of 8/6/25

Role	Name	Affiliation	Vote	Notes
	Clint Gill	DE	3	
	Alisha Mulkey	MD		No response do date
	Cassie Davis	NY	4	I agree with Tamie on the name clarification of pasture/other hay low and pasture/other hay high.
or standard in the standard in			1	we believe that the proposed loading rates are too low and should be more in line with crops that receive manure. Mass balance would indicate that regular applications of manure throughout the year on managed hay/pasture would require a higher loading rate especially considering crops only receive manure periodically, yet they load at nearly three times the proposed loading rates for these new land use types.
	Scott Heidel	PA	1	
	Tim Larson	VA	5	
	Dave Montali	WV	4	
	Bo Williams	EPA	3	
	Ken Staver	UMD	3	there is a concern that this might end up increasing loads
At-1	Tamie Veith	USDA-ARS	2	One concern noted by the USDA groups (ARS and NRCS) is in the terminology of "pasture" versus "managed pasture". It seems that, as a land use type, "managed pasture" is actually nutrient amended, fertilized, or treated pasture. Perhaps terminologies of "low fertility pasture" and "high fertility pasture" or something similar would better capture the distinction.
	Lisa Duriancik	USDA-NRCS	2	NRCS, need more time for consultation
	Alex Soroka	USGS	3	
	Zach Easton	VT	4	



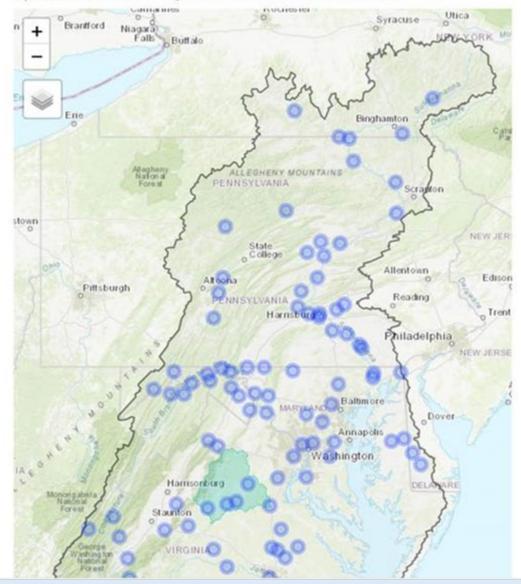
● Total Nitrogen ○ Total Phosphorus ○ Suspended Sediment

Step 2: Select the monitoring station by clicking either Map or Table:

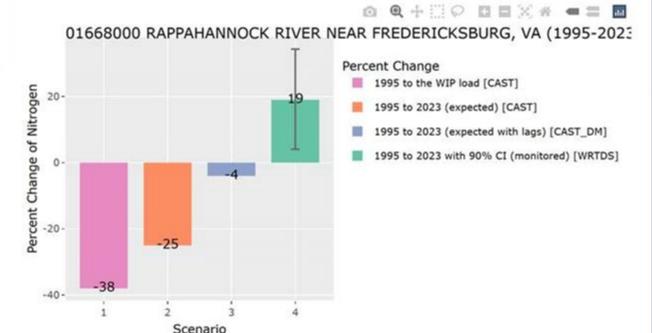
Map

Data Table

Tip: Move mouse cursor to any circle marker to show the station name.



#### Interactive Plot



(Note 1: Negative values indicate load reductions; positive values indicate load increases.)

(Note 2: To obtain values in million pounds (Mlbs), multiply the percent change shown in this plot by the CAST load in the first year of the assessment period, which is available in the Data Table under the Timeseries tab.)

#### Data Type

WRTDS: Monitored load - computed using the USGS WRTDS flow-normalization method (source).

CAST: Expected load in the long term - computed using the Chesapeake Bay Program Watershed Model (source).

CAST\_DM: Expected load with lags - computed using the Chesapeake Bay Program Watershed Model (source).

### Interpretive Text

For Nitrogen at 01668000 RAPPAHANNOCK RIVER NEAR FREDERICKSBURG, VA, the period of analysis is 1995-2023.

1. Overall reduction - comparing the baseline year of 1995 with the WIP load:

## Questions?

## Next Steps

- We will need to collect everyone's vote
- Comments/concerns will be recorded
- Suggestions/revisions will be considered
- Need technical justifications if vote to hold or stop.

## Let's try again:

- We should adopt the following Land Use Loading Rate Ratios:
  - Managed
     Pasture (High Application) =
     1.52
  - Managed Hay (High Application) =1.56

### Consensus Continuum

