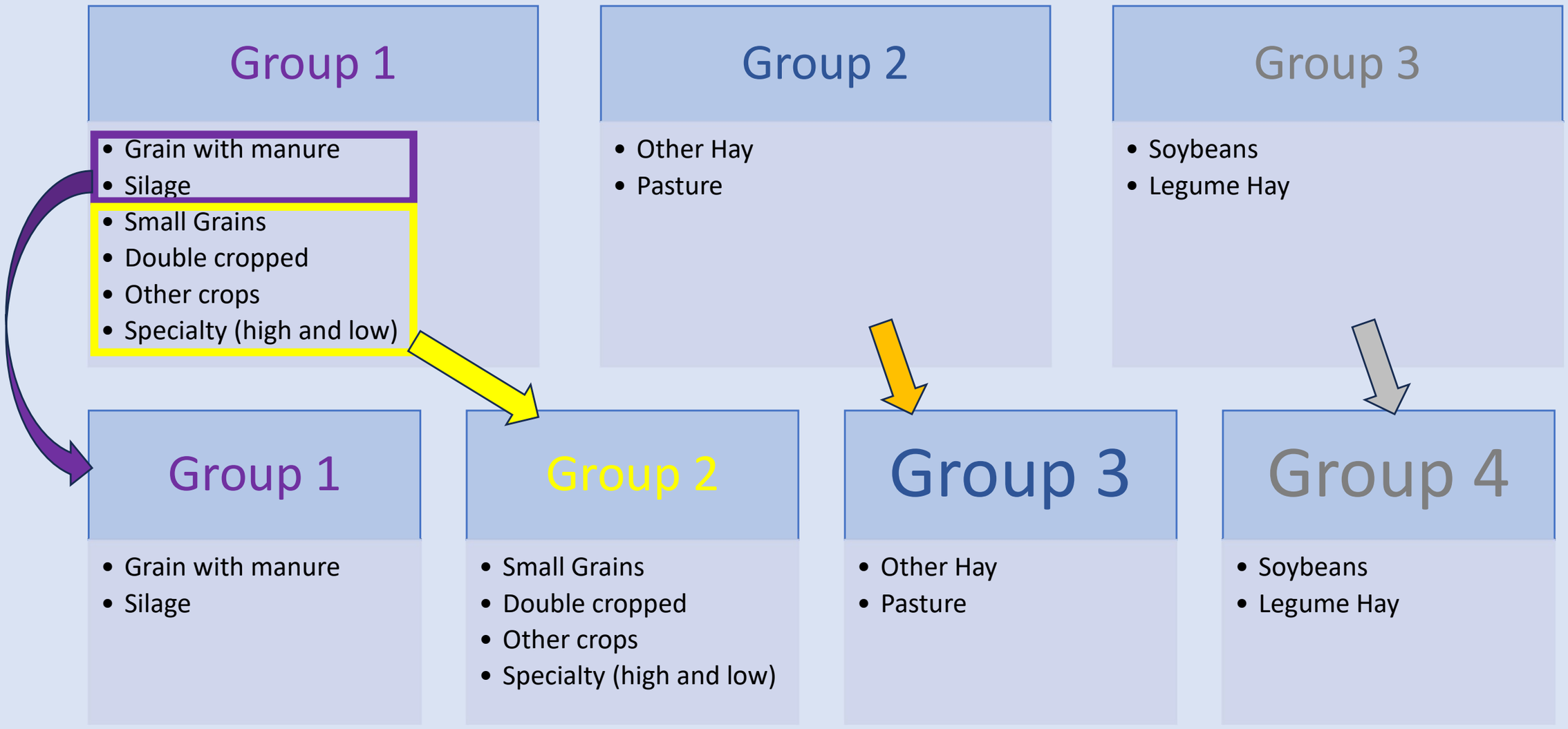
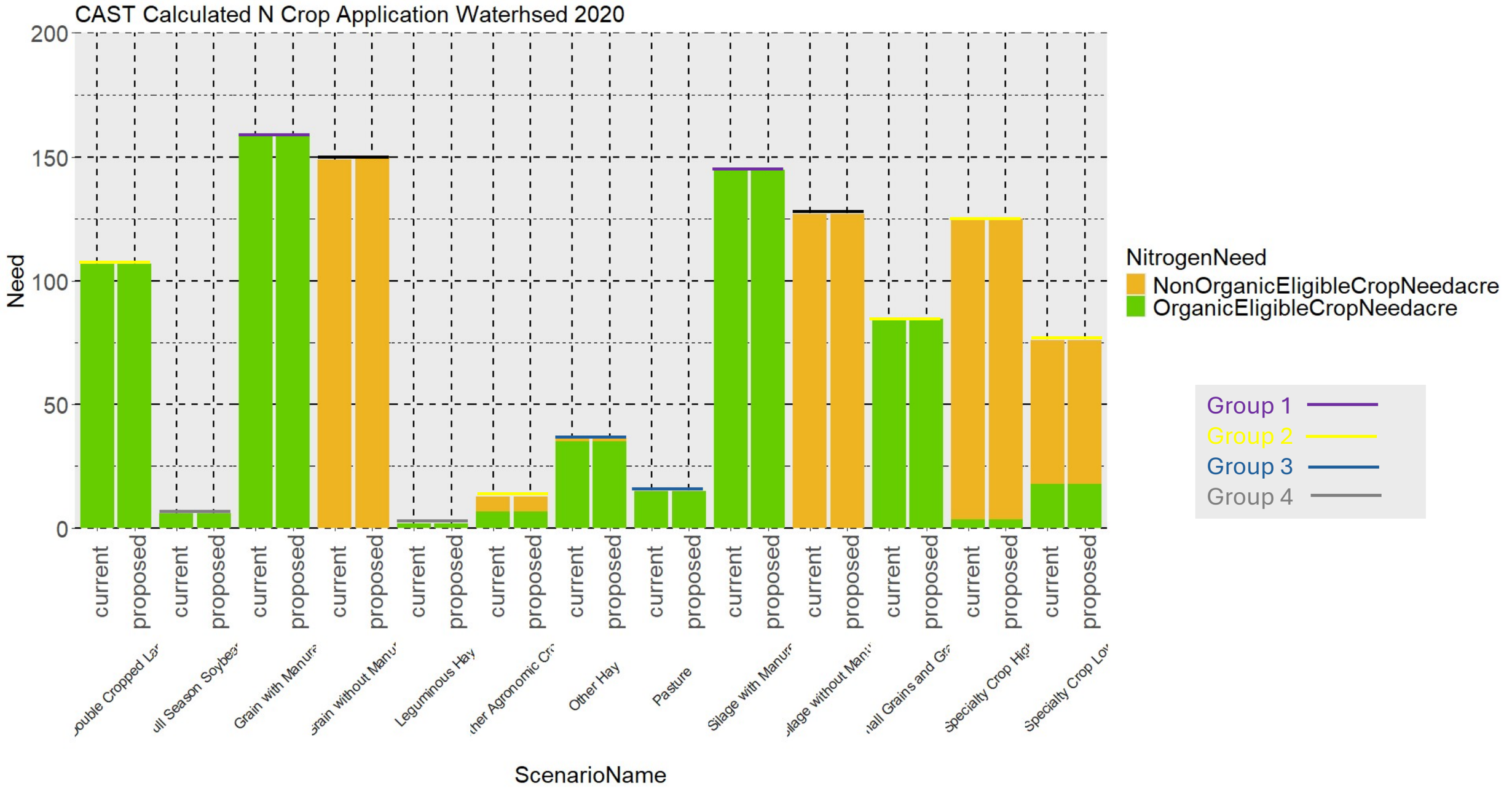
Hay and Pasture Model Deficiencies

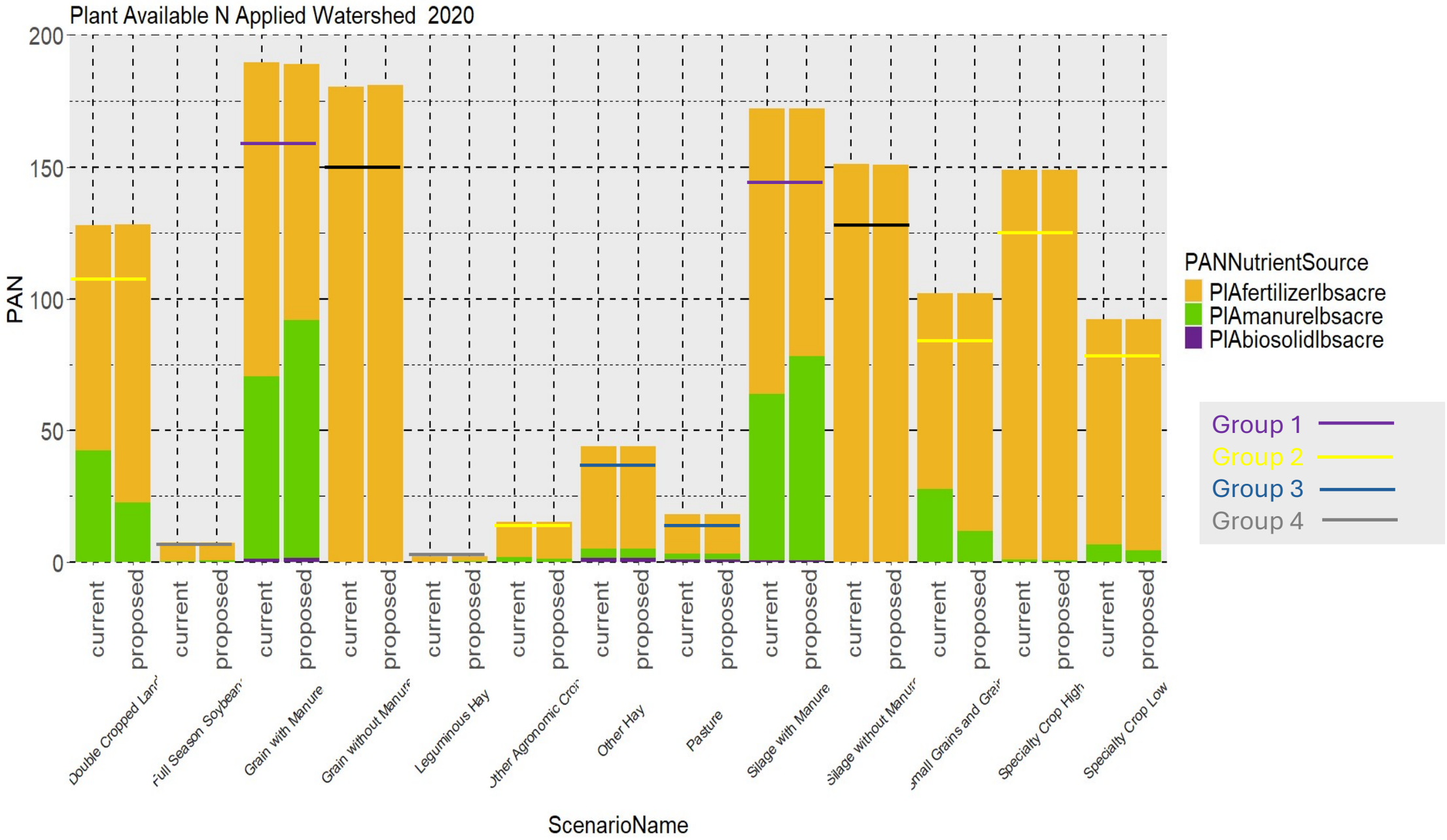
James Martin and Tim Larson

Virginia Department of Conservation and Recreation

Recap:


Group 1
Grain with manure
Silage
Small Grains
Double cropped
Other crops
Specialty (high and low)
Group 2
Other Hay
Pasture
Group 3
Soybeans
Legume Hay
Group 1
Grain with manure
Silage
Group 2
Small Grains
Double cropped
Other crops
Specialty (high and low)
Group 3
Other Hay
Pasture
Group 4
Soybeans
Legume Hay


CAST Calculated N Crop Application Waterhsed 2020
Need
200
150
100
50
0
current
proposed
Grain with Manure
Grain without Manure
Leguminous Hay
Other Hay
Pasture
Silage with Manure
Silage without Manure
Specialty Crop High
Specialty Crop Low
ScenarioName
NitrogenNeed
NonOrganicEligibleCropNeedacre
OrganicEligibleCropNeedacre
Group 1
Group 2
Group 3
Group 4


Plant Available N Applied Watershed 2020
PAN
200
150
100
50
0
current
proposed
Double Cropped Land
Full Season Soybean
Grain with Manure
Grain without Manure
Leguminous Hay
Other Agronomic Crop
Other Hay
Pasture
Silage with Manure
Silage without Manure
Small Grains and Grain
Specialty Crop High
Specialty Crop Low
ScenarioName
PANNutrientSource
PlAfertilizerlbsacre
PlAmanurelbsacre
PlAbiosolidlbsacre
Group 1
Group 2
Group 3
Group 4

Agricultural Acres by Load Source

While Cropland makes up more than 50% of agricultural land use, we have it split up among 10 load sources and nearly 100 crops

Pasture and Other Hay are the two largest Load Sources of agricultural acres across the Bay Watershed and include about a dozen crops

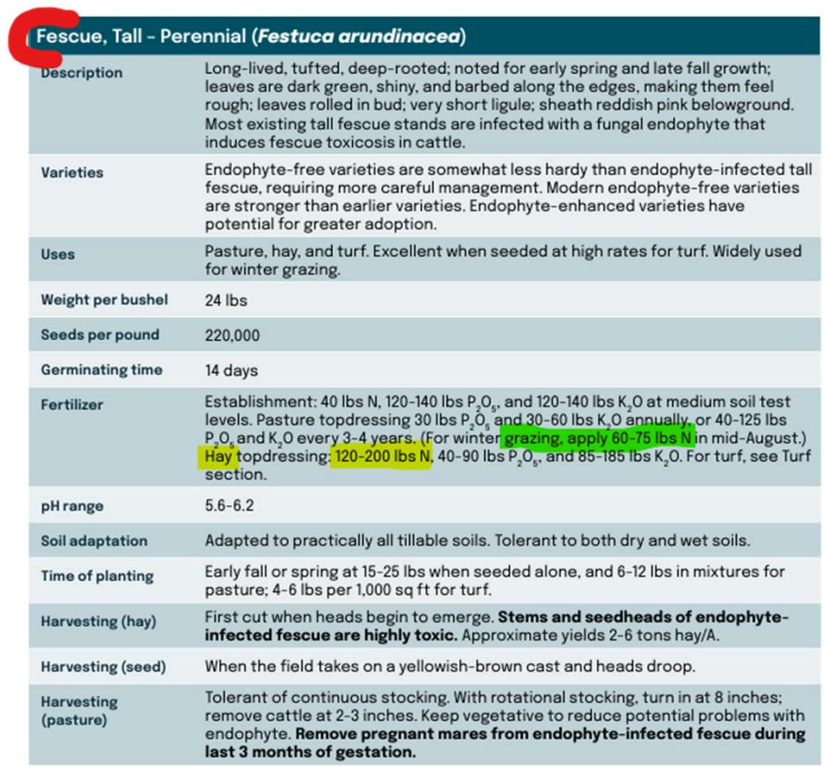
Combined they total **38%** of agricultural land use acres baywide, and **58% in Virginia;** 89% of which are associated with just **two** crop types

They are also significant in NY, PA, and WV

Sum of AcresP6	DE	MD	NY	PA	VA	WV	Baywide
Ag Open Space	0.0%	1.3%	5.2%	2.8%	2.8%	2.5%	2.9%
Cropland	94.6%	78.0%	41.5%	54.3%	37.4%	12.7%	50.5%
Double Cropped Land	23.5%	18.2%	6.5%	8.8%	6.5%	1.8%	9.3%
Full Season Soybeans	21.4%	21.2%	4.9%	9.2%	11.5%	1.9%	10.7%
Grain with Manure	25.6%	12.3%	3.9%	8.4%	3.6%	1.4%	7.2%
Grain without Manure	11.6%	12.3%	6.0%	8.3%	5.9%	1.8%	7.7%
Other Agronomic Crops	4.8%	6.9%	8.6%	9.0%	6.0%	3.9%	7.5%
Silage with Manure	0.2%	1.1%	5.5%	4.5%	1.0%	0.5%	3.0%
Silage without Manure	0.0%	0.2%	1.0%	0.8%	0.2%	0.1%	0.5%
Small Grains and Grains	3.0%	3.8%	2.8%	2.9%	1.7%	0.5%	2.6%
Specialty Crop High	1.5%	0.7%	0.5%	0.5%	0.3%	0.1%	0.5%
Specialty Crop Low	2.9%	1.3%	1.8%	1.7%	0.7%	0.6%	1.4%
Leguminous Hay	0.6%	2.4%	15.7%	11.8%	1.8%	1.0%	7.9%
Other Hay	2.1%	8.4%	22.7%	17.1%	20.1%	31.3%	17.8%
Pasture	2.6%	9.8%	14.9%	14.0%	38.0%	52.4%	20.8%
Grand Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

LGU recommendations for Pasture and Hay N application

LGU	
VA Tech	Other Hay **120-200** lbs/acre N Pasture **60-75** lbs/acre N
Penn State	50lbs/T or **~150** lbs/acre
UDE	40-60lbs/T or **~135** lbs/acre
UMD	**200-250** lbs/acre
Rutgers	40lbs/T
WVU	50lbs/T



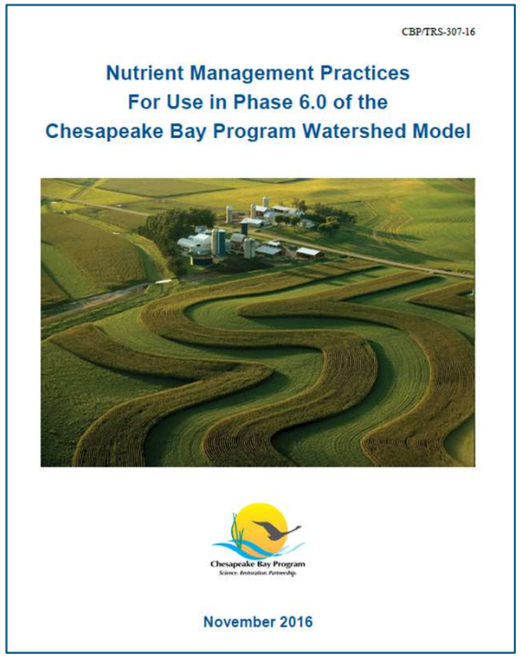
Fescue, Tall – Perennial (*Festuca arundinacea*)	
Description	Long-lived, tufted, deep-rooted; noted for early spring and late fall growth; leaves are dark green, shiny, and barbed along the edges, making them feel rough; leaves rolled in bud; very short ligule; sheath reddish pink belowground. Most 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-infected tall fescue, requiring more careful management. Modern endophyte-free varieties 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 Turf section.
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.**

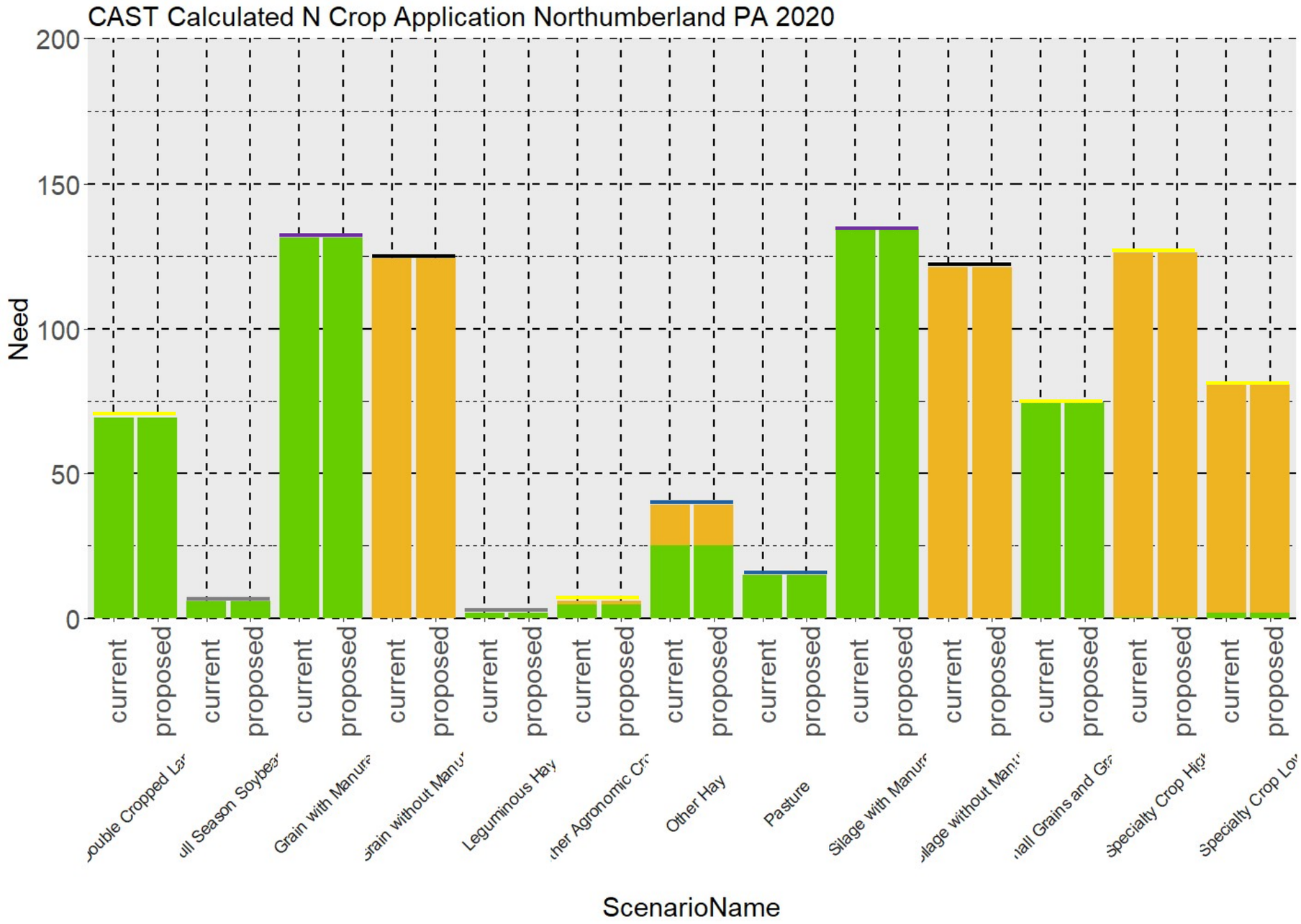
Sources:
https://extension.psu.edu/first-cut-forage-considerations#:~:text=A%20general%20recommendation%20is%2050,expected%20in%20the%20subsequent%20cut.
https://agsci.psu.edu/aasl/soil-testing/fertility/handbooks/agronomic/forms/st2-fertilizer-recommendations-lime-conversions
https://njaes.rutgers.edu/fs1295/#:~:text=They%20also%20account%20for%20the,before%20rotating%20to%20forage%20crops.
https://extension.wvu.edu/agriculture/pasture-hay-forage/hay-management/pasture-and-hay-production-potential
https://extension.wvu.edu/files/d/6a116f8f-955c-41d1-9cbf-d2d9c1bda919/crop-fertilizer-recommendations.pdf
https://www.udel.edu/content/dam/udellmages/canr/pdfs/extension/environmental-stewardship/nutrient-recommendations/UD_Extension_Recommended_2020_CSG_Perennial_Established_Hay_all.pdf#:~:text=Delaware%20growers%20should%20use%20field%20history%20to,determining%20the%20yield%20goal%20for%20a%20specific.
https://extension.umd.edu/sites/extension.umd.edu/files/2021-04/SFM-1.pdf

Nutrient Management BMP panel report

"N Core NM BMP multiplier values for Other Hay and Pasture were set at 1.00 because the CBP Partnership's modification of the LGU N application recommendations created a uniform and much-reduced N application rate goal for these two agricultural land uses that included an assumed implementation rate of NM BMPs across the entire CBW. Therefore, the Panel could not apply a N application rate BMP multiplier other than 1.00 to these two land uses."

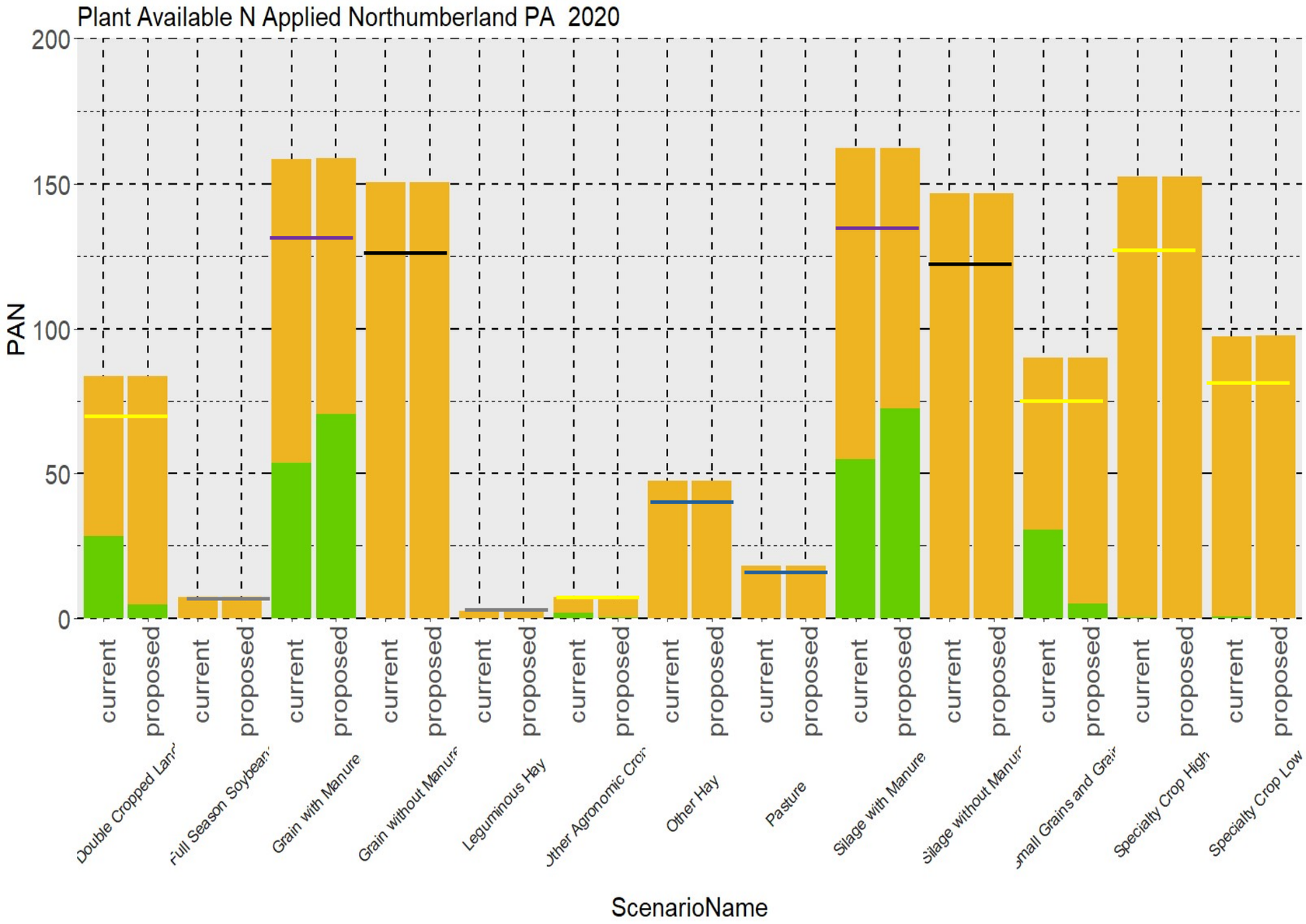
Source: **Nutrient Management Practices For Use in Phase 6.0 of the Chesapeake Bay Program Watershed Model (November 2016) p. 24**





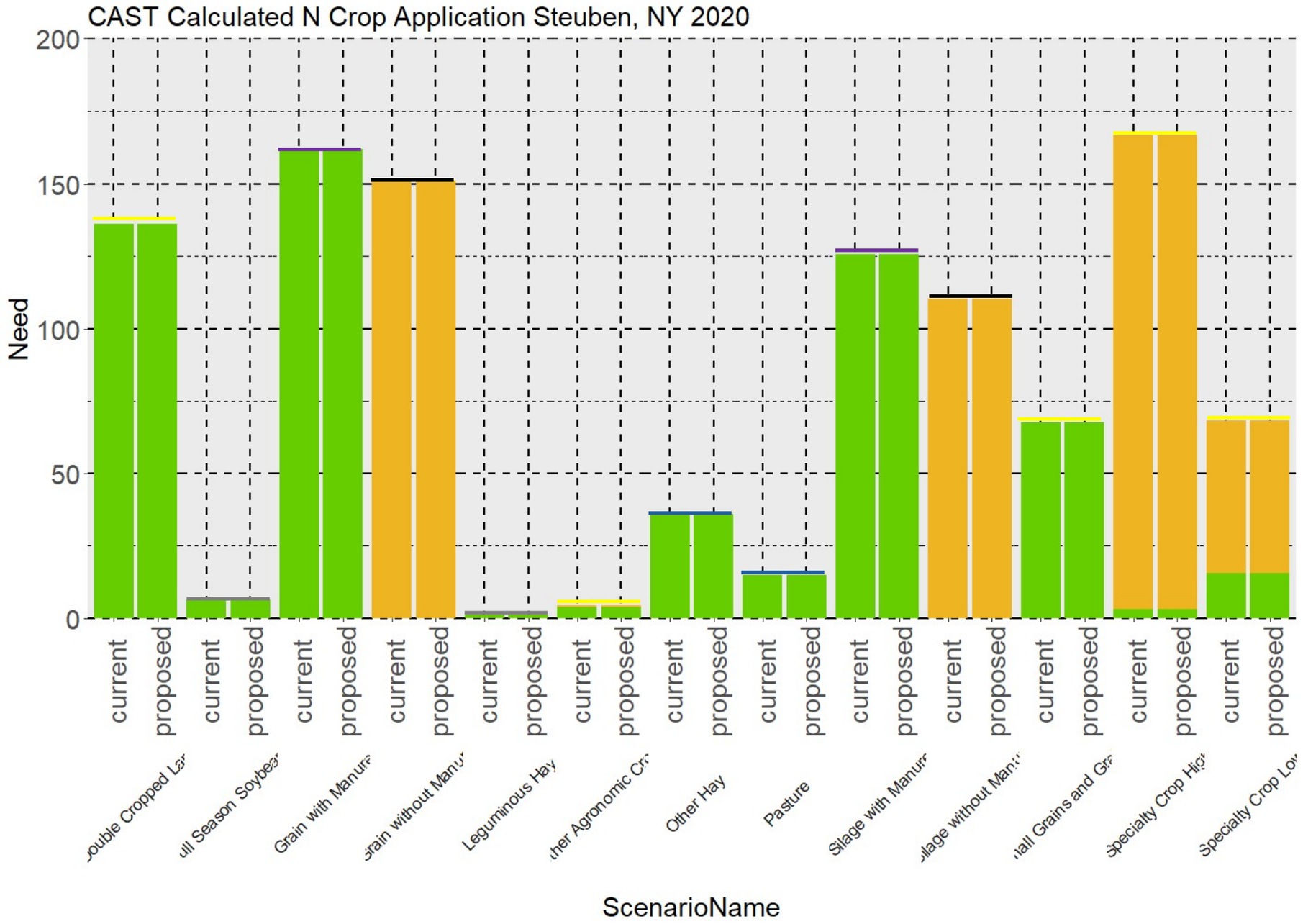
POULTRY HEAVY

NitrogenNeed
NonOrganicEligibleCropNeedacre
OrganicEligibleCropNeedacre



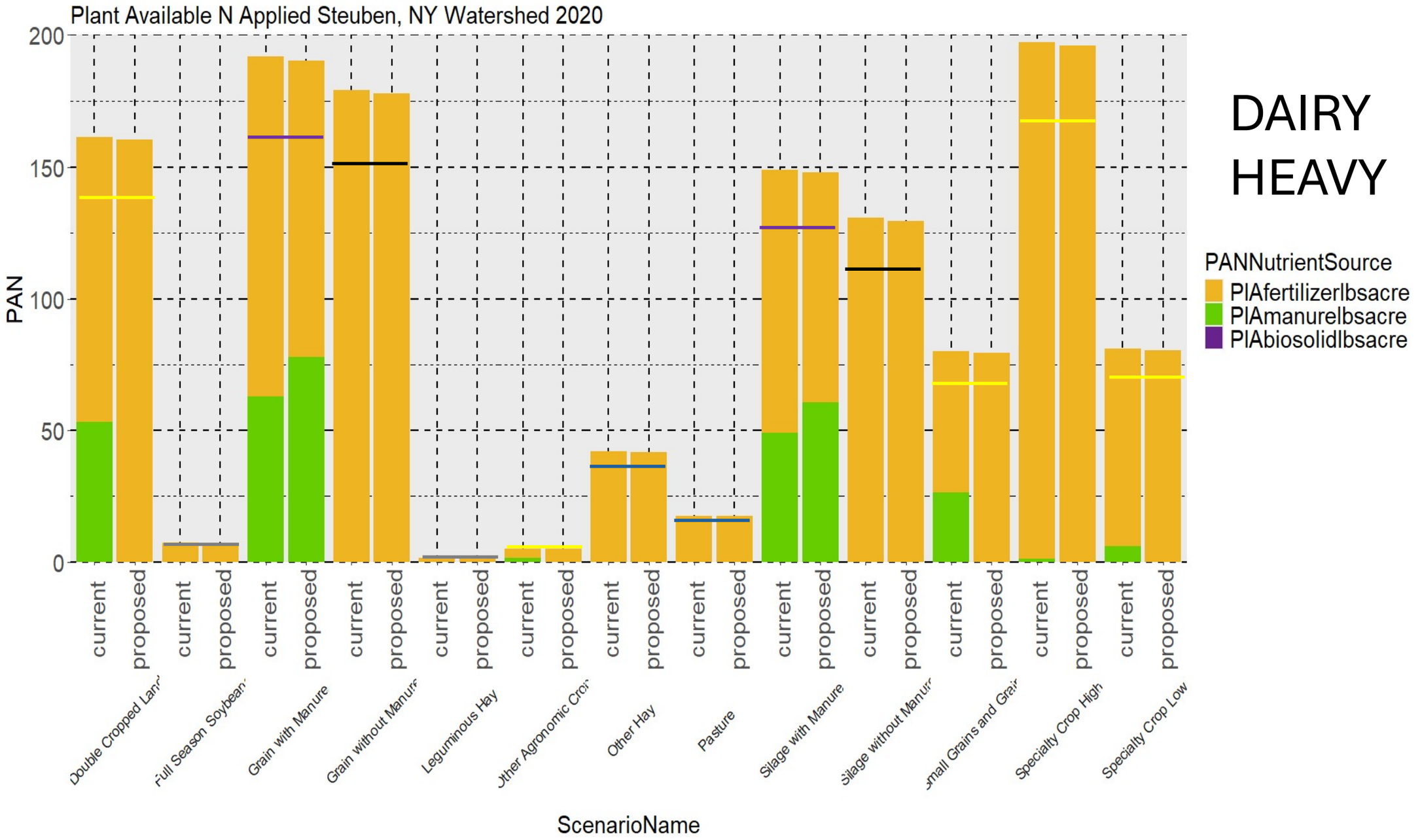
POULTRY HEAVY

PANNutrientSource
- PlAfertilizerlbsacre
- PlAmanurelbsacre
- PlAbiosolidlbsacre



DAIRY HEAVY

NitrogenNeed
NonOrganicEligibleCropNeedacre
OrganicEligibleCropNeedacre


Plant Available N Applied Steuben, NY Watershed 2020
PAN
200
150
100
50
0
current
proposed
Double Cropped Land
Full Season Soybean
Grain with Manure
Grain without Manure
Leguminous Hay
Other Agronomic Crop
Other Hay
Pasture
Silage with Manure
Silage without Manure
Small Grains and Grain
Specialty Crop High
Specialty Crop Low
ScenarioName
DAIRY
HEAVY
PANNutrientSource
PlAfertilizerlbsacre
PlAmanurelbsacre
PlAbiosolidlbsacre

Hay Yields

NASS Survey
"Quick Stats"

2023 STATE AGRICULTURE OVERVIEW
Pennsylvania

† Survey Data from Quick Stats as of: Dec/11/2024

Farms Operations †

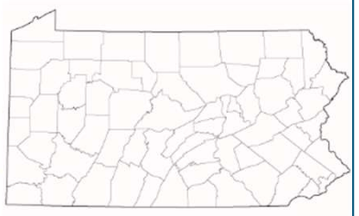
Farm Operations - Area Operated, Measured in Acres / Operation	145
Farm Operations - Number of Operations	49,000
Farm Operations - Acres Operated	7,100,000

Livestock Inventory †

Cattle, Cows, Beef - Inventory (First of Jan. 2024)	215,000
Cattle, Cows, Milk - Inventory (First of Jan. 2024)	465,000
Cattle, Incl Calves - Inventory (First of Jan. 2024)	1,380,000
Cattle, On Feed - Inventory (First of Jan. 2024)	85,000
Goats, Meat & Other - Inventory (First of Jan. 2024)	39,000
Goats, Milk - Inventory (First of Jan. 2024)	14,000
Sheep, Incl Lambs - Inventory (First of Jan. 2024)	99,000
Hogs - Inventory (First of Dec. 2023)	1,460,000
Chickens, Broilers - Production, Measured in Head	230,800,000
Turkeys - Production, Measured in Head	8,000,000

Milk Production †

Milk, Dry, Nonfat, Human - Production, Measured in Plants	4
Milk - Production, Measured in Lb / Head	21,157
Milk, Dry, Nonfat, Human - Production, Measured in Lb	169,620,000
Milk - Production, Measured in $	2,109,826,000
Milk - Production, Measured in Lb	9,859,000,000



Crops - Planted, Harvested, Yield, Production, Price (MYA), Value of Production †
Sorted by Value of Production in Dollars

Commodity	Planted All Purpose Acres	Harvested Acres	Yield	Production	Price per Unit	Value of Production in Dollars
HAY & HAYLAGE						
HAY & HAYLAGE		1,330,000	3.12 TONS / ACRE DRY BASIS	4,156,000 TONS, DRY BASIS		754,870,000
HAY & HAYLAGE, (EXCL ALFALFA)		1,000,000	2.94 TONS / ACRE DRY BASIS	2,941,000 TONS, DRY BASIS		470,560,000
HAY & HAYLAGE, ALFALFA	50,000	330,000	DRY BASIS	1,215,000 TONS, DRY BASIS		284,310,000

2023 STATE AGRICULTURE OVERVIEW
Virginia

† Survey Data from Quick Stats as of: Dec/11/2024

Farms Operations †

Farm Operations - Area Operated, Measured in Acres / Operation	187
Farm Operations - Number of Operations	39,000
Farm Operations - Acres Operated	7,300,000

Livestock Inventory †

Cattle, Cows, Beef - Inventory (First of Jan. 2024)	574,000
Cattle, Cows, Milk - Inventory (First of Jan. 2024)	66,000
Cattle, Incl Calves - Inventory (First of Jan. 2024)	1,320,000
Cattle, On Feed - Inventory (First of Jan. 2024)	14,000
Goats, Meat & Other - Inventory (First of Jan. 2024)	34,000
Goats, Milk - Inventory (First of Jan. 2024)	5,400
Sheep, Incl Lambs - Inventory (First of Jan. 2024)	79,000
Hogs - Inventory (First of Dec. 2023)	245,000
Chickens, Broilers - Production, Measured in Head	274,500,000
Turkeys - Production, Measured in Head	15,500,000

Milk Production †

Milk - Production, Measured in Lb / Head	20,882
Milk - Production, Measured in $	342,220,000
Milk - Production, Measured in Lb	1,420,000,000

Crops - Planted, Harvested, Yield, Production, Price (MYA), Value of Production †
Sorted by Value of Production in Dollars

Commodity	Planted All Purpose Acres	Harvested Acres	Yield	Production	Price per Unit	Value of Production in Dollars
HAY						
HAY		1,155,000	2.13 TONS / ACRE	2,464,000 TONS	167 $ / TON	400,288,000
HAY, (EXCL ALFALFA)		1,120,000	2.1 TONS / ACRE	2,352,000 TONS	165 $ / TON	376,320,000
HAY, ALFALFA		35,000	3.2 TONS / ACRE	112,000 TONS	216 $ / TON	23,968,000

2023 STATE AGRICULTURE OVERVIEW
Maryland

† Survey Data from Quick Stats as of: Dec/11/2024

Farms Operations †

Farm Operations - Area Operated, Measured in Acres / Operation	159
Farm Operations - Number of Operations	12,600
Farm Operations - Acres Operated	2,000,000

Livestock Inventory †

Cattle, Cows, Beef - Inventory (First of Jan. 2024)	45,000
Cattle, Cows, Milk - Inventory (First of Jan. 2024)	40,000
Cattle, Incl Calves - Inventory (First of Jan. 2024)	161,000
Cattle, On Feed - Inventory (First of Jan. 2024)	6,500
Hogs - Inventory (First of Dec. 2023)	21,000
Chickens, Broilers - Production, Measured in Head	278,000,000

Milk Production †

Milk - Production, Measured in Lb / Head	21,150
Milk - Production, Measured in $	185,274,000
Milk - Production, Measured in Lb	846,000,000

Crops - Planted, Harvested, Yield, Production, Price (MYA), Value of Production †
Sorted by Value of Production in Dollars

Commodity	Planted All Purpose Acres	Harvested Acres	Yield	Production	Price per Unit	Value of Production in Dollars
HAY						
HAY		205,000	2.53 TONS / ACRE	519,000 TONS	172 $ / TON	88,515,000
HAY, (EXCL ALFALFA)		160,000	2.4 TONS / ACRE	384,000 TONS	150 $ / TON	57,600,000
HAY, ALFALFA		45,000	3 TONS / ACRE	135,000 TONS	235 $ / TON	30,915,000
SOYBEANS	470,000	460,000	47 BU / ACRE	21,620,000 BU	11.8 $ / BU	272,412,000

2023 STATE AGRICULTURE OVERVIEW
Delaware

† Survey Data from Quick Stats as of: Dec/11/2024

Farms Operations †

Farm Operations - Area Operated, Measured in Acres / Operation	242
Farm Operations - Number of Operations	2,150
Farm Operations - Acres Operated	520,000

Livestock Inventory †

Cattle, Cows, Beef - Inventory (First of Jan. 2024)	1,500
Cattle, Cows, Milk - Inventory (First of Jan. 2024)	2,600
Cattle, Incl Calves - Inventory (First of Jan. 2024)	10,500
Hogs - Inventory (First of Dec. 2023)	2,800
Chickens, Broilers - Production, Measured in Head	245,300,000

Milk Production †

Milk - Production, Measured in Lb / Head	17,815
Milk - Production, Measured in $	10,726,000
Milk - Production, Measured in Lb	48,100,000

Crops - Planted, Harvested, Yield, Production, Price (MYA), Value of Production †
Sorted by Value of Production in Dollars

Commodity	Planted All Purpose Acres	Harvested Acres	Yield	Production	Price per Unit	Value of Production in Dollars
HAY						
HAY		12,000	2.83 TONS / ACRE	34,000 TONS	189 $ / TON	6,345,000
HAY, (EXCL ALFALFA)		8,000	2.6 TONS / ACRE	21,000 TONS	160 $ / TON	3,381,000
HAY, ALFALFA		4,000	3.2 TONS / ACRE	13,000 TONS	235 $ / TON	2,964,000

Overview of Virginia Proposal

1. **Establish new LUs for <u>Managed Hay</u> and <u>Managed Pasture.</u>** Acres of managed hay and pasture would be reported by States by Sept. 1 (like is done for Construction and Harvested Forest). Default values for states that do not provide acres is set at 100% of NM acres on Hay and Pasture reported the previous progress year.
2. Managed Hay and Managed Pasture **will use LGU recommended rates** for nutrient application (120lbs/acre and 60lbs/acre N respectively, for VA).
3. **Add Managed Hay to Group 1** for manure application spread.
   Add Managed Pasture to Group 2 for manure application spread.
4. **The legacy hay/pasture LUs would remain in Group 3.** The legacy LUs would be reduced by the same number of acres. Each of the new land uses would have the same loading rate ratios and crop distributions as their legacy LU. The expected application on the legacy LUs would remain unchanged (35lbs/acre and 15lbs/acre respectively)
5. **NM BMPs would be eligible on Managed Hay and Managed Pasture**. The NonNMNitrogenFactor for Managed Hay and Managed Pasture would be set to 1.2 and the NonNMPhosphorusFactor would be set to 1.0 (same as currently used for Legume Hay). Unmanaged Hay and Pasture would continue to have 1.0 for both nonNM N and P (0% effectiveness).

Manure Spread Groups

Group 1

- Grain with manure
- Silage
- Small Grains
- Double cropped
- Other crops
- Specialty (high and low)

Group 2

- Other Hay
- Pasture

Group 3

- Soybeans
- Legume Hay

Group 1

- Grain with manure
- Silage
- Managed Other Hay

Group 2

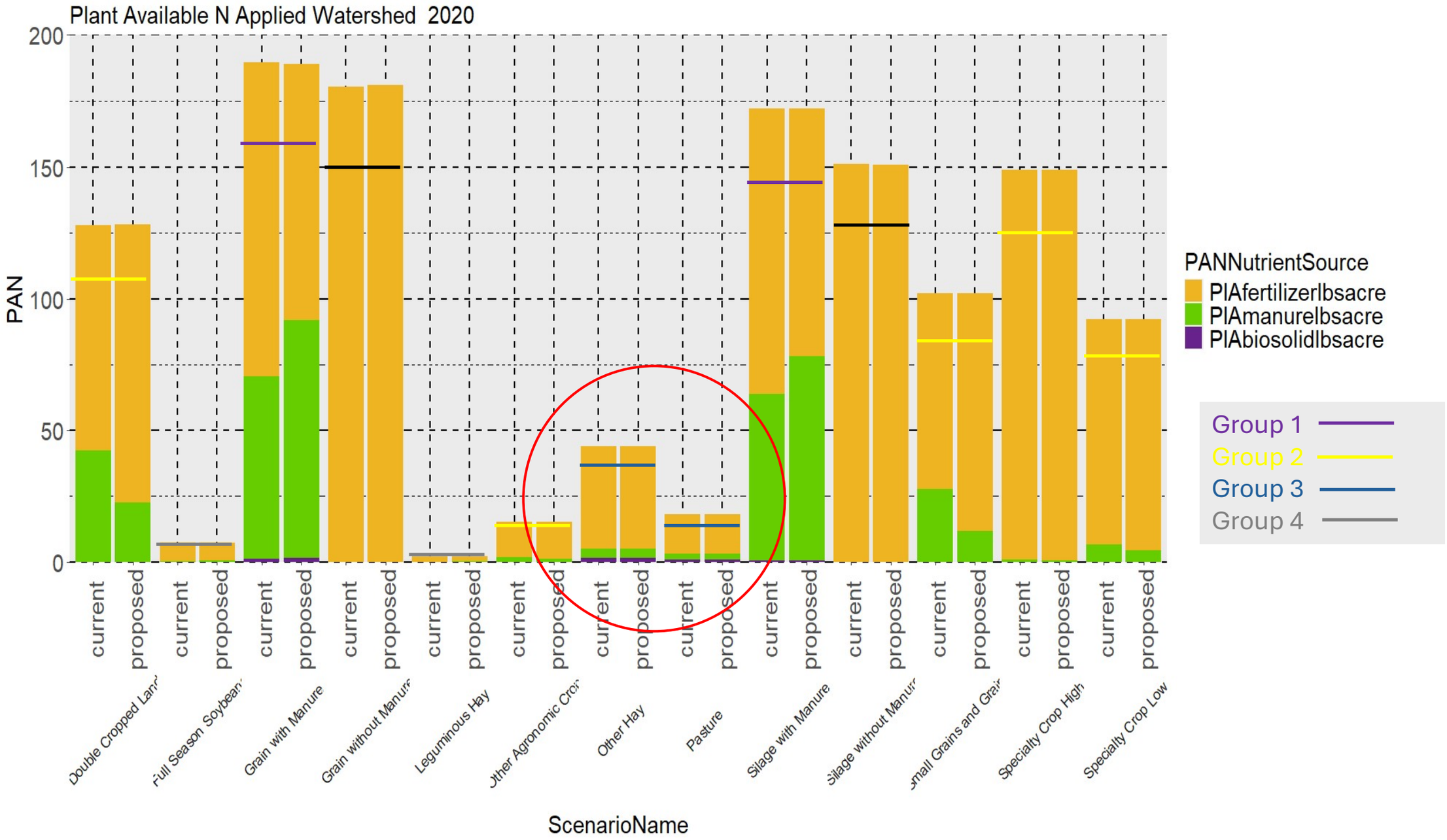
- Small Grains
- Double cropped
- Other crops
- Specialty (high and low)
- Managed Pasture

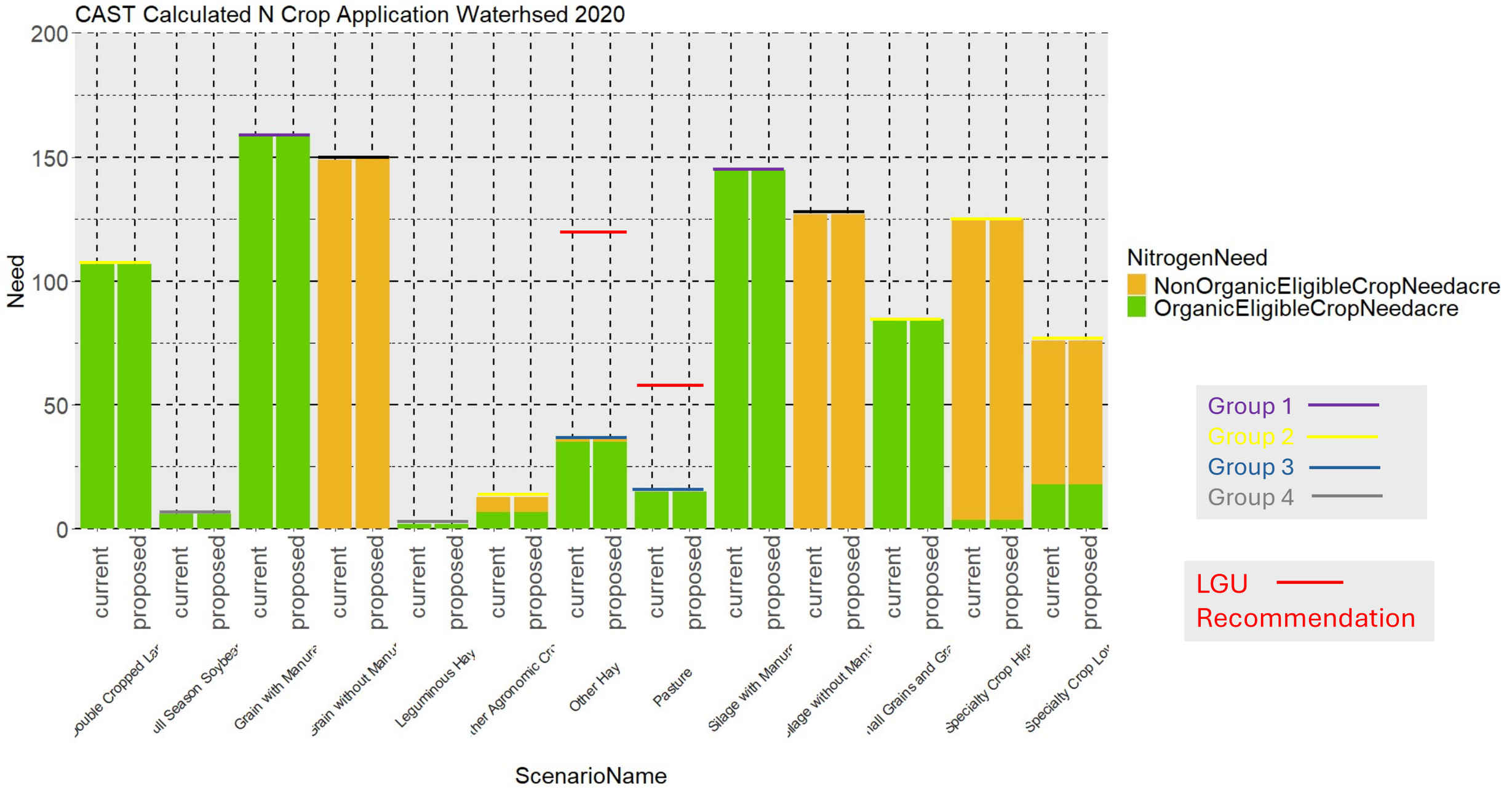
Group 3

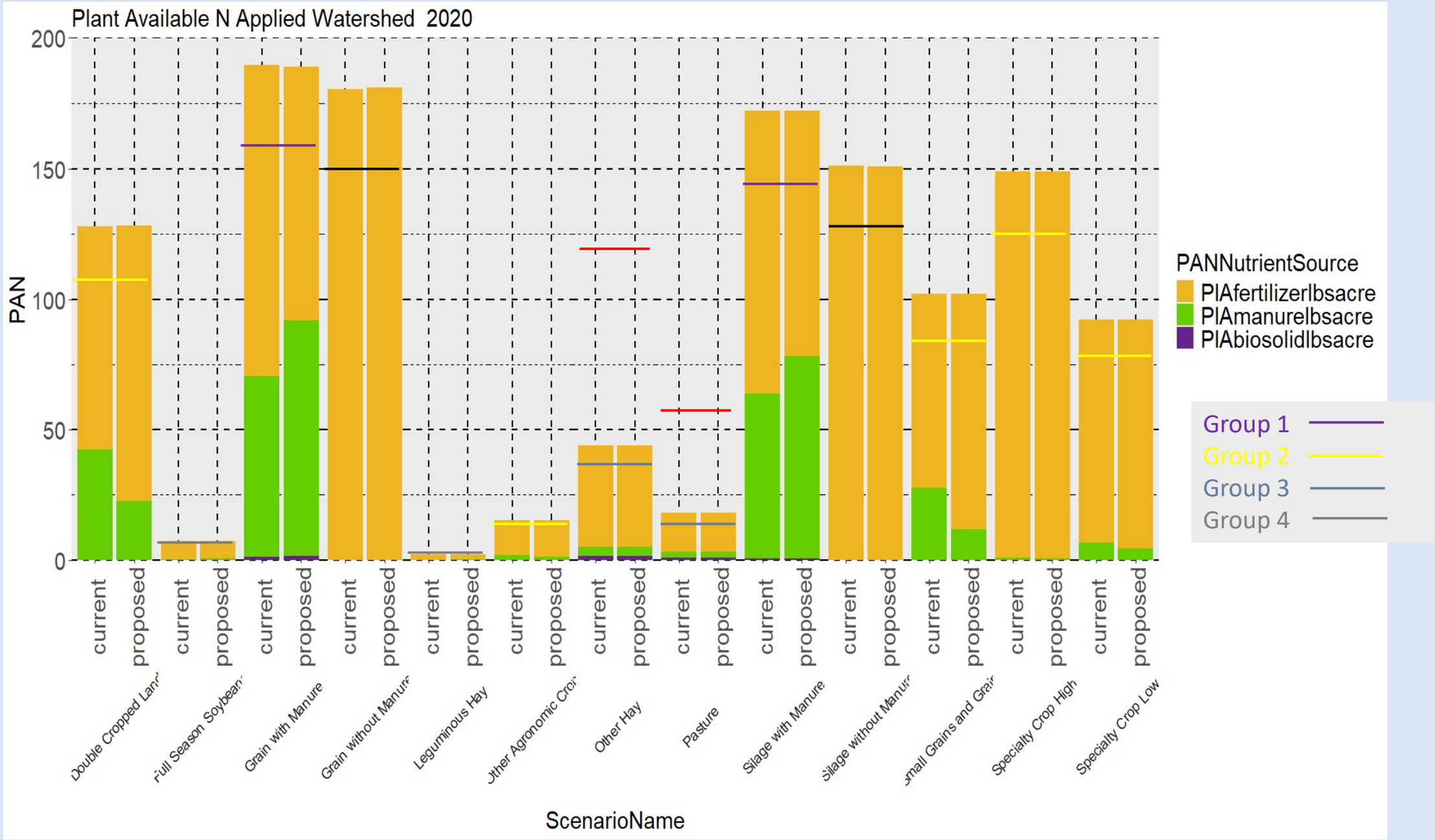
- Other Hay
- Pasture

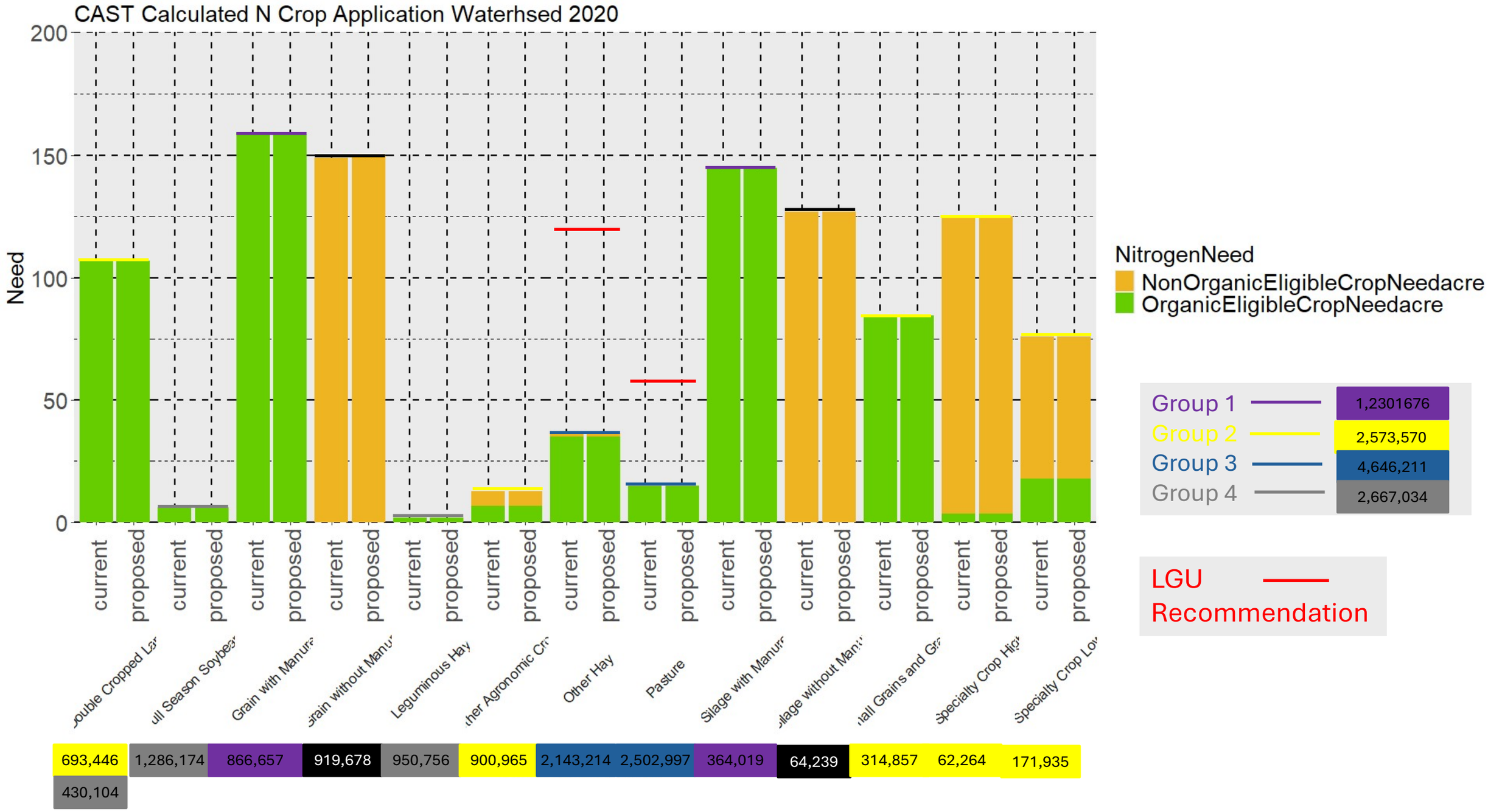
Group 4

- Soybeans
- Legume Hay


Plant Available N Applied Watershed 2020
PAN
200
150
100
50
0
current
proposed
Double Cropped Land
Full Season Soybean
Grain with Manure
Grain without Manure
Leguminous Hay
Other Agronomic Crop
Other Hay
Pasture
Silage with Manure
Silage without Manure
Small Grains and Grain
Specialty Crop High
Specialty Crop Low
ScenarioName
PANNutrientSource
PlAfertilizerlbsacre
PlAmanurelbsacre
PlAbiosolidlbsacre
Group 1
Group 2
Group 3
Group 4


CAST Calculated N Crop Application Waterhsed 2020
Need
200
150
100
50
0
current
proposed
Other Hay
Pasture
Leguminous Hay
Grain with Manure
Grain without Manure
Silage with Manure
Specialty Crop
ScenarioName
NitrogenNeed
NonOrganicEligibleCropNeedacre
OrganicEligibleCropNeedacre
Group 1
Group 2
Group 3
Group 4
LGU
Recommendation


Plant Available N Applied Watershed 2020
PAN
200
150
100
50
0
current
proposed
Double Cropped Land
Full Season Soybean
Grain with Manure
Grain without Manure
Leguminous Hay
Other Agronomic Crop
Other Hay
Pasture
Silage with Manure
Silage without Manure
Small Grains and Grain
Specialty Crop High
Specialty Crop Low
ScenarioName
PANNutrientSource
PlAfertilizerlbsacre
PlAmanurelbsacre
PlAbiosolidlbsacre
Group 1
Group 2
Group 3
Group 4


CAST Calculated N Crop Application Waterhsed 2020
Need
200
150
100
50
0
current
proposed
Other Hay
Pasture
NitrogenNeed
NonOrganicEligibleCropNeedacre
OrganicEligibleCropNeedacre
Group 1
Group 2
Group 3
Group 4
1,2301676
2,573,570
4,646,211
2,667,034
LGU
Recommendation
693,446
1,286,174
866,657
919,678
950,756
900,965
2,143,214
2,502,997
364,019
64,239
314,857
62,264
171,935
430,104

Our Ask Today

- Support from the AMT for:
  - **Create two new LU classes for testing and demonstration.** Managed Hay acres would be set to be 25% of legacy LU, and Managed Pasture acres would be set to be 10% of legacy LU.
  - **Use the LGU recommendations.**
  - **Review scenario outputs of N application** to see the effect they would have on manure applications and to look for unintended consequences. New bar charts comparing current Phase 6 and the new scenario, for the following counties previously reviewed:

DE	MD	NY	PA	VA	WV
• Kent • New Castle • Sussex	• Frederick • Sommerset • Caroline • Dorchester	• NONE Steuben	• Chester • Franklin • Adams • Lancaster Northumberland	• Amelia • Buckingham • Cumberland • Page • Rockingham • Accomack • Albemarle • Augusta • Beford	• Hardy • Pendleton