Nutrient Management Panel Phase 5 Report

Agriculture and Watershed Technical Workgroup Discussion

July 16, 2015

A Glimpse to How We Got Here

Fall 2011

Ag Workgroup convenes the Phase 5 Nutrient Management Expert Panel in Fall 2011

Fall 2013

CBP Partnership receives first report from NM Expert Panel and **APPROVES** the definitions for ***three tiers*** of Nutrient Management effort and the ***efficiency recommendations for Tier 1.***

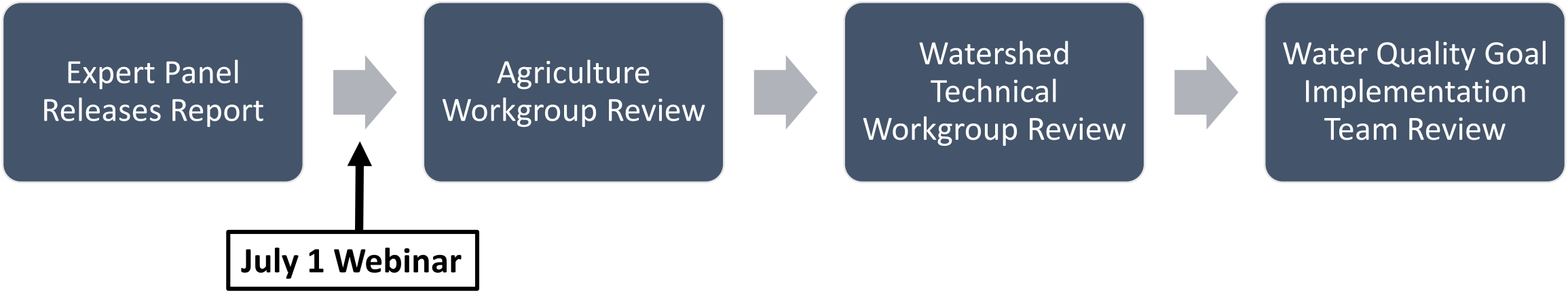
Fall 2014

CBP Partnership receives second report from NM Expert Panel and identifies substantive concerns about recommended efficiencies for TIER 2 and inherent challenges associated with verification. Expert Panel is reconvened and provided additional time to evaluate alternatives and re-consider ag land uses.

Summer 2015

Efficiency recommendations are made for Tiers 2 and 3 that separate N and P benefits and provide additional scrutiny to the agricultural land uses for which nutrient management benefits are realized. Guidance to states for ***non-visual assessment of Nutrient Management*** for all Tiers is included.

Partnership Review Period



Phase 5 Nutrient Management Expert Panel

Chris Brosch, CBP Nutrient Management Expert Panel Chair

Agriculture Workgroup Phase 5 Expert Panel Membership

- Comprised of Research Scientists, Extension Specialists, Nutrient Management Program Specialists, Policy Specialists

  - **County Conservation Districts:**
    - New York (1)

  - **State Agencies:**
    - Delaware (1)
    - Maryland (1)
    - New York (1)
    - Pennsylvania (1)
    - Virginia (1)
    - West Virginia (1)

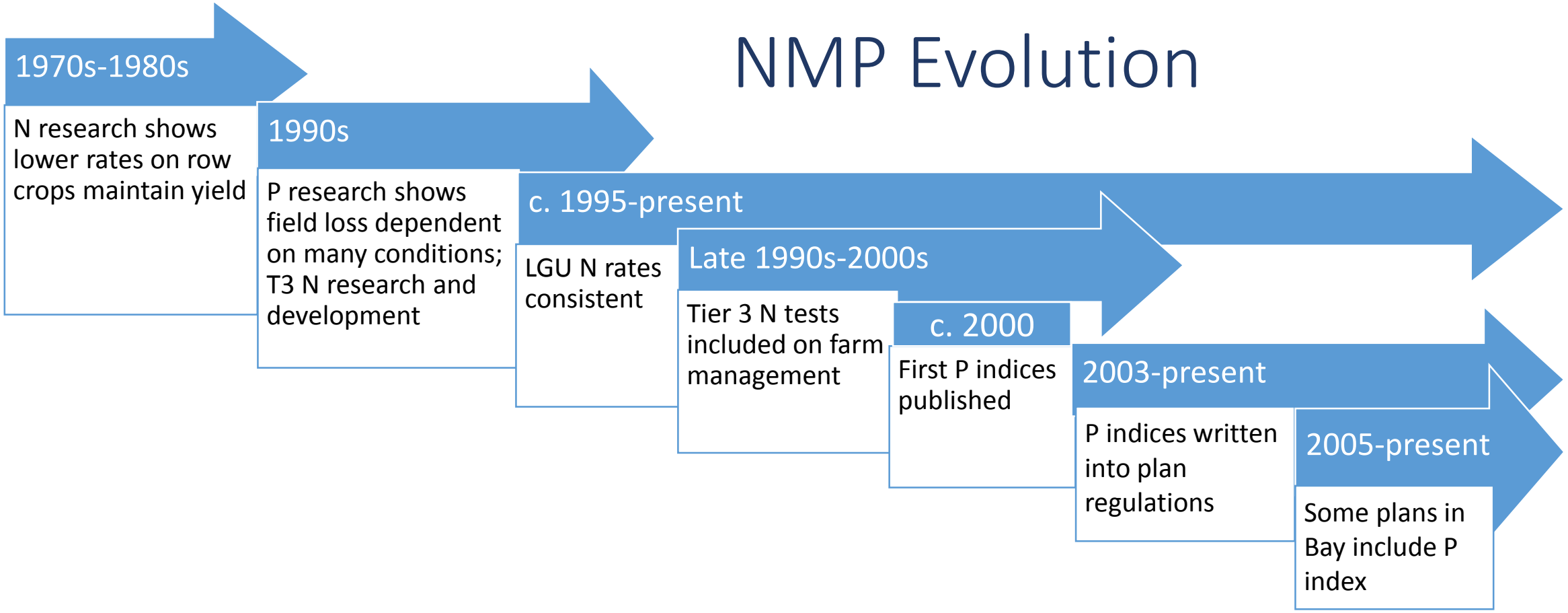
Federal Agencies:

- USDA Agricultural Research Service (3)
- USDA Natural Resources Conservation Service (1)

- **Universities:**
  - Maryland (6)
  - Pennsylvania (2)
  - Virginia (3)
  - West Virginia (1)
  - Johns Hopkins (1)

- **Non-Governmental Organizations:**
  - Conserve Pennsylvania (1)
  - Northeast Pasture Consortium (1)
  - International Plant Nutrition Inst. (1)

NMP Evolution



Tier 1 Plans

Tier 3 Plans

Tier 2 Plans

Tier Definitions

Chris Brosch, CBP Nutrient Management Expert Panel Chair

Phase 5 Expert Panel's revised tiers of Nutrient Application Management

Tier 3 Nitrogen Adaptive Nutrient Application Management

Ex: PSNT, CSNT, var. rate

Tier 3 Phosphorus Adaptive Nutrient Application Management

Ex: variable rate

Tier 2 Nitrogen Field Level Nutrient Application Management

Ex: split N applications, setbacks, incorporation

Tier 2 Phosphorus Field Level Nutrient Application Management

Ex: manure/soil P management; use of an assessment

Tier 1 Crop Group Nutrient Application Management

*Adoption of land grant university recommendations for proper **nutrient source and rate**, but including consideration of timing, and placement (4Rs)*

4Rs Emphasized in Nutrient Management Tiers

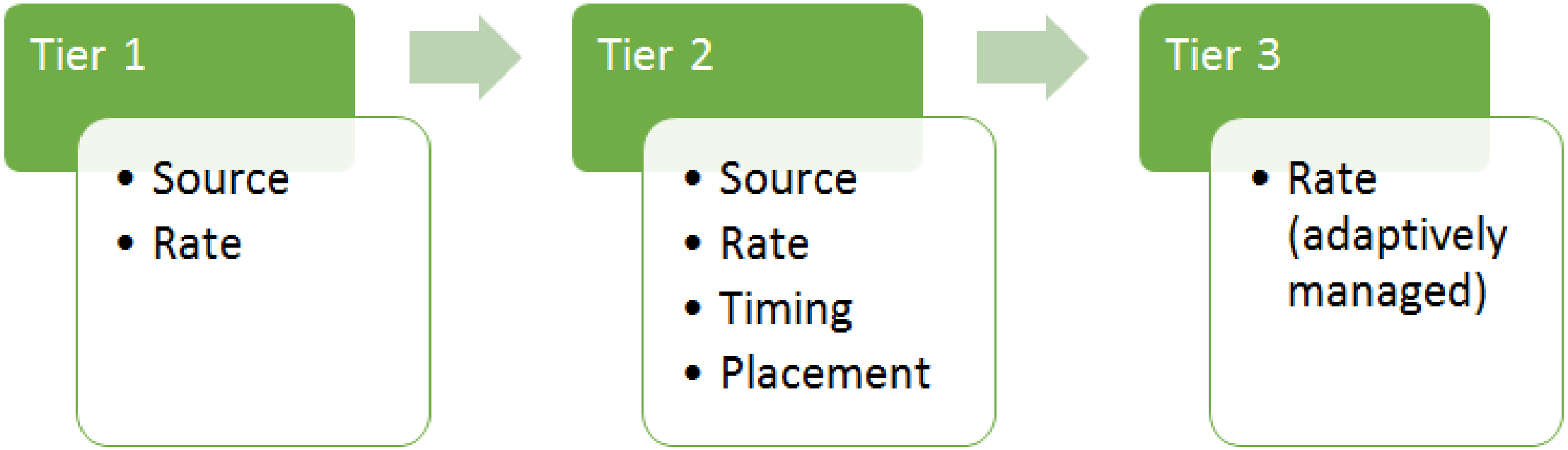


Figure 10. Diagram that shows the most relevant of the 4Rs of nutrient management as considered by the panel to influence the recommended reduction efficiencies.

Eliminating old NM BMPs

- Decision/Precision Ag: 4% TN reduction for technology based nutrient applications or decisions
- Enhanced Nutrient Management: 7% TN reduction for application rates below LGU recommended rates.

Reduced N application

Minimally impacted yield

Literature Support for Tiers

Chris Brosch, CBP Nutrient Management Expert Panel Chair

Tier 2 N – Manure Incorporation

- **Reducing** ammonia volatilization
- N reduction efficiency determined by the ammonia conserved by incorporation within one day after application and using tillage implements that would leave at least 30% residue cover (chisel plow or light tandem-disk)
- Final small-plot estimate = 10% of the applied manure ammonium-N
- Temporary until Phase 6.0 Manure Incorporation panel conducts review for Phase 6.0 Model

Tier 2 N – Timing of N Applications

- Timing: one of the 4Rs
- N **use efficiency is increased** by applying N in phase with crop need
- N **loss risk is reduced** by decreasing exposure to loss pathways
- N reduction efficiencies estimated by comparing corn yields from replicated N-response trials over many site-years
- Panel used data from both corn and wheat studies
- Hayland managed similarly

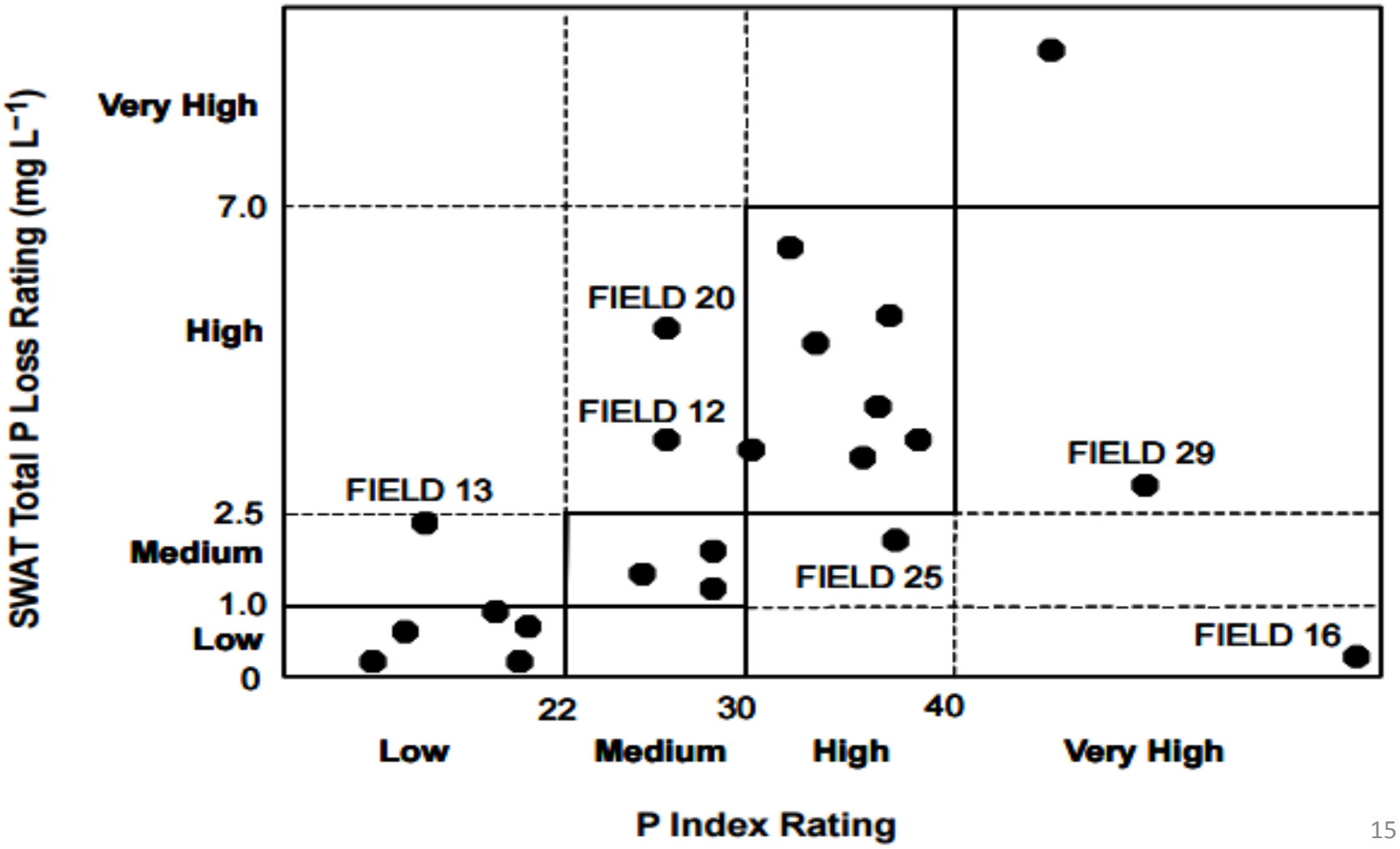
Tier 2 P – Manure Incorporation

- Reducing risk of early season surface losses from manure spreading
  - Comes at cost of soil erodibility
- Coarser textured, lower sloped fields show benefit from mixing surface applied manure with upper soil. ~40+%
  - Fine textured, steep slopes have too high a risk of soil and nutrient loss to yield a net benefit
- Mixing of surface soil where sediment-bound P can reduce surface loss risk, as well
- One of several elements contributing to P-index
  - Evidence was used in support of P-index recommended credit.

Tier 2 P – P Site Index

Change in PSI rating from High to Medium = 35% reduction in P loss

(Veith, 2005)



Tier 2 P – Setbacks

- Setback values were not considered in the Tier credit calculation explicitly
- Identified as contributing to conservativeness
  - Practiced after the calibration
  - Results in lower nutrient applications/acre
  - Evidence of water quality protection could be stronger

Tier 3 N – PSNT, CSNT, ISNT, FSNT

Mid/Late season soil or plant tissue tests

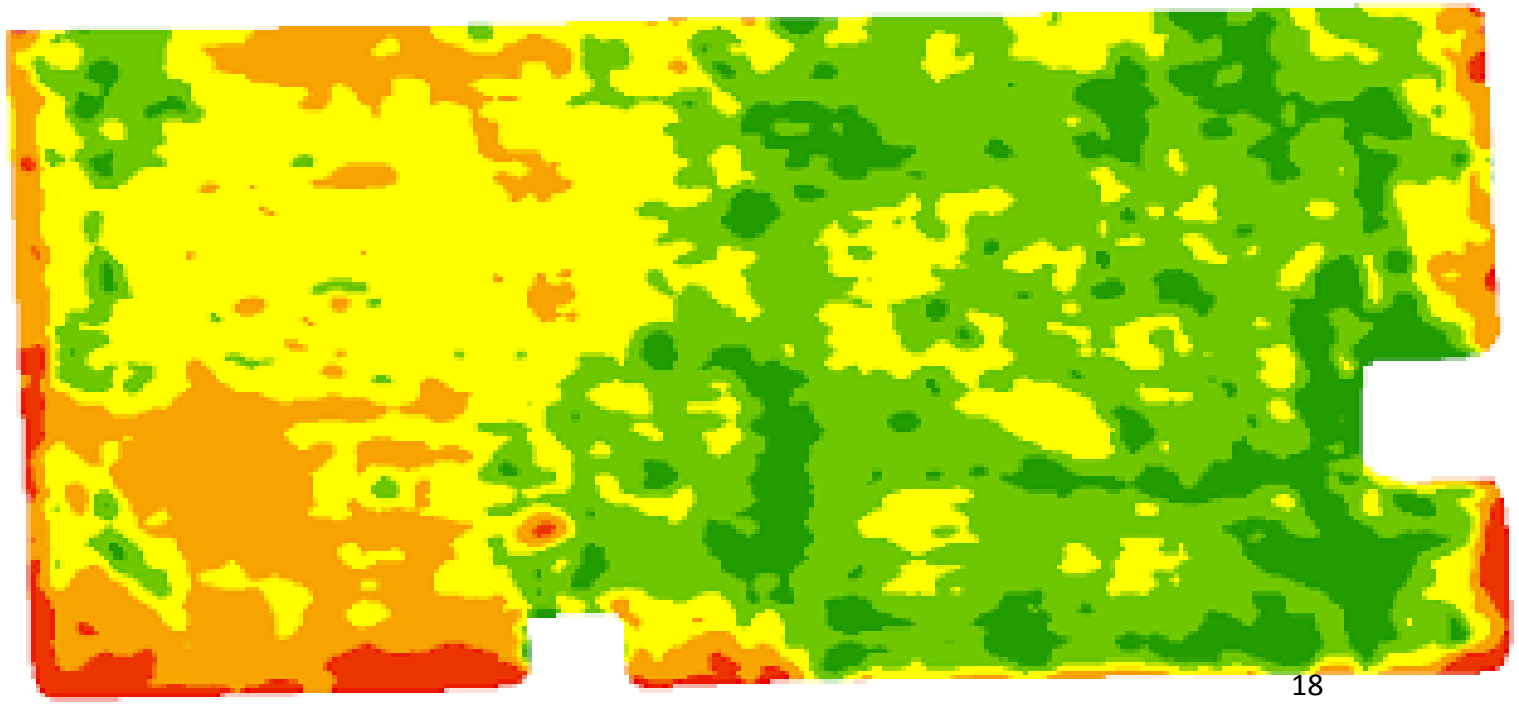
Effective application requires that producers:

- Conduct the tests
- Manage N fertilizer applications based on test results so that excess N is not added where no yield response would be expected

Annual N fertilizer application rates are typically reduced through the recommendations based on test results following the season(s).

Tier 3 N – Variable rate N applications

- Studies in VA compared N application rates based on Virginia Tech Corn Algorithm to standard N rate
- Average VTCA N rate was 24 kg/ha (~20 percent) less than the standard farmer's rate



Effectiveness Estimates

Chris Brosch, CBP Nutrient Management Expert Panel Chair

Applicable land uses by Tier

Tier 1

- Row w/ manure
  - HWM
  - LWM
- Specialty row crops (HOM)
- Pasture (PAS)
- Nursery (NUR)
- Hay w/ nutrients (HYW)
- Alfalfa (ALF)

Tier 2N

- Row w/ manure
  - HWM
  - LWM
- Hay w/ nutrients (HYW)

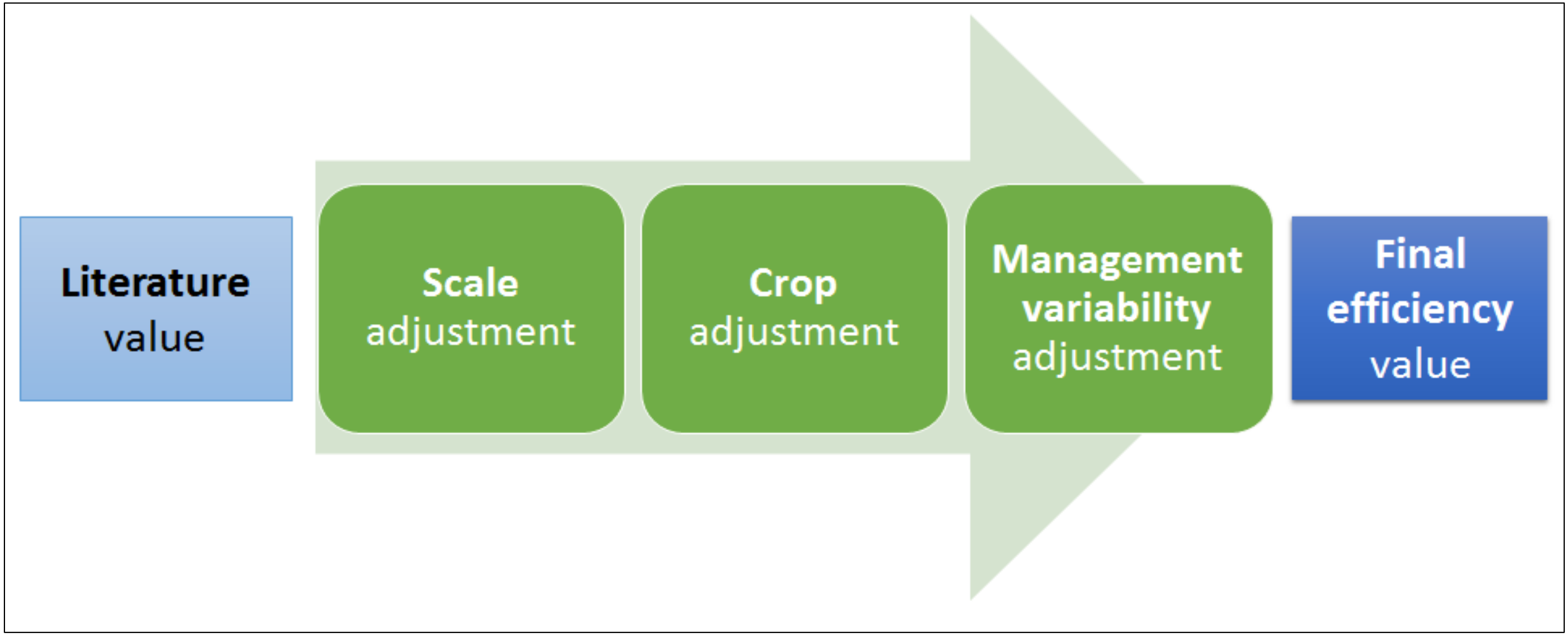
Tier 2P

- Row w/ manure
  - HWM
  - LWM
- Hay w/ nutrients (HYW)
- Alfalfa (ALF)

Tier 3

- Row w/ manure
  - HWM
  - LWM

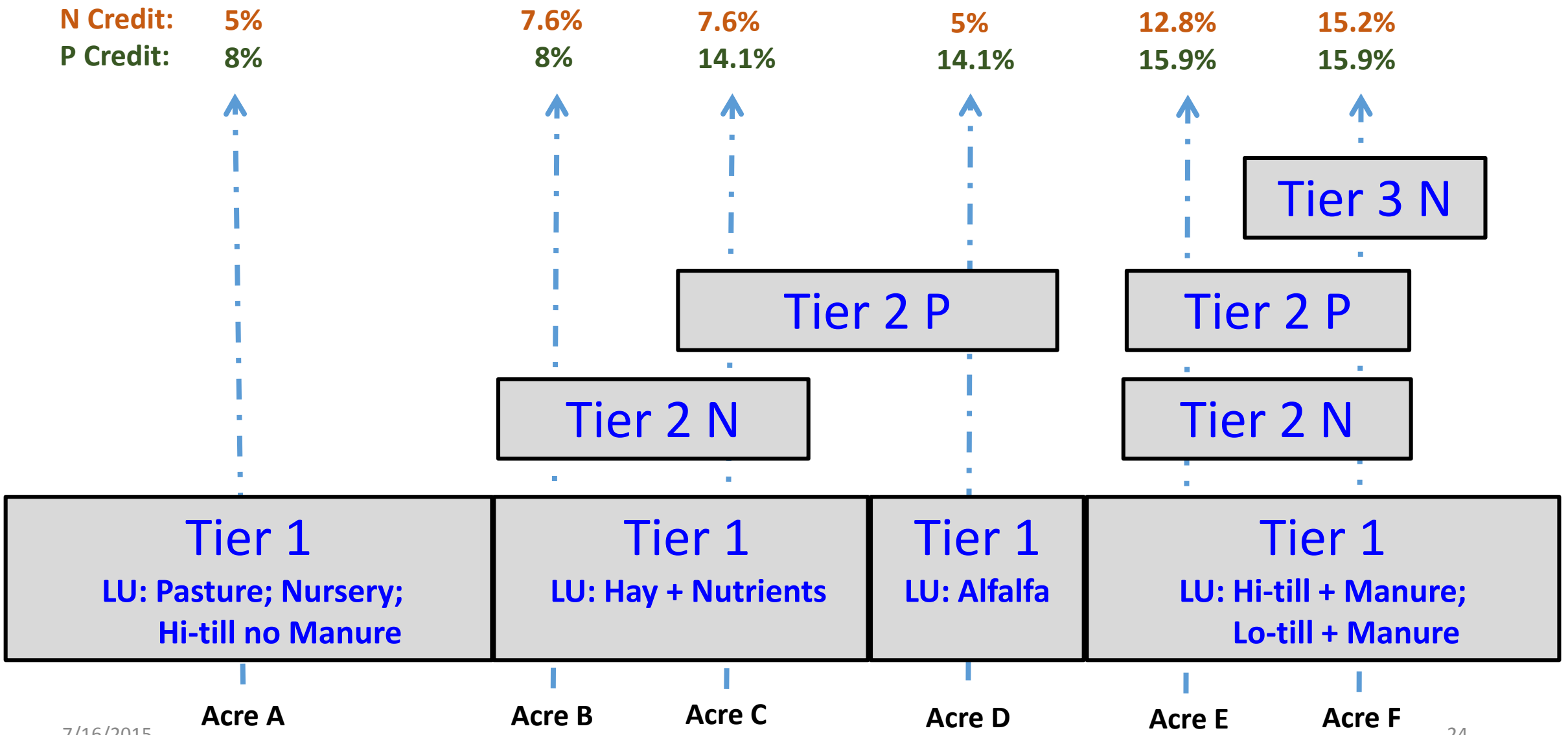
Adjustments to literature values



Recommended final efficiency value *(highest in bold)*

		High-Till with Manure	Low-Till with Manure	High-Till without Manure	Pasture	Hay with Nutrients	Alfalfa	Nursery
Tier 1 Reduction from no NMP	TN	9.25	9.25	**5**	**5**	5	**5**	**5**
	TP	10	10	**8**	**8**	8	8	**8**
Tier 2 Reduction from no BMP	TN	12.79	12.79	N/A	N/A	**7.6**	N/A	N/A
	TP	**15.94**	**15.94**	N/A	N/A	**14.07**	**14.07**	N/A
Tier 3 Reduction from no BMP	TN	**15.23**	**15.23**	N/A	N/A	N/A	N/A	N/A

Examples of crediting options



Discussion

Review of Fall 2014 comments raised on Nutrient Management Phase 5 Report

Chris Brosch, CBP Nutrient Management Expert Panel Chair

Need for increased scientific support for Tier credit

- Limited data to support manure application timing
- Limited N split application data on leaching and on total nitrogen
- Lack of justification for P site indices benefit
- Lack of data to support setbacks
- Lack of data to support fertilizer banding
- **Need for increased detail on how the literature sources were used by the panel to develop effectiveness estimates**

Increased scientific support for Tier credit

Revised report section 3.3 explains justification for effectiveness estimates for each component of each Tier

Highlights:

- Effect of timing shifted entirely to split applications (not eliminating bad actors)
- Where N Leaching identified as sole pathway needed for credit
  - Volatilization and denitrification are both only further reduced
  - added implicit conservatism.
- P site index research reviewed
  - back up documentation on incorporation of manure
  - banding and setbacks considered as implicitly contributing to conservative estimate.

Adjustments to literature values

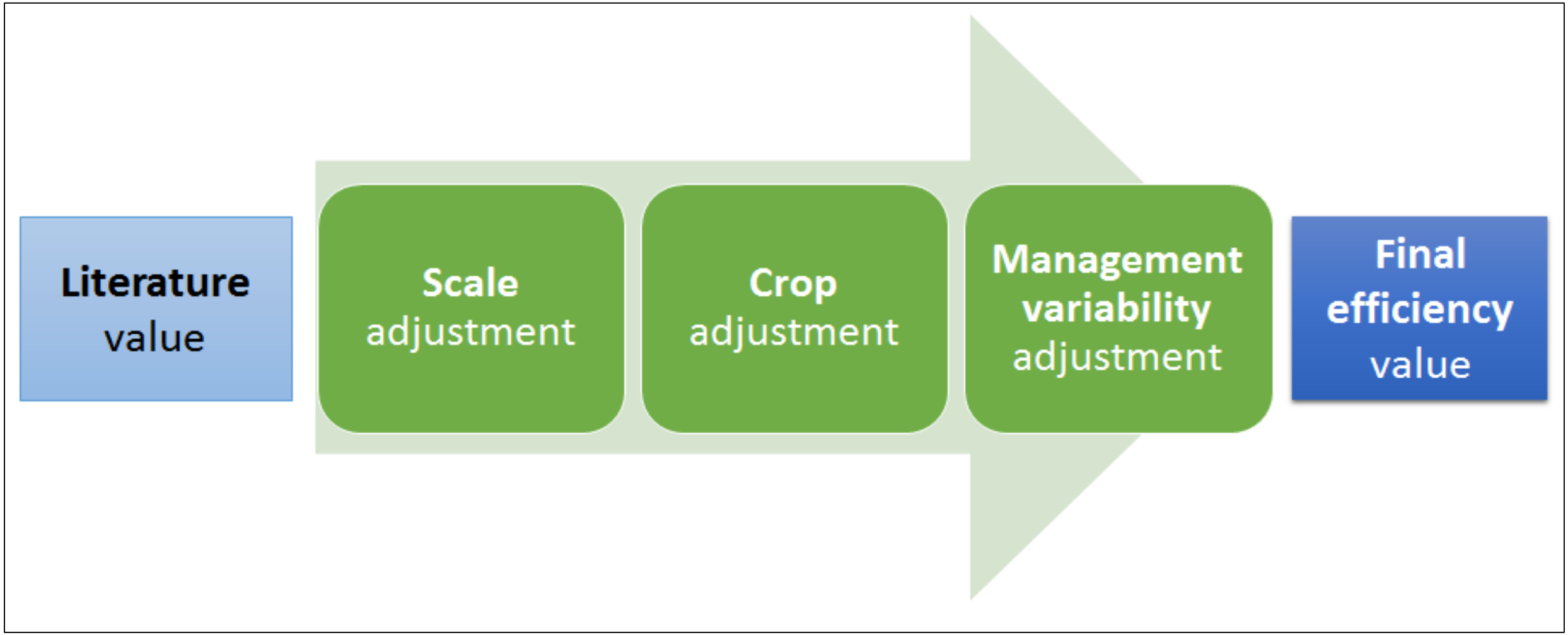


Table 7. Nutrient reduction credits for each Tier component, adjustment factors applied, and final Tier credit recommendations

Tier	Component	Geography	Literature value	Research scale	Scaling adjustment	Relevant crops	Land use/crop adjustment	Model Considerations and Mgt. Variability adjustment	Mgt. Variability adjustment	Adjusted efficiency	Tier credit
Tier 2 N	N timing	Coastal Plain	15.6%	plot	75%	Corn	51%	Impl. scheduling challenges	80%	4.7%	Row Crop: 3.9% Hay w/ nutr.: 2.8%
		Piedmont	8.9%	plot	75%	Corn	51%	Impl. scheduling challenges	80%	2.7%	
		All	14.9%	plot	75%	Small grains	15%	Impl. scheduling challenges	80%	1.4%	
	N timing – ½ Avg for hay	Hay with nutrients landuse	6.6%	plot	75%	Non-legumes	70%	Impl. scheduling challenges	80%	**2.8%**	
	Manure incorporation[1]		10%	plot	75%	Corn, small grains	66%	N savings → N loss	30%	1.5%	
	Enhanced efficiency fertilizers (deferred)										
Tier 2 P	Manure incorporation	Appl./R&V	0%	plot	75%	Corn, small grains	66%	Simulated storm effect	20%	0%	**6.6%**
		Piedmont	46%	plot	75%	Corn, small grains	66%	Simulated storm effect	20%	4.6%	
		Coastal Plain	48%	plot	75%	Corn, small grains	66%	Simulated storm effect	50%	11.9%	
	P Site Index	All	35%	farm	75%	All crops	100%	Model value, response lag, effect on farm P budget	25%	**6.6%**	
	Setbacks (deferred)										
Tier 3 N	PSNT	Coastal Plain	8.1%	plot	75%	Corn	51%	N savings → N loss	60%	1.8%	**2.8%**
		Piedmont	26.6%	plot	75%	Corn	51%	N savings → N loss	40%	4.0%	
	CSNT	All	20%	plot	75%	Corn	51%	Results inform future decision	40%	3.0%	
	ISNT	All	33%	plot	75%	Corn	51%	Results inform future decision	50%	6.3%	
	FSNT	All	10%	plot	75%	Small grains	15%		80%	0.9%	
	Variable rate N fertilizer	All	10%	plot	75%	Corn	51%		80%	3%	
		All	5%	plot	75%	Wheat	15%		80%	0.5%	
	Adapt-N (deferred)										

Need for increased transparency with panel process

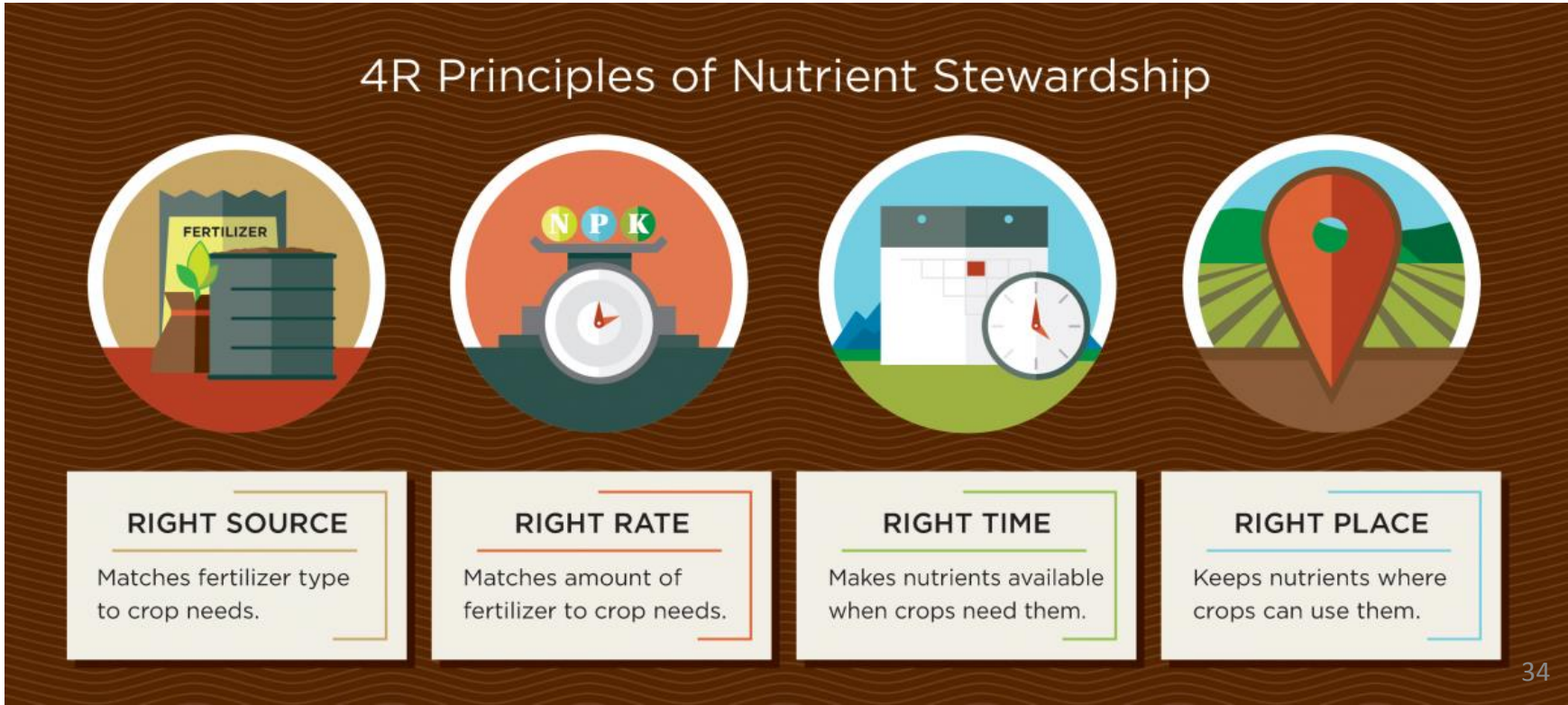
- Include details of panel discussions and decision making in the report
- Follow BMP protocol:
  - Required elements to be included in report
  - Review and approval process

Increased transparency with panel process

- Revised report section 3.3 explains process for developing effectiveness estimates
- Section 3.2 is a summary of panel discussions January – June 2015
- Appendix E: crosswalk between report sections and required BMP protocol elements
- Webinar to document process and continued concerns was performed April 6.
- Well publicized comment period began June 25
- July 1 webinar for report rollout
- Webinar for response to comments to be scheduled in August

Need for improved clarity of Tier definitions

- Definitions should provide clear understanding of whether an acre is under Tier 1 vs. Tier 2 management
- Describe how the 4Rs relate to each Tier



Improved clarity of Tier definitions

- State Program review of applicability to 590 standard in development for Tier 2 credit, see next slide

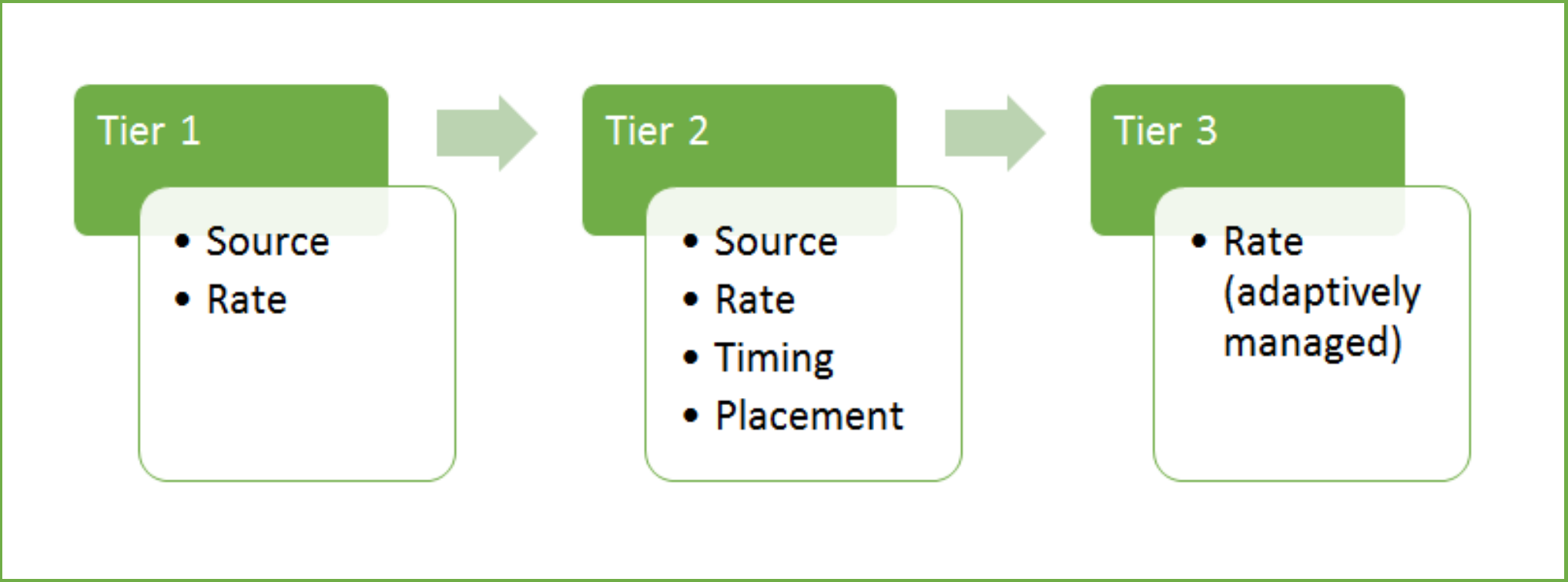


Figure 3. Diagram that shows the most relevant of the 4Rs of nutrient management as considered by the panel to influence the recommended reduction efficiencies.

Table 11. Summary of current NM regulations adopted by the six Chesapeake Bay watershed states.

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		Delaware	Maryland	New York	Pennsylvania	Virginia	West Virginia
Current state nutrient management regulations adopted		2007	2005 Revised 2012 Revised 2015	2004	2006	2006 Revised 2014	2011 47CSR10 "CAFO Rule"
Regs apply to:	**CAFOs**	All CAFOs	All CAFOs	All medium and large CAFOs (per EPA size thresholds)	All CAOs > 8 AUs and all CAFOs > 8 AUs	CAFOs/AFOs under DEQ permit ≥300 AU	All Permitted CAFOs and unpermitted Large CAFOs
	Other animal operations	Other animal operations ≥8 AU	Other animal operations ≥8 AU	Not a regulation, but required for producers engaged in State or Federal programs for nutrient management practices. Voluntary for others.	Tier 2 plans voluntary for non CAOs and non CAFOs. Tier 1 plans required for all operations where manure is produced or used	Voluntary	Voluntary Note: USDA requires a CNMP based on their 590 Standard for certain practices.
	Cropland, pasture, nursery	Cropland, pasture, nursery with applications to ≥10 ac	Cropland, pasture, nursery with applications to ≥10 ac	Not a regulation, but required for producers engaged in State or Federal programs for nutrient management practices. Voluntary for others.	Plans are required to include all cropland, hay land, pasture land, and heavy use areas. Plans also must include fields on farms that import manure from a CAO or CAFO	Voluntary	Voluntary Note: USDA requires a CNMP based on their 590 Standard for certain practices.
Timing (N)		Timing and method of nutrient application shall correspond as closely as possible with plant nutrient uptake characteristics, while considering cropping system limitations, weather and climatic conditions and field accessibility	(2005) Sept 1 to Nov 14 apply nutrients @ University rate; Nov 15 to Feb 28 no application of nutrients (exceptions for manure inadequate storage, apply @ P removal rates for spring crop) (2012) 2012 to 2015 - Sept 10 to Nov 15 apply nutrients @ University rate; apply manure @ P removal rate for spring crop(not to exceed	Nutrient application timings are based on efficient crop nutrient utilization, cropping system logistics, field conditions, and several field-level environmental risk assessments concerning runoff, leaching, erosion, and volatilization losses.	PA Nutrient Mgmt regulations require nutrients to be applied during times and conditions that will hold the nutrients in place for crop growth, and protect surface water and groundwater. The PA 590 standard requires that split applications of nutrients be considered when developing a nutrient management plan to address NPS pollution of surface and groundwater. The PA 590 standard states	Every plan has specified timing recommendations to enhance uptake and reduce loss to the environment.	Nutrient application timing is required by PSI on a field by field basis. CAFO standards require split application of inorganic N on hay and grains.

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Need for Additional Detail on Tracking and Reporting

- Concern about increasing nutrient reductions due to accounting change rather than change on the ground
  - Document when states adopted Tier 2 plans
- Increased detail about the records/data needed to substantiate the reported implementation for each Tier
- Consideration of CEAP report information about level of nutrient management occurring in CBW

Tracking Issues

- NM has historically been tracked and reported to the CBPO on a farm acreage level (i.e. total acres of NMPs).
- This is the same tracking criteria for tier 2 plans, but the magnitude of recorded data about the 4Rs has become much more rigorous.
  - Manure testing for source information
  - Calibration records for the fertilization equipment, if owned
  - Contracts for nutrient services
  - Field or sub field level records of rates for each season
  - Field or sub field level records of timing for each fertilization
  - Field or sub field level records of method for each fertilization
- CEAP was not considered in more detail than the Fall 2014 response to comments.

Verification

- Concerns about crediting Tier 2 NM now and then possibly having to remove some or all of the credit in the future when states have adopted verification protocols
- Concerns about increasing credit for NM before verification protocols are adopted
- Recommend that verification be a requirement for states to claim Tier 2 credit

Verification

- Revised report: section 6
- Non-visual BMPs are difficult to verify and we need to primarily rely on the NMP's and on-farm documentation.
- The jurisdictions are currently developing BMP verification protocols which will identify the methods for verifying NM to implement in Jan 2018.
- Enabling the tracking and reporting of detailed management actions on specific fields or subfields will require retooling of the current partnership framework, as well as inspection and verification procedures.
- The panel recommends criteria for crediting acres to the tier and sub-tier (N vs. P), but adoption and reporting will be a new and unprecedented challenge for the partnership to address.

Tier 1 Non-Visual Assessment

1. Plan is available in electronic or paper format.
2. Plan is developed cooperatively by a trained professional and the farmer.
3. Plan expiration date is no longer than three years after written.
4. Plan uses soil lab analysis from farm samples to inform application rates of nutrients.
5. Plan is implemented and followed according to the CGNAM definition and the intent where:
   - Crop yields are estimated based on records or soil productivity estimates for the entire farm;
   - Nutrient applications adhere to contemporary LGU specifications for N rate;
   - P fertilizers are applied at a rate consistent with the contemporary LGU recommendations; and
   - Nutrient application timing is considered to further reduce N and P losses.

Tier 2 Non-Visual Assessment

Tier 2 includes <u>all</u> elements of a Tier 1 plan, and the enhancements bolded below.

1. Plan uses soil lab analysis from farm samples to inform application rates of nutrients.
   - If soil test levels of P warrant a **P risk assessment (or P-index),** one is performed and the recommendations to reduce losses are followed for the entirety of the plan.
2. Plan is implemented and followed according to the FLNAM definition and the intent where:
   - Crop yields are estimated based on records or soil productivity estimates for **each field** using **contemporary guidelines from state programs**;
   - Nutrient application rates **do not exceed** contemporary LGU specifications for N and **P (including manure)**; and
   - Fertilizer and manure applications are **timed** and placed (e.g., lower risk times for runoff and leaching, setbacks, incorporation, etc.) to reduce risk of N and P loss.

Tier 3 Non-Visual Assessment

Tier 3 includes <u>all</u> elements of a Tier 2 plan, and supplementary records showing either:

1. Variable rate applications of N on each field were performed resulting in a net change in N rates for the field; or
2. An Illinois Soil Nitrogen Test (ISNT), Corn Stalk Nitrate Test (CSNT), Pre-side dress Nitrate Test (PSNT), or Fall Soil Nitrate Test (FSNT) was performed resulting in a net change in N rates for the field.

Other comments

- Concern about double counting manure incorporation as part of NM and as a separate BMP
- Explain how reduction efficiencies can apply to the row crop land use when not all crops receive manure
- How do the panel recommendations account for evidence of increases in manure and fertilizer applications?

Phase 5

Nutrient Application Management INCLUDES manure incorporation*

*no manure injection credited in progress

Phase 6

Nutrient Application Management

Manure Injection/ Incorporation

Land Use contribution to Ag acres under tiers (2012 proportions)

Tier 1

- Row w/ manure
  - HWM
  - LWM
- Specialty row crops (HOM)
- Pasture (PAS)
- Nursery (NUR)
- Hay w/ nutrients (HYW)
- Alfalfa (ALF)
- 92% of ag acres

Tier 2N

- Row w/ manure
  - HWM
  - LWM
- Hay w/ nutrients (HYW)
- 58% of acres

Tier2P

- Row w/ manure
  - HWM
  - LWM
- Hay w/ nutrients (HYW)
- Alfalfa (ALF)
- 66% of acres

Tier 3

- Row w/ manure
  - HWM
  - LWM
  - 41% acres

Table 7. Nutrient reduction credits for each Tier component, adjustment factors applied, and final Tier credit recommendations

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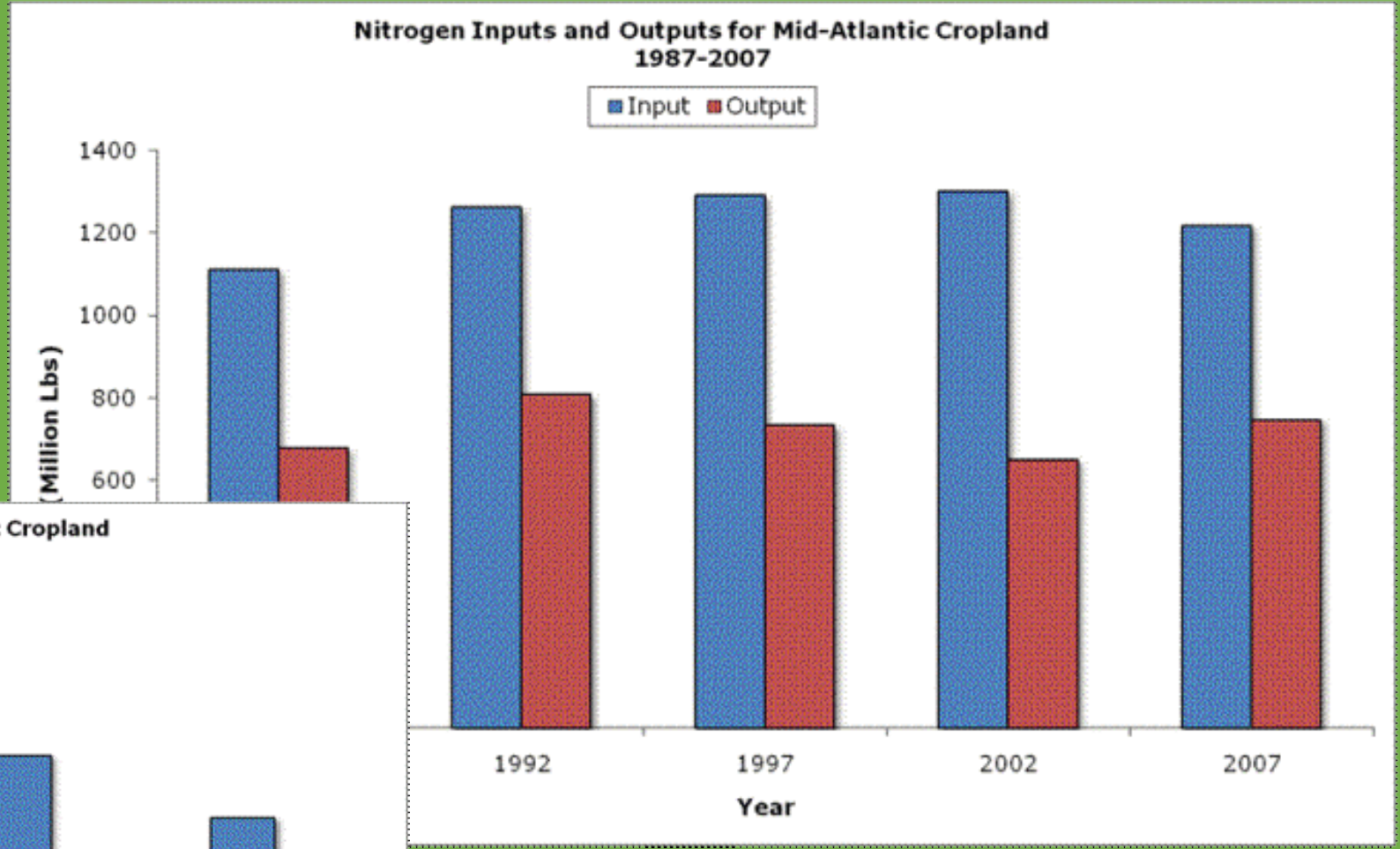
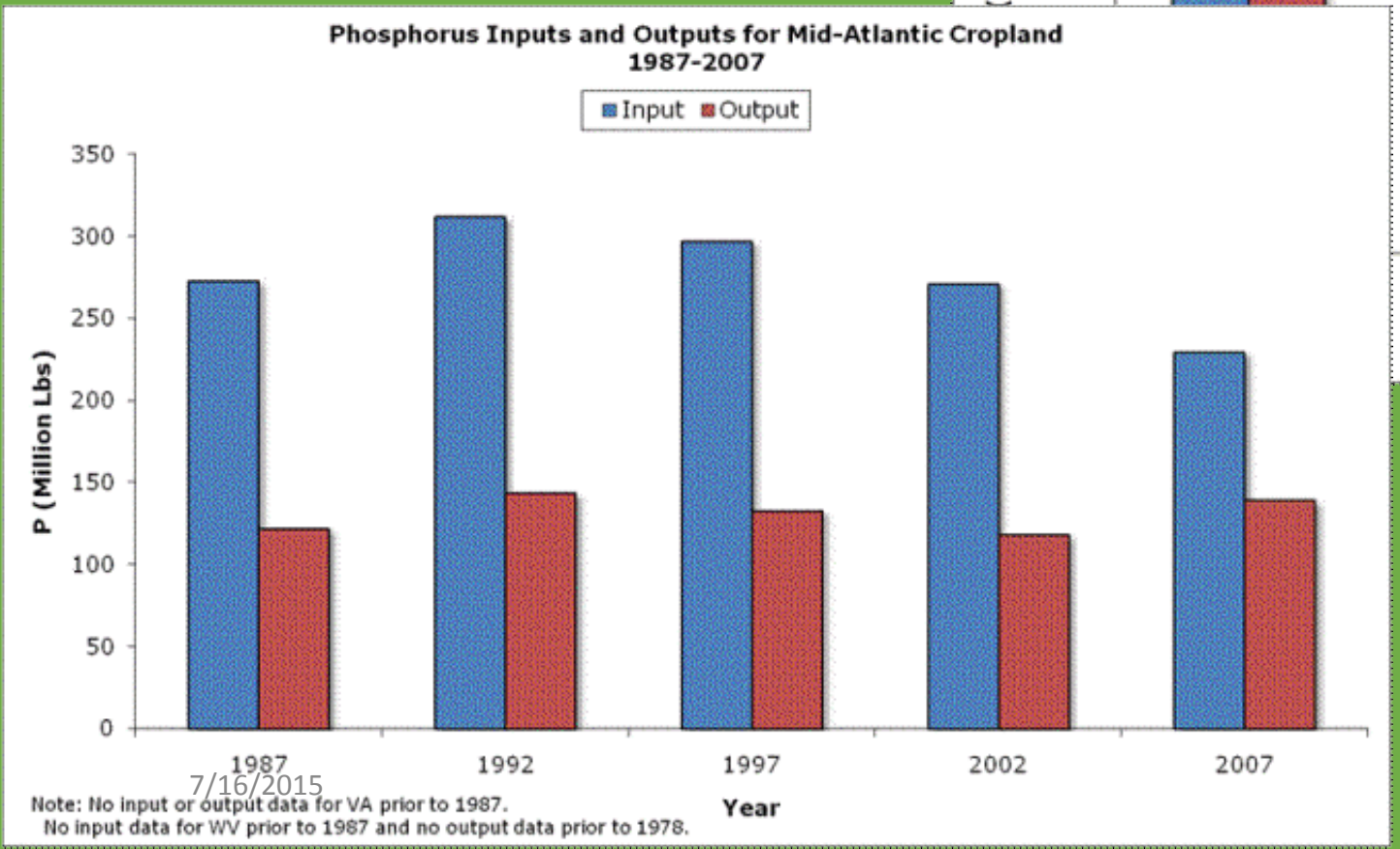
	Adapt-N (deferred)										

MAWP Data


Nitrogen Inputs and Outputs for Mid-Atlantic Cropland
1987-2007
Input
Output
1400
1200
1000
800
600
(Million Lbs)
1992
1997
2002
2007
Year


Phosphorus Inputs and Outputs for Mid-Atlantic Cropland
1987-2007
Input
Output
350
300
250
200
150
100
50
0
P (Million Lbs)
1987
1992
1997
2002
2007
Year
Note: No input or output data for VA prior to 1987.
No input data for WV prior to 1987 and no output data prior to 1978.

Topics for Phase 6 Expert Panel

- Tiered efficiency for specialty crops and legumes
- Tier 3 P, i.e. variable rate efficiency & whole farm balance
- Values for setbacks
- Verification and reporting enhancements