Options for simulating atmospheric deposition change

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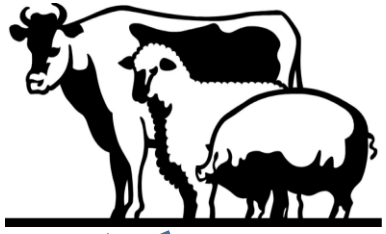
CBPO

Phase 6 Inputs Conceptual Model

Livestock Manure (and Biosolids)



Barnyard

Fertilizer

Nutrient Application Prescription

Pasture

Access Area

Crops

River

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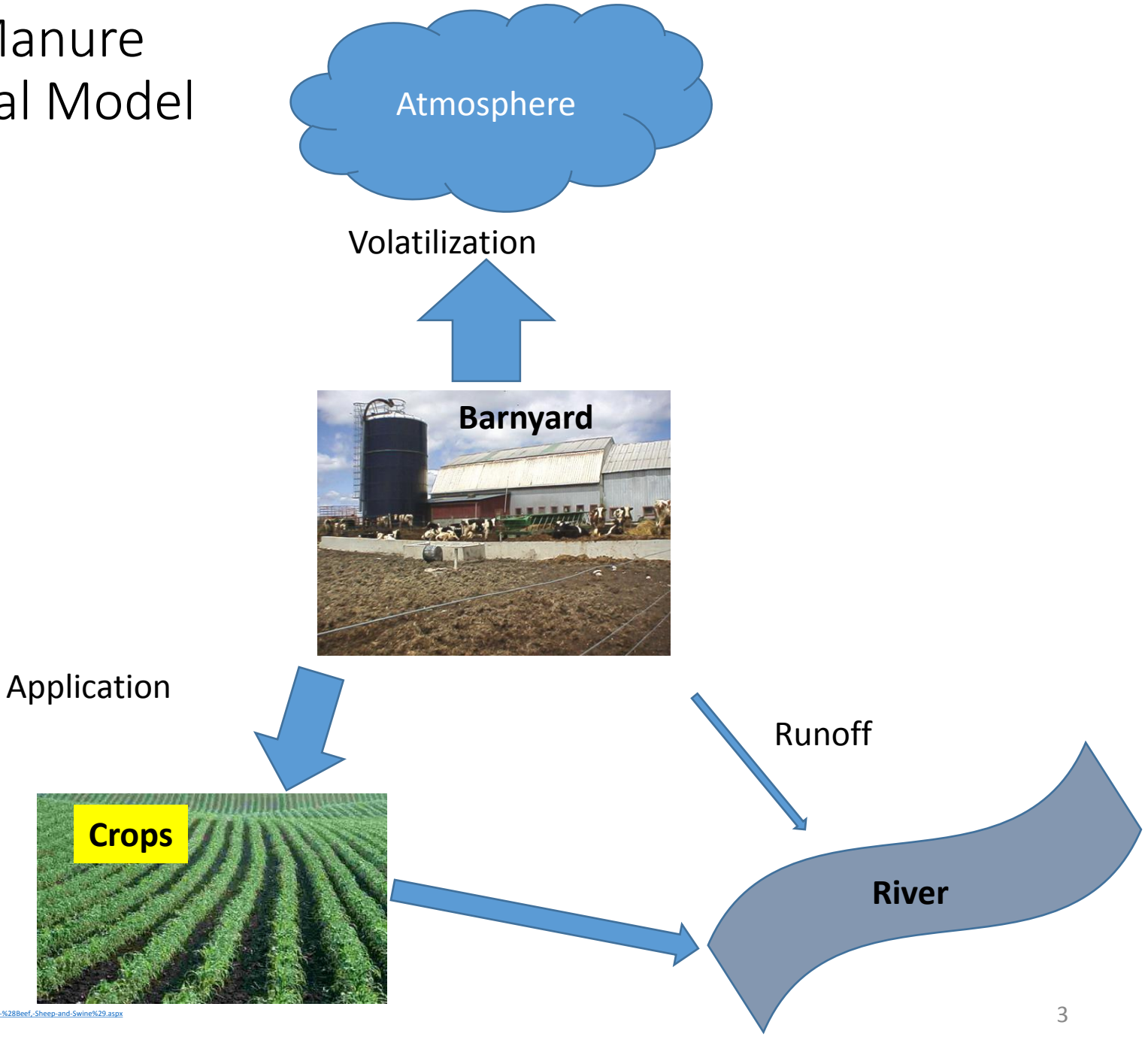
http://nh.water.usgs.gov/project/champlain_bmp/ag.htm

Phase 5 Manure Conceptual Model



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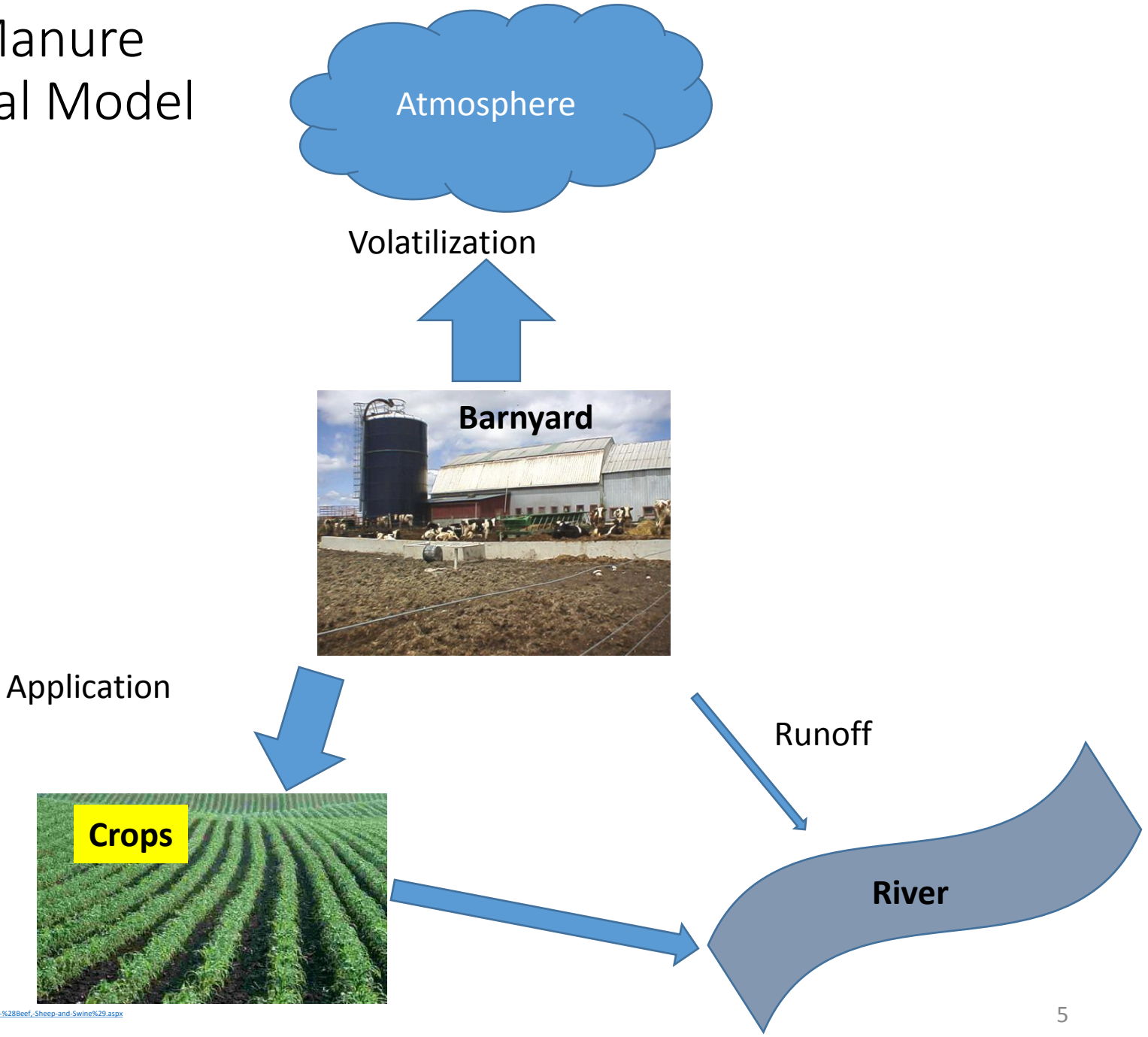
Manure Volatilization BMPs

- Lagoon Covers
  - all livestock
  - reduces NH3 volatilization within the barnyard by 15%.
- Alum
  - all poultry
  - reduces NH3 volatilization within the barnyard by 50%.

- Total Possible Effect = 36 Million lbs of volatilization reduction
- Average effect for 1 acre barnyard ~ 1500 lbs/year of volatilization

Phase 5 Manure Conceptual Model



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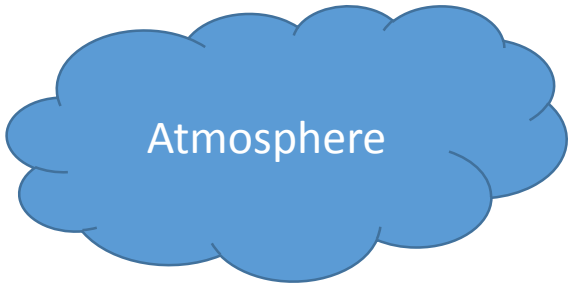

Volatilization

Add volatilization practices

Effect exaggerated

Application

Runoff

River

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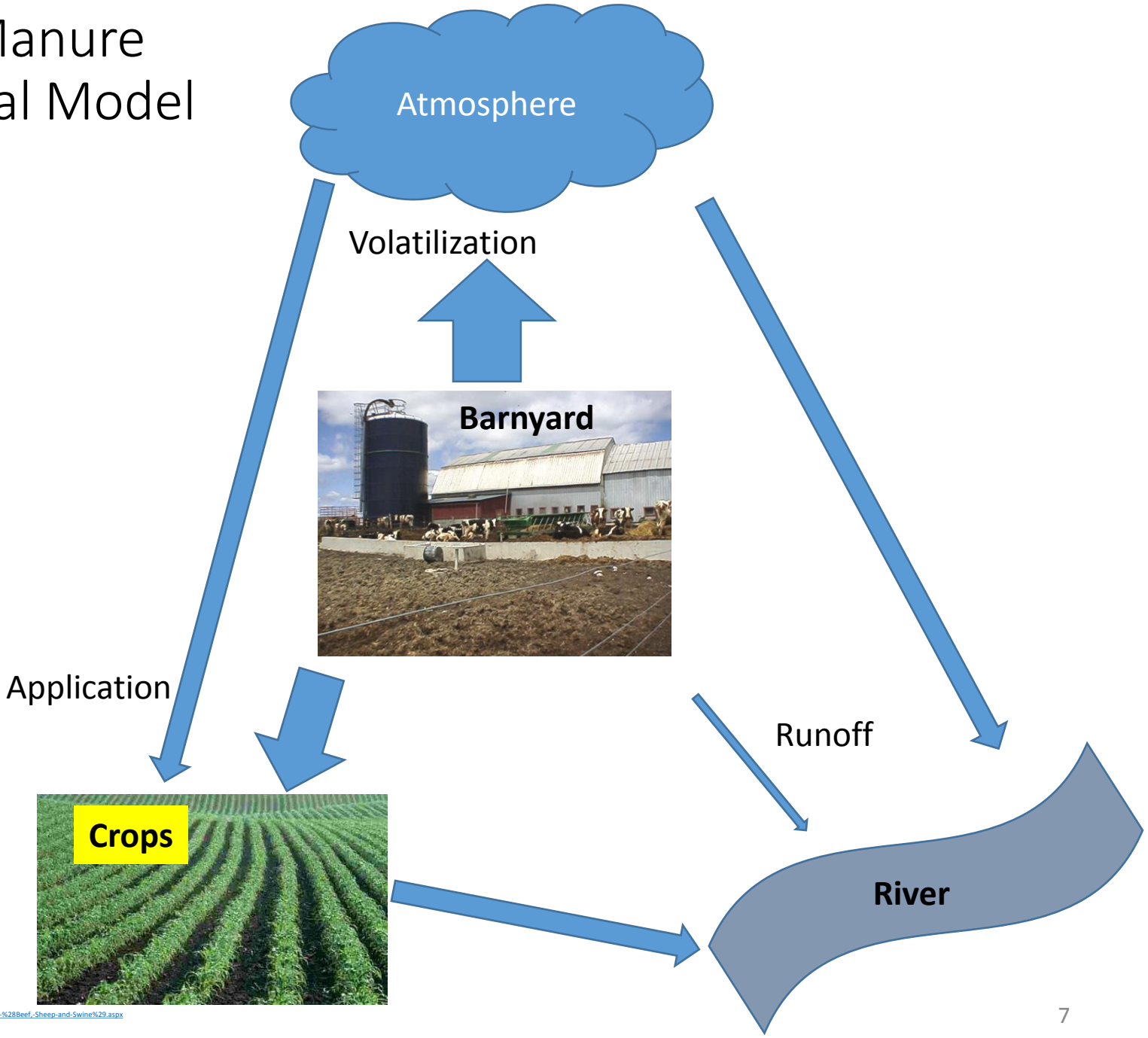
Phase 6 Manure Conceptual Model



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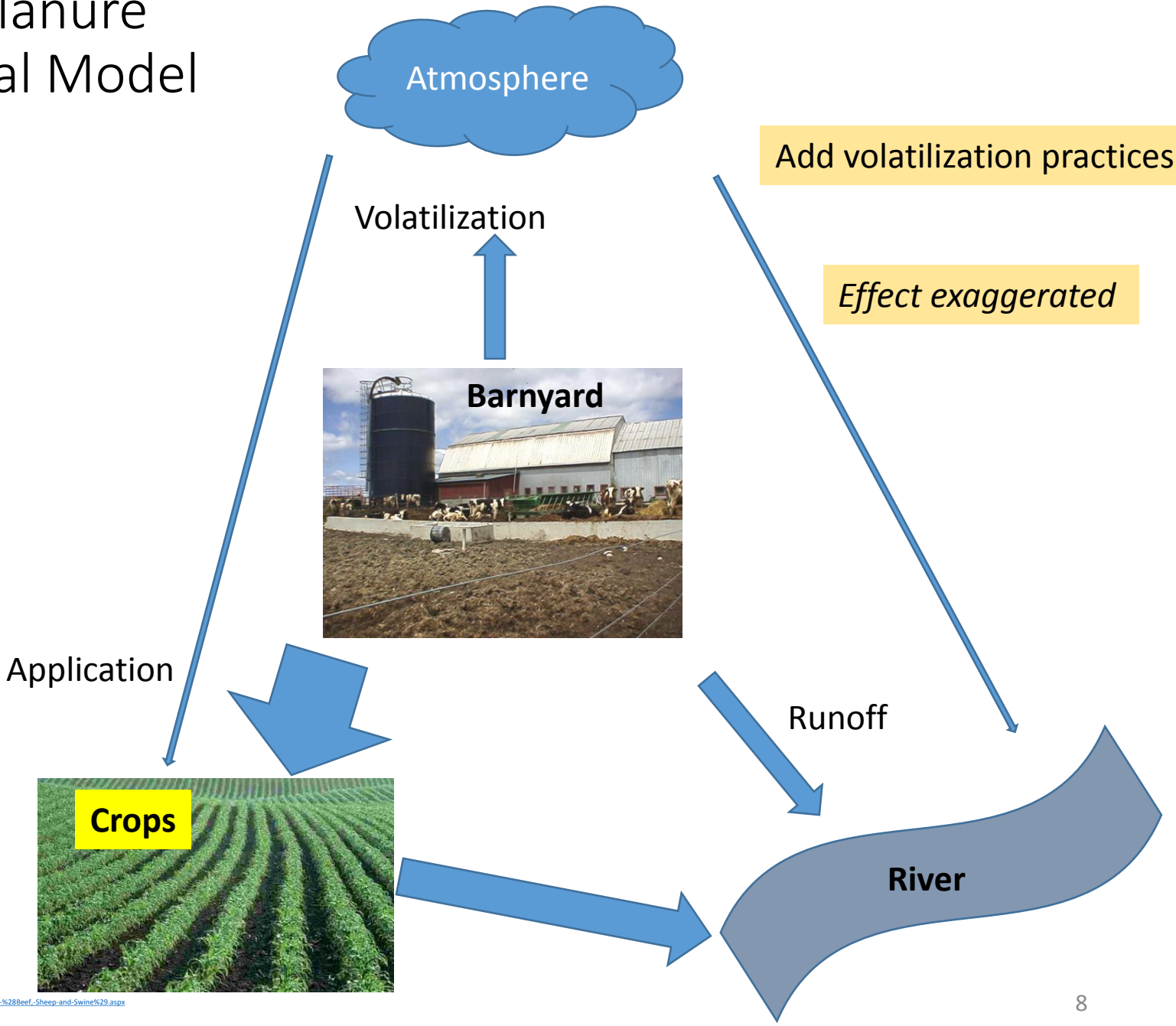
Phase 6 Manure Conceptual Model



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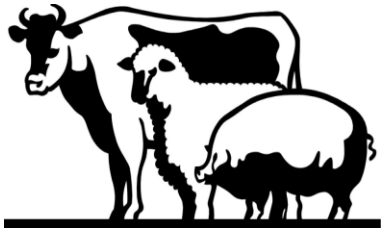
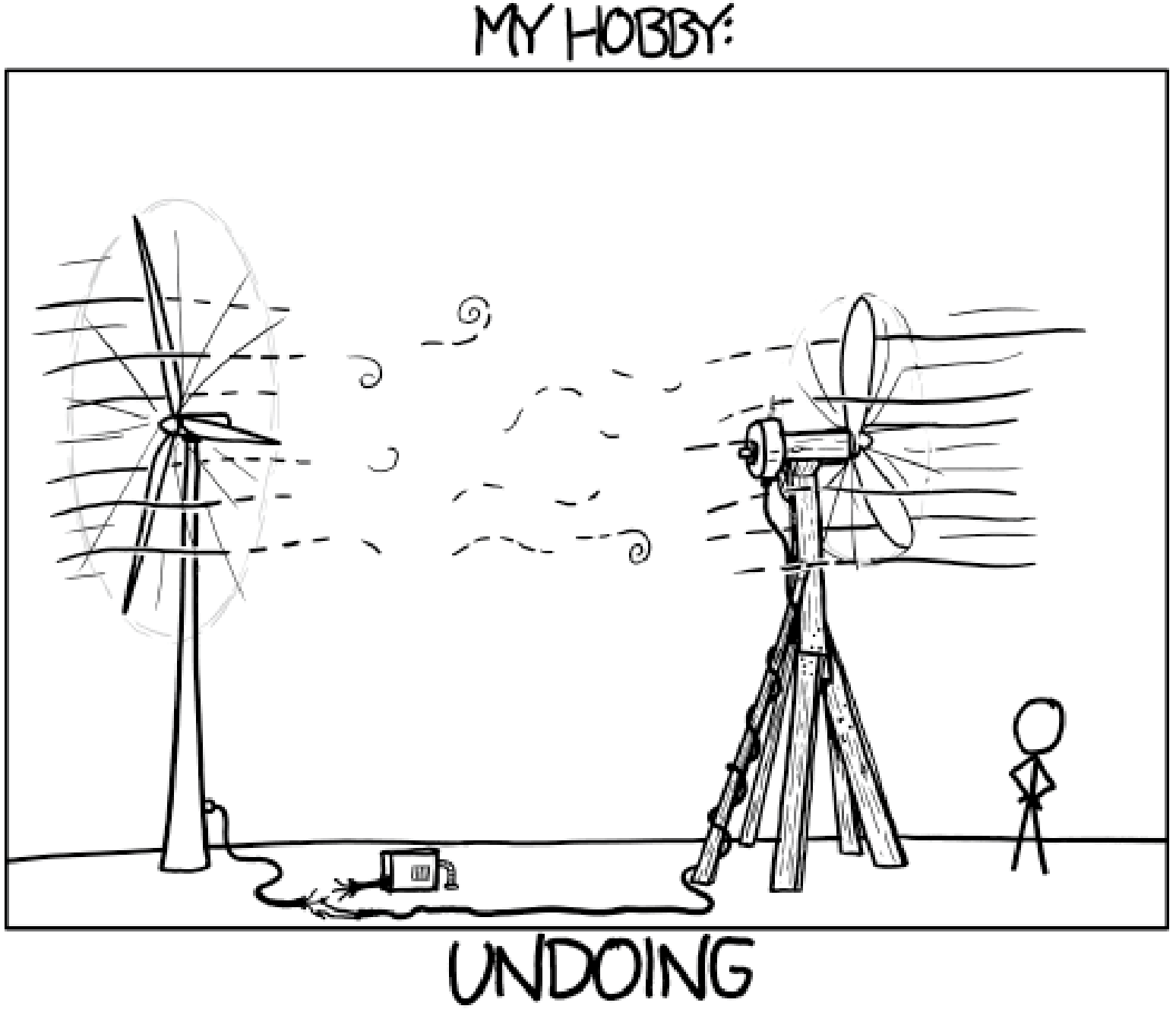
Manure Treatment Technologies



Reactive N

Non-Reactive N

Compost
Gasification
Pyrolysis



http://xkcd.com/1119/

Questions

- How much of what is volatilized in the CB watershed comes down in the watershed?
- How much of deposited makes it to the Bay?

- Some BOE calculations to inform the discussion. Actual credit would be determined from final P6 model values.

The Aggregate State Transfer Functions at the Watershed Level can be Parsed to the Watershed Area within each State

EPA United States Environmental Protection Agency

State Level Transfer Coefficients to State Watershed Area

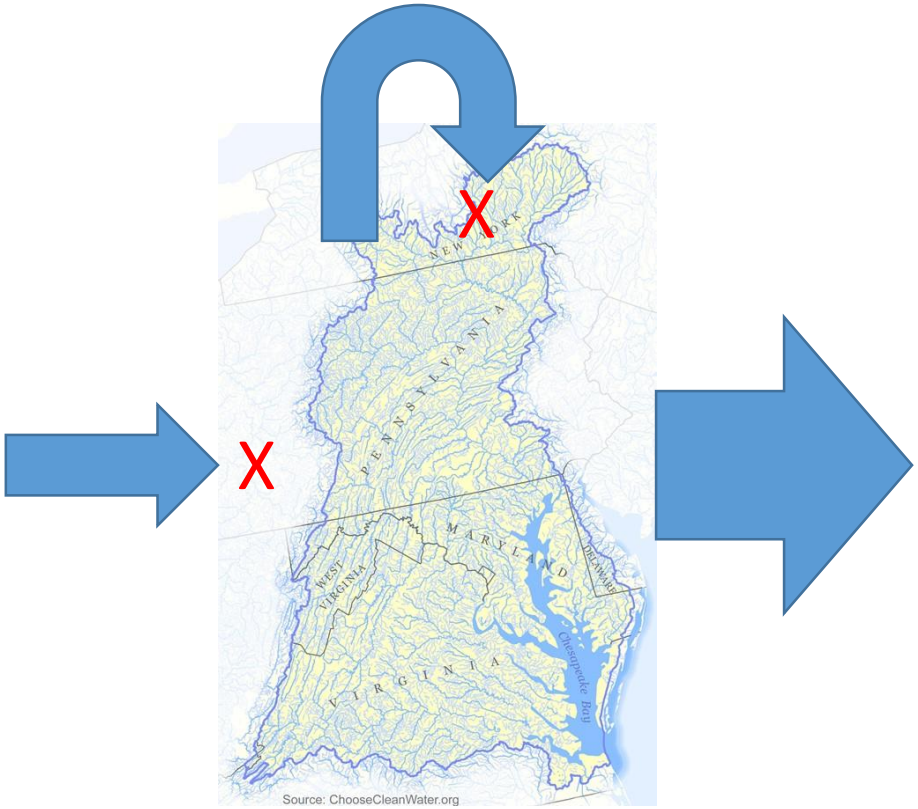
Emitter → / Receptor ↓	Delaware	Maryland	New York	Pennsylvania	Virginia	W. Virginia
	kg-N/ton-N	kg-N/ton-N	kg-N/ton-N	kg-N/ton-N	kg-N/ton-N	kg-N/ton-N
Delaware	5.40	2.31	0.44	0.87	1.10	0.44
Maryland	19.46	57.16	5.30	14.33	20.95	10.60
New York	5.31	7.25	11.50	10.47	4.76	4.73
Pennsylvania	23.86	49.09	16.37	62.28	24.79	28.11
Virginia	19.55	43.34	7.84	20.59	85.05	27.70
W. Virginia	1.88	6.04	1.03	3.73	5.50	9.88
WaterSHED Aggregate	75.46	165.19	42.49	112.27	142.15	81.47

Robin Dennis – presentation to Modeling Workgroup 1/8/13

Only 5% to 20% of NOx Deposited in Watershed

	Emitter	Emitter	Emitter	Emitter	Emitter	Emitter
Receptor	DE	MD	NY	PA	VA	WV
DE	0.6%	0.3%	0.0%	0.1%	0.1%	0.0%
MD	2.1%	6.3%	0.6%	1.6%	2.3%	1.2%
NY	0.6%	0.8%	1.3%	1.2%	0.5%	0.5%
PA	2.6%	5.4%	1.8%	6.9%	2.7%	3.1%
VA	2.2%	4.8%	0.9%	2.3%	9.4%	3.1%
WV	0.2%	0.7%	0.1%	0.4%	0.6%	1.1%
Total	8.3%	18.2%	4.7%	12.4%	15.7%	9.0%

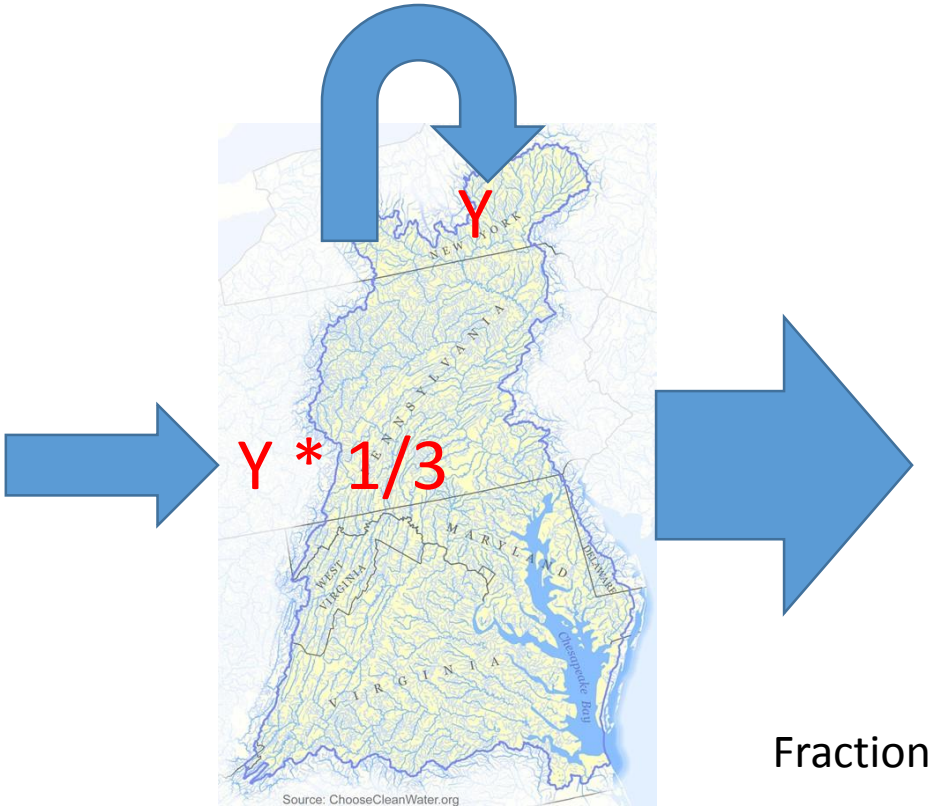
50% of NOx from outside of CB Watershed



At most, 20% of emissions are deposited

25% of NH3 from outside of CB Watershed

Assume that transport out is related to transport in.



Fraction deposited $\frac{Y}{Y + 4Y/3}$ = 40%





Phase 6 Model Structure

Average Load = Δ Inputs * Sensitivity

*

Land Use Acres

*

BMPs

*

Land to Water

Direct Loads

*

Stream Delivery

*

River Delivery

Phase 6

Of the deposited, 13% gets to the stream

Phase 6 sensitivities to atmospheric deposition (lb to stream / lb input)

Phase 5.3.2 land use	ORGN	NO3	NH3	TN	million acres
Conventional Till with Manure	0.083	0.226	0.01	0.319	3.7
Conventional Till without Manure	0.009	0.363	0.015	0.387	0.3
Hay without Nutrients	0.004	0.258	0.014	0.276	2.0
Alfalfa	0	0.212	0.004	0.216	0.8
Pasture	0.007	0.13	0.004	0.141	2.7
Pervious Developed	0.012	0.12	0.006	0.138	3.0
Impervious Developed	0.435	0	0.199	0.634	1.2
Wooded and Other	0.003	0.049	0.003	0.055	26.7
Water				1	0.4

Weighted Average = 0.133





Phase 6 Model Structure

Average Load + Δ Inputs * Sensitivity

*

Land Use Acres

*

BMPs Assume 10%

*

Land to Water = 1

*

Direct Loads

Stream Delivery

*

River Delivery

} = about 60%

Phase 6





Pounds to Bay per pound emitted

0.4

Average Load + Δ Inputs * Sensitivity

0.13

*

Land Use Acres

*

BMPs 0.9

*

Land to Water = 1

*

Direct Loads

Stream Delivery

*

River Delivery

} 0.6

0.4 * 0.13 * 0.9 * 1 * 0.6 = **3%**

How do we simulate change in deposition for a single practice?

- 1. Credit everyone
- 2. Credit the practice
- 3. Credit the land segment

- Total effect =
  - 36,000,000 * 0.03 = 1,000,000 lbs

- Single BMP effect
  - 1500 * 0.03 = 45 lbs

Credit everyone

- Modify entire atmospheric deposition data set for each scenario based on the estimated change in emissions

- Most closely reflects reality
- Most labor-intensive
- Very small benefit to everyone for each practice

Each acre gets one millionth of a pound for a typical BMP

One 50th of a lb at E3

EPA United States Environmental Protection Agency

The Aggregate State Transfer Functions at the Watershed Level can be Parsed to the Watershed Area within each State

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14

Credit the county

- Modify the atmospheric deposition data set for each scenario based on the estimated change in emissions
- Count watershed-wide results as occurring in the county

- Somewhat reflects actual processes
- Moderately labor-intensive
- Small benefit to all land uses in the county for each practice

Each acre gets less than one thousandth of a pound for a typical BMP

One 50th of a lb at E3

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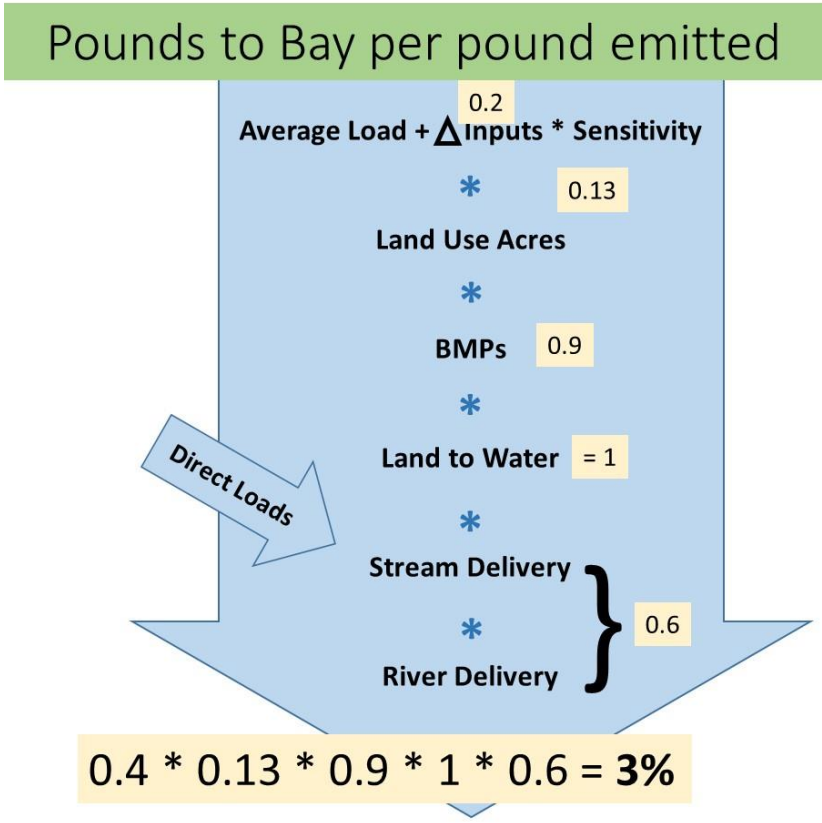
Total	8.3%	18.2%	4.7%	12.4%	15.7%	9.0%

Credit the practice

- Using simple assumptions consistent with the WSM, create a pound credit equal to 1% of the restricted N.
- Accounting rather than modeling
- Least labor-intensive
- Applies Benefits to the point of application of the BMP

45 lb reduction is about a 10% reduction for a barnyard



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