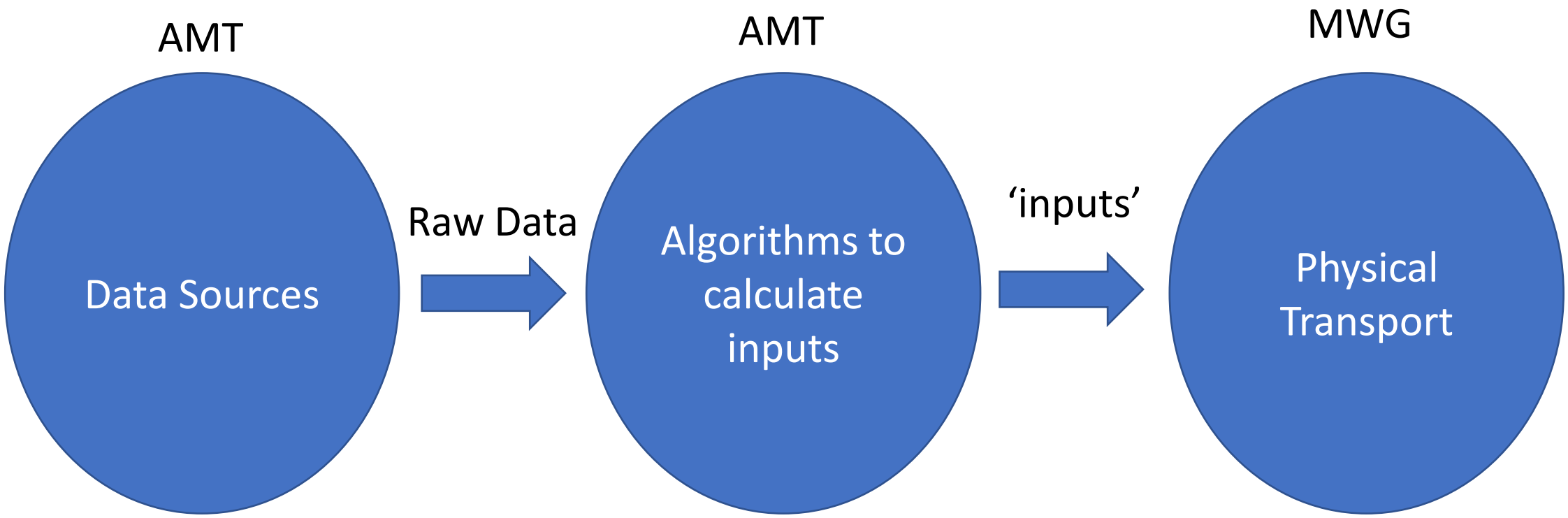
Load Calculation in CAST

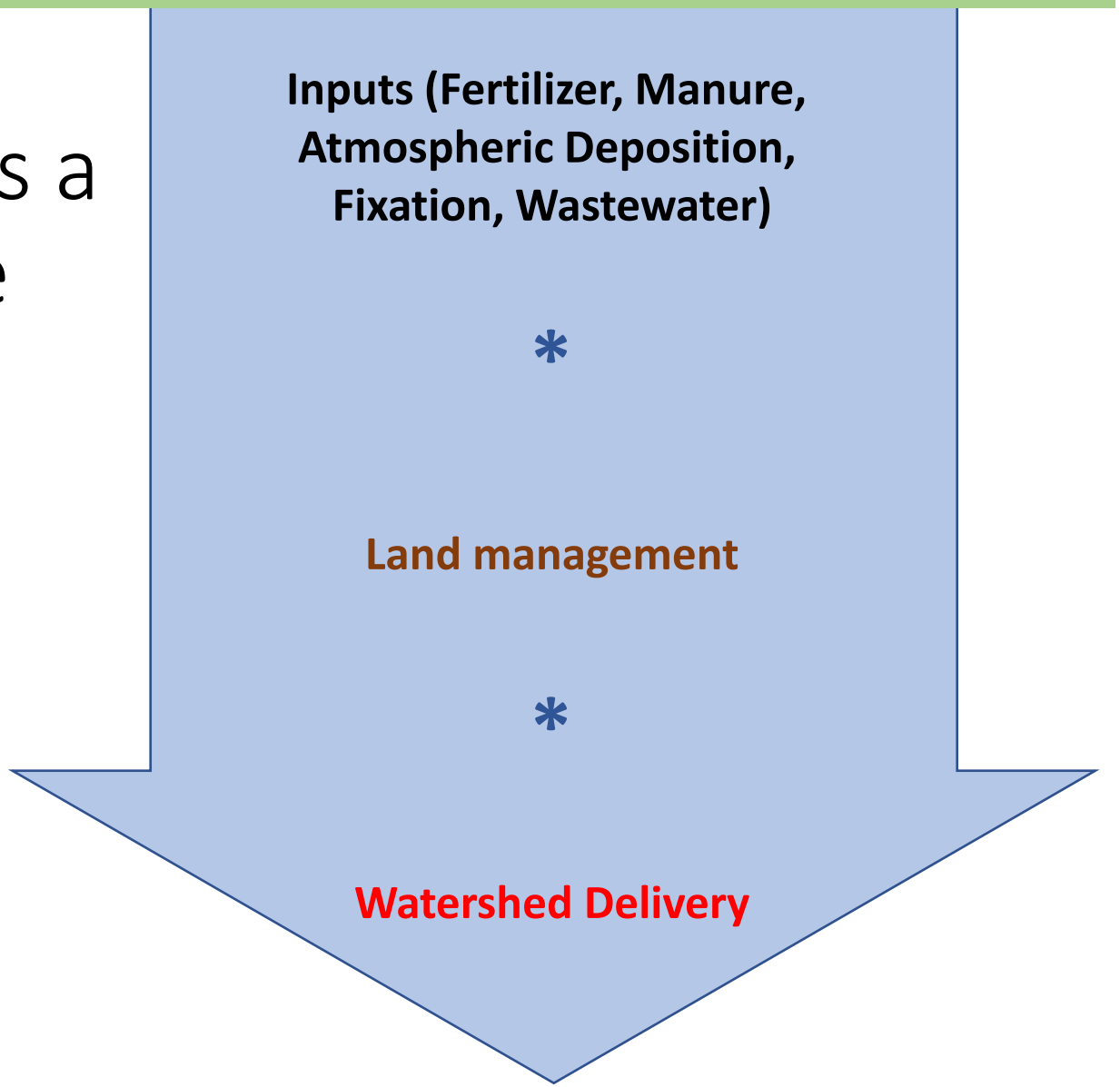
Gary Shenk 1/13/2023

CAST Domains



CAST Structure

CAST is a simple model



Load by land-river segment and land use

CAST is a simple model

CAST Structure

Inputs (Fertilizer, Manure, Atmospheric Deposition, Fixation, Wastewater)

*

Land management

*

Watershed Delivery

Load by land-river segment and land use

CAST Structure

Average Load

+

△ Inputs * Sensitivity

*

BMPs

*

Acres

*

Land to Water

*

River Delivery

Load by land-river segment and land use

CAST Structure

Illustrative example

Average Load

+

△ Inputs * Sensitivity

*****

BMPs

*****

Acres

*****

Land to Water

*****

River Delivery

Average nitrogen load to stream for double cropped ag land watershed wide is 32 pounds per acre

Load by land-river segment and land use

CAST Structure

Illustrative example

Average Load

+

△ Inputs * Sensitivity

*****

BMPs

*****

Acres

*****

Land to Water

*****

River Delivery

Load by land-river segment and land use

Your area applies 115 pounds of fertilizer while the watershed-wide average is 140.

Each additional pound of fertilizer results in 0.2 lbs of runoff

32 + (115-140) * 0.2 = 27 lbs/acre

CAST Structure

Illustrative example

Average Load

+

△ Inputs * Sensitivity

*****

BMPs

*****

Acres

*****

Land to Water

*****

River Delivery

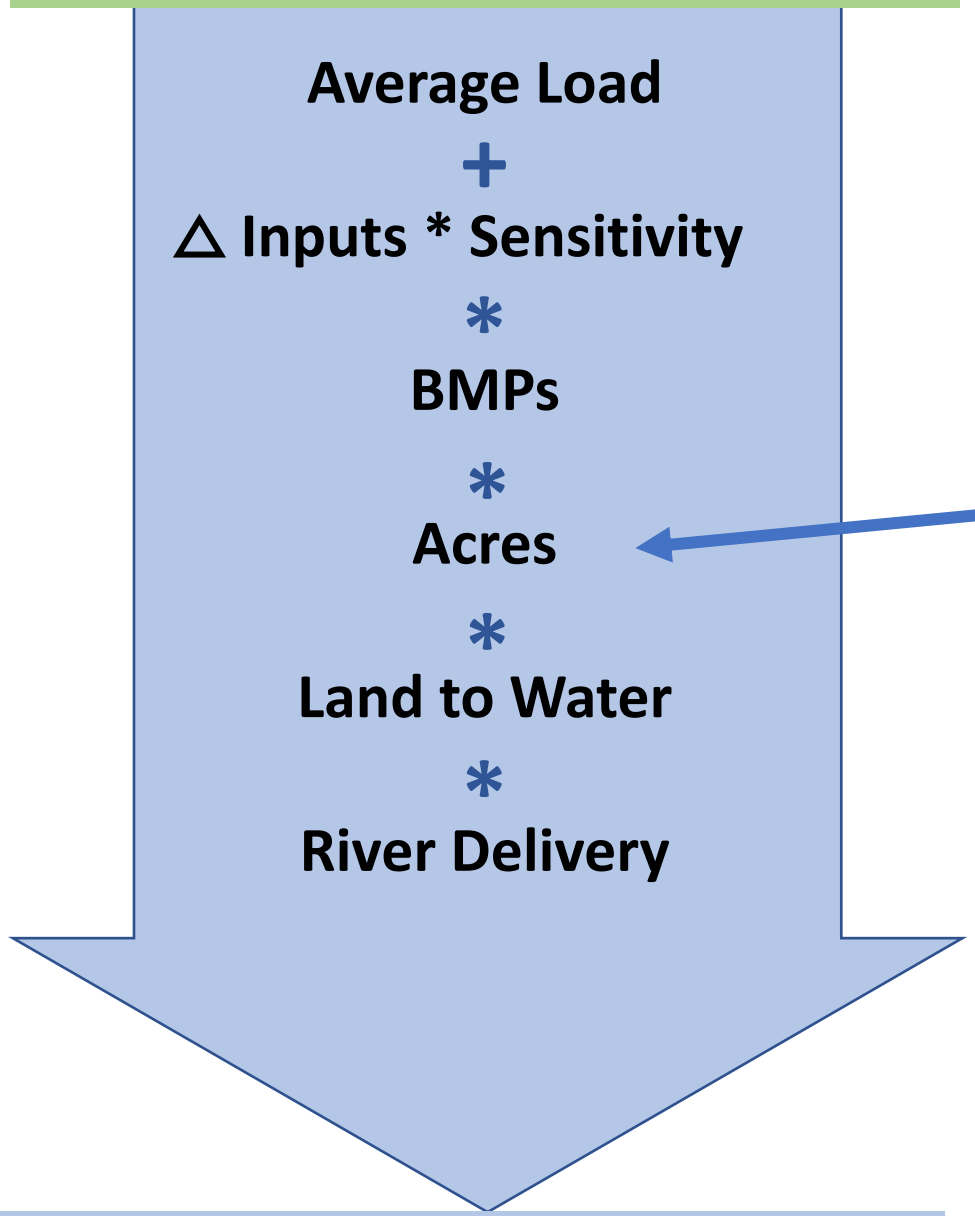
BMPs are applied which give, in aggregate, a 1/3 reduction

27 * (1-.33) = 18 lbs/acre

Load by land-river segment and land use

CAST Structure

Illustrative example



There are 100 acres of double cropped land in this segment

18 lbs/acre * 100 acres = 1800 lbs

Load by land-river segment and land use

CAST Structure

Illustrative example

Average Load

+

△ Inputs * Sensitivity

*****

BMPs

*****

Acres

*****

Land to Water

*****

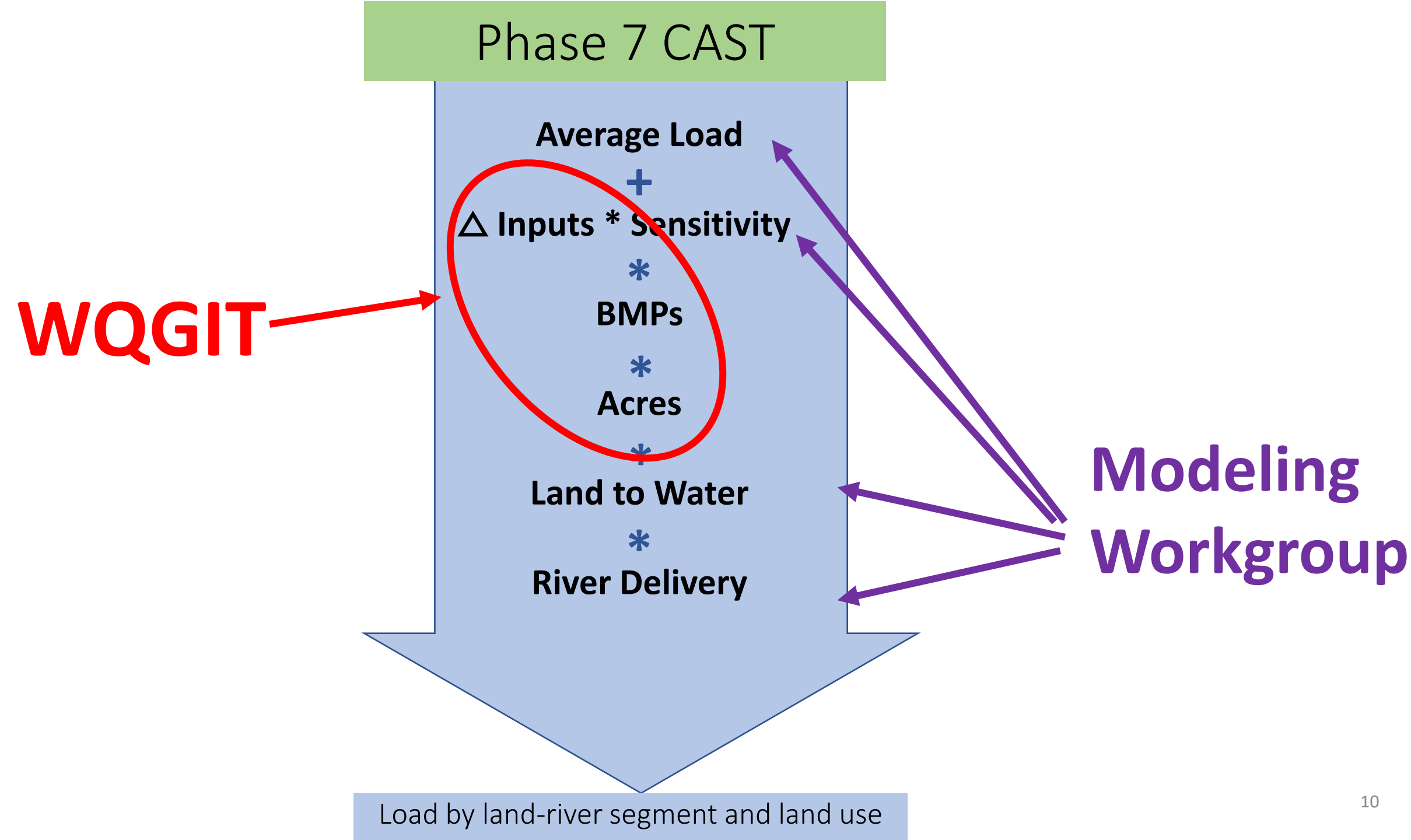
River Delivery

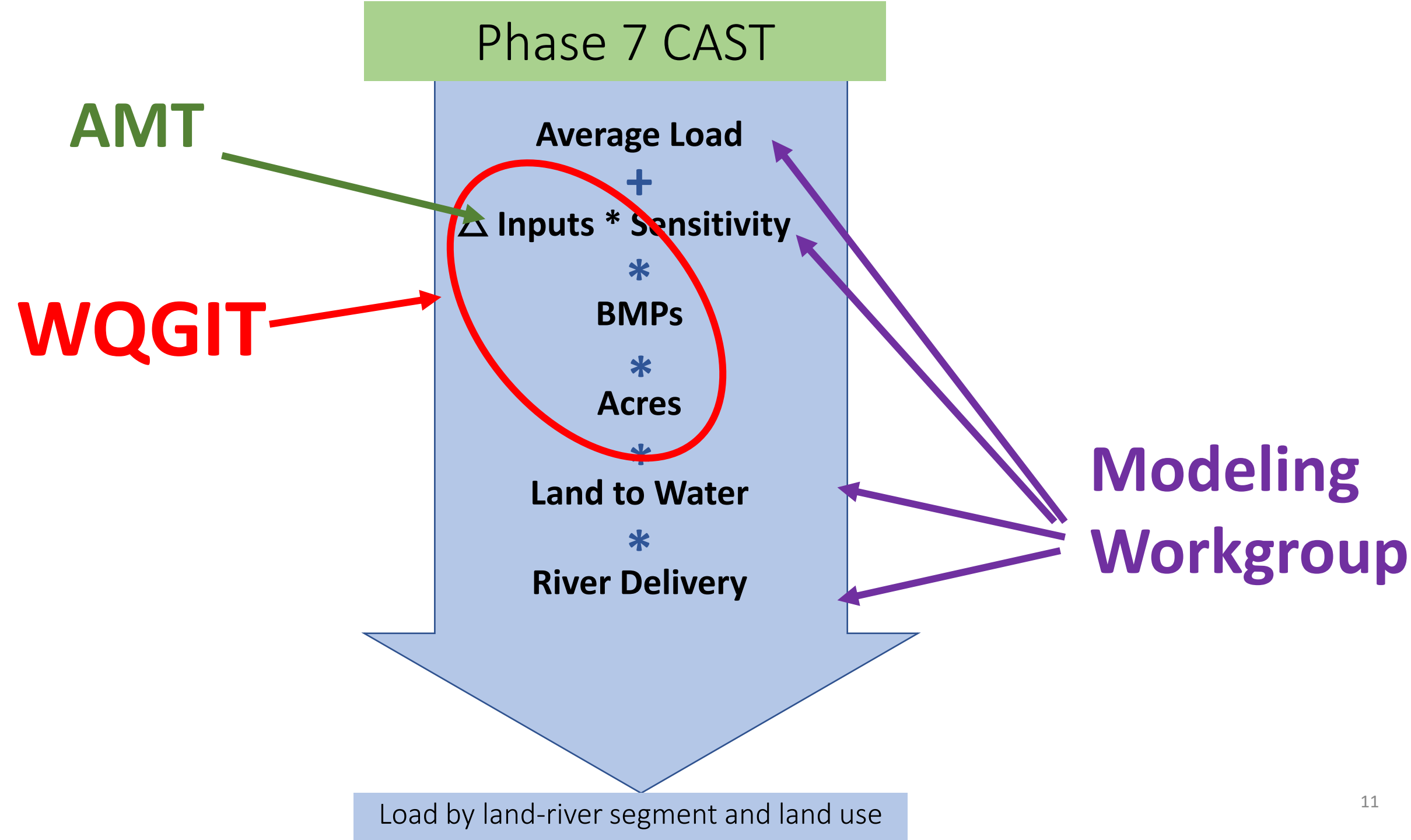
The land here is 50% leaker than average due to high groundwater recharge in the piedmont carbonate

The river system reduces loads by 10%

1800 lbs * 1.5 * (1-.10) = 2430 lbs
Delivered to the Bay from this land use and segment

Load by land-river segment and land use


Phase 7 CAST
Average Load
+
△ Inputs * Sensitivity
*
BMPs
*
Acres
*
Land to Water
*
River Delivery
WQGIT
Modeling Workgroup
Load by land-river segment and land use


Phase 7 CAST
AMT
WQGIT
Average Load
+
Δ Inputs * Sensitivity
*
BMPs
*
Acres
*
Land to Water
*
River Delivery
Modeling Workgroup
Load by land-river segment and land use

Phase 7 CAST

Average Load

△ Inputs * Sensitivity

*

BMPs

*

Acres

*

Land to Water

*

River Delivery

Average Loads

Average Loads – Average edge-of-small-stream loading rate for a given land use for the entire CB watershed

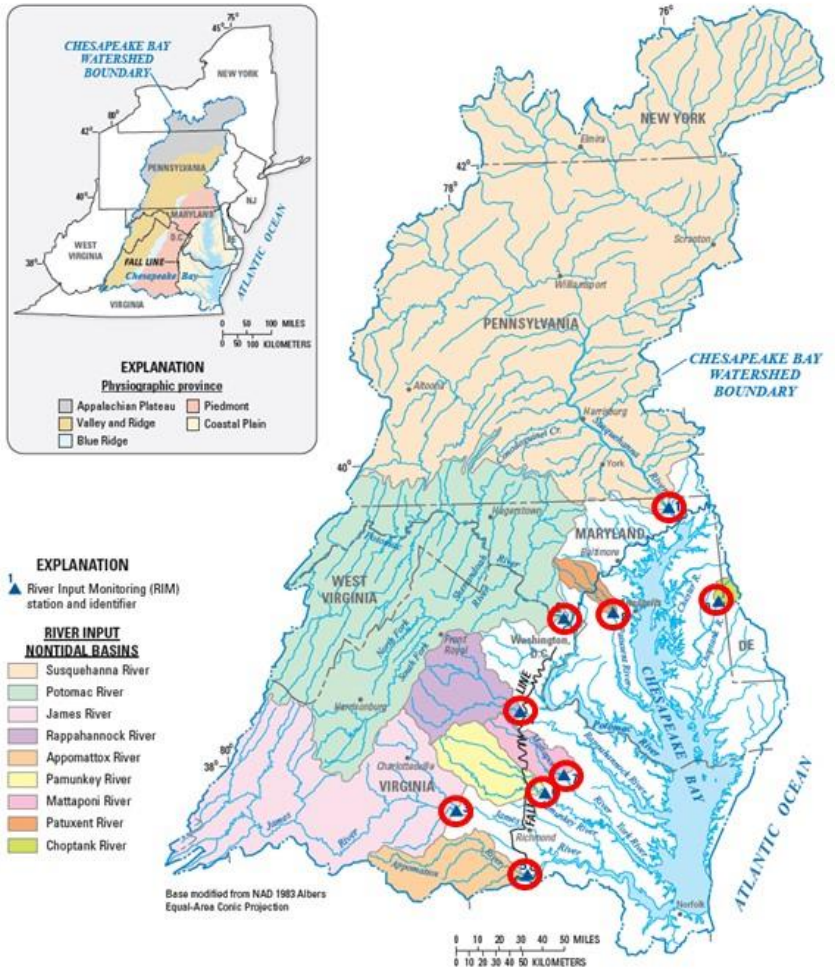
Estimate Total Non-point Source

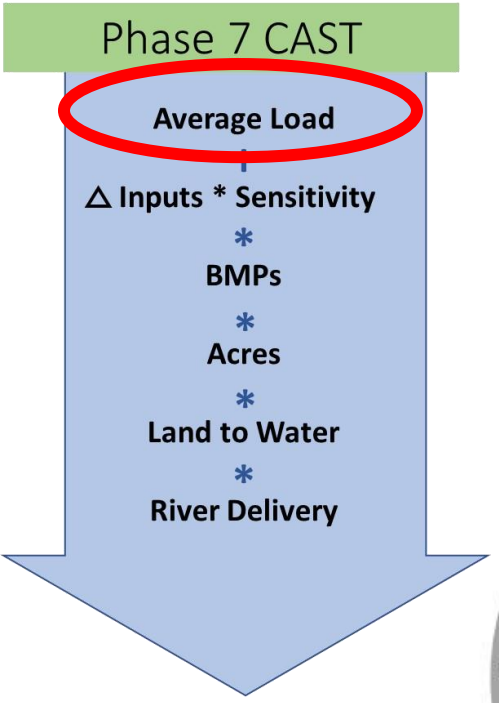
Modeling Workgroup

Monitoring Data

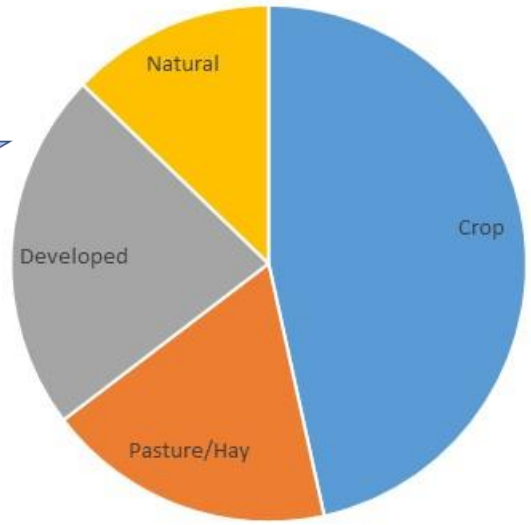
subtract point source

divide by transport





Average Loads



Average Loads – Average edge-of-small-stream loading rate for a given land use for the entire CB watershed

Divide into Broad Classes

Modeling Workgroup

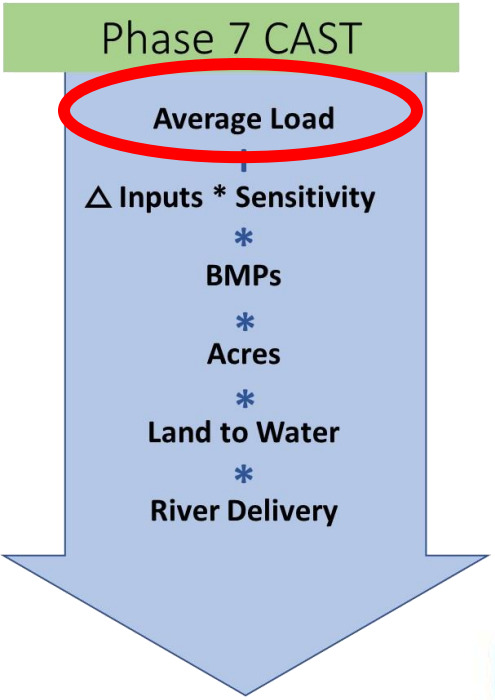
P5: Multiple models

Phase 5.3.2

Sparrow

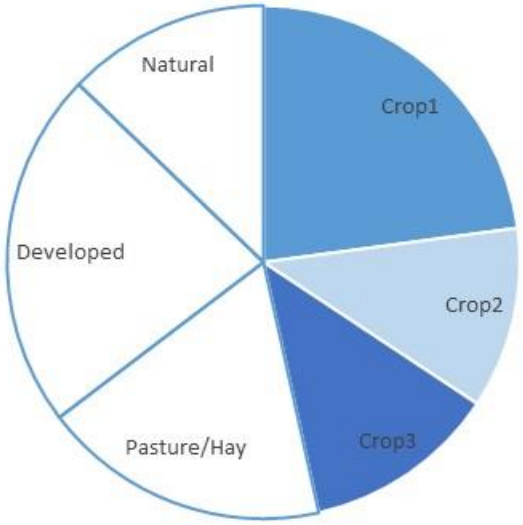
CEAP

P6: Multiple Models and CalCAST



Average Loads

Average Loads – Average edge-of-small-stream loading rate for a given land use for the entire CB watershed



Split Classes into individual land uses

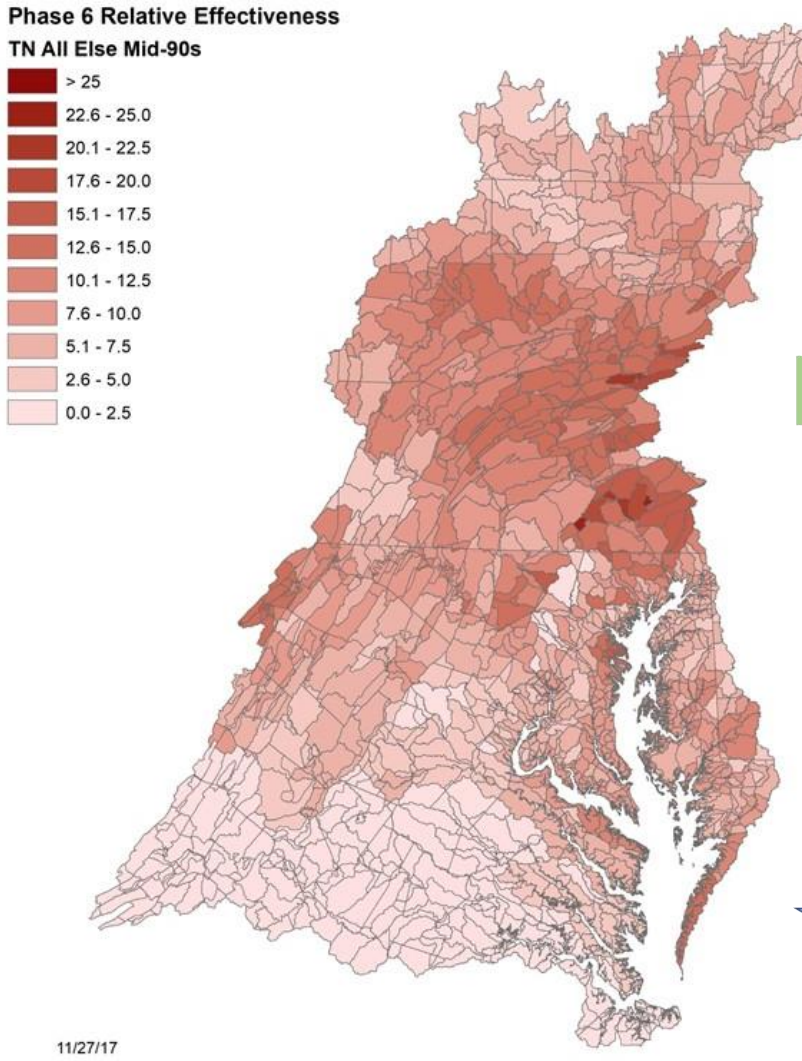
MWG and WQGIT Workgroups

Multiple lines of evidence to develop ratios

- for example silage is 16% higher than grain

Watershed Delivery Potential

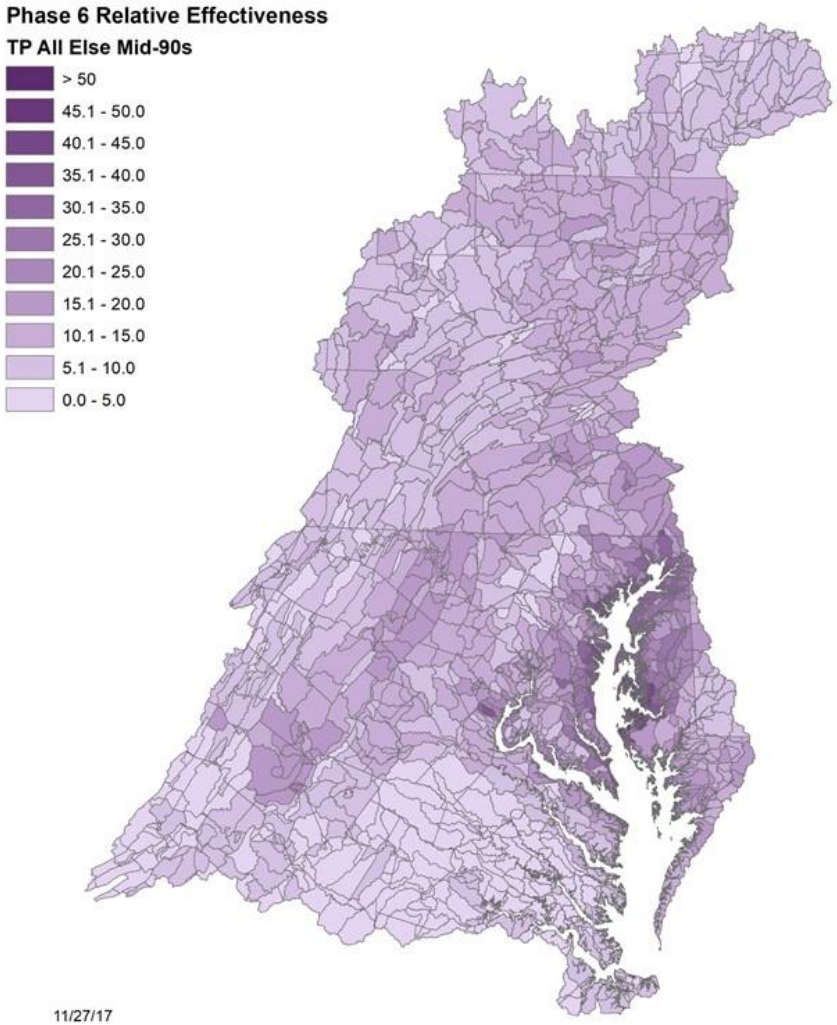
Phase 6 Nitrogen



Phase 7 CAST

Average Load
+
△ Inputs * Sensitivity
*
BMPs
*
Acres
*
Land to Water
*
River Delivery

Phase 6 Phosphorus

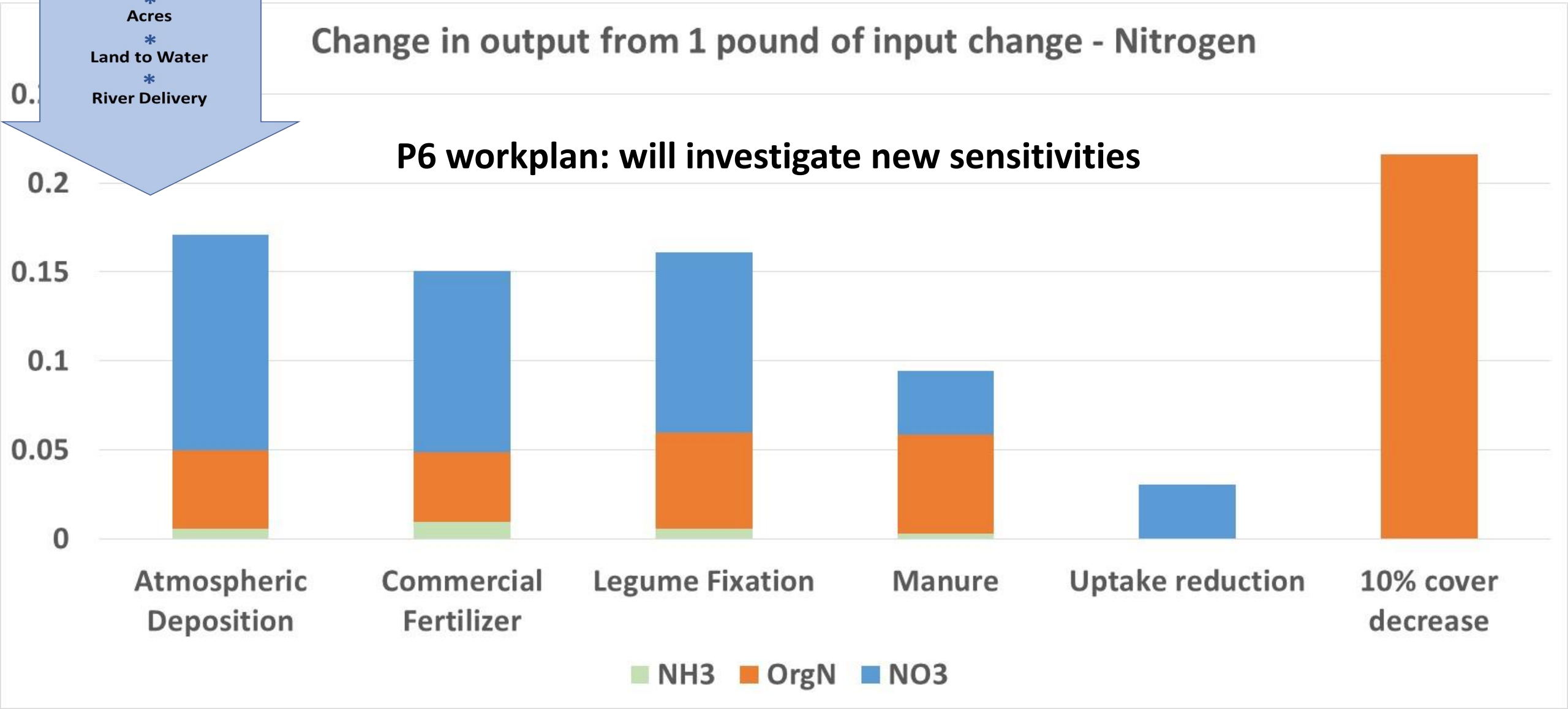


Phase 7 CAST

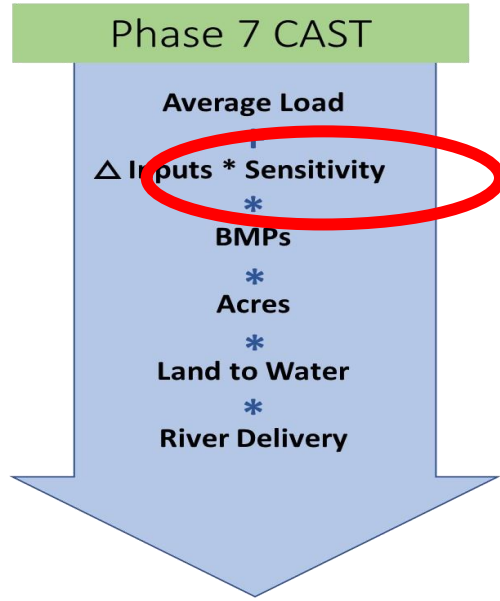
Average Load
+
Δ Inputs * Sensitivity
*
BMPs
*
Acres
*
Land to Water
*
River Delivery

Double Cropped land

Sensitivities – all else being equal…



P Sensitivities



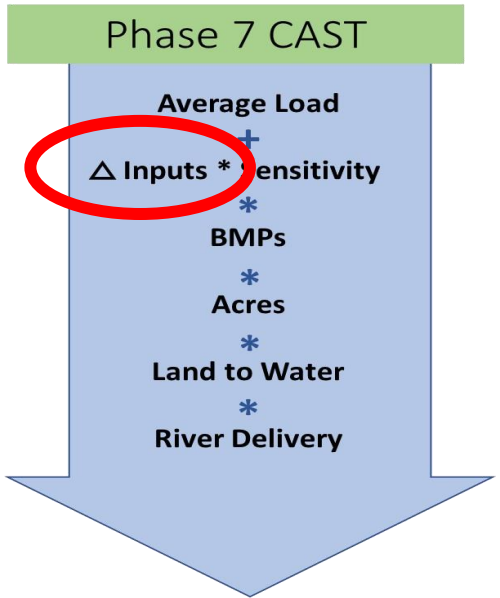
P6 workplan: will investigate new sensitivities

Input	Input Unit	Average Slope	Median Slope	Median S_R	Relative Sensitivity
Soil P	ppm	0.017	0.015	0.696	Moderately sensitive
Sediment Washoff	ton/ac	0.181	0.168	0.633	Moderately sensitive
Stormflow	Inches	0.064	0.057	0.403	Moderately sensitive
Water Extractable P	lbs/acre	0.021	0.018	0.187	Slightly sensitive

Inputs - AMT

Nitrogen

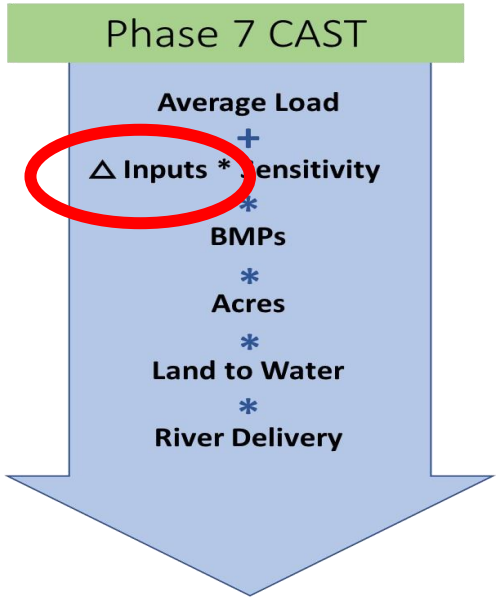
- Commercial Fertilizer
- Manure
- Fixation
- Uptake
- Vegetative Cover



Phosphorus

- Soil P
  - Soil P measurements
  - Manure
  - Fertilizer
  - Uptake
- Water Extractable P

Consistency > Accuracy

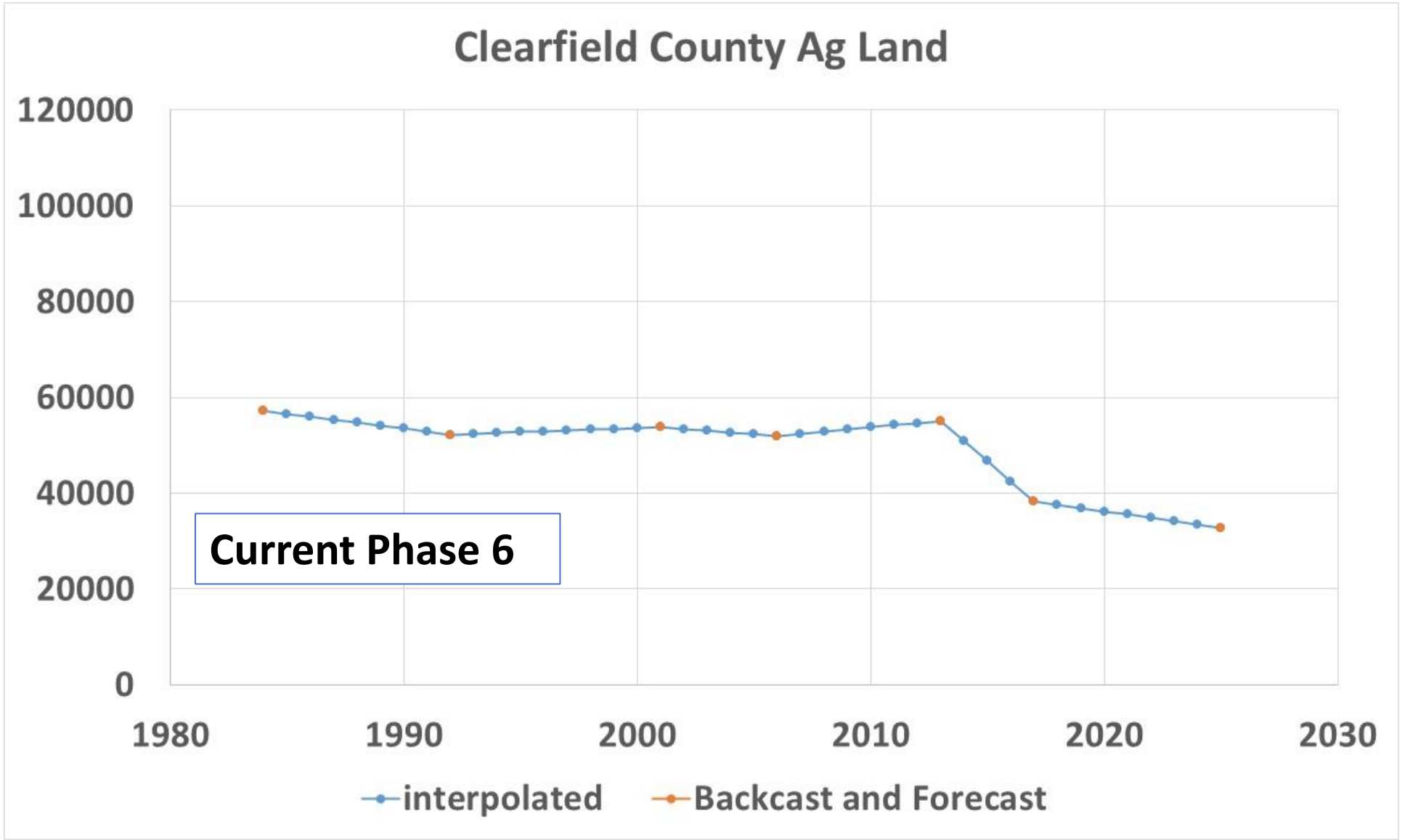


Accuracy of the spatial and temporal trends is more important that the absolute value

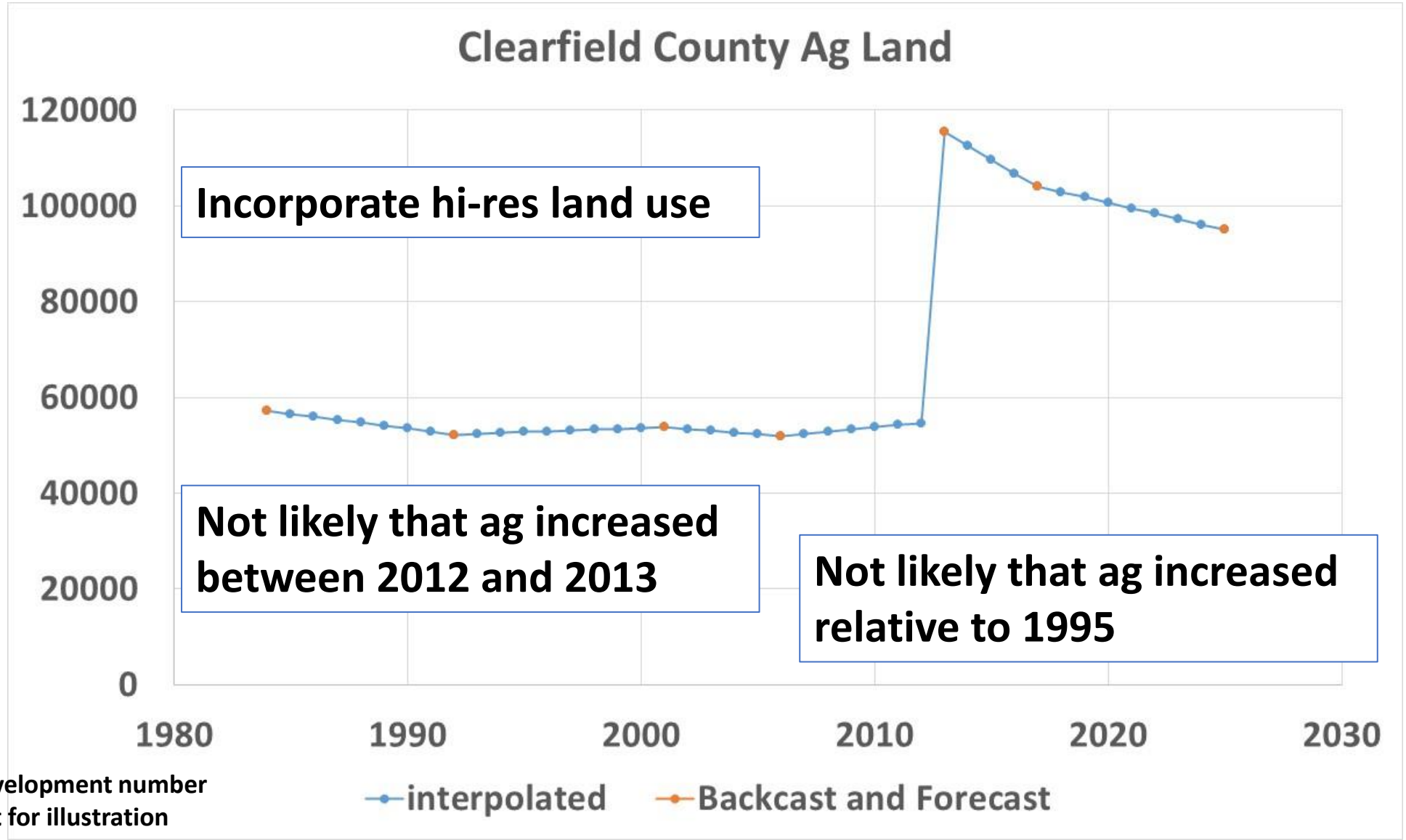
Spatial - Model used to allocate responsibility between jurisdictions

Temporal - Model used to track TMDL, based on changes since 1995

Consistency example

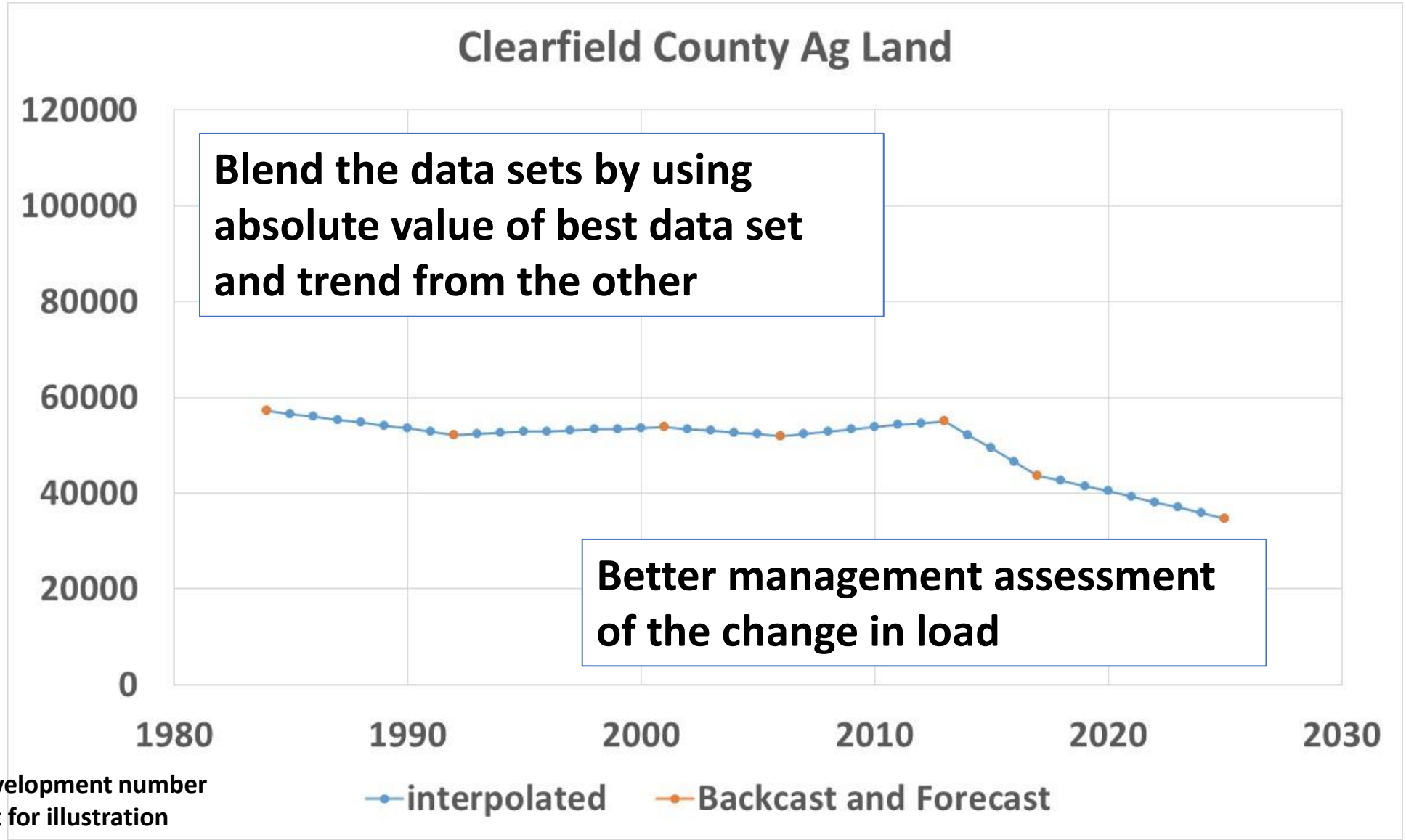


Consistency example



2013 is current development number
2017 and 2025 just for illustration

Consistency example



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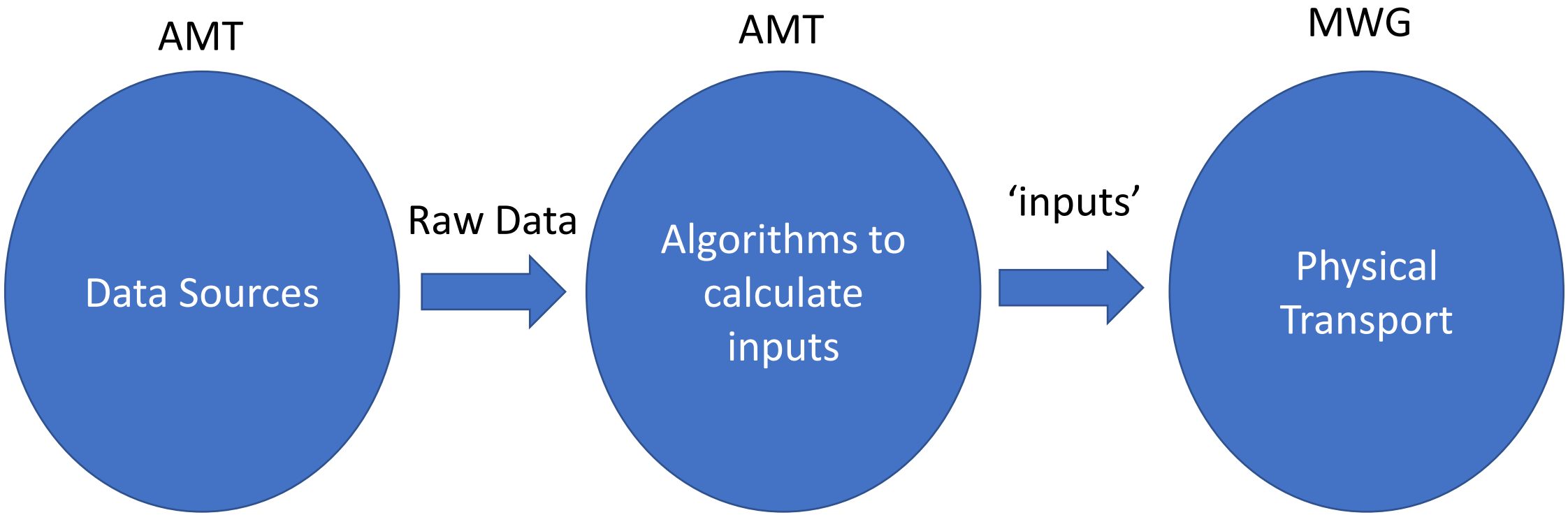
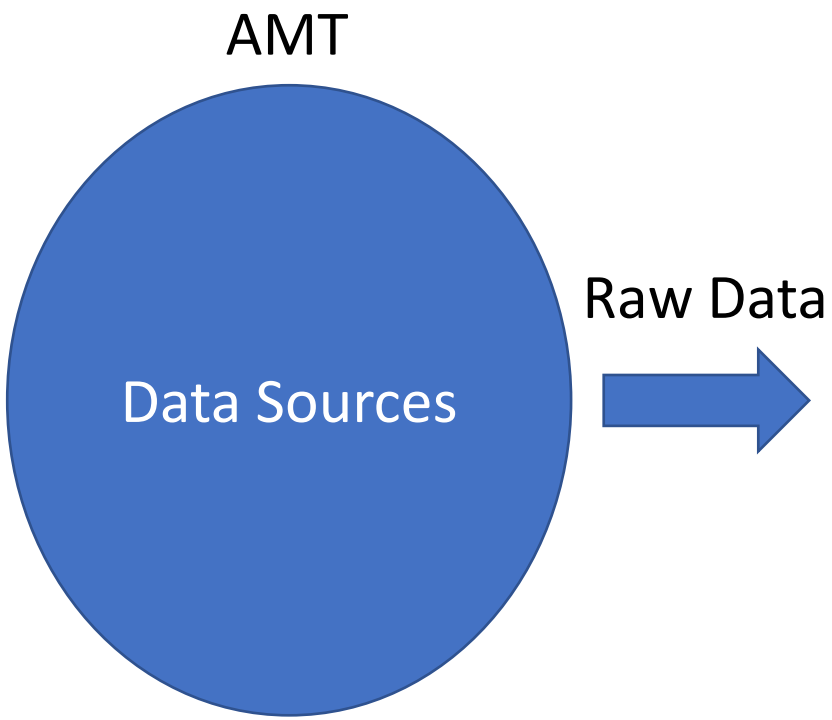
CAST Domains

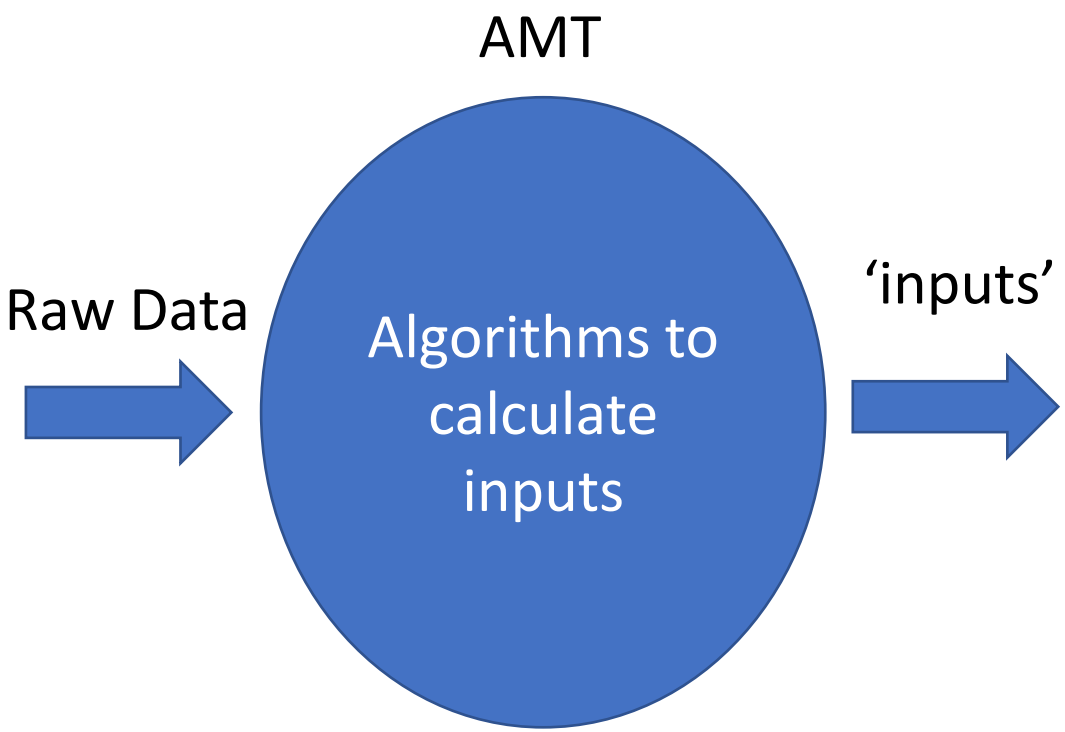


Data Sources



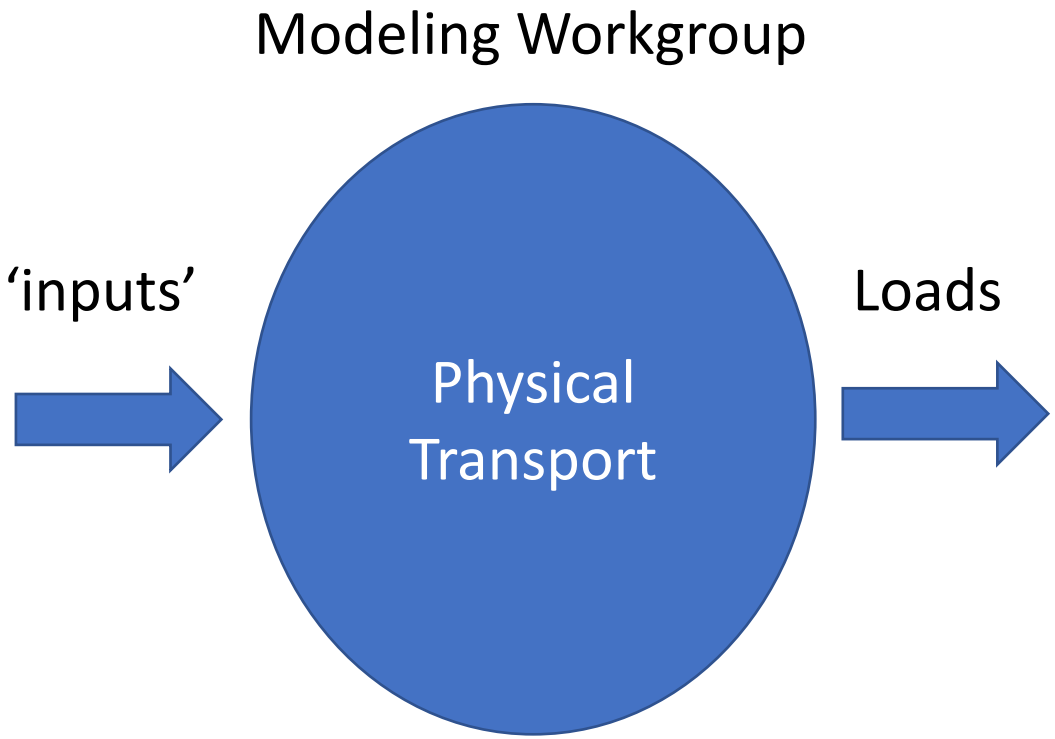
- Are we missing categories of sources?
  - Non-ag examples:
    - At one time, atmospheric deposition was unknown
    - Boat releases are being added
- Are we using the best data source?
  - Are other sources available?
  - What is the relative quality?

Algorithms



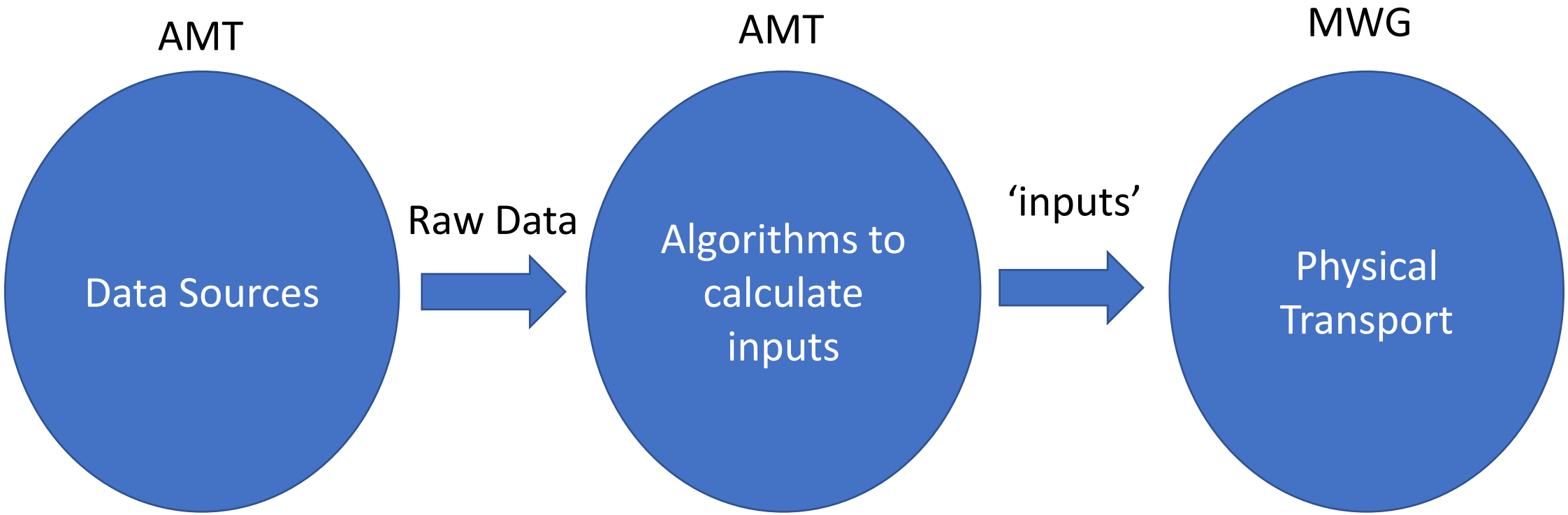
- Do the existing algorithms produce reasonable results?
  - differences between counties
  - differences between scenarios
- How to change?
  - Keep
  - Modify
  - Start from scratch

Physical Transport



- Decisions made in Modeling Workgroup
- Will not the be focus of AMT
- Recommendations can be made to the MWG from anyone in the partnership
- Anyone can participate in MWG discussions

CAST Domains



Watershed Model Plan – Big Picture

2022	2022	2022	2022	2023	2023	2023	2023	2024	2024	2024	2024	2025	2025	2025	2025	2026	2026	2026	2026
1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Work plan			Build	Work plan	Build Models			Work plan	Build Models			Work plan	Build Models			Review Models			

Build Model Structure

Improve Models

Review Models