Poultry Sources in Chesapeake Bay Program Nitrogen Modeling
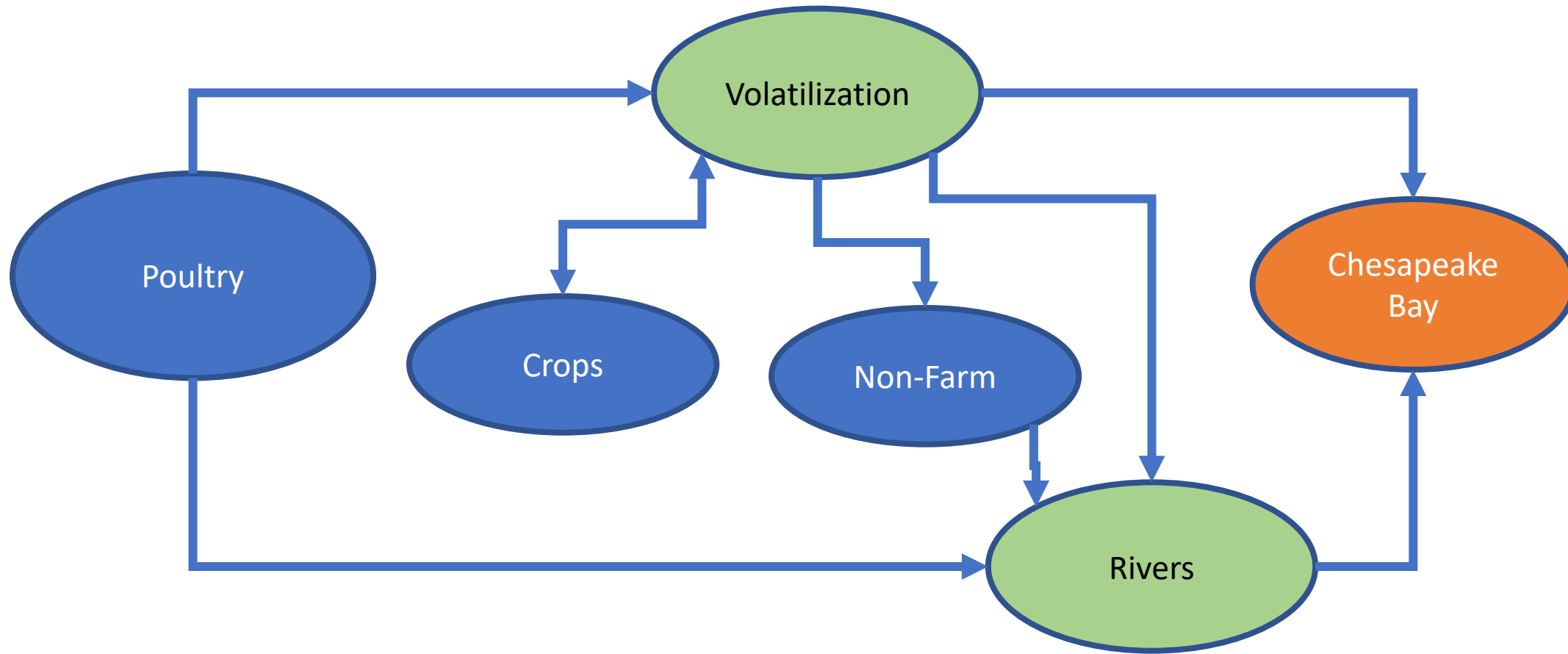
Gary Shenk – CBPO

04/20/2022

STAC workshop

Improving Modeling and Mitigation Strategies for Poultry Ammonia Emissions

Across the Chesapeake Bay Watershed
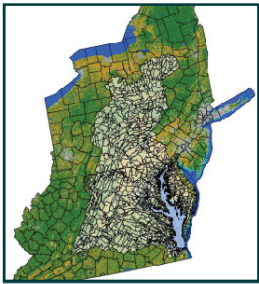
The Chesapeake Bay Poultry Ammonia Issue

...along with other forms of nitrogen from ag, other sources of nitrogen, plus phosphorus and sediment
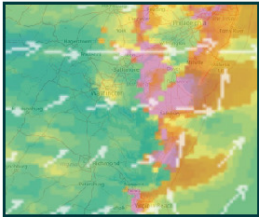
CBP TMDL Water Quality Models

Data and Model Inputs

Pollution Control Data
Land Use Data
Point Sources Data
Septic Data
U.S. Census Data
Agricultural Data

Land Use Change Model

Airshed Model

Precipitation Data
Meteorological Data
Elevation Data
Soil Data

What are the load changes due to land use, BMPS, Wastewater
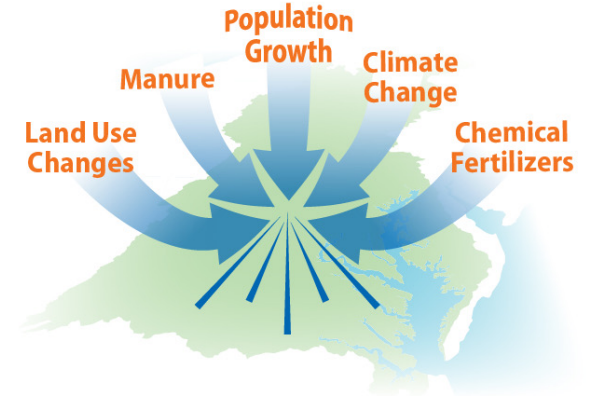
CAST and Dynamic Watershed Model

How do load changes affect dissolved oxygen

Estuary Model

Model Outputs

Prediction of Impacts

Population Growth
Manure
Land Use Changes
Climate Change
Chemical Fertilizers

BMP Implementation Results

N
P
Sediment

Water Quality
DO

Background:
https://www.chesapeakebay.net/documents/Understanding_Chesapeake_Bay_Modeling_Tools.pdf

Nitrogen

Legend:
- Smoothed Atmospheric Deposition
- Manure
- Biosolids
- Fixation
- Agricultural Inorganic Fertilizer
- Fertilizer on Developed
- Wastewater (right axis)
- Septic (right axis)

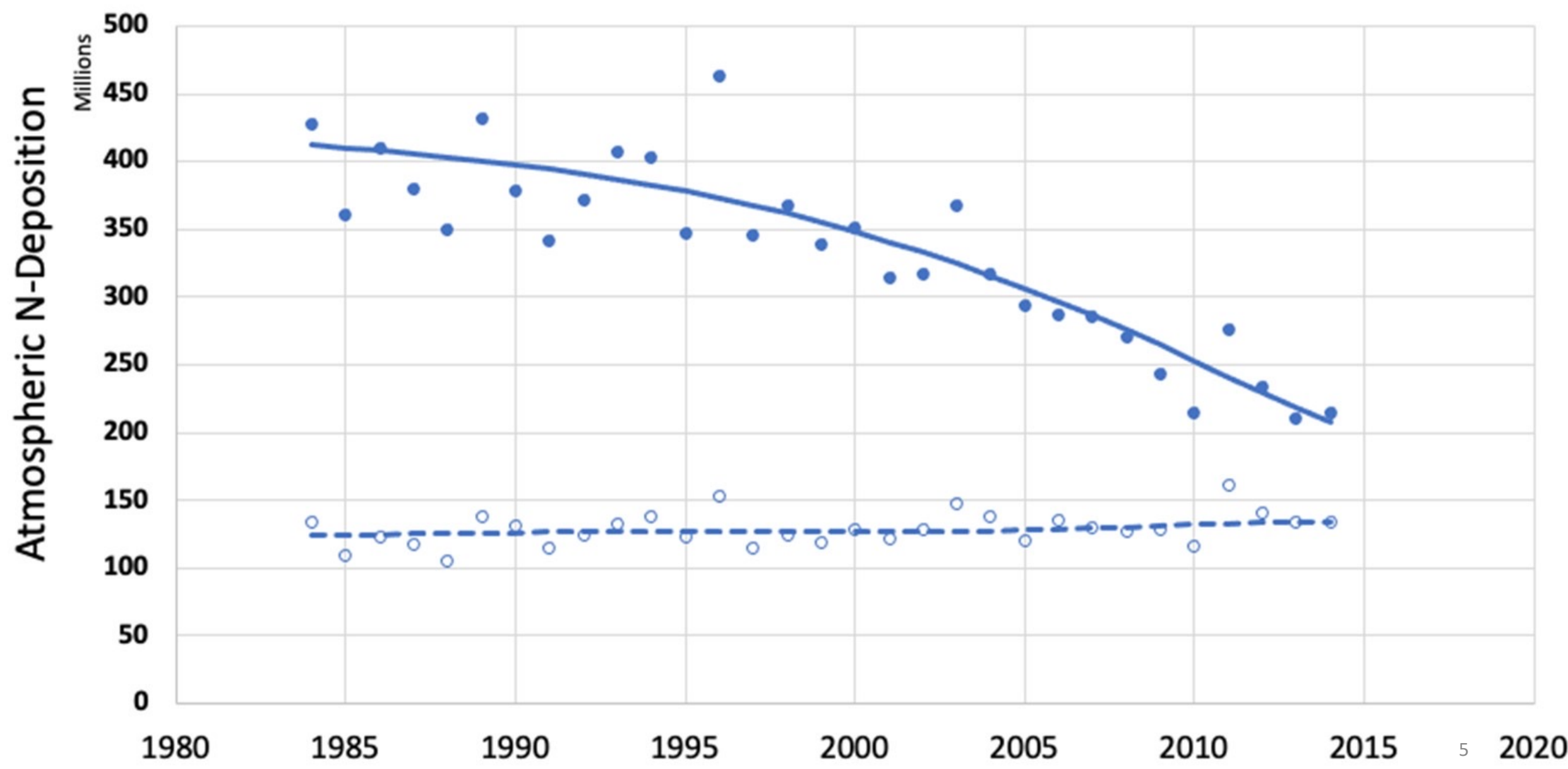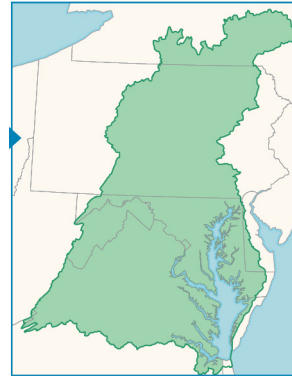Phase 6 documentation, section 3
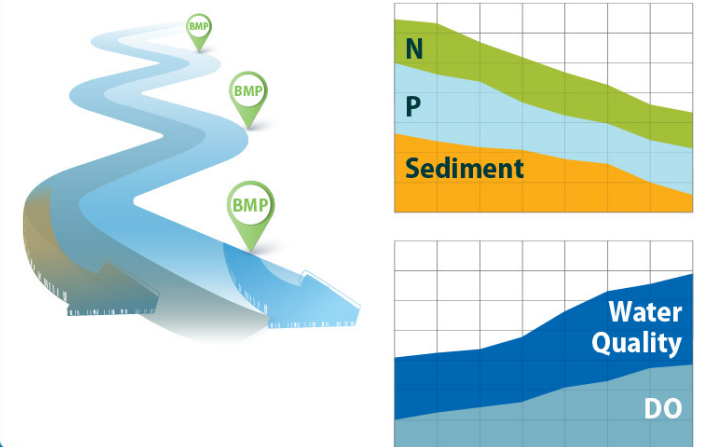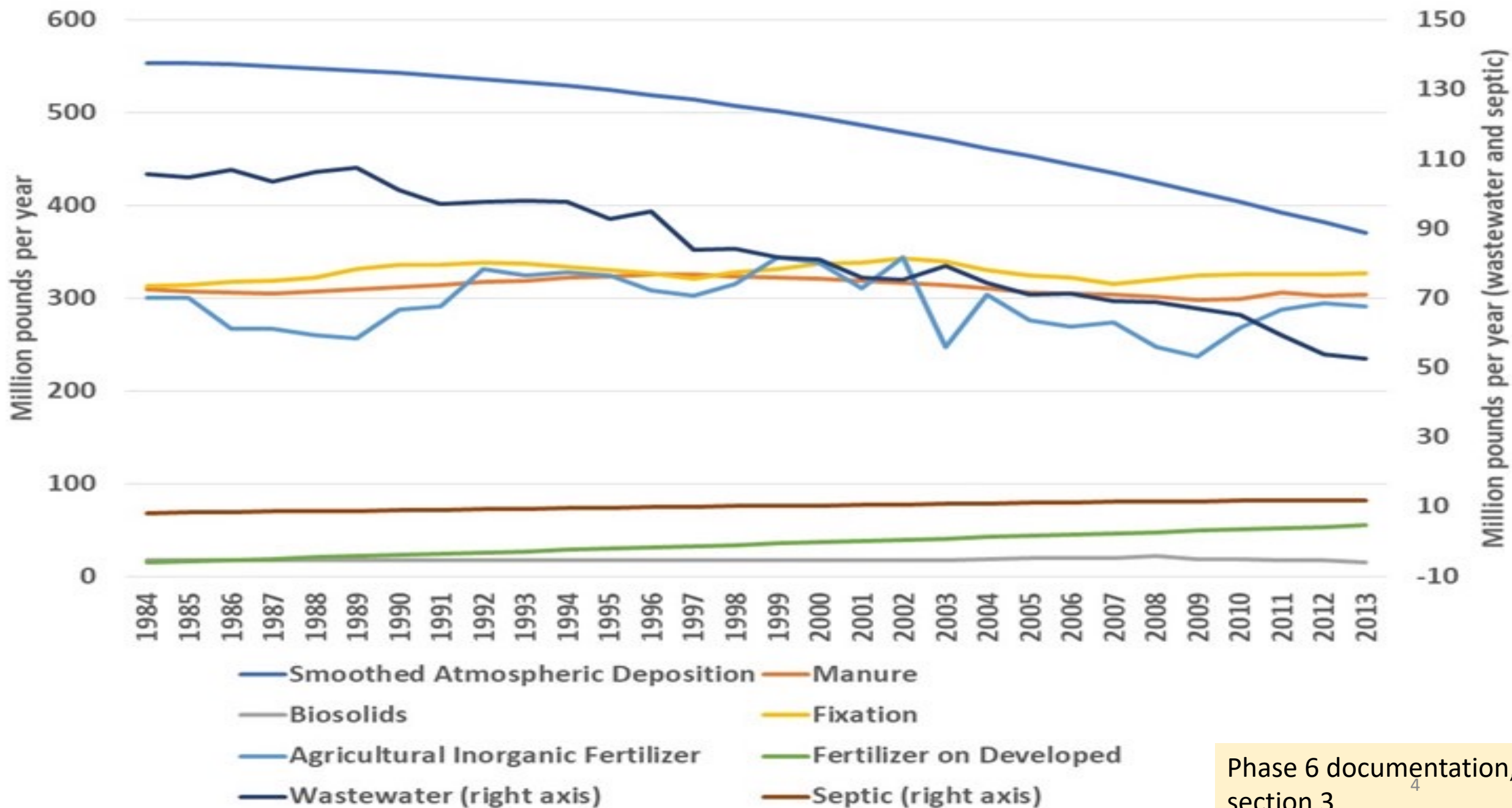
Use of CBP Watershed Model (CAST)

Organization that can pay for, encourage, and/or compel management

Phase 6 Watershed Model/CAST

Proposed **Strategy**

Nitrogen, Phosphorus, Sediment

Compare to goals

CAST Structure

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

*

Land management

*

Watershed Delivery

Nitrogen for a land use in a geographic area

Nitrogen Sources to the Chesapeake

CAST Structure

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

*

Land management

*

Watershed Delivery

- Stream Erosion 6%
- Direct Deposition 6%
- pasture/hay 10%
- Shoreline 1%
- Natural/Mixed 11%
- crop 32%
- Wastewater 11%
- Septic 3%
- feeding space 4%
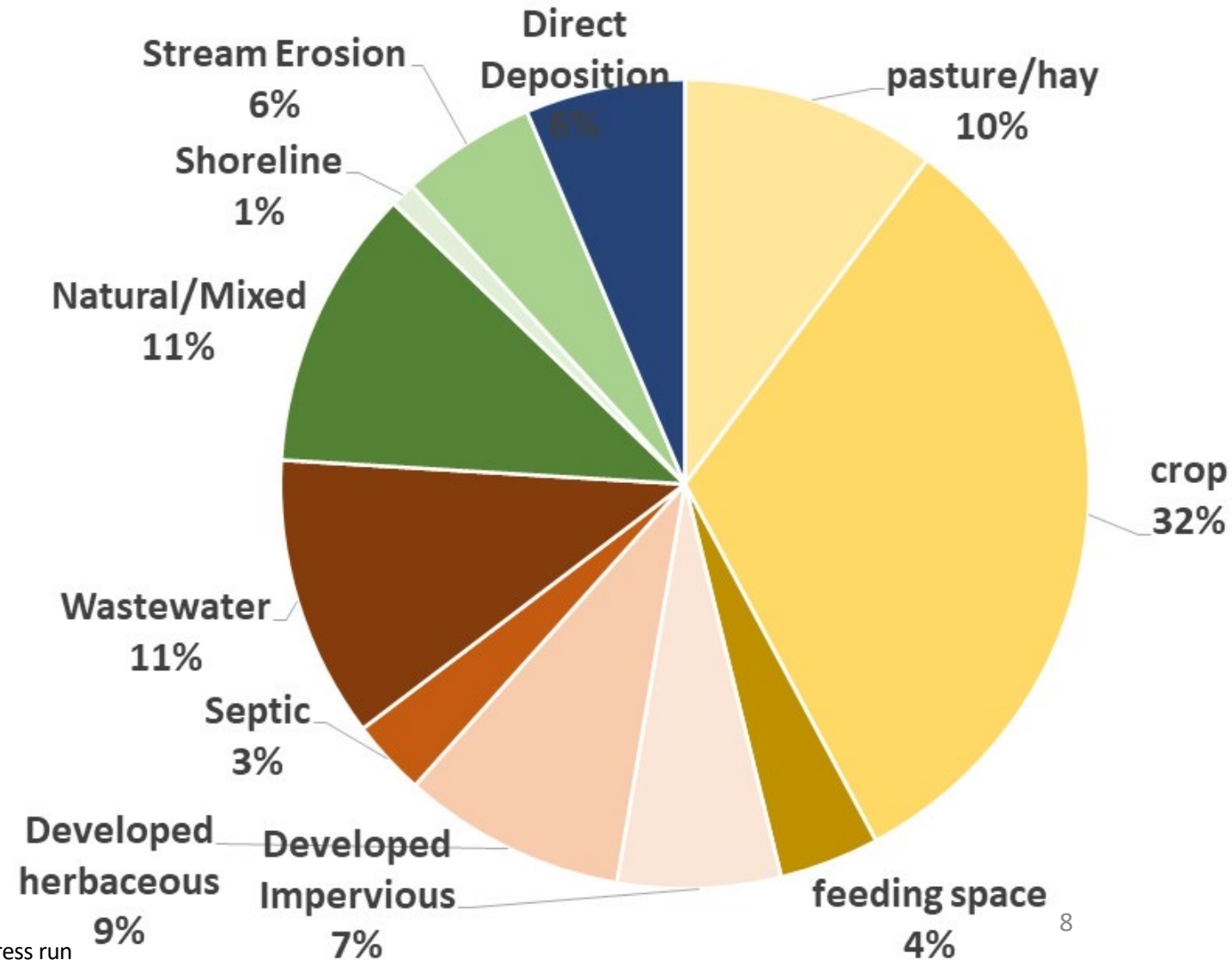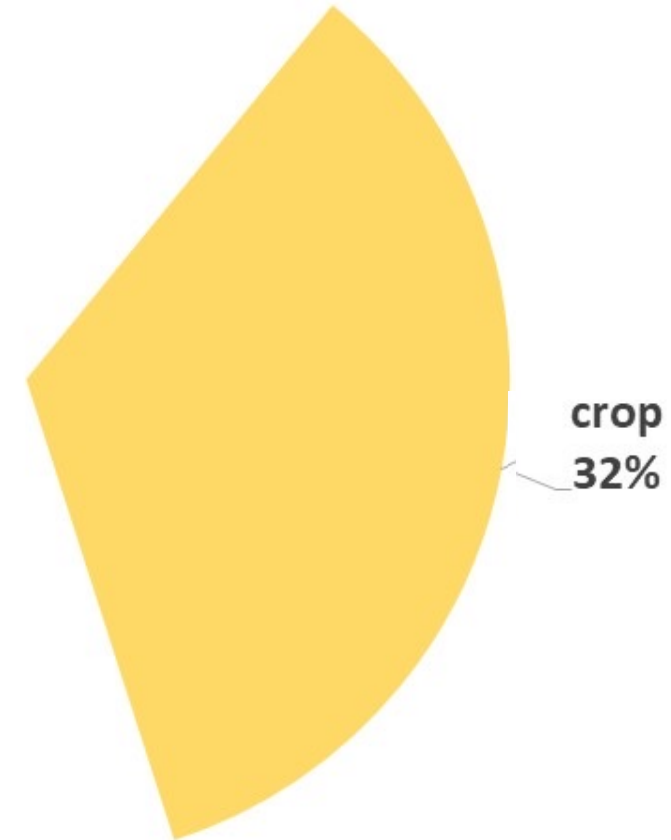- Developed herbaceous 9%
- Developed Impervious 7%

Nitrogen Sources to the Chesapeake

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

*

Land management

*

Watershed Delivery

crop 32%

CAST-2019 2020 Progress run

Nitrogen Sources to the Chesapeake

CAST-2019 2020 Progress run

Sources of N in 2020

Atmospheric number is based on draft CMAQ runs. Do not cite!

CAST-2019 2020 Progress RA run   https://www.chesapeakeprogress.com/clean-water/water-quality   CMAQ presentation; assumed deposited percentage is delivered percentage and half is reduced

Poultry load to Bay million lbs per year

PoultryManure, 13.2

Poultry Atdep, 6.0

- Total = 19.2 million lbs nitrogen per year of 259 total
  - Atmospheric number is based on draft CMAQ runs. Do not cite!
- Other estimates of poultry atmospheric deposition are very similar
  - Joe Wood calculated 5.9 million based on the effectiveness of biofilters

CAST-2019 2020 Progress RA run   https://www.chesapeakeprogress.com/clean-water/water-quality   CMAQ presentation; assumed deposited percentage is delivered percentage and half is reduced

Sources of N in 1985

Fraction of atmospheric deposition from poultry is not available for 1985

N fate in CAST
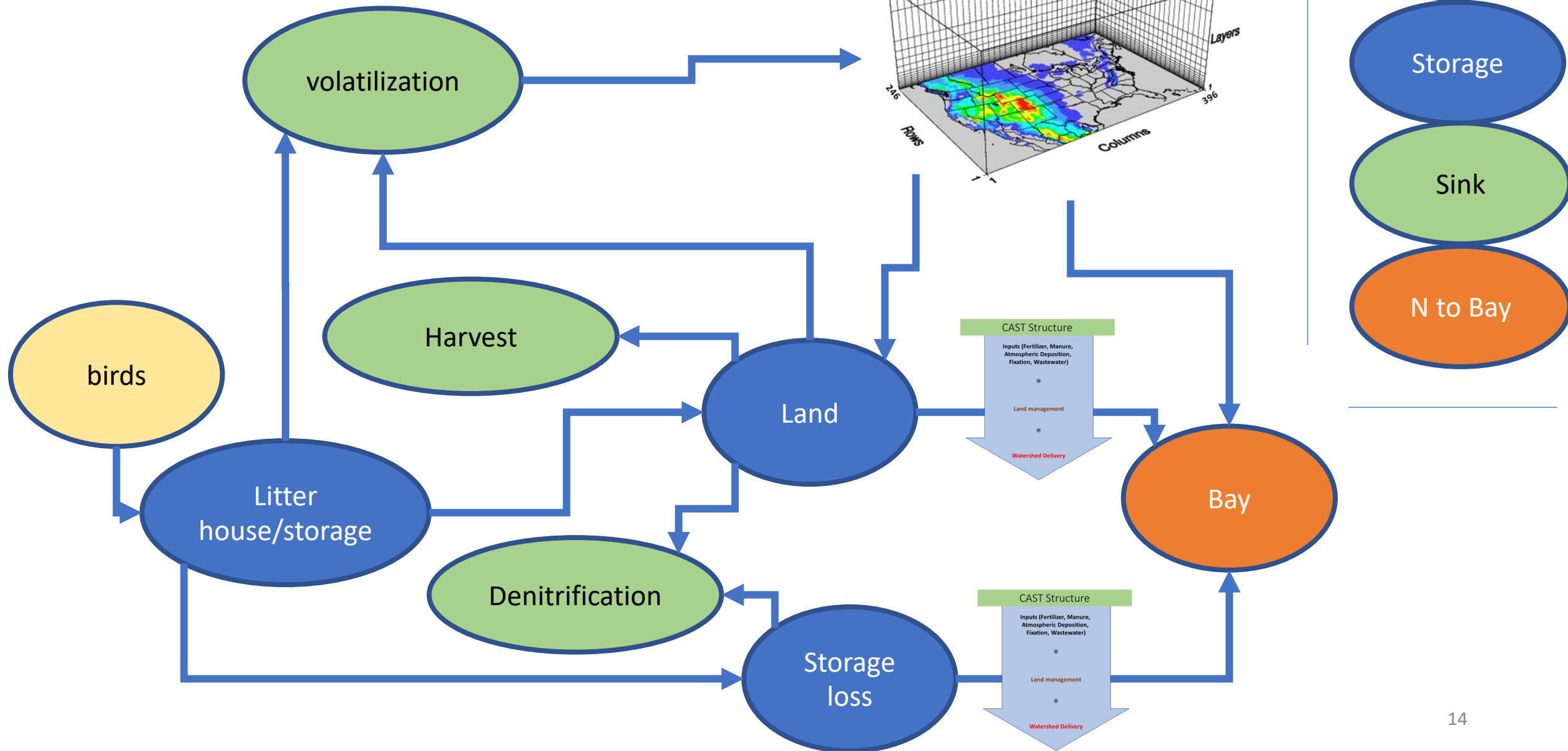
Filtered emissions

CMAQ

Legend:
- Source
- Storage
- Sink
- N to Bay

Nodes: volatilization, Harvest, birds, Land, Litter house/storage, Denitrification, Storage loss, Bay

CAST Structure
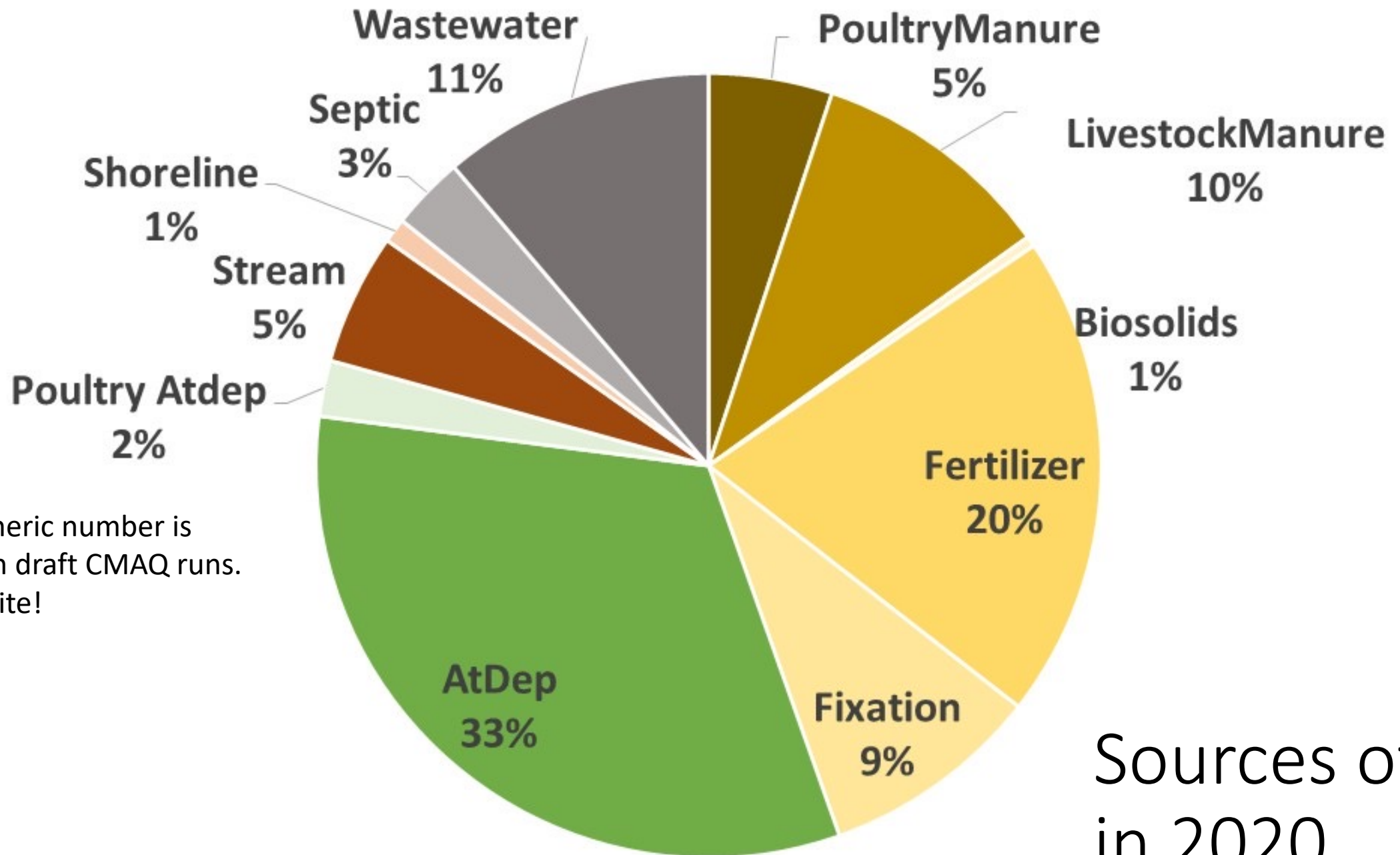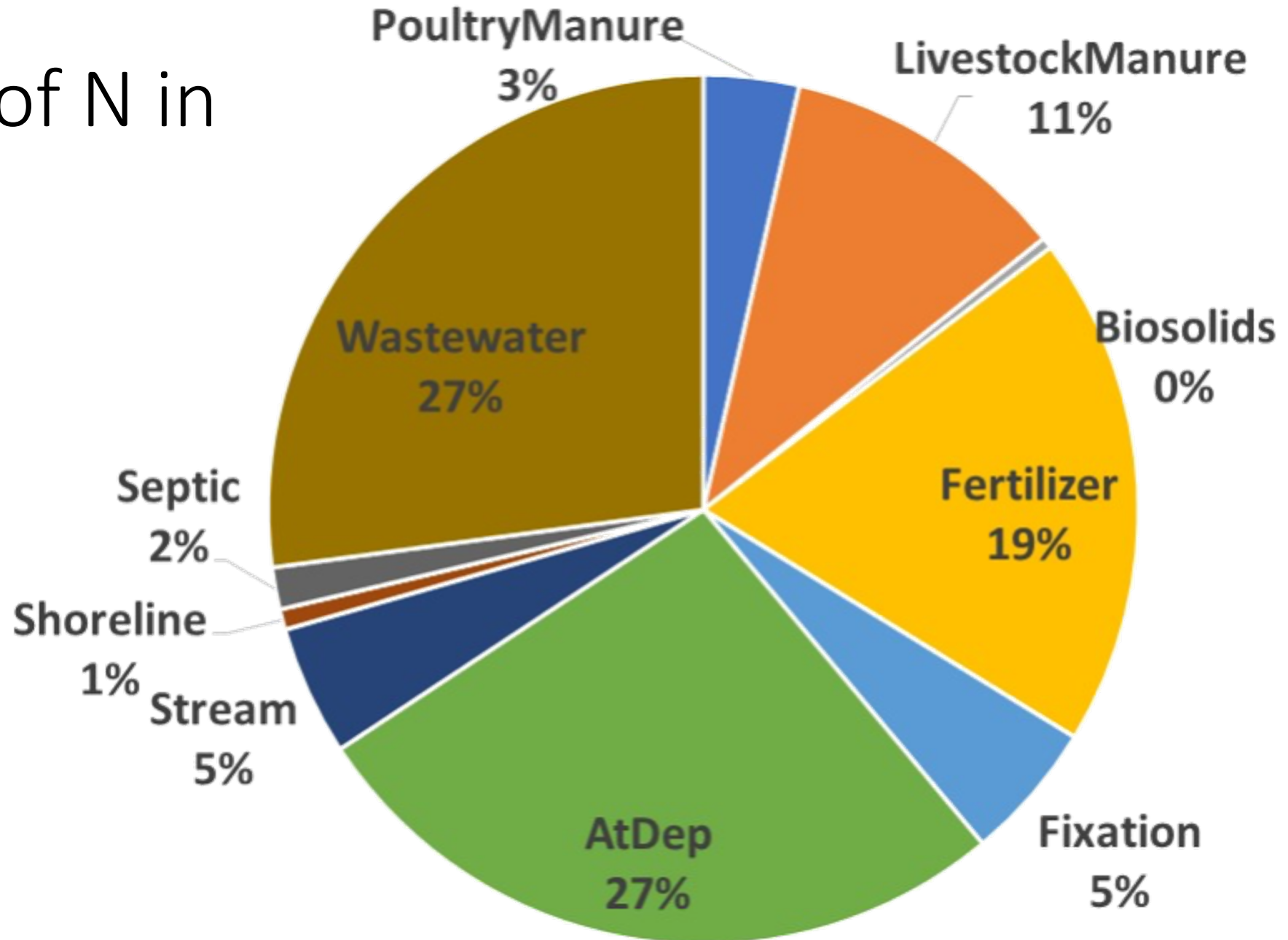Inputs (Fertilizer, Manure, Atmospheric Deposition, Fixation, Wastewater)
*
Land management
*
Watershed Delivery

15
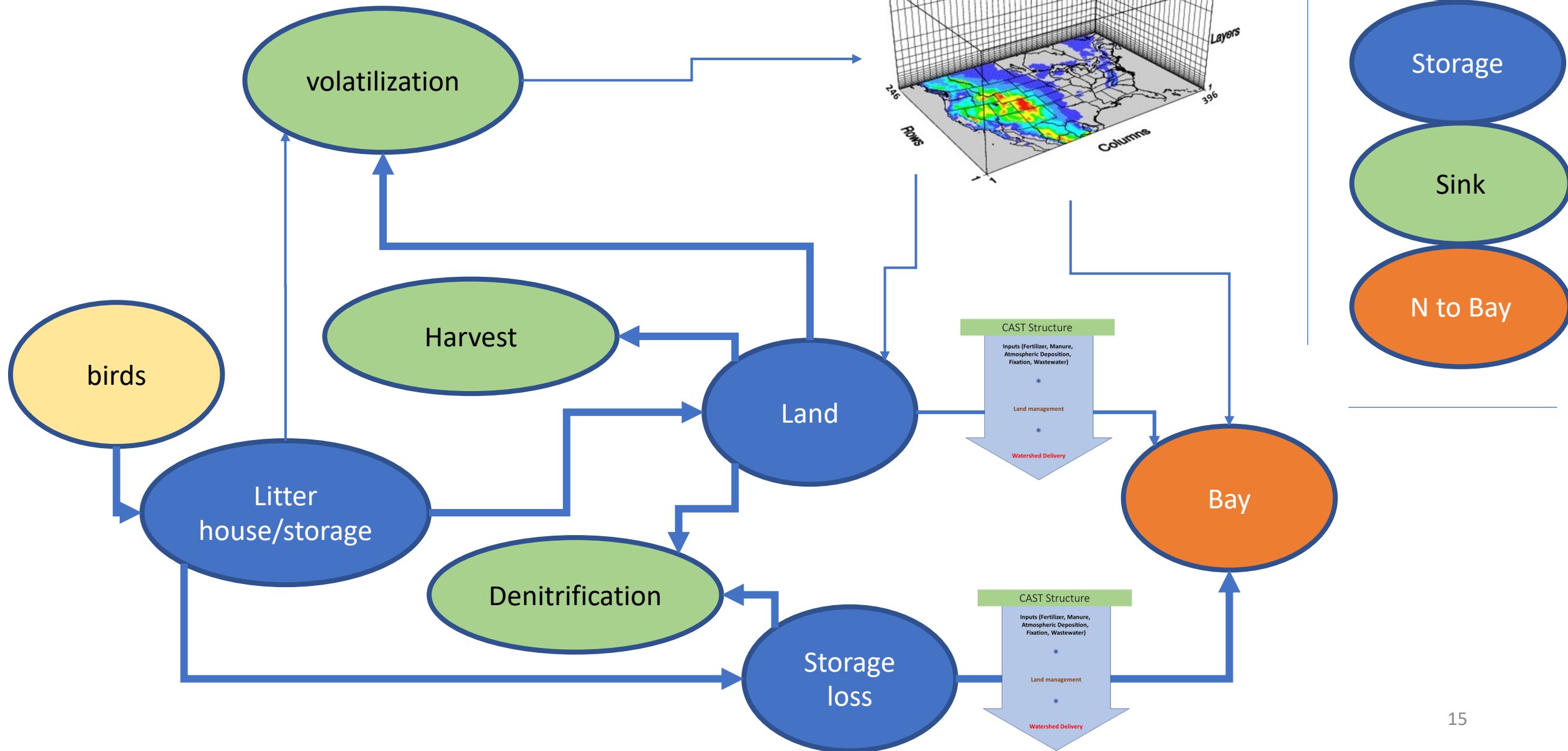
Restrict volatilization

CMAQ

Legend:
- **Source** (yellow)
- **Storage** (blue)
- **Sink** (green)
- **N to Bay** (orange)

Diagram labels: volatilization, Harvest, birds, Litter house/storage, Land, Denitrification, Storage loss, Bay, CAST Structure, Inputs (Fertilizer, Manure, Atmospheric Deposition, Fixation, Wastewater), Land management, Watershed Delivery
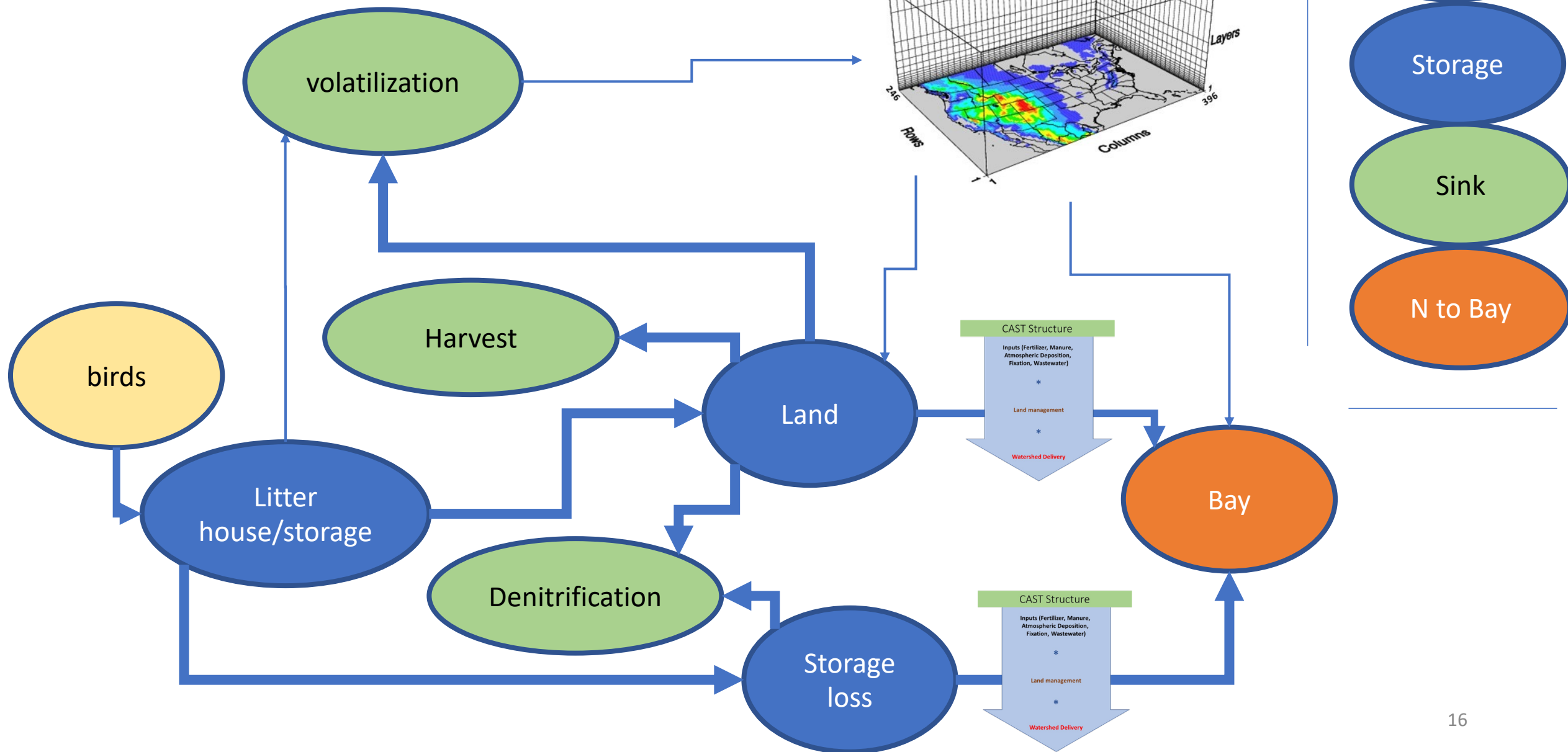
Potential Reductions currently available in CAST

Million pounds of N reduction to the tidal waters

Totals
Amendments   1.2 Mlbs
Biofilters   3.5 Mlbs

Implemented to date
819 pounds

Legend: ■ Amendments ■ Biofilters

Source: CAST scenarios from Joe Wood
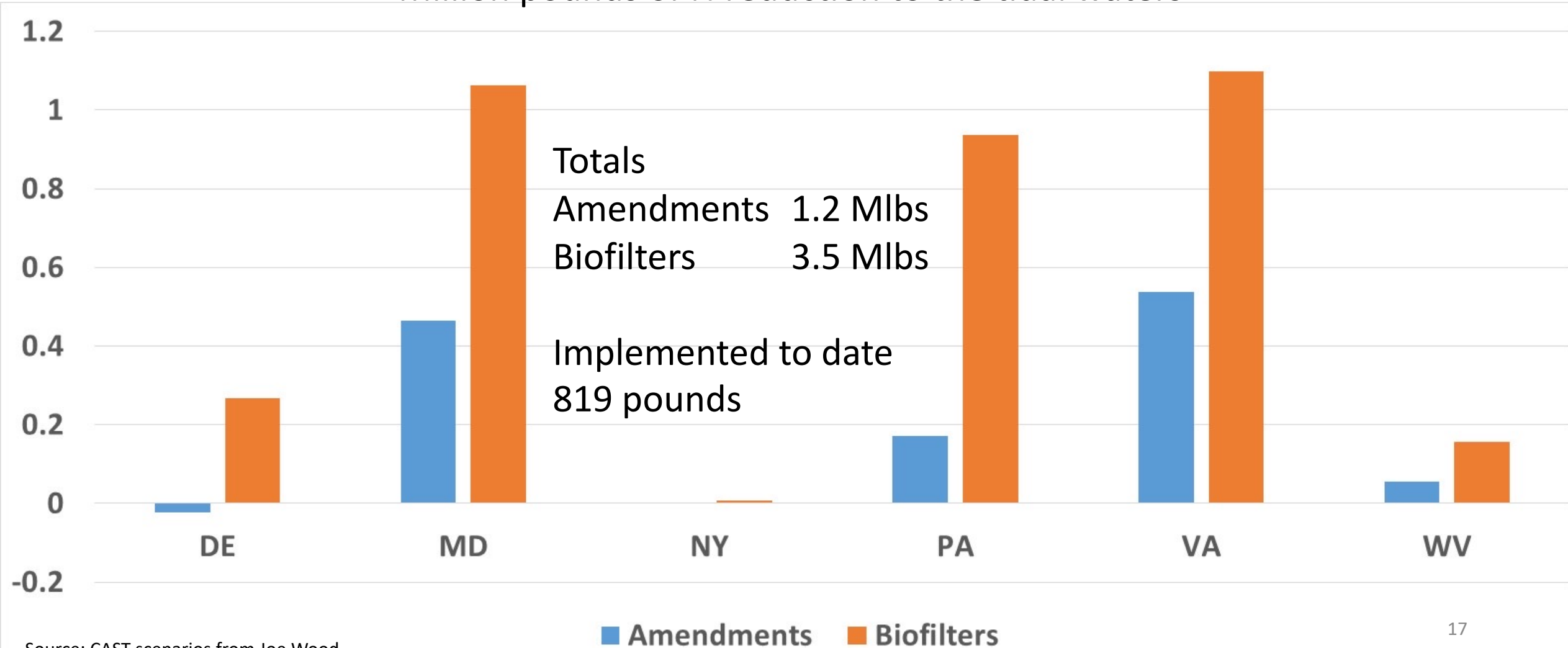
Summary

- The CBP tracks nitrogen loads to the Chesapeake from poultry litter
  - Land application
  - Atmospheric deposition
  - Storage losses
- Poultry litter accounts for 7% or so of nitrogen loads to the Chesapeake
  - The percentage has grown with increases in poultry and decreases in other sources
- Restricting or capturing ammonia emissions could reduce nitrogen to the Bay