Developing County-Level Nutrient Inventories

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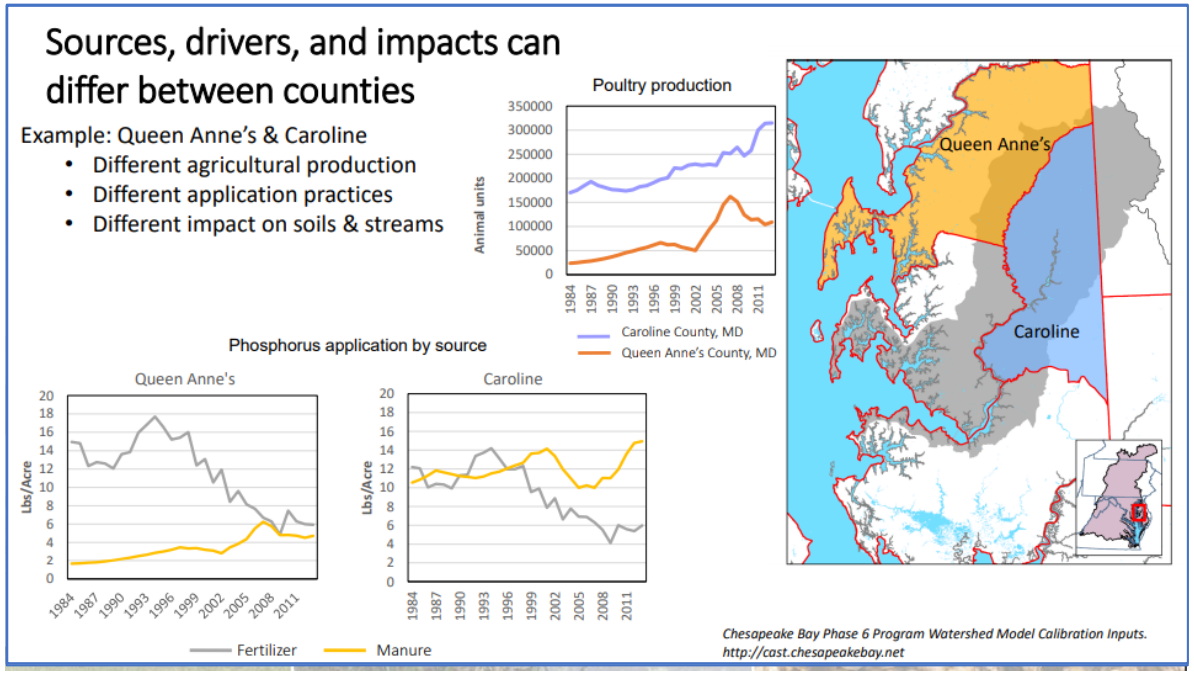
Modeling Quarterly
10/9/2019

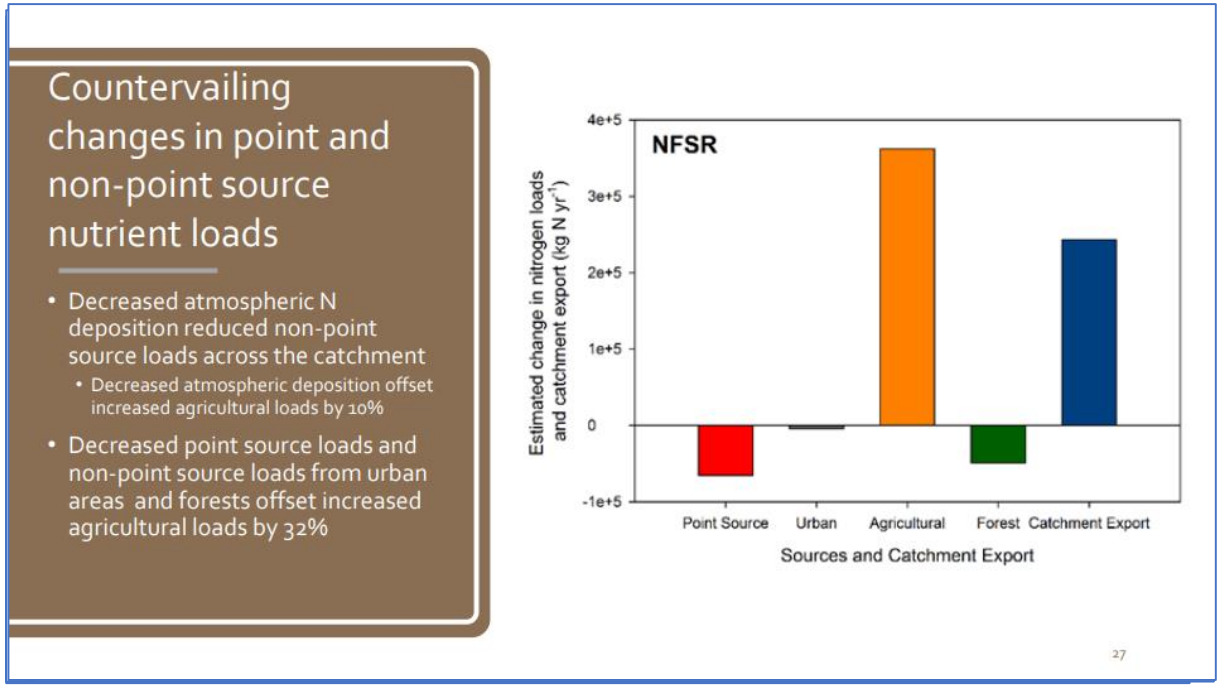
A reminder…

At the April 2018 Modeling Quarterly…

Emily presented on work integrating modeling, monitoring and research to build local water quality stories that demonstrate to partners the utility of the information



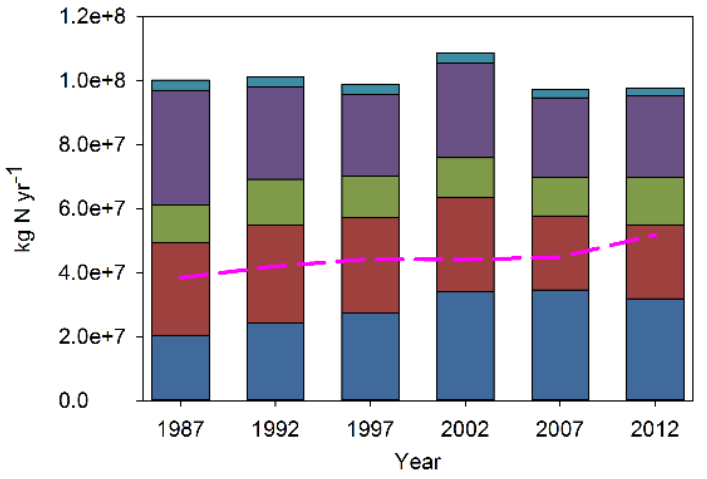
Robert presented work on a national nutrient inventory that he helped develop, then used to explain water quality trends at some CBP non-tidal network monitoring stations

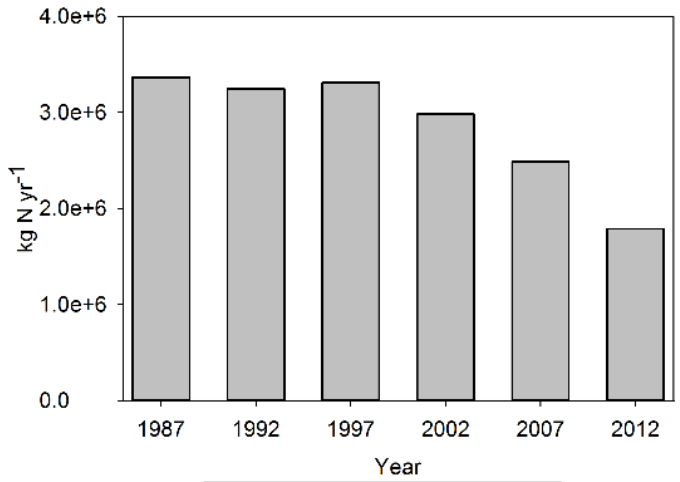


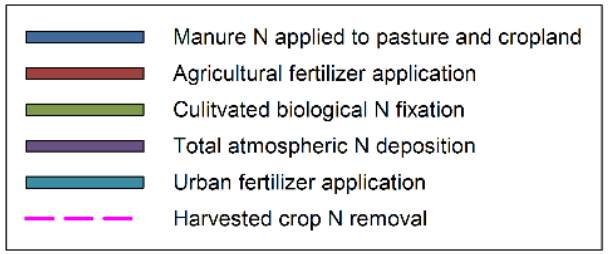
A reminder…

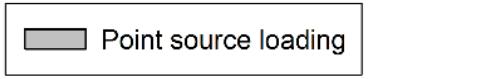
We discussed:

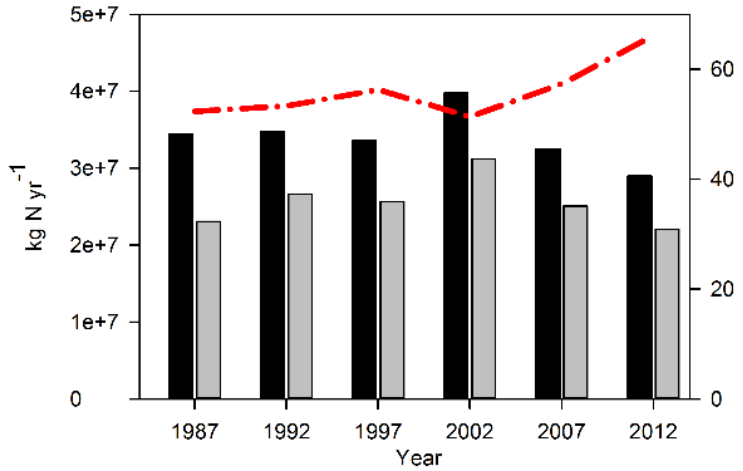
- Using CBP Phase 6 model inputs to develop a nutrient inventory for the Bay watershed
- Utilizing these inputs to explain water quality at all NTN stations
- Modeling WG members brought up county-level nutrient inventories as being a potentially useful interim product

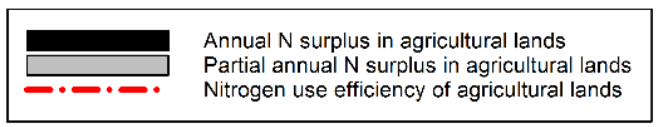


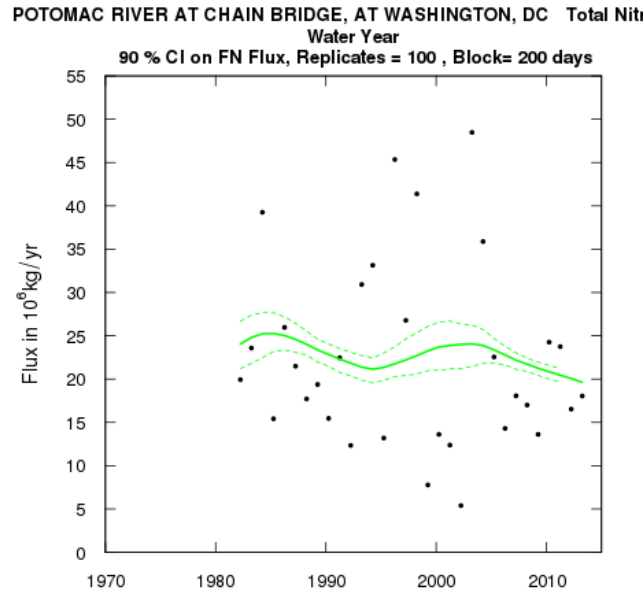












County-level Nutrient Inventory

Creating Database: Data from 1985 - 2018

- Data downloaded from CAST
  - FIPS
  - County Name
  - State Abbreviation
  - Acres (Ag, Developed, Natural)
  - NO23
  - NH3
  - OrgN
  - PO4
  - OrgP
  - Stored Nutrients Lbs
  - Riparian Pasture Nutrients Lbs
  - Biosolids Lbs Applied
  - Direct Deposit Manure Applied
  - Fertilizer Lbs Applied
  - Urban Fertilizer Lbs Applied
  - Legume Lbs Fixed
  - Municipal Wastewater Treatment Plant
  - Industrial Wastewater Treatment Plant
  - Combined Sewer Overflow
  - Septic
- Data from 2010 Census
  - Population
- Data calculated from CAST data
  - Poultry – filtered for broilers, layers, pullets, & turkeys from Stored Nutrient Lbs Applied
  - Livestock – filtered for beef, dairy, goats, hogs and pigs for breeding, hogs for slaughter, horses, other cattle, sheep and lambs from Stored Nutrient Lbs Applied
  - Poultry & Livestock
  - Total Point Source
  - Crop Removal
  - Total N Atmospheric Deposition
  - Total Ag Application – Poultry + Livestock + Ag Fertilizer
  - Nitrogen Use Efficiency
  - Ag Surplus

County-level Nutrient Inventory

Chesapeake Bay Program
Science. Restoration. Partnership.

FACTSHEET!

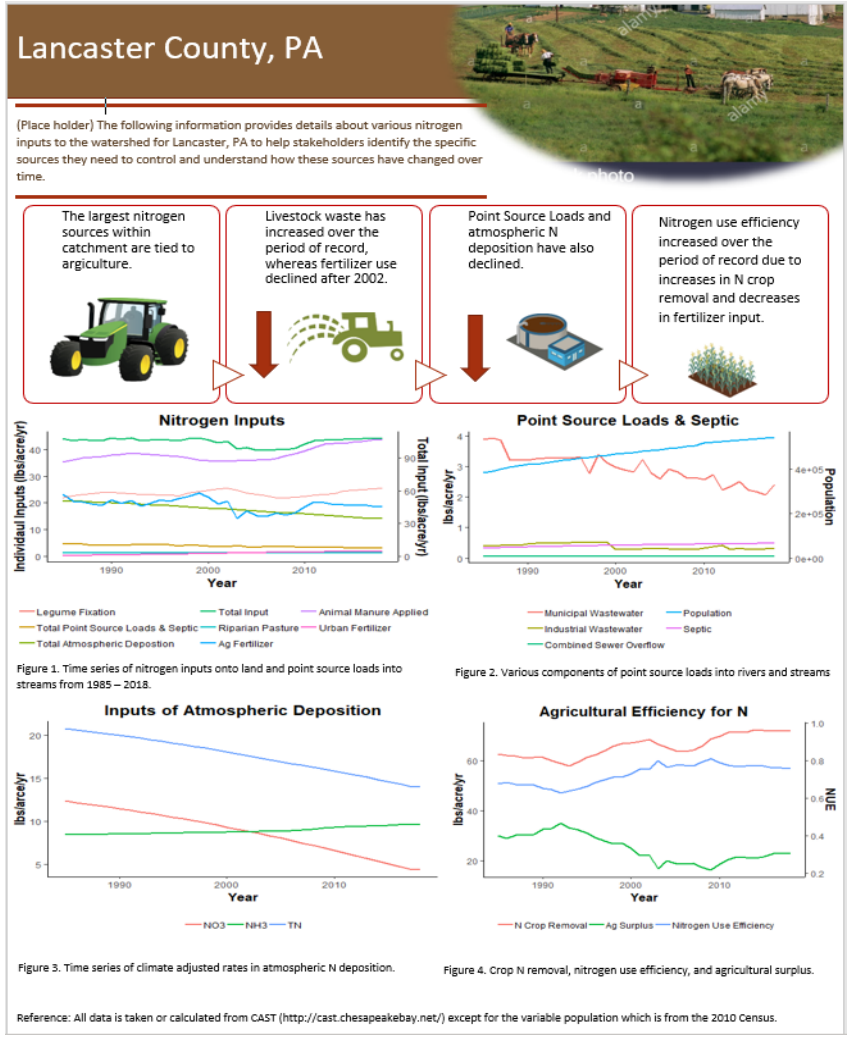


Figure 1. Time series of nitrogen inputs onto land and point source loads into streams from 1985 – 2018.

Figure 2. Various components of point source loads into rivers and streams

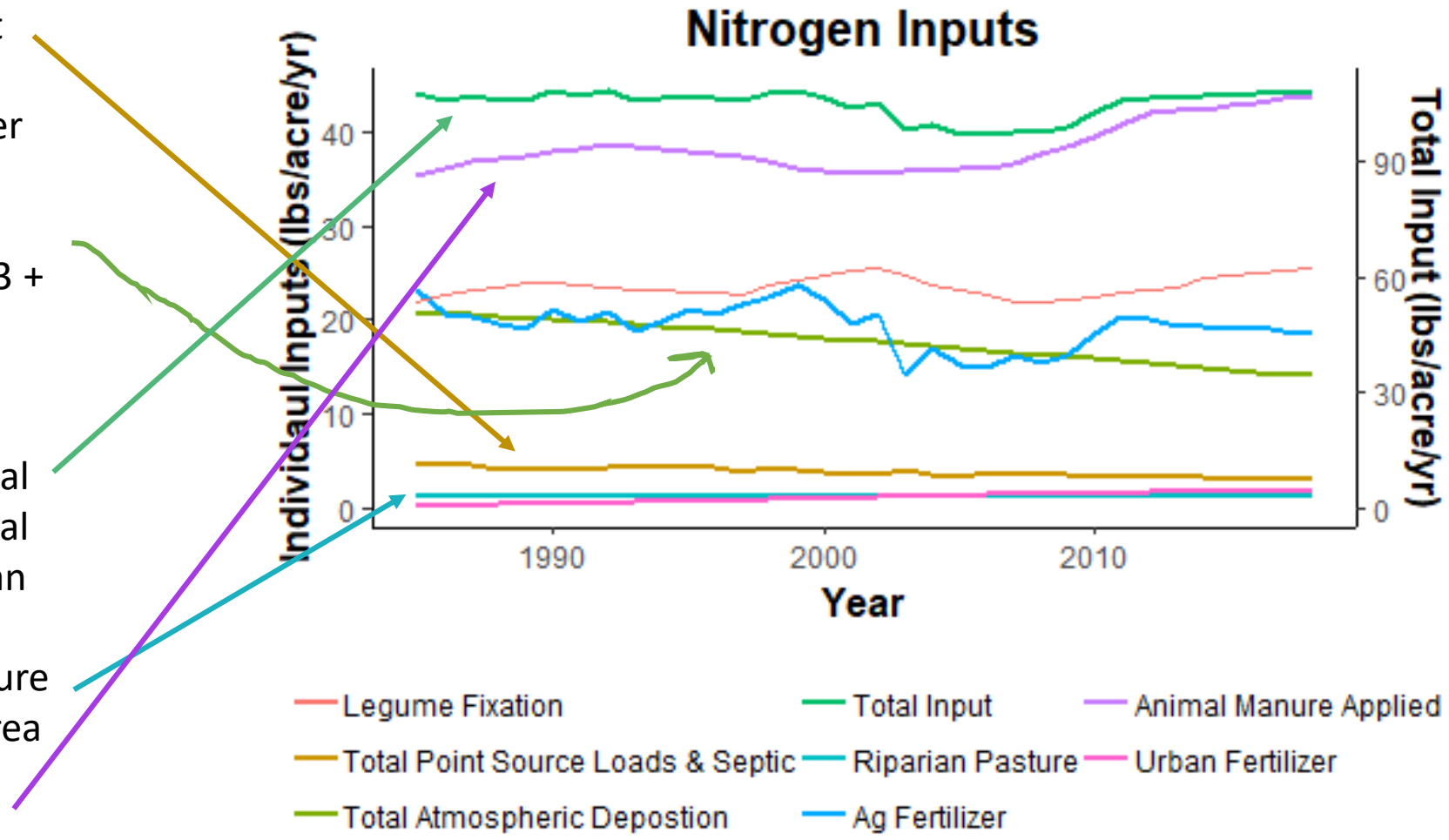
Figure 3. Time series of climate adjusted rates in atmospheric N deposition.

Figure 4. Crop N removal, nitrogen use efficiency, and agricultural surplus.

Reference: All data is taken or calculated from CAST (http://cast.chesapeakebay.net/) except for the variable population which is from the 2010 Census.

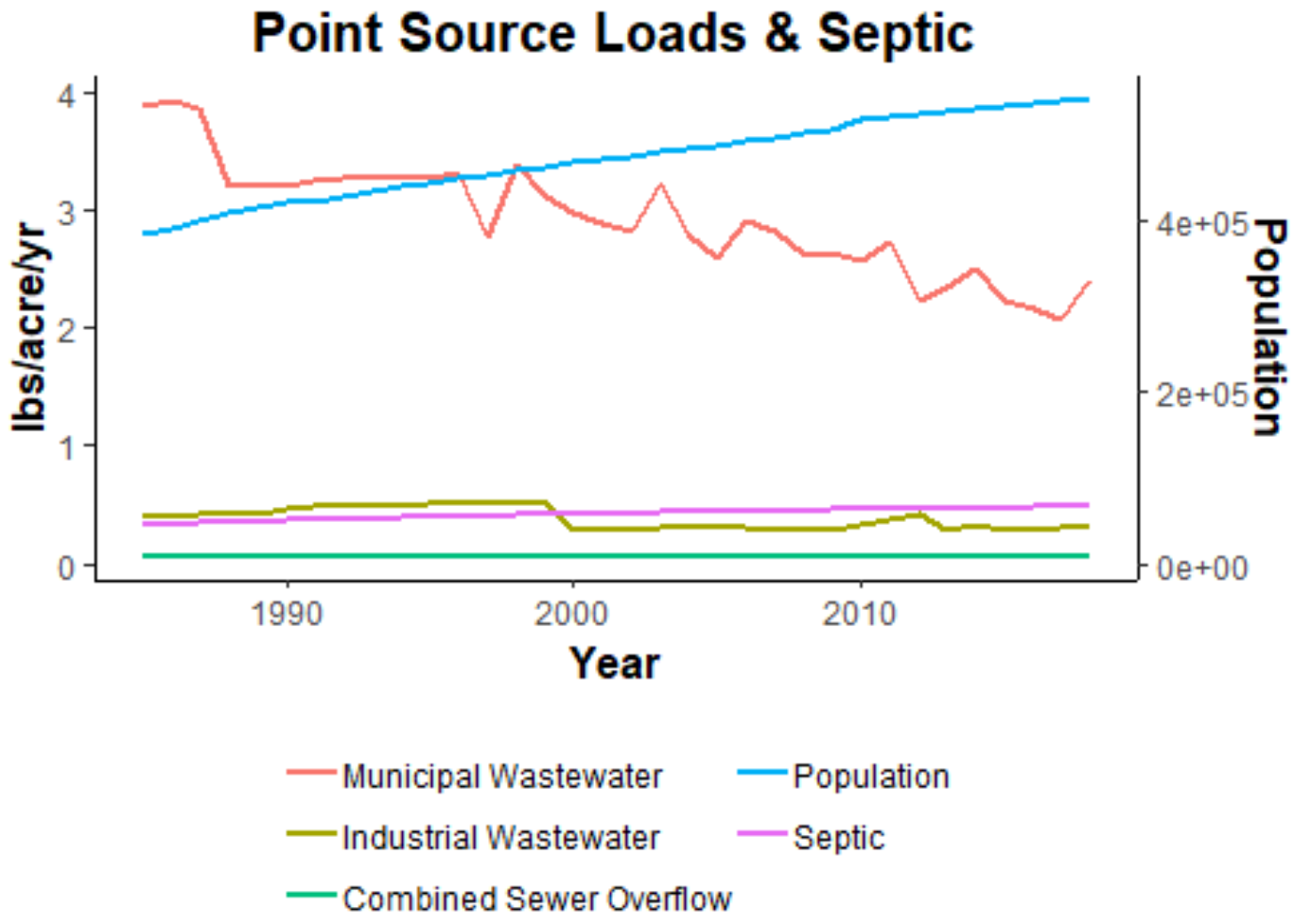
Time Series for Nitrogen: Nitrogen Inputs

- Total Point Source Loads & Septic = Municipal Wastewater Treatment Plant + Industrial Wastewater Treatment Plan + Combined Sewer Overflow + Septic
- Total Atmospheric Deposition = (NH3 + NO3 on land acres) + (NH3 + NO3 + Organic Nitrogen on water acres)
- Total Input = Legume + Poultry + Livestock + Riparian Pasture + Total Point Source Loads & Septic + Total N Atmospheric Deposition + Urban Fertilizer + Ag Fertilizer
- Riparian Pasture = Livestock manure deposited into stream/riparian area
- Animal Manure Applied = Direct manure deposited on pasture



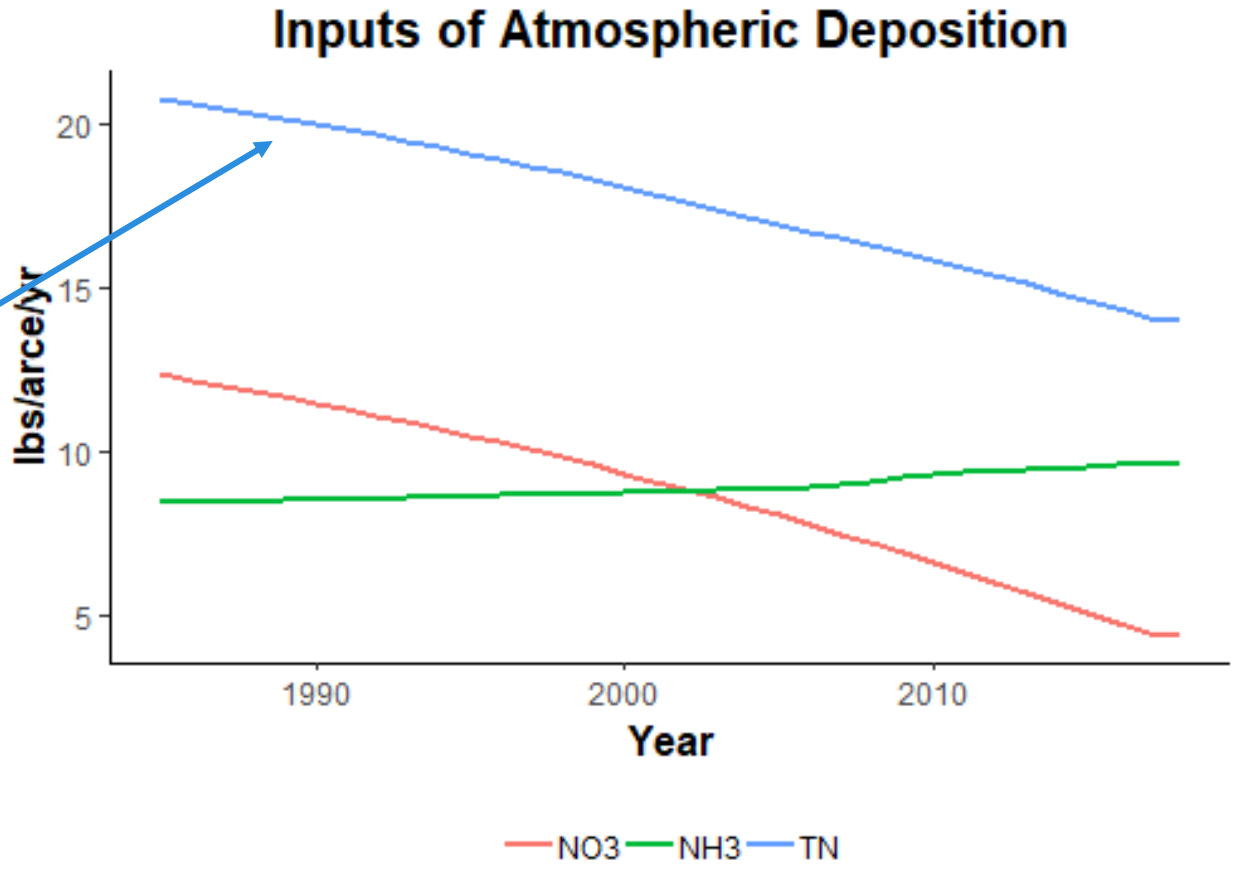
Time Series for Nitrogen: Point Source Loads & Septic

- Various components of point source loads into rivers and streams.
- While Population is increasing, Municipal Wastewater is decreasing over the period of record.



Time Series for Nitrogen: Atmospheric Deposition

- Time series of climate adjusted rates in Atmospheric Deposition.
- Total N = (NH_3 + NO_3 on land acres) + (NH_3 + NO_3 + organic nitrogen on water acres).



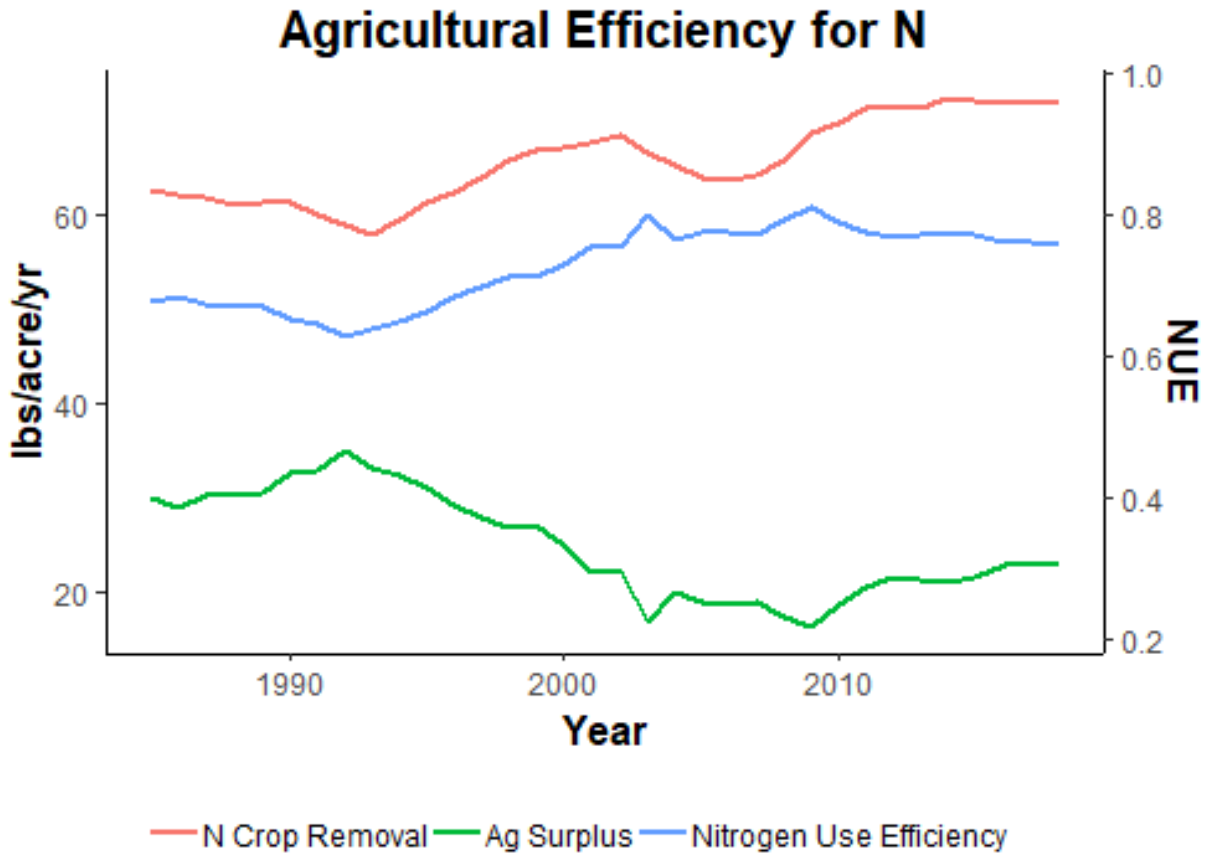
Time Series for Nitrogen: Agricultural Efficiency

Ag Surplus is the extra N ag inputs not used.

- Ag Surplus = Legume + Poultry + Livestock + Atm Dep On Ag Land + Ag Fertilizer - N Crop Removal

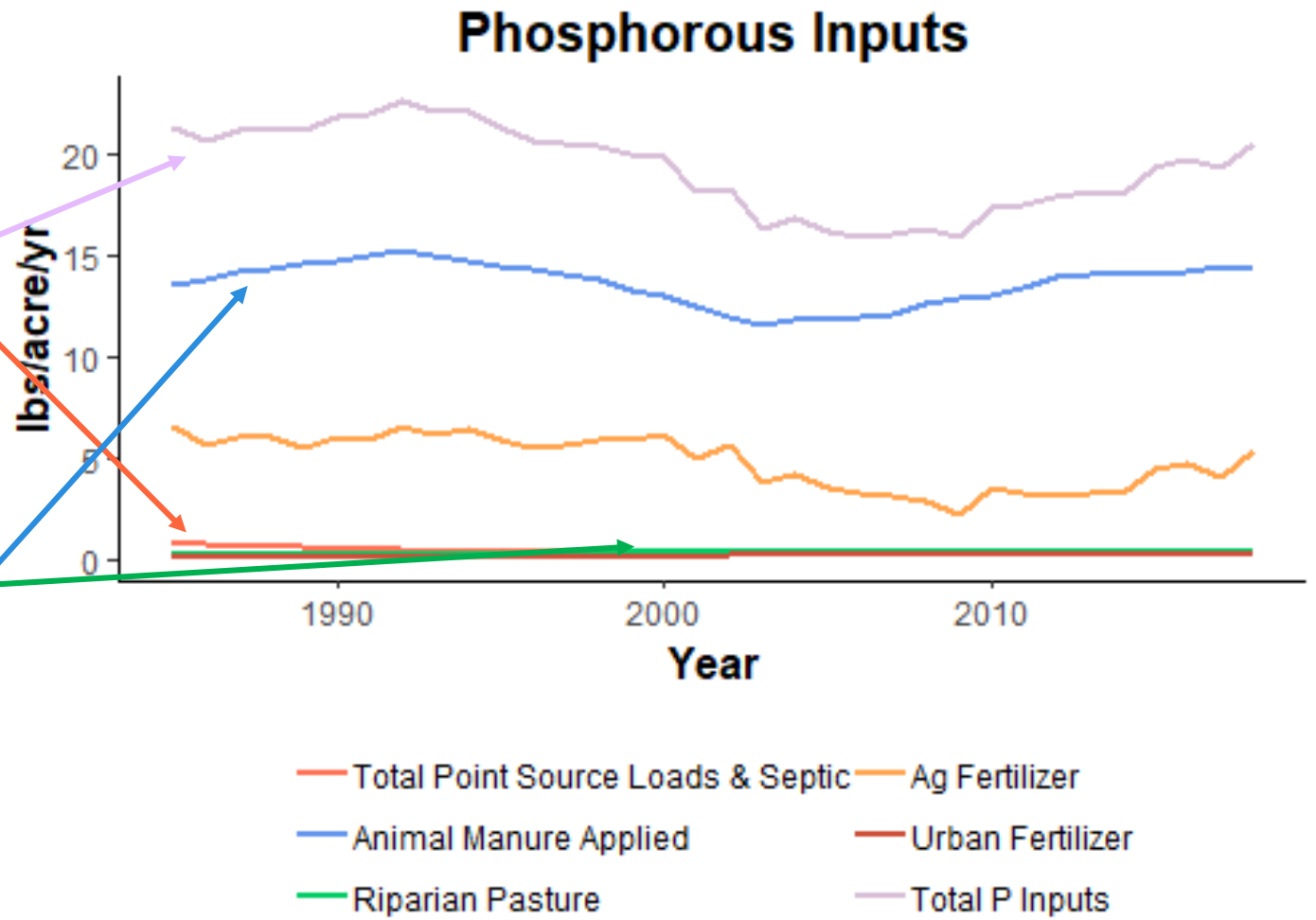
Nitrogen Use Efficiency (NUE) is the proportion of N removed from the field after harvest (crop out for N put in).

- NUE = N Crop Removal / (Legume+ Poultry + Livestock+ Atm Dep On Ag Land+ Ag Fertilizer)



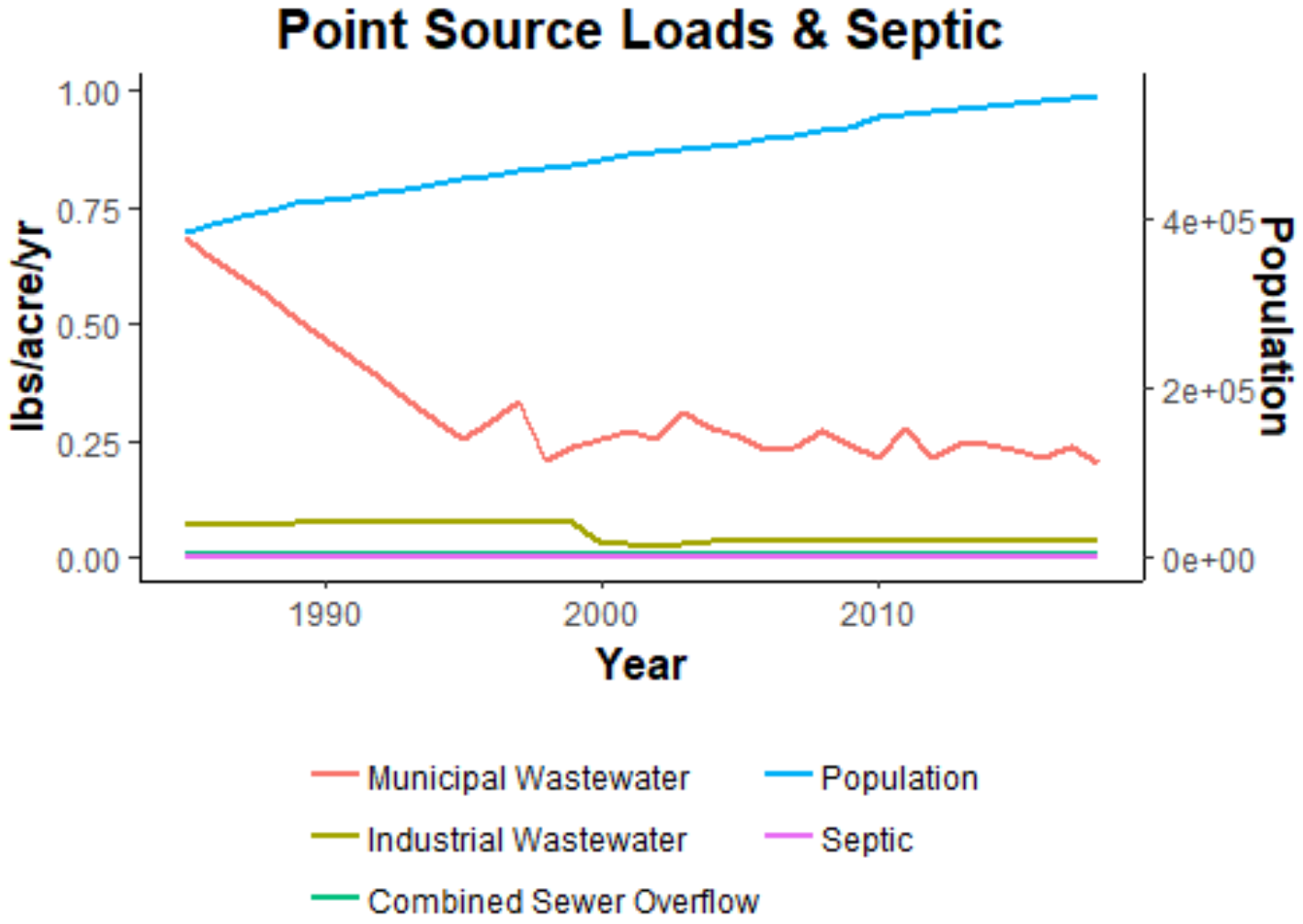
Time Series for Phosphorous: Phosphorous Inputs

- Total Point Source Loads & Septic = Municipal Wastewater Treatment Plant (MWTP) + Industrial Wastewater Treatment Plant (IWTP) +Combined Sewer Overflow (CSO) + Septic
- Total P Inputs = Poultry + Livestock + Riparian Pasture+ Total Point Source loads + Septic + Total Phosphorous Atmospheric Deposition + Urban Fertilizer+ Ag Fertilizer
- Riparian Pasture = Livestock manure deposited into stream/riparian area
- Animal Manure Applied = Direct manure deposited on pasture



Time Series for Phosphorous: Point Source Loads & Septic

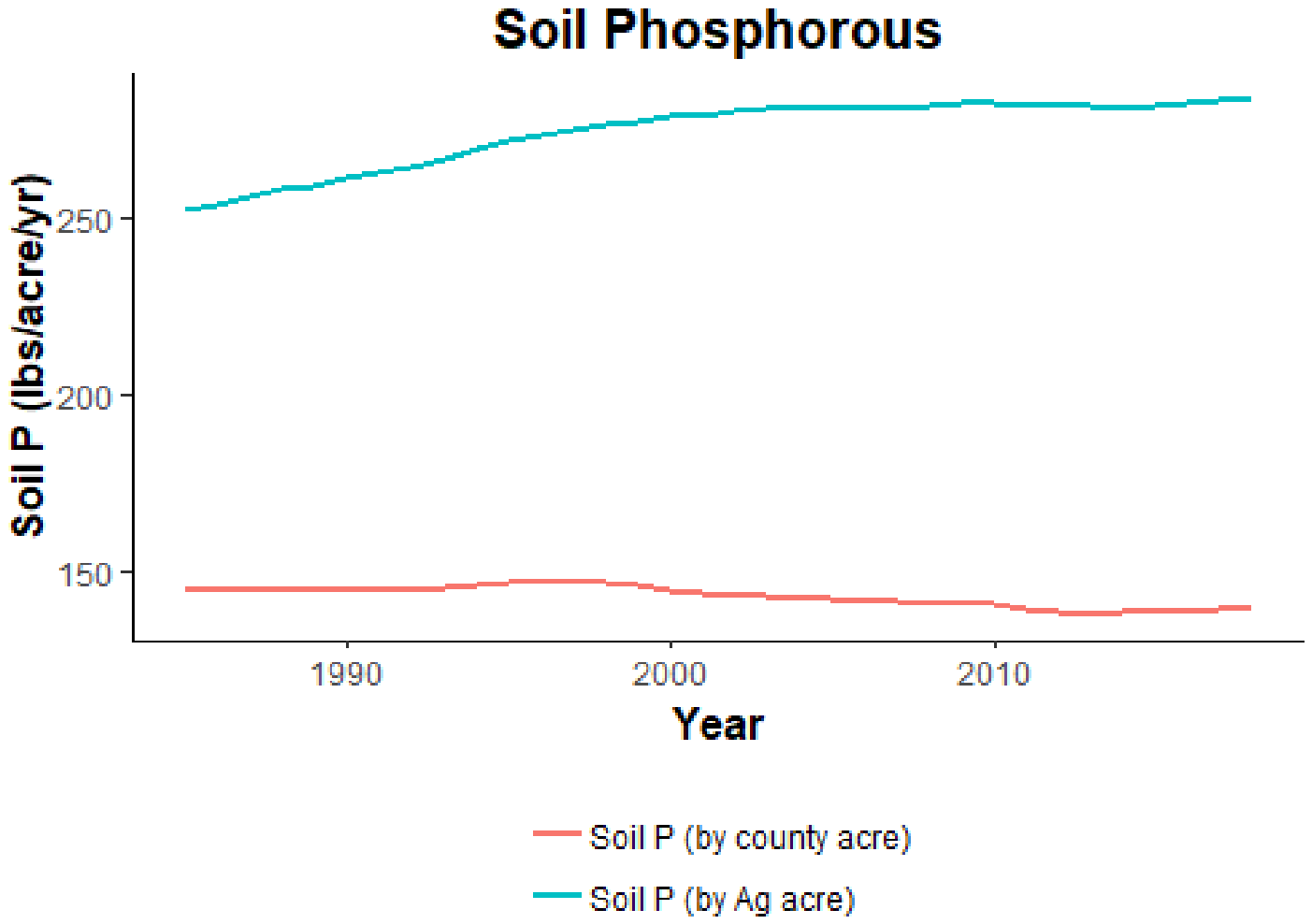
- Various components of point source loads into rivers and streams.
- While Population is increasing, Municipal Wastewater is significantly decreasing over the period of record.



Time Series for Phosphorous: Soil Phosphorous

- Soil P by county acre = Phosphorous level in soil normalized by Lancaster County area

- Soil P by Ag acre = Phosphorous level in soil normalized by Lancaster County **Agricultural** area



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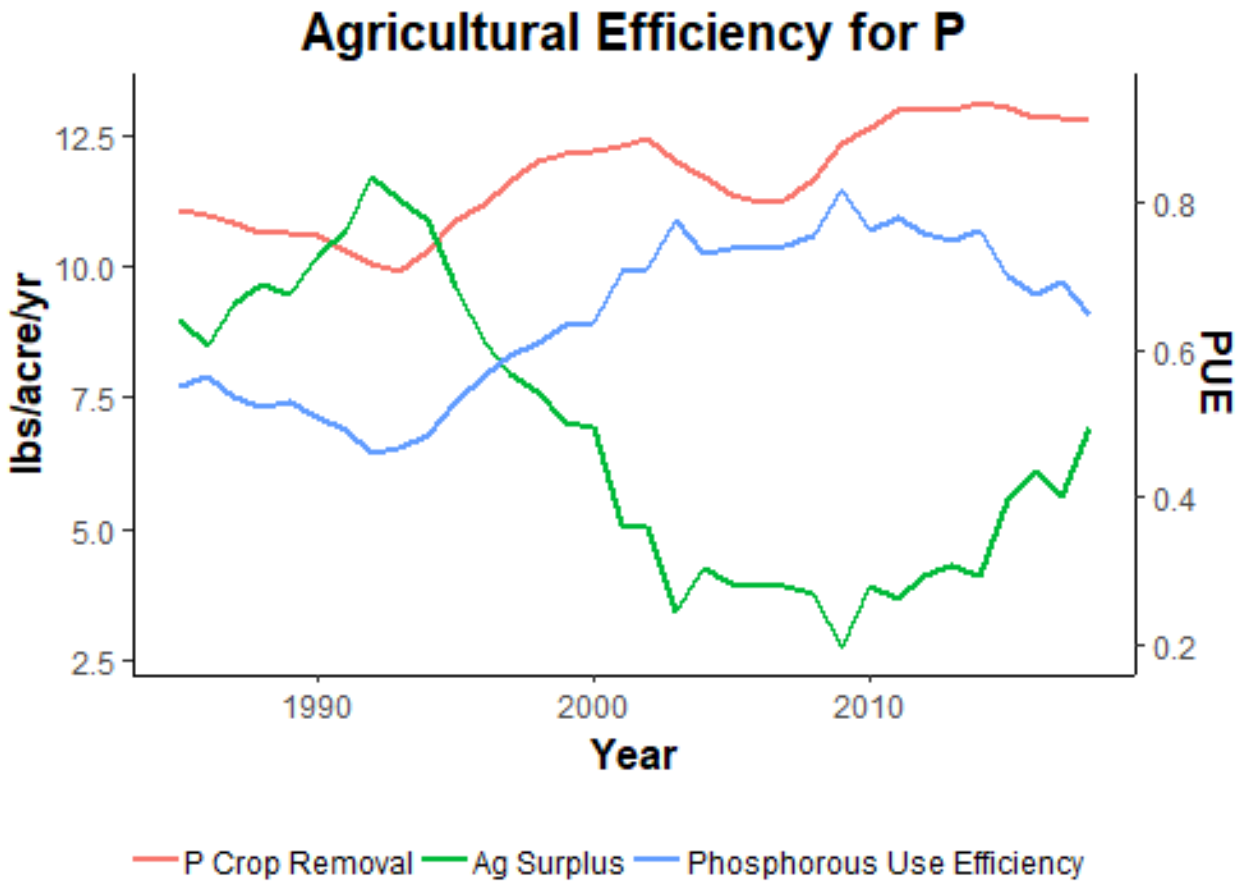
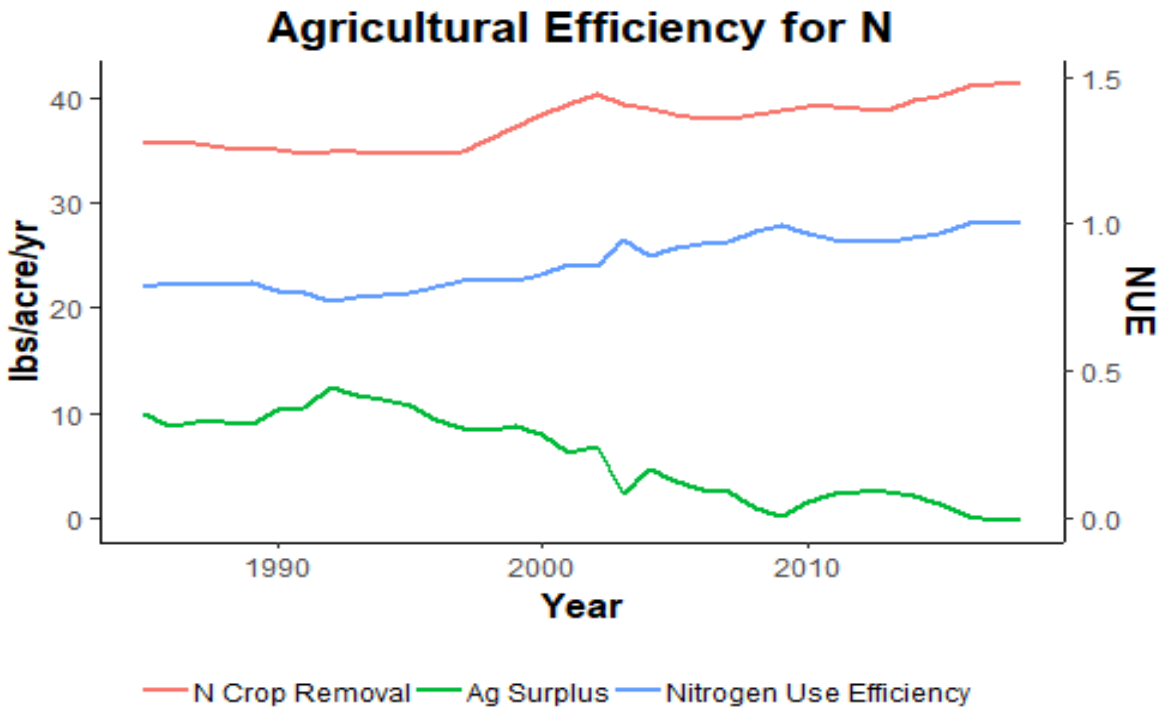
Phosphorous Use Efficiency (PUE) is the proportion of P removed from the field after harvest (crop out for P put in).

- PUE = N Crop Removal / (Poultry + Livestock+ Ag Fertilizer)

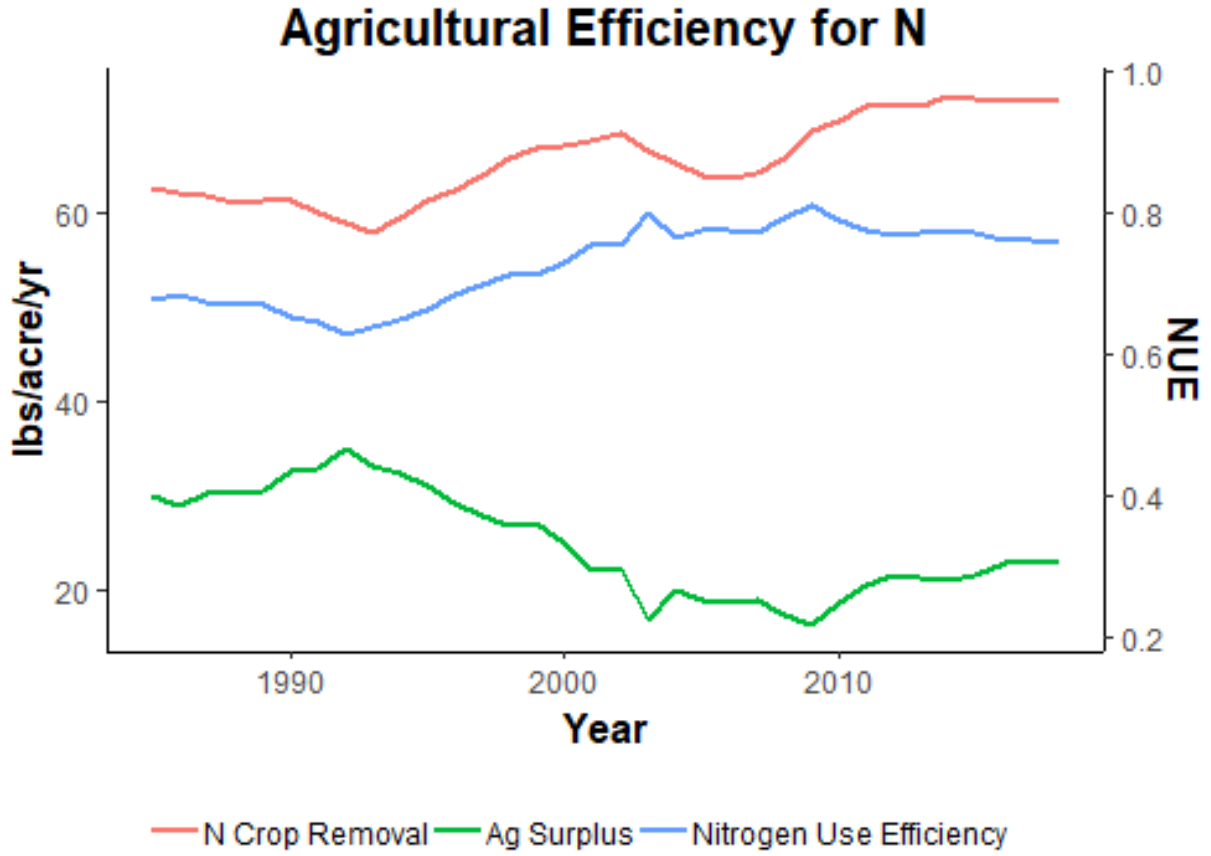


Are certified nutrient management plans effective?

Washington County, MD

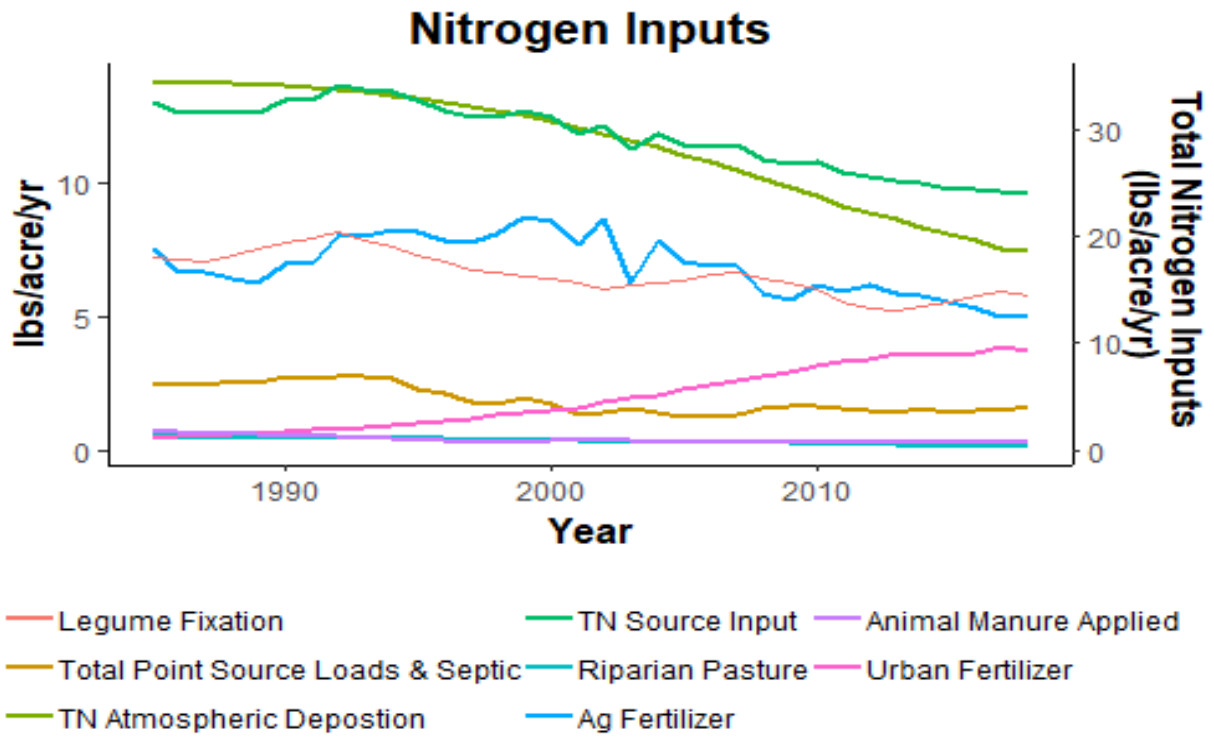


Lancaster County, PA



Impacts of suburbanization on nitrogen inputs?

Loudoun County, VA



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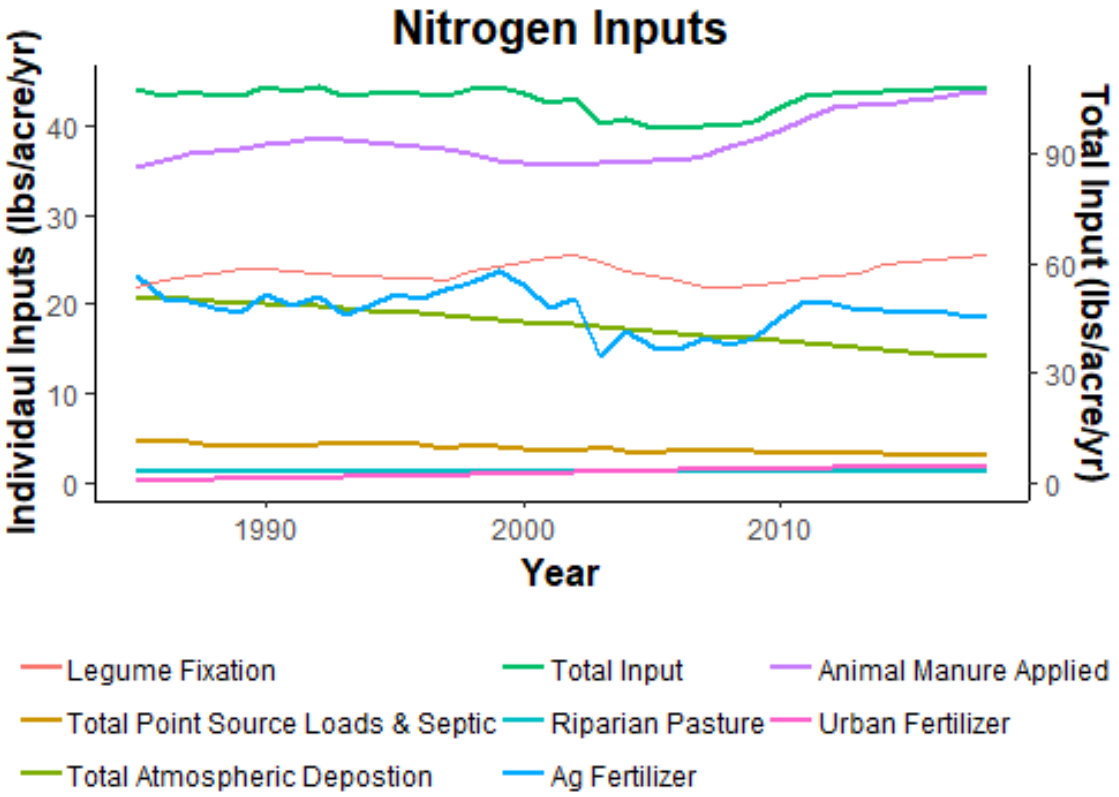

Next steps

- Gather feedback on county-level nutrient inventory fact sheets from WQGIT and its workgroups (e.g. Agriculture, Watershed Technical)
- Gather feedback on fact sheets from user partners (e.g. county-level partners, planning district commissions, conservation districts
- Finish compiling county-level nutrient inventory database and make publicly available for partners
- Discuss how to develop watershed-level nutrient inventory
- Utilize nutrient inventory to begin analyzing water quality trends at non-tidal network stations