STAC Proactive Workshop: Assessing the Environment In Outcome Units

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Presentation to STAC 3/27/2019

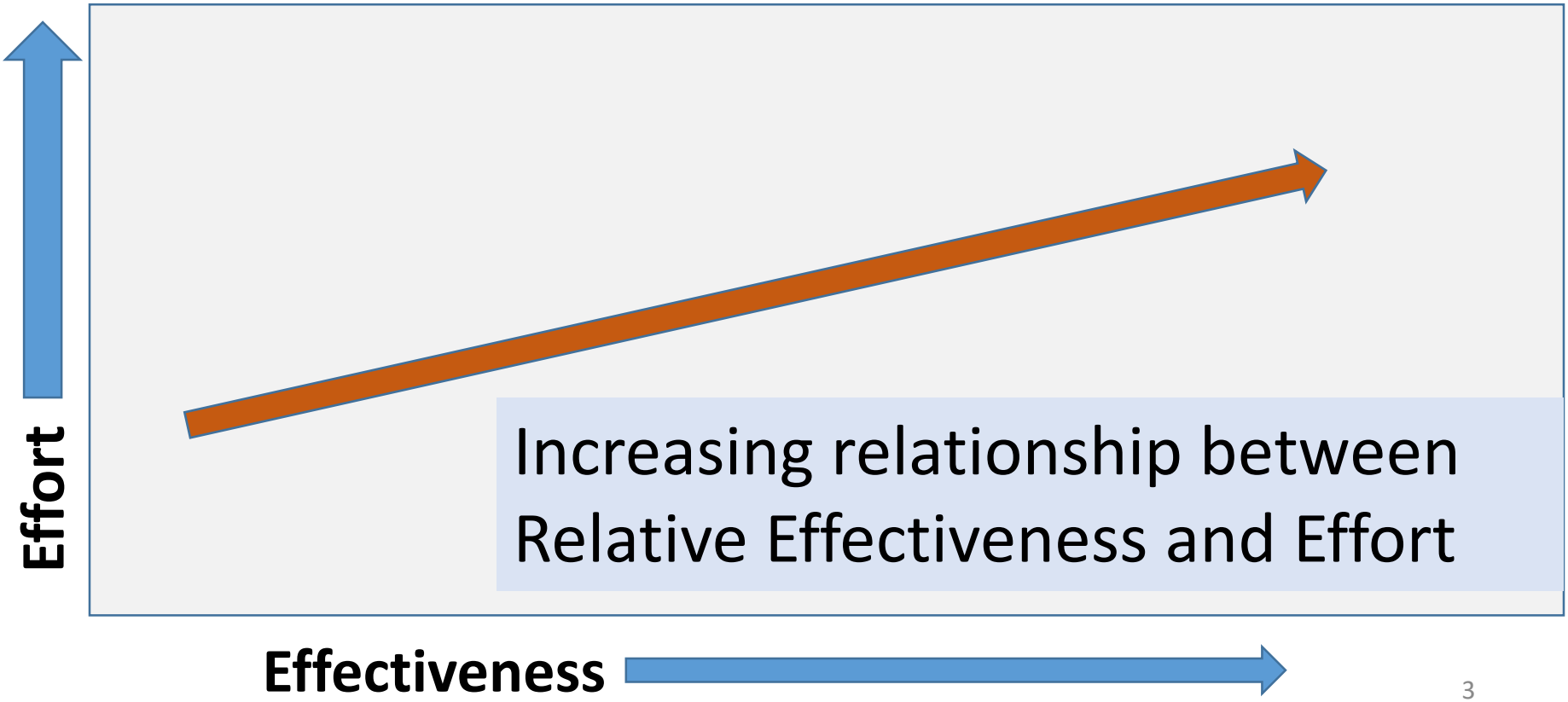
Motivation

- Inspired by June, 2017 presentation to STAC by Antti Iho
- TMDL caps TN and TP
- Inorganic nutrients may have a greater impact on eutrophication compared to organic forms.
- The location and timing of delivery also has effects
- Using a currency of eutrophication potential rather than TN and TP could results in more effective and more cost-effective management

- Explore whether the science is ripe and appropriate for calculating *eutrophying units* as a common currency that can be used to compare alternative restoration strategies.

Guidelines for Planning Targets

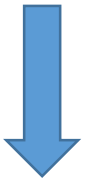
- Areas that contribute the most to the problem must do the most to resolve the problem.

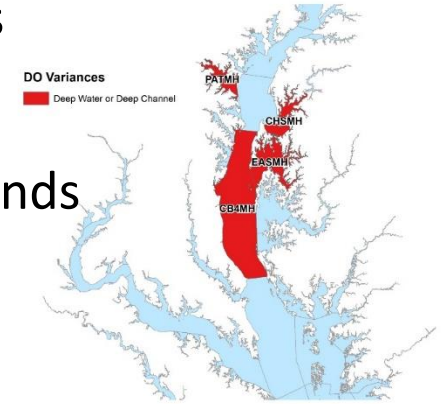


How eutrophying units have been used
Estimated Loads to the Bay with Conowingo Dam and Reservoir at Infill Conditions

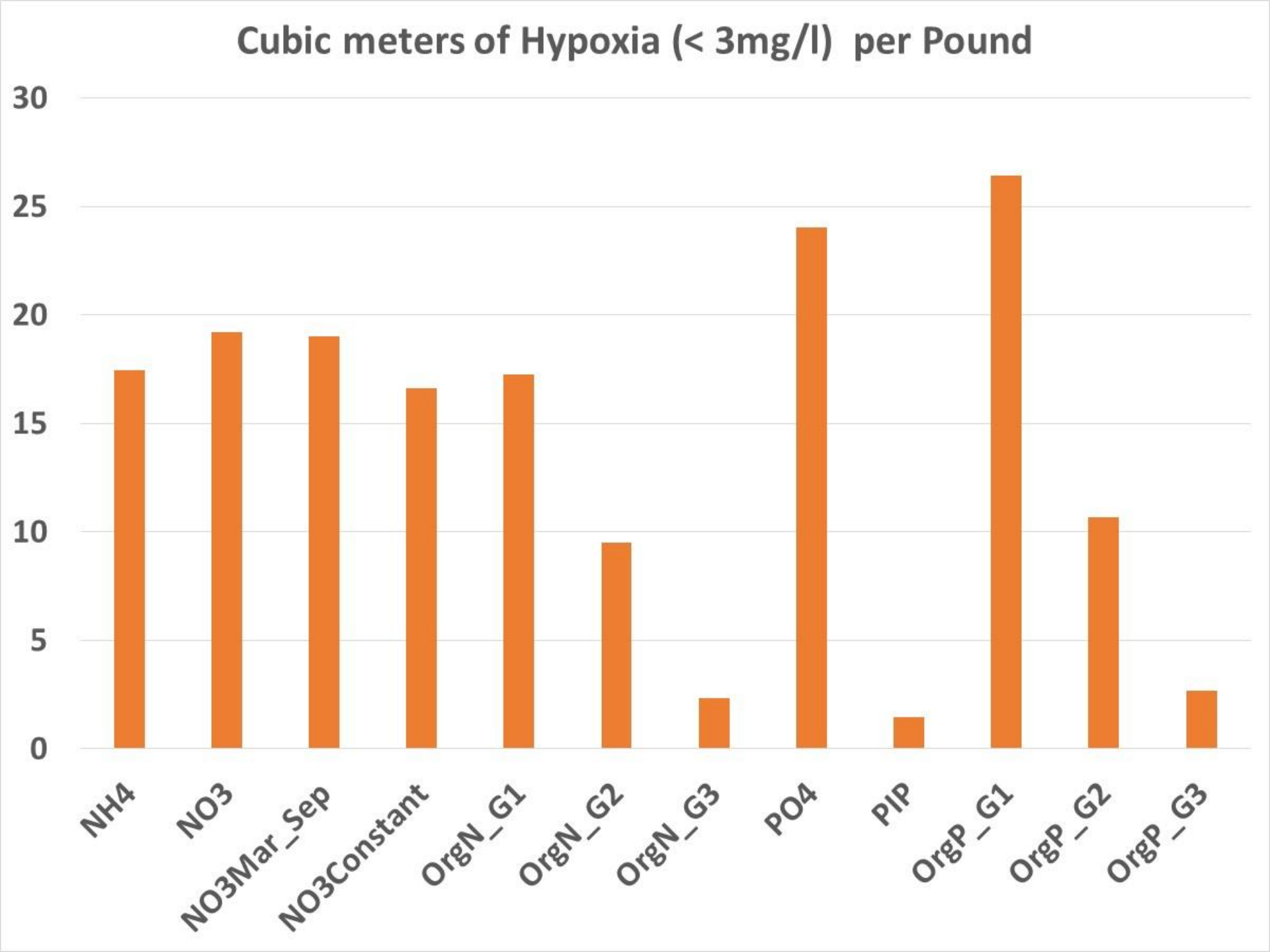
Additional Nitrogen Load: 13 million pounds

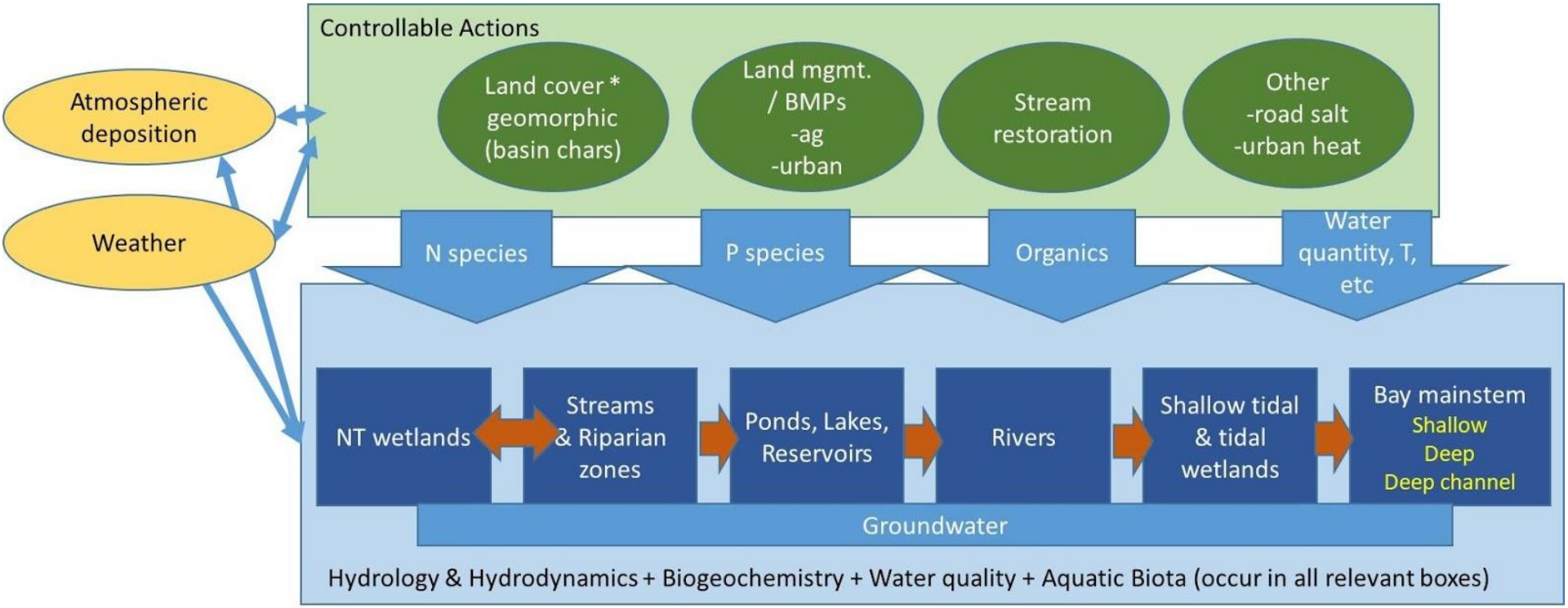
Additional Phosphorus Load: 1.8 million pounds



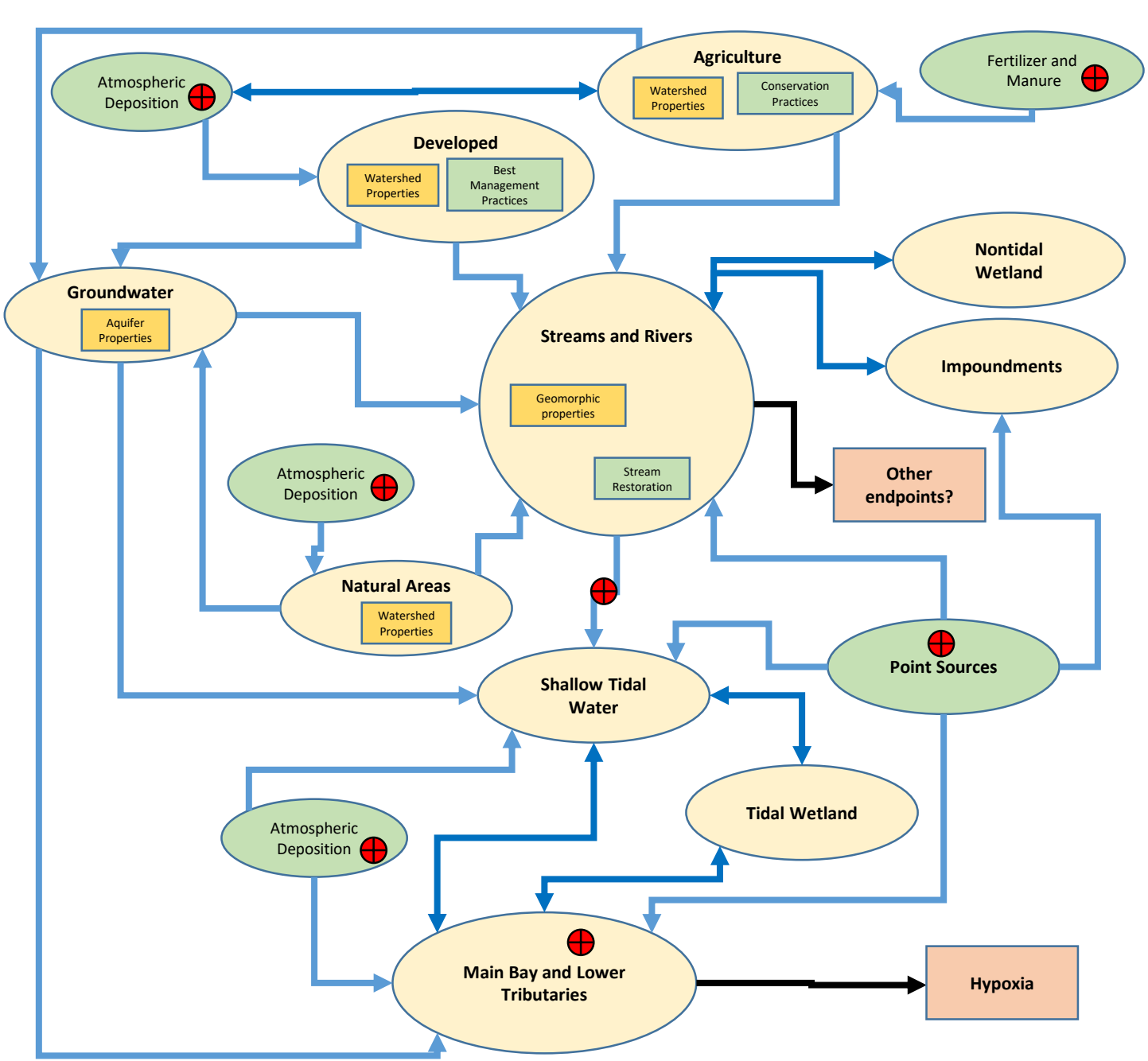


HOWEVER: These are less bioavailable nutrients and its delivery to Bay is dependent on large storm events. Equivalent to 6 million pounds of Nitrogen and 0.26 million pounds of Phosphorus when measured as DO effects


Cubic meters of Hypoxia (< 3mg/l) per Pound
30
25
20
15
10
5
0
NH4
NO3
NO3Mar_Sep
NO3Constant
OrgN_G1
OrgN_G2
OrgN_G3
PO4
PIP
OrgP_G1
OrgP_G2
OrgP_G3


Controllable Actions
Land cover * geomorphic (basin chars)
Land mgmt. / BMPs -ag -urban
Stream restoration
Other -road salt -urban heat
Atmospheric deposition
Weather
N species
P species
Organics
Water quantity, T, etc
NT wetlands
Streams & Riparian zones
Ponds, Lakes, Reservoirs
Rivers
Shallow tidal & tidal wetlands
Bay mainstem
Shallow
Deep
Deep channel
Groundwater
Hydrology & Hydrodynamics + Biogeochemistry + Water quality + Aquatic Biota (occur in all relevant boxes)

Conceptual model of nutrient-driven hypoxia related to nutrient species and timing



Environments

Natural Factors

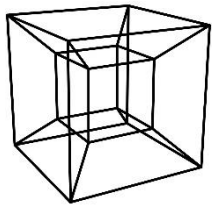
Management Levers

Management Endpoint

⊕ This symbol denotes a flux or effect that is reasonably well monitored specifically for nutrient species and timing

Blue Arrows represent a nutrient flux between environments. All fluxes are understood to have characteristics related to species and timing.

Climate change is an extra dimension



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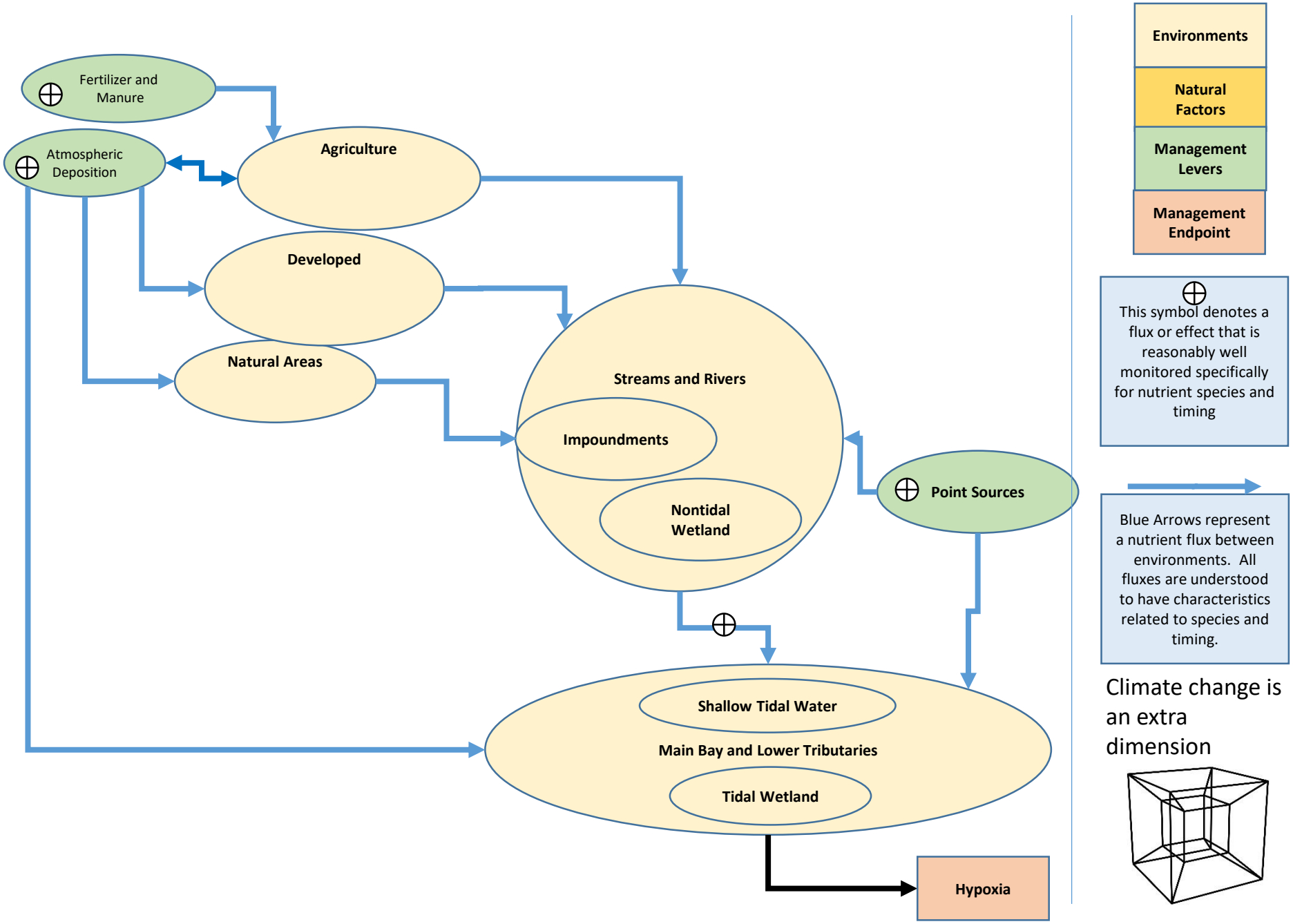

Recommendations - Land

- Evaluate BMPs for species and timing – data exist for some and need additional work
- Improve understanding of soil transport and speciation processes
- Create the necessary models to assess what actions could be effective
- Reassess soil fertility recommendations

Recommendations - Rivers

- Assess more endpoints
  - HABs, fisheries
  - Drinking water, freshwater fisheries, nuisance algae
- Create map / model / characteristic length over which input speciation matters
  - Synthesize research
  - Map physical stream system

Recommendations - Bay

- Consider multiple Endpoints
  - DO, clarity, chlorophyll, HABs, SAV, living resources
- Improve the Shallow water models
- Re-examine biogeochemistry in models
  - Consider the effect of nutrient ratios
- Start somewhere – WWTPs?