G1, G2, G3 Particulate Organics

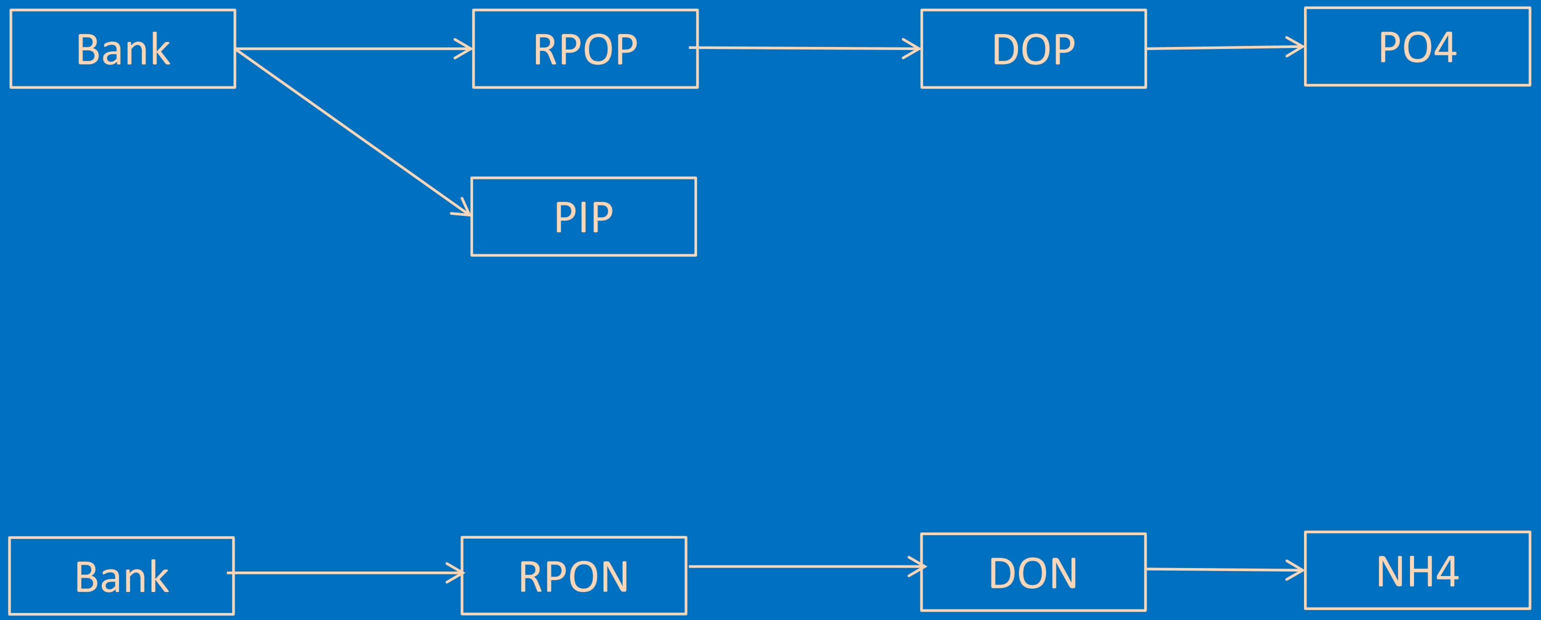
A developing theme in this phase of the study is the inclusion of nutrient sources other than conventional point and non-point sources:

- Reservoir Scour
- Shoreline Erosion
- Wetlands Loss

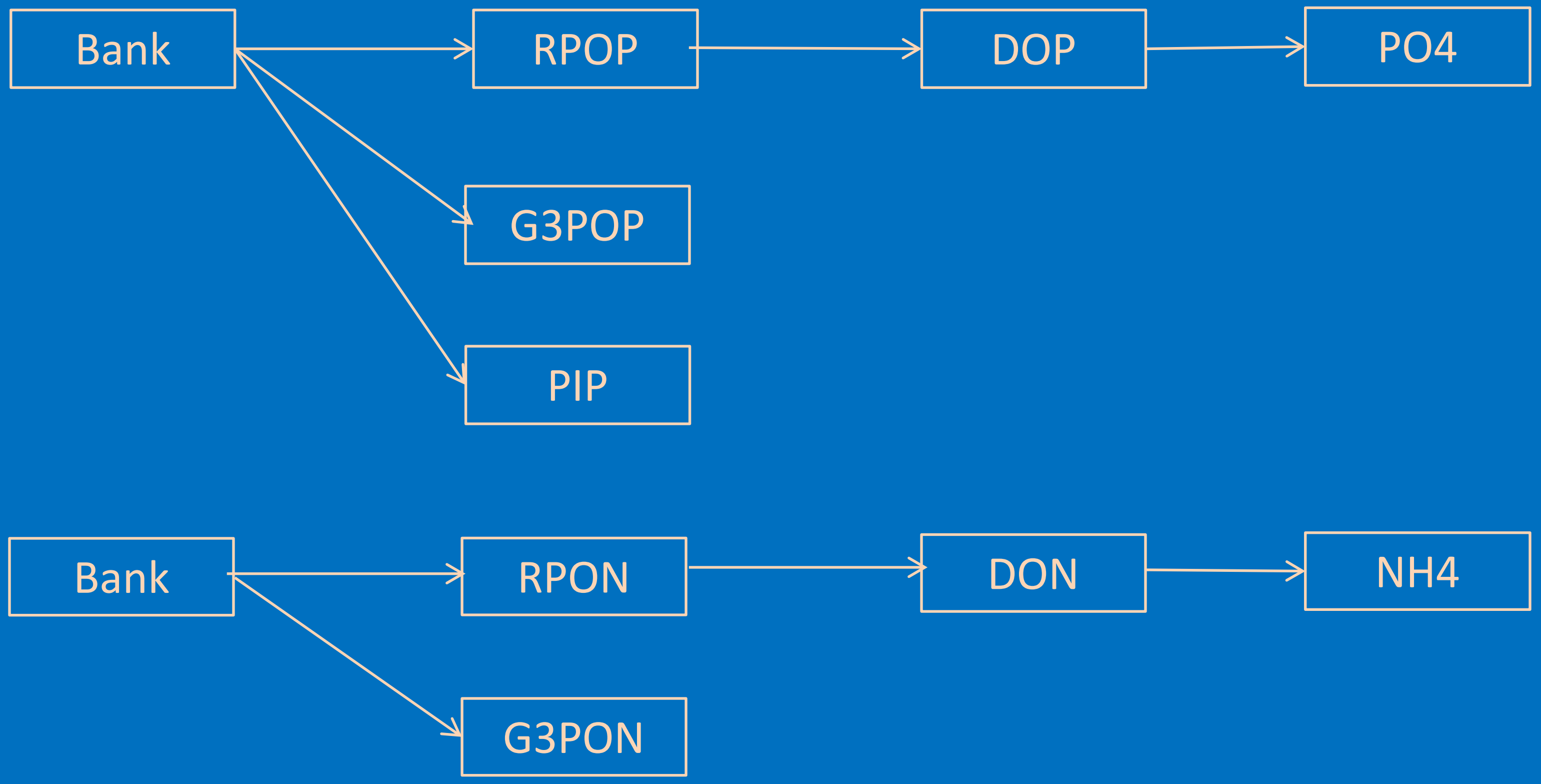
New Loads Necessitate Model Revisions

- Since 1988, we have had two classes of reactive material in the water column, labile and refractory, but three classes of reactive material in the sediments, G1, G2, G3.
- Refractory material was split into G2 and G3 when deposited in the sediments.
- We had the ability to vary the splits by location e.g. near a fall-line vs. open water.
- Now we need to specify composition of various sources e.g. shoreline loads vs. phytoplankton.

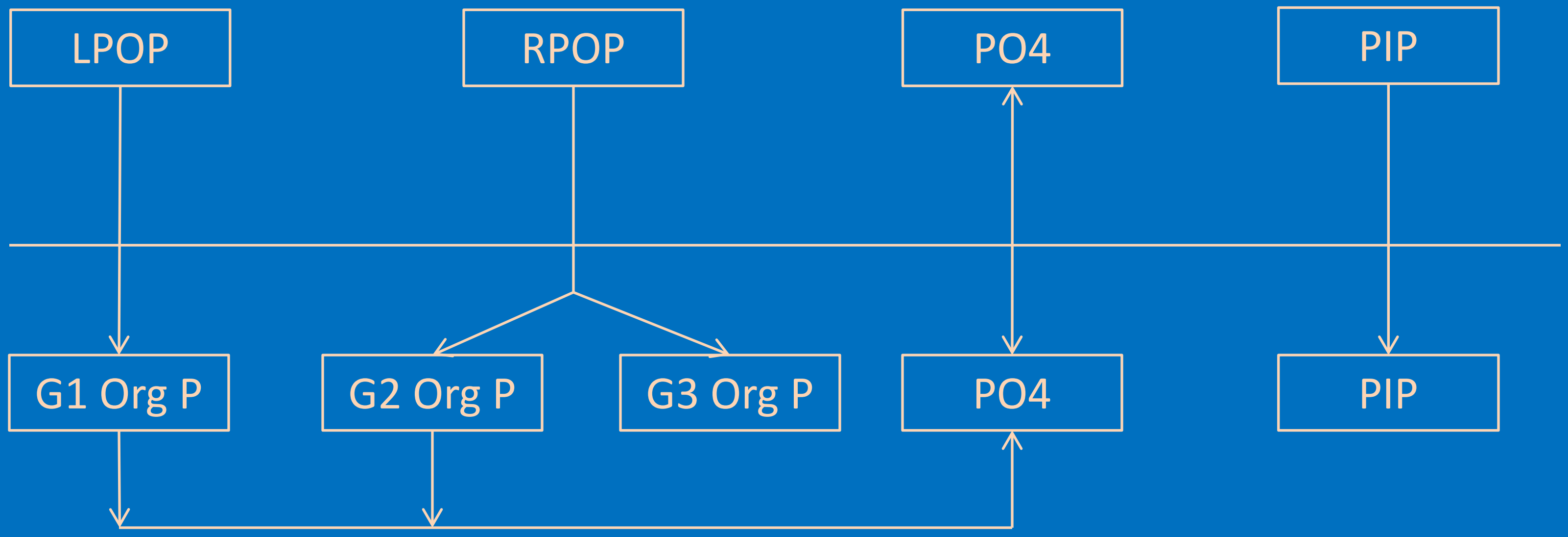
Initial Routing of Bank Nutrient Loads to Water Column



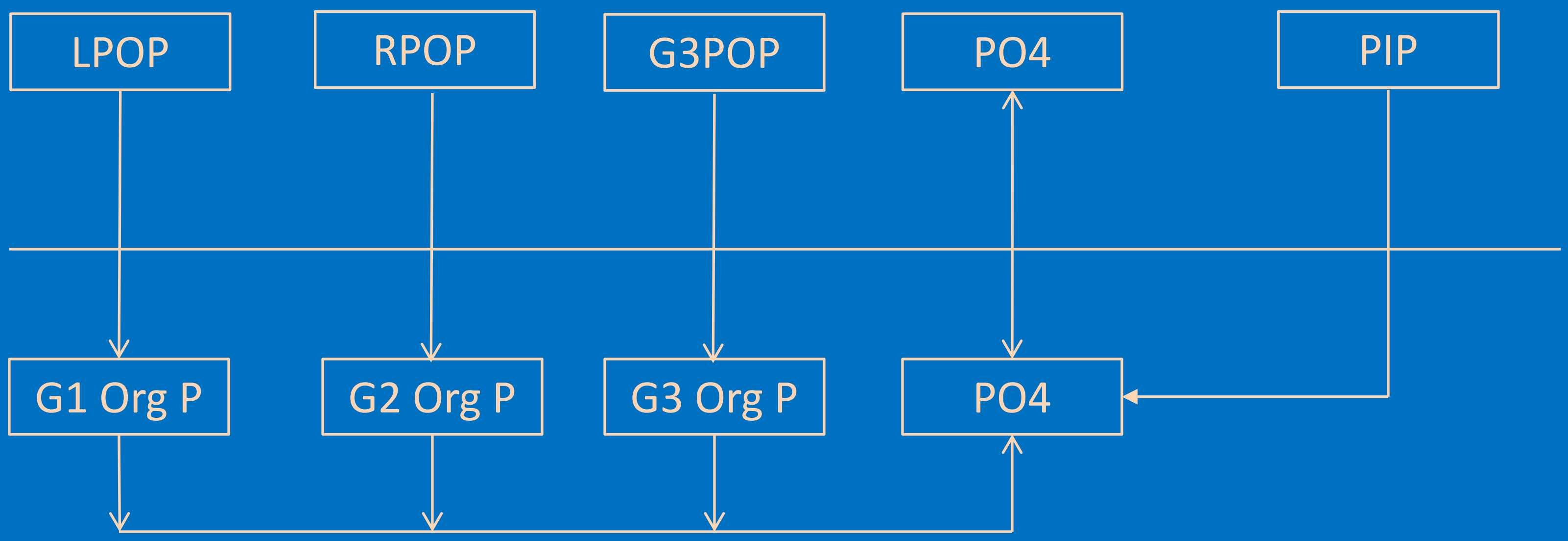
Revised Routing of Bank Nutrient Loads to Water Column



Former Routing of Water Column P to Sediments



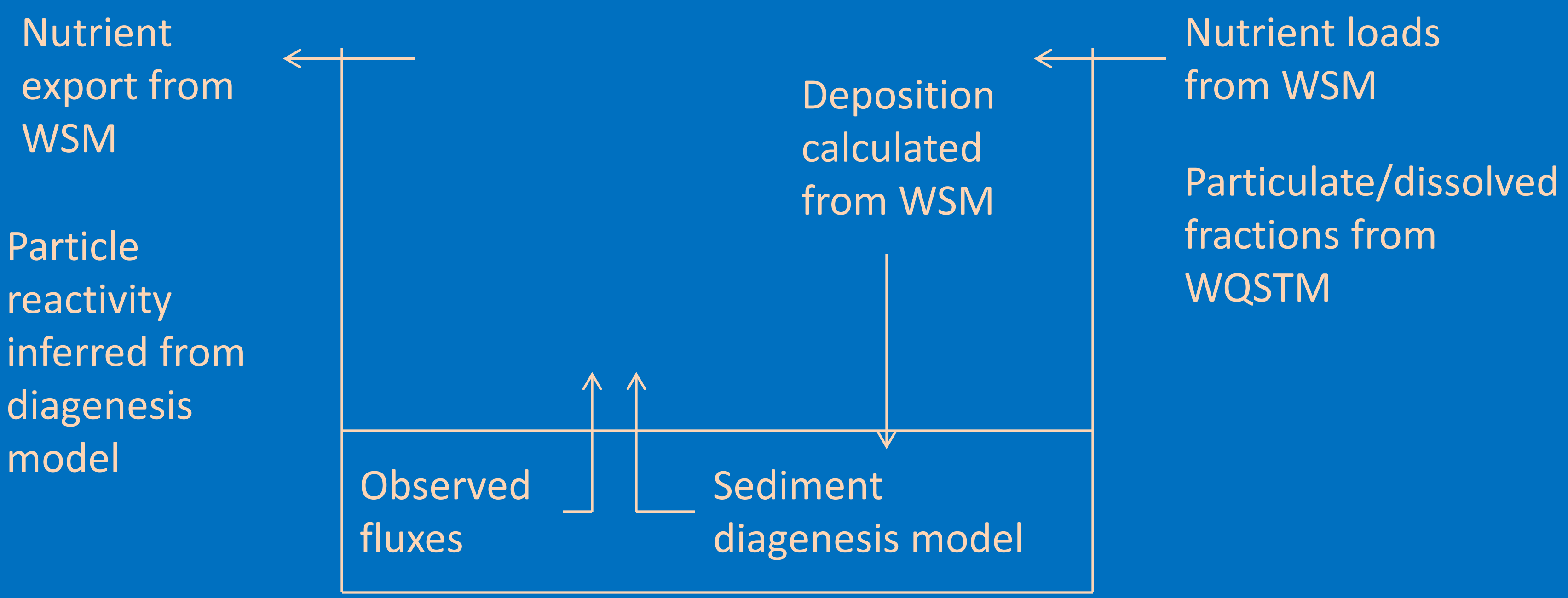
Revised Routing of Water Column P to Sediments



Bottom Scour Conowingo Reservoir

- The Tropical Storm Lee sediment plume caused concern, controversy for Chesapeake Bay.
- The Lower Susquehanna River Watershed Assessment indicated a reservoir scour event is not an environmental catastrophe.
- The LSRWA raised multiple issues regarding the nature of Conowingo infill, quantification of bottom scour, and reactivity of scoured material.

Conowingo Particulate Reactivity



Reactivity of Watershed Loads

Splits of particulate nutrients into reactive classes were obtained from an ongoing study of the Conowingo Reservoir (Qian Zhang, personal communication). For the Susquehanna River, the reactive splits are influenced by flow above 6,500 $m^3\ s^{-1}$. The relationships used to determine the reactive classes are of the form:

$$Fg1 = FLPON - \propto 1 \cdot (Q - 6500) \quad (1)$$
$$Fg2 = FRPON - \propto 2 \cdot (Q - 6500) \quad (2)$$
$$Fg3 - 1 - Fg1 - Fg2 \quad (3)$$

in which:

Fg1 = labile fraction of particulate organic nitrogen ($0 < Fg1 < 1$)
Fg2 = refractory fraction of particulate organic nitrogen ($0 < Fg2 < 1$)
Fg3 = G3 fraction of particulate organic nitrogen ($0 < Fg3 < 1$)
α1 = Effect of flow > 6,500 $m^3\ s^{-1}$ on Fg1 ($s\ m^{-3}$)
α2 = Effect of flow > 6,500 $m^3\ s^{-1}$ on Fg2 ($s\ m^{-3}$)
Q = Flow at Conowingo outfall ($m^3\ s^{-1}$)

Reactivity of Watershed Loads

Calculation of Reactive Fractions of Watershed Particles			
Parameter	Nitrogen	Phosphorus	Carbon
Fraction Labile	0.15	0.3	0.15
Fraction Refractory	0.45	0.4	0.35
α1	7.49×10^{-6}	1.091×10^{-5}	7.64×10^{-6}
α2	1.638×10^{-5}	9.49×10^{-6}	1.33×10^{-5}

The values of FLPON and FRPON determined for the Susquehanna are transferred to the other river inputs without flow effects.

Shoreline Erosion Loads

- Shoreline erosion solids loads have been in the model since circa 2000.
- For the TMDL an expert panel was convened to derive state-of-the-art estimates.
- Nutrient loads associated with the solids were not incorporated into the 2010 TMDL.
- Our immediate concern is to incorporate shoreline nutrient loads into the TMDL as per request from WQGIT.

Shoreline Erosion Loads

- The nutrient content of the solids is specified by the WQGIT: 0.29 mg N/g solids, 0.205 mg P/g solids.
- Assign 14% of shoreline phosphorus to PIP based on Ibison's data.
- We initially split the nutrients to maintain system-wide loading of available nutrients. We have adjusted these splits slightly since for calibration purposes.
- The remaining particulate phosphorus and all particulate nitrogen is split as follows: 20% refractory, 80% G3

Loads from Wetlands Erosion

Thus, we propose a program that:

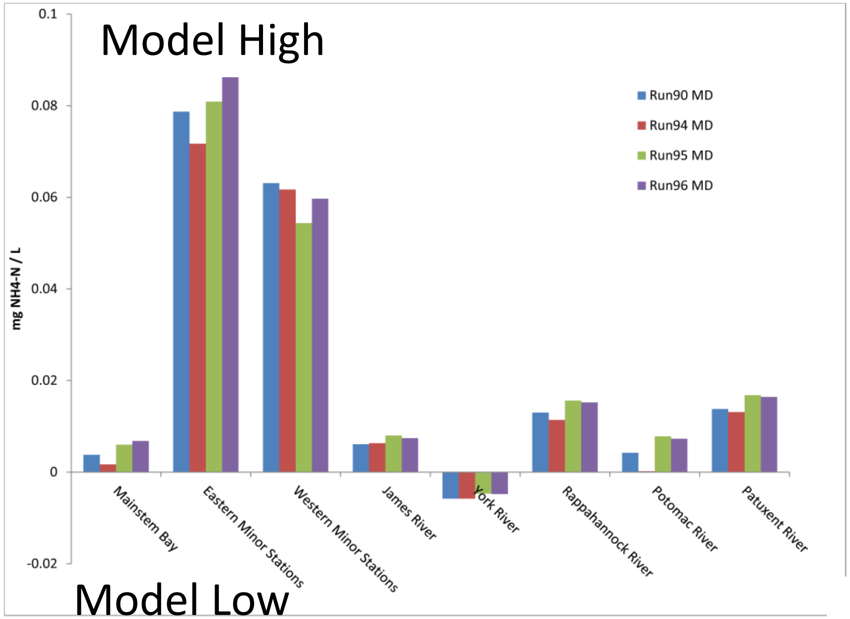
- Characterizes the lability of eroding wetland materials from tidal freshwater, oligohaline and brackish marsh environments.
- Uses direct measures of decomposition for both aerobic and anaerobic estuarine settings.
- Considers the release of inorganic P under different depositional scenarios.
- Ensures reasonable geographic distribution of wetlands, including eastern and western shore environments.

- We are working franticly to complete a field and laboratory program to characterize loads (nutrient loads, reactivity) from wetlands erosion.
- We hope to get results in time to incorporate into this study phase.
- At present, we do not consider nutrient loads from wetlands erosion.
- Some Chesapeake Bay tidal wetlands are rapidly eroding e.g. Blackwater Wildlife Refuge. Other areas may be accreting, at present.
- It's uncertain how sensitive the model results might be to inclusion of wetlands erosion loads (mass and reactivity).

Conowingo Particulate Reactivity

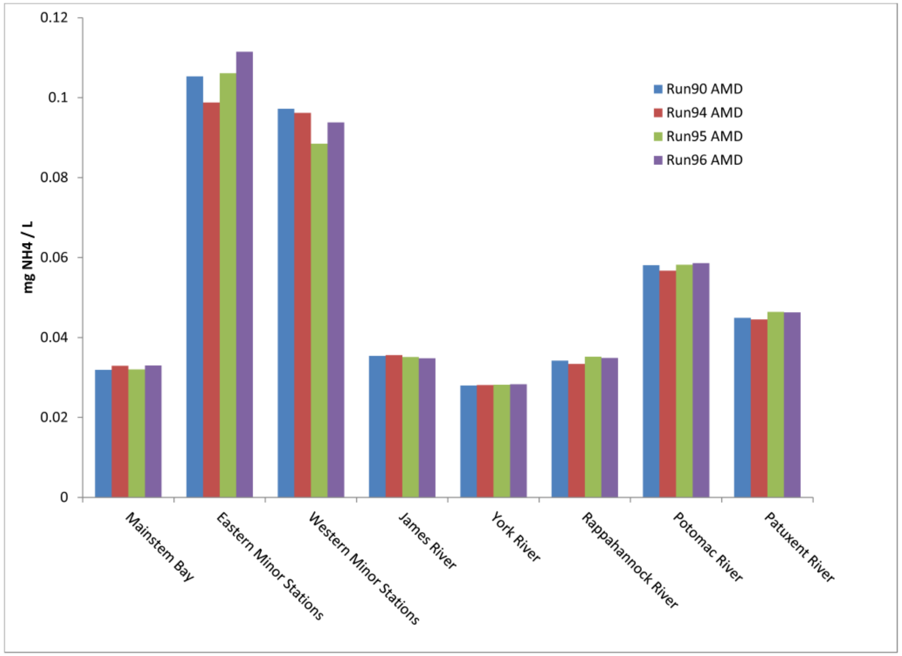
Sensitivity Runs

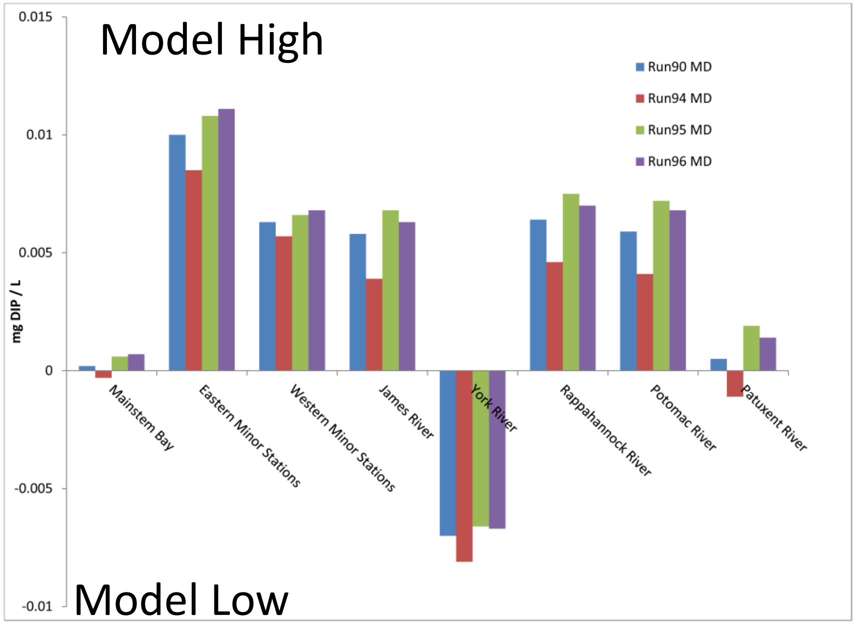
- Run94 – Reduce G1 diagenesis rate in sediment model from 0.03 to 0.01/d (as per Testa et al.).
- Run95 – Convert 30% of refractory (G2) material at fall lines to labile (G1). From 0% G1, 76% G2, 24% G3 to 23% G1, 53% G2, 24% G3. No added reactive nutrients.
- Run96 – Convert 30% of inert (G3) material at fall lines to refractory (G2). From 76% G2, 24% G3 to 83% G2, 17% G3. Additional reactive nutrients



NH4 Mean Difference

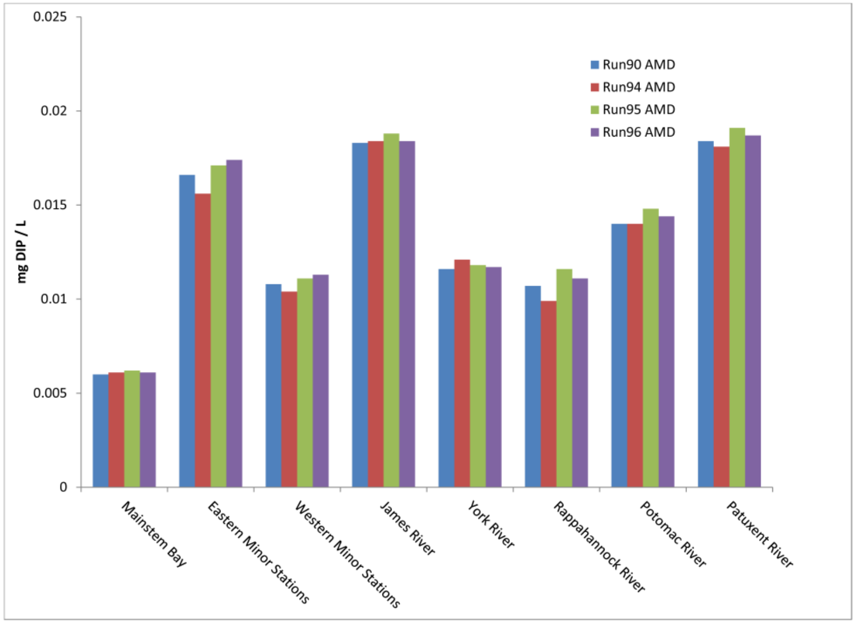
Absolute Mean Difference

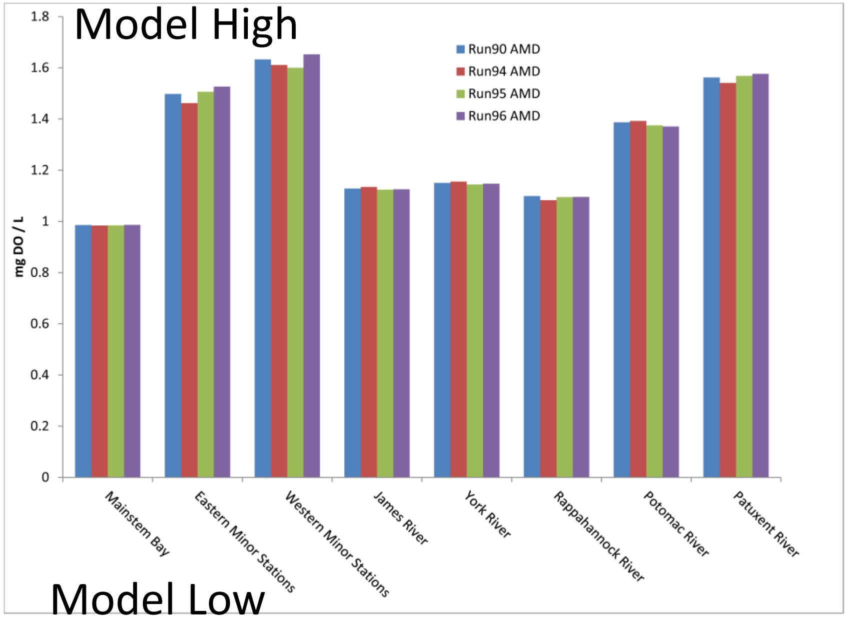




DIP Mean Difference

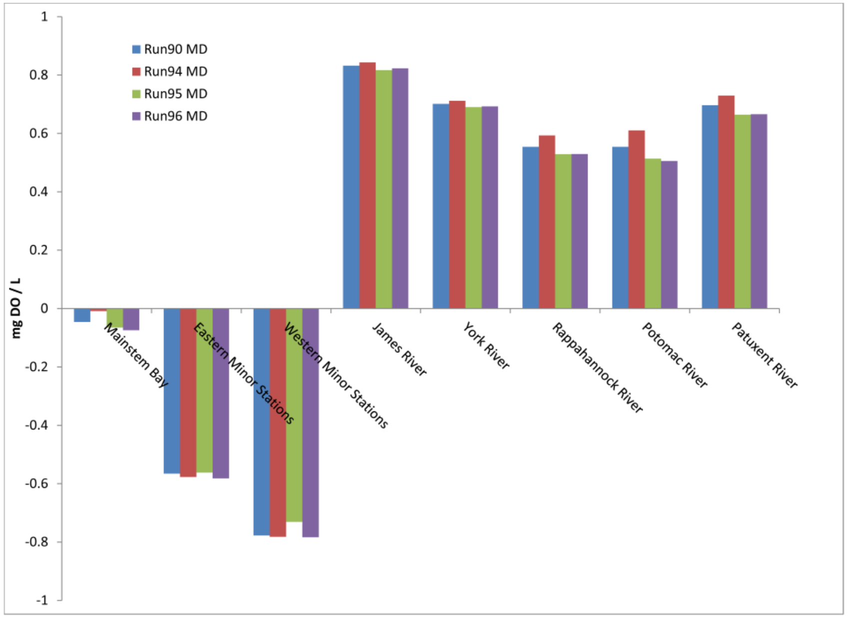
Absolute Mean Difference

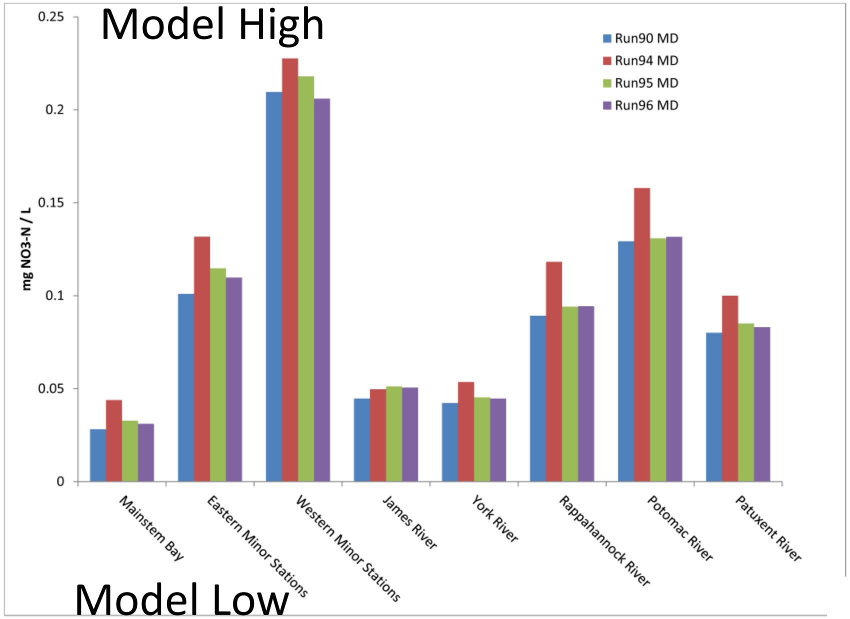




DO Mean Difference

Absolute Mean Difference





NO3 Mean Difference

Absolute Mean Difference