Stream Restoration and Sediment Delivery Update

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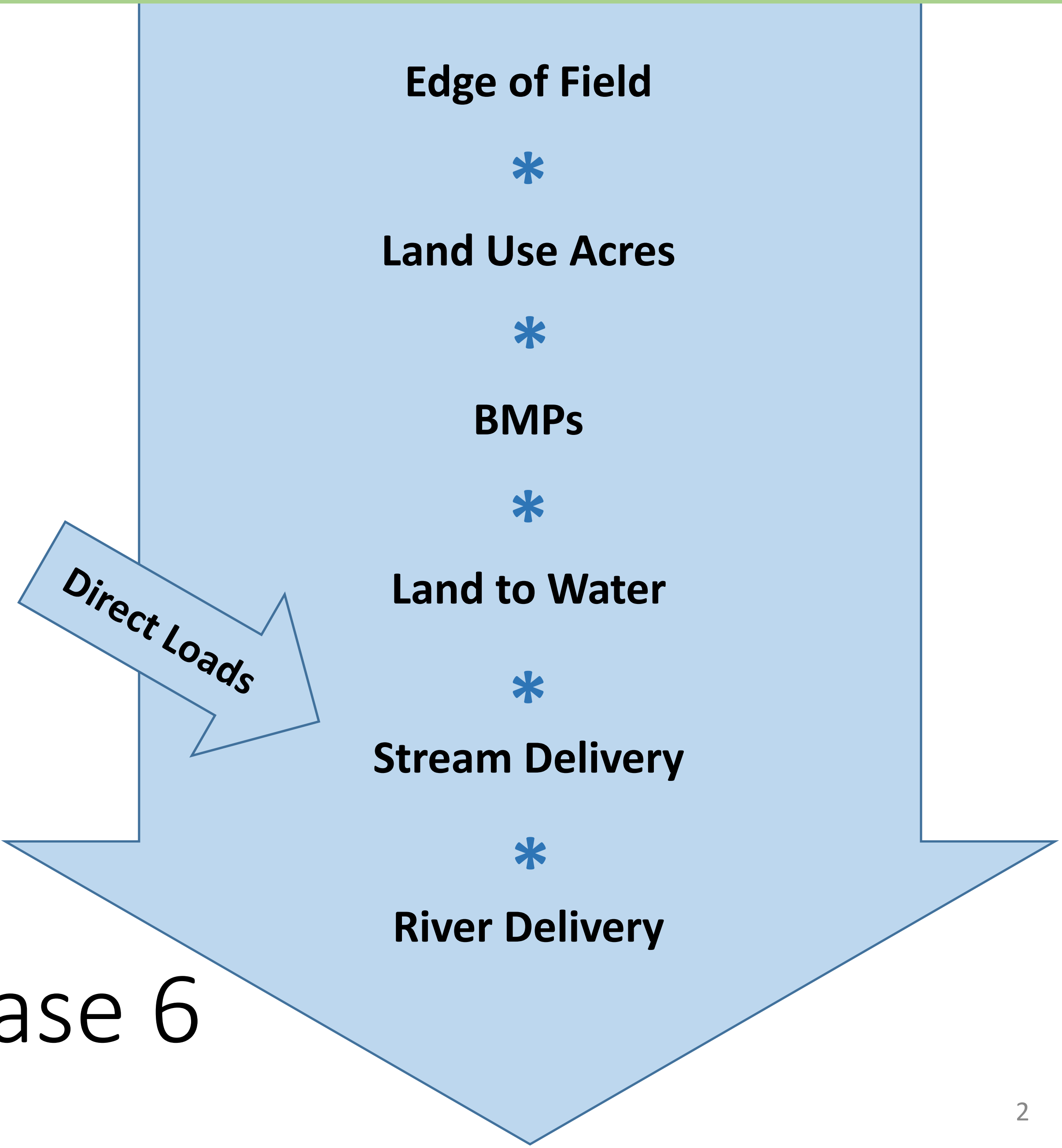
Urban Stormwater Workgroup
2/20/18

Steady State Phase 6 Model Structure

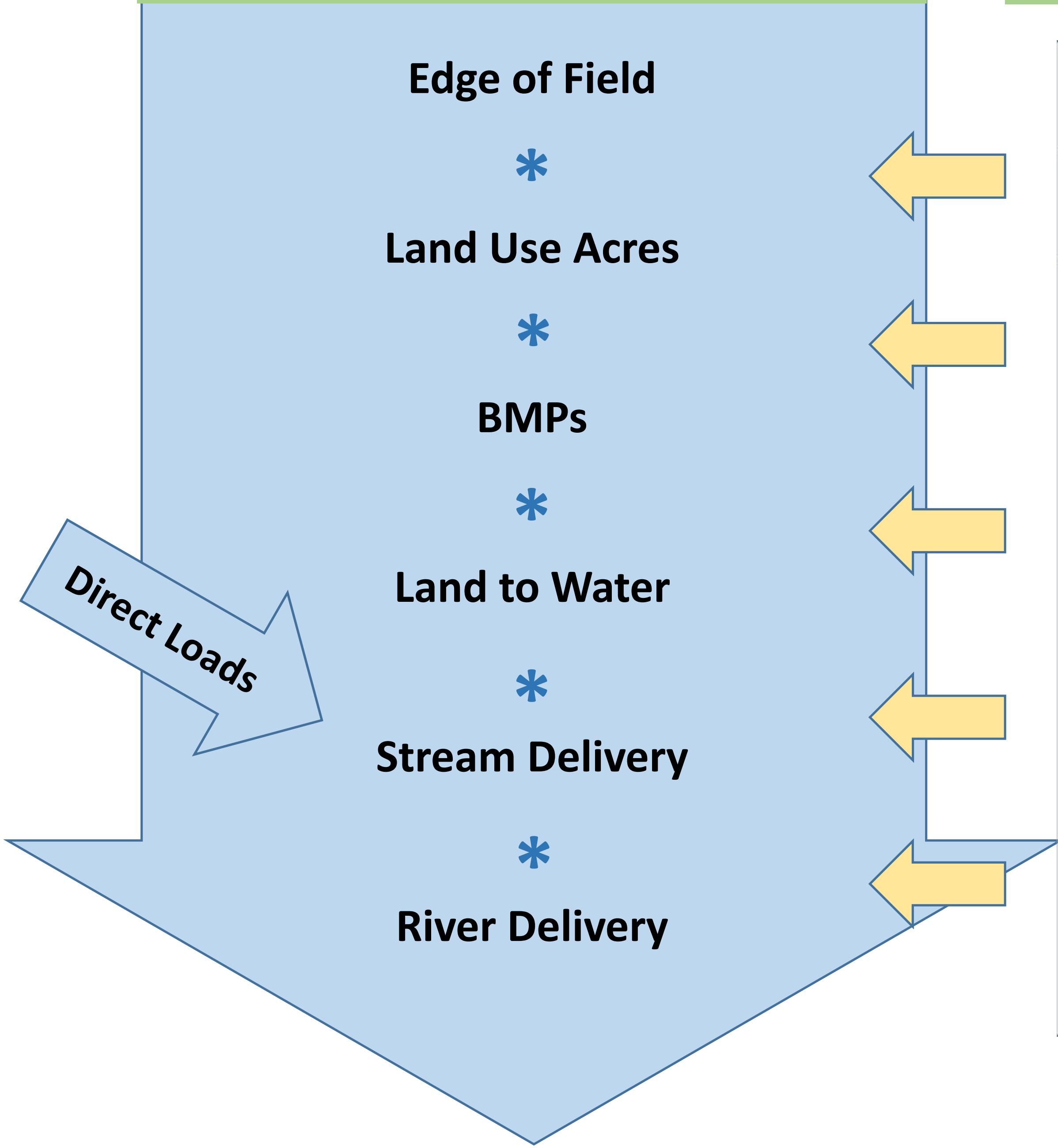




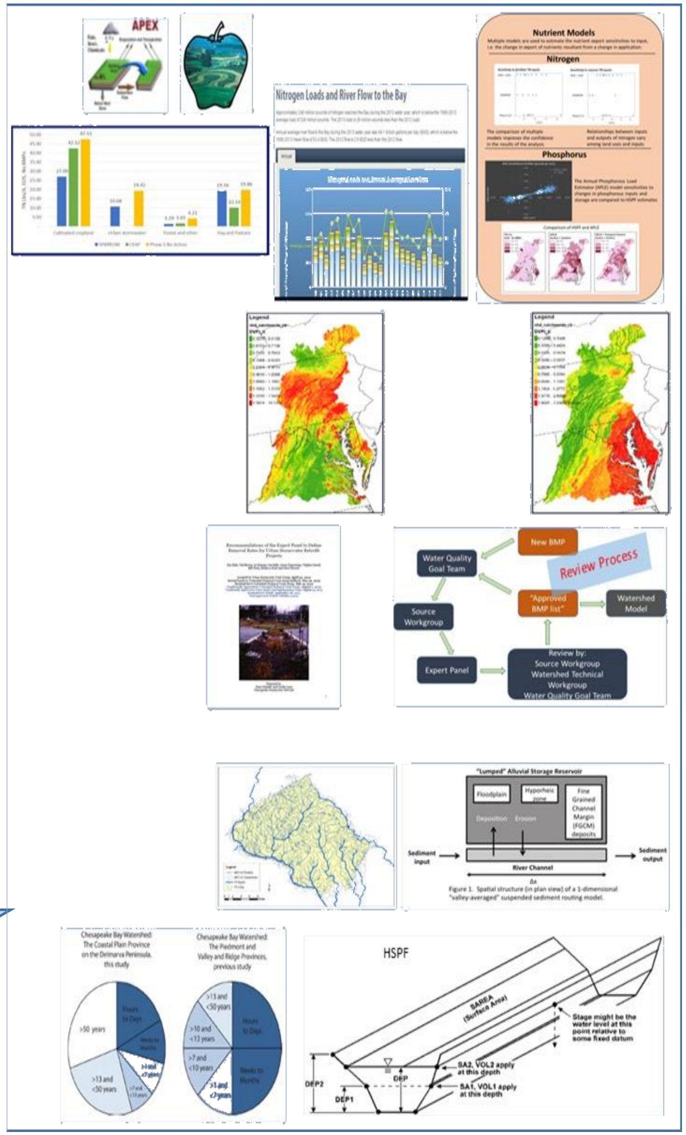


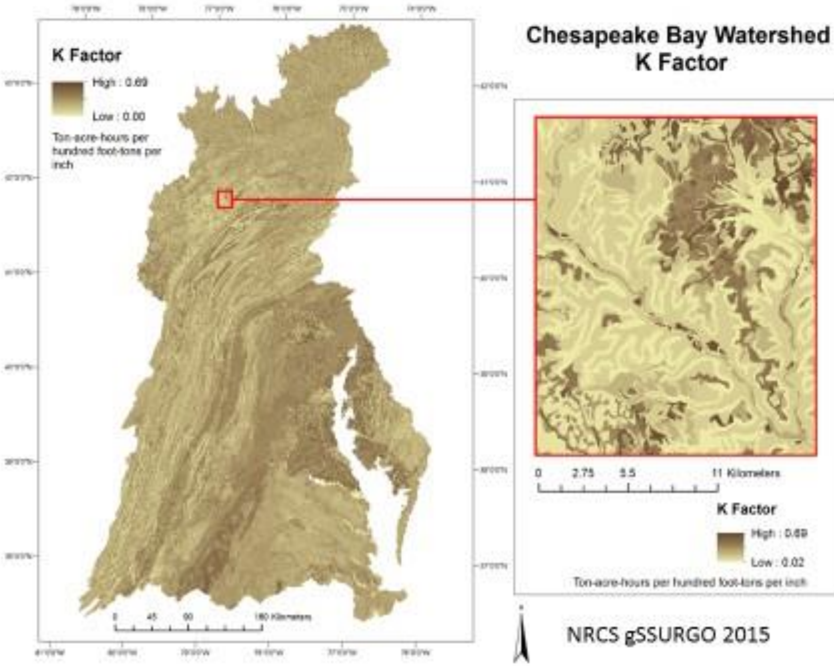
Phase 6

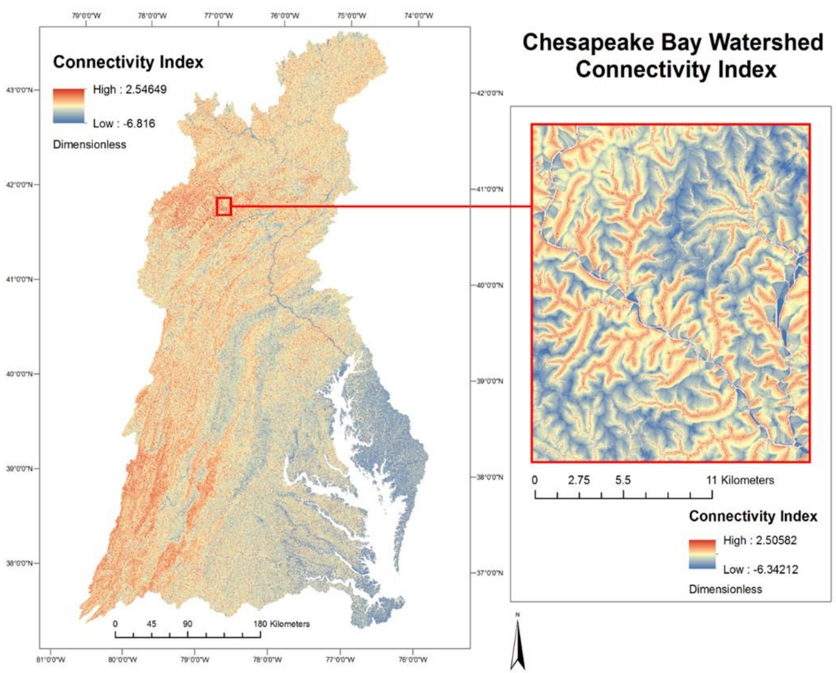
Keep It Simple

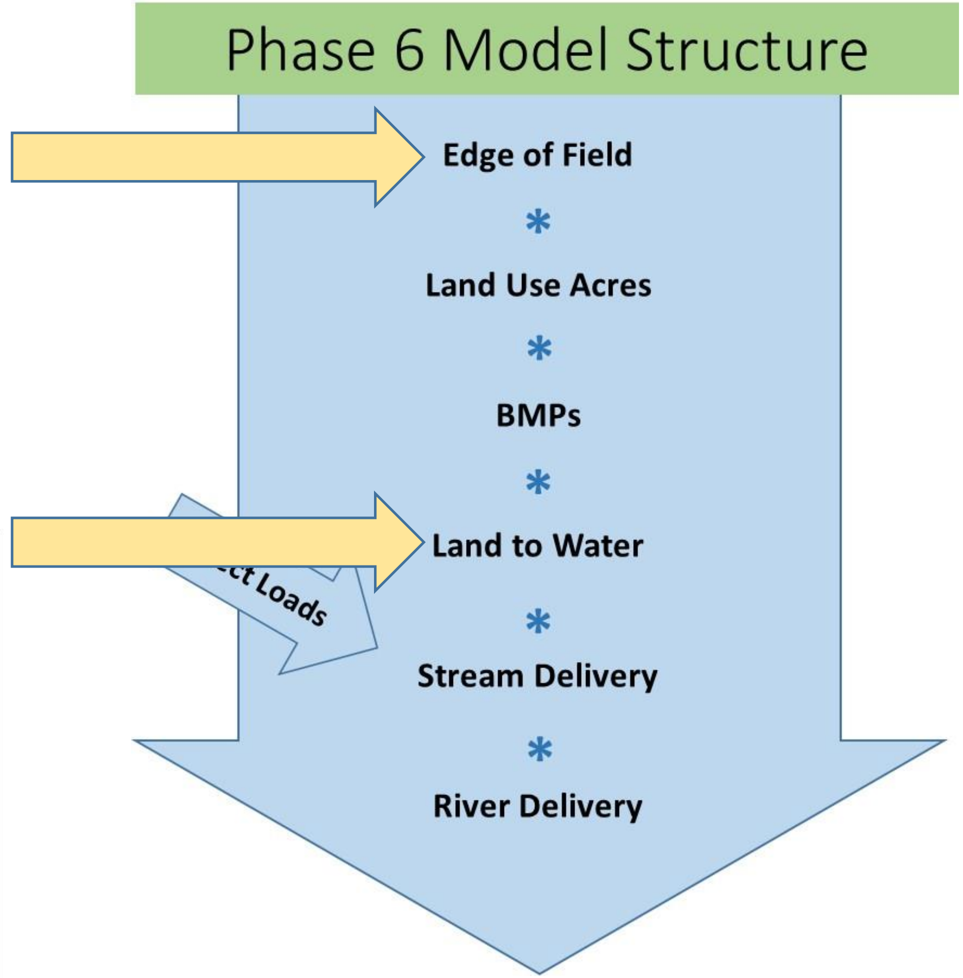


Include Everything

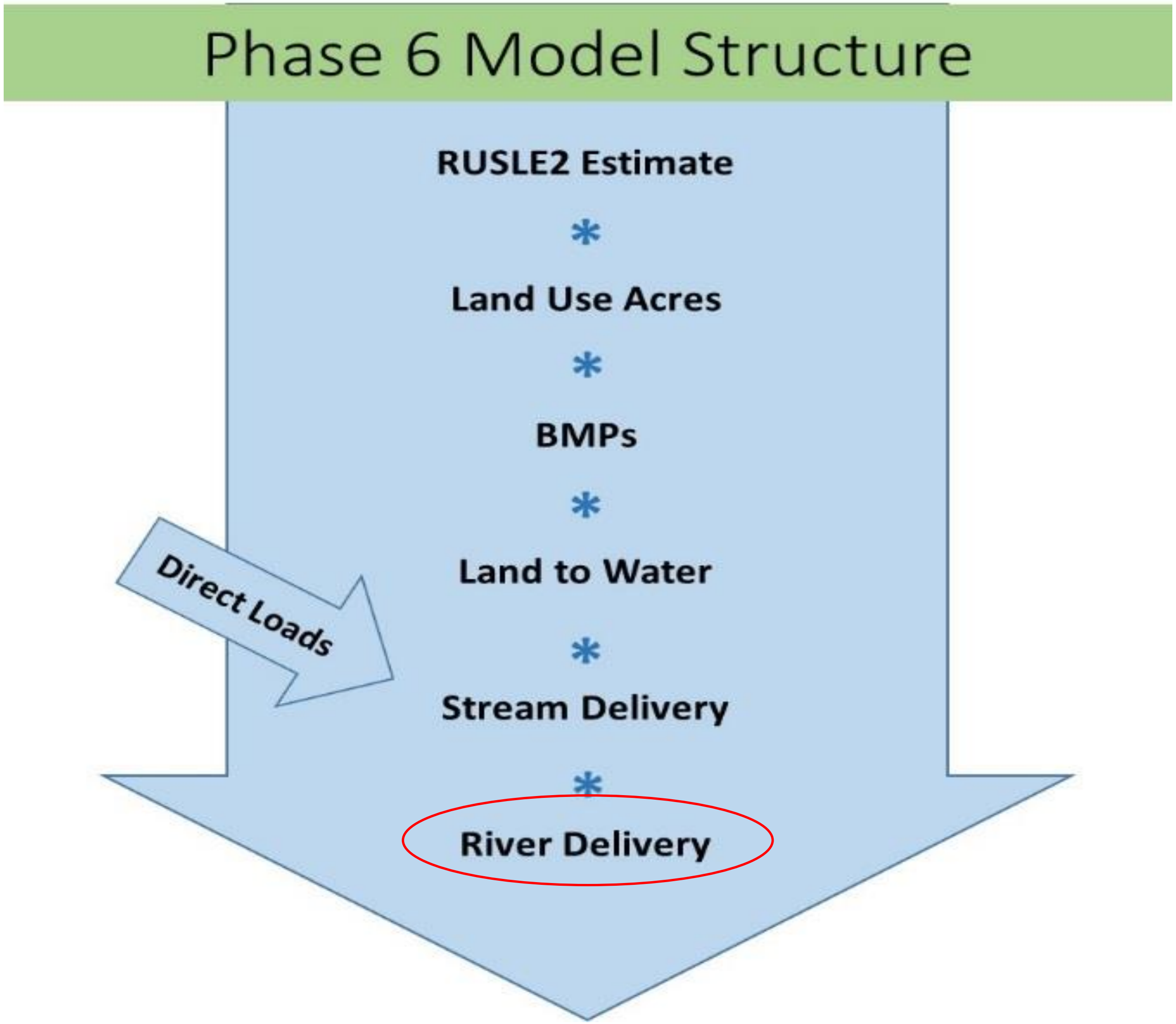



Chesapeake Bay Watershed
K Factor
K Factor
High : 0.69
Low : 0.00
Ton-acre-hours per hundred foot-tons per inch
0 2.75 5.5 11 Kilometers
K Factor
High : 0.69
Low : 0.02
Ton-acre-hours per hundred foot-tons per inch
NRCS gSSURGO 2015

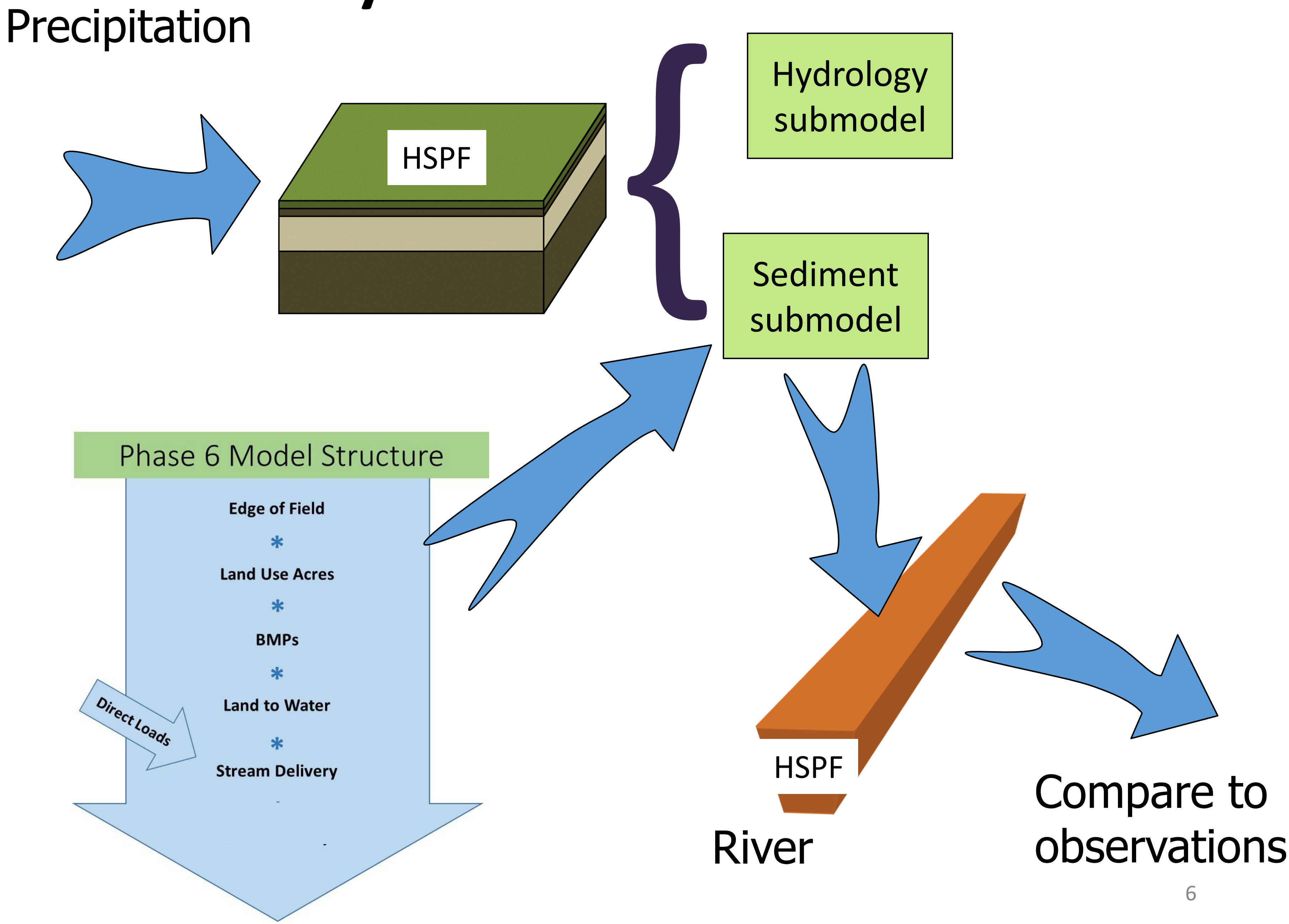

Chesapeake Bay Watershed
Connectivity Index
Connectivity Index
High : 2.54649
Low : -6.816
Dimensionless
0 45 90 180 Kilometers
0 2.75 5.5 11 Kilometers
Connectivity Index
High : 2.50582
Low : -6.34212
Dimensionless


Phase 6 Model Structure
Edge of Field
*
Land Use Acres
*
BMPs
*
Land to Water
*
Stream Delivery
*
River Delivery

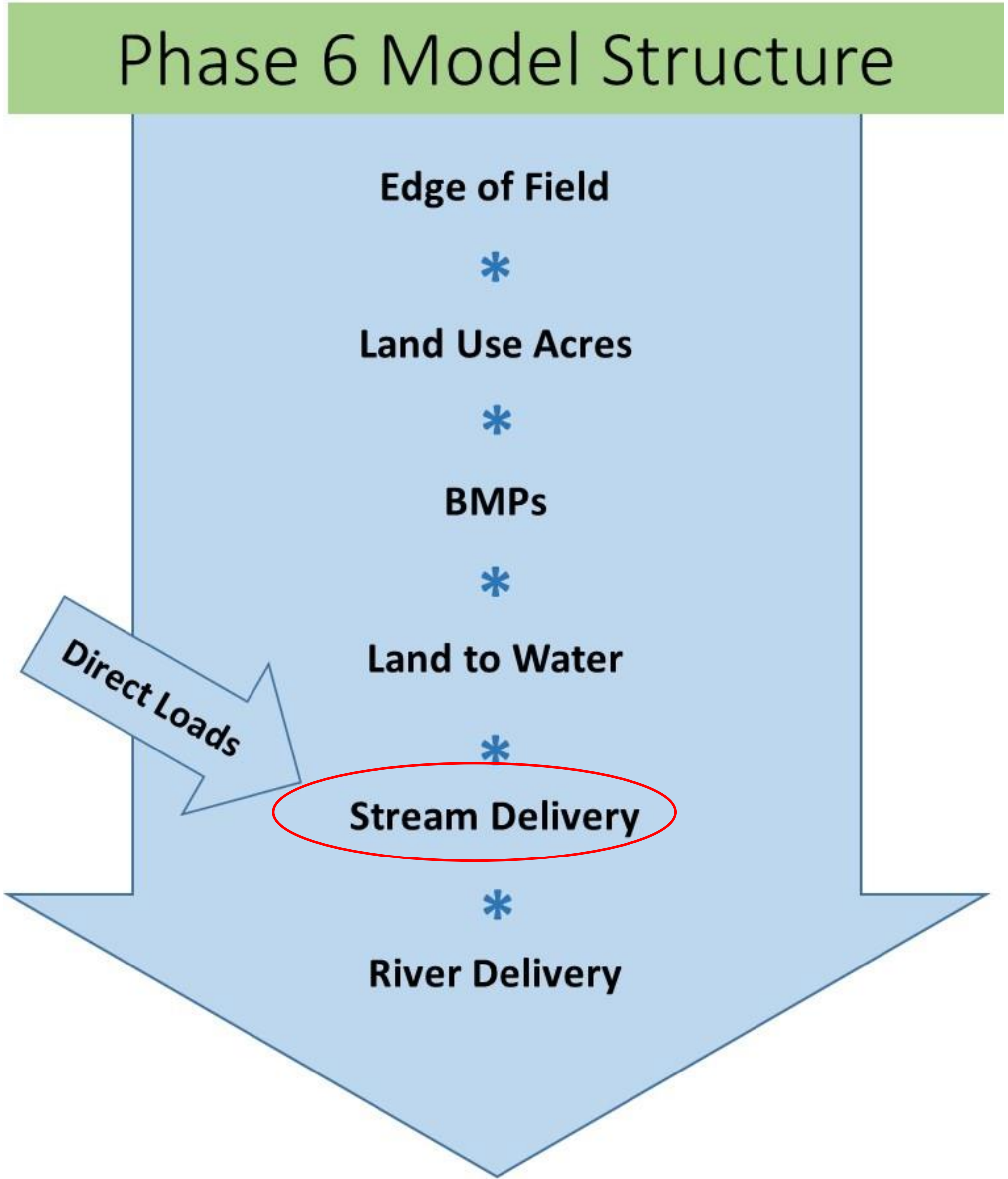
Sediment Delivery Ratio



River Delivery Calibrated in the HSPF model

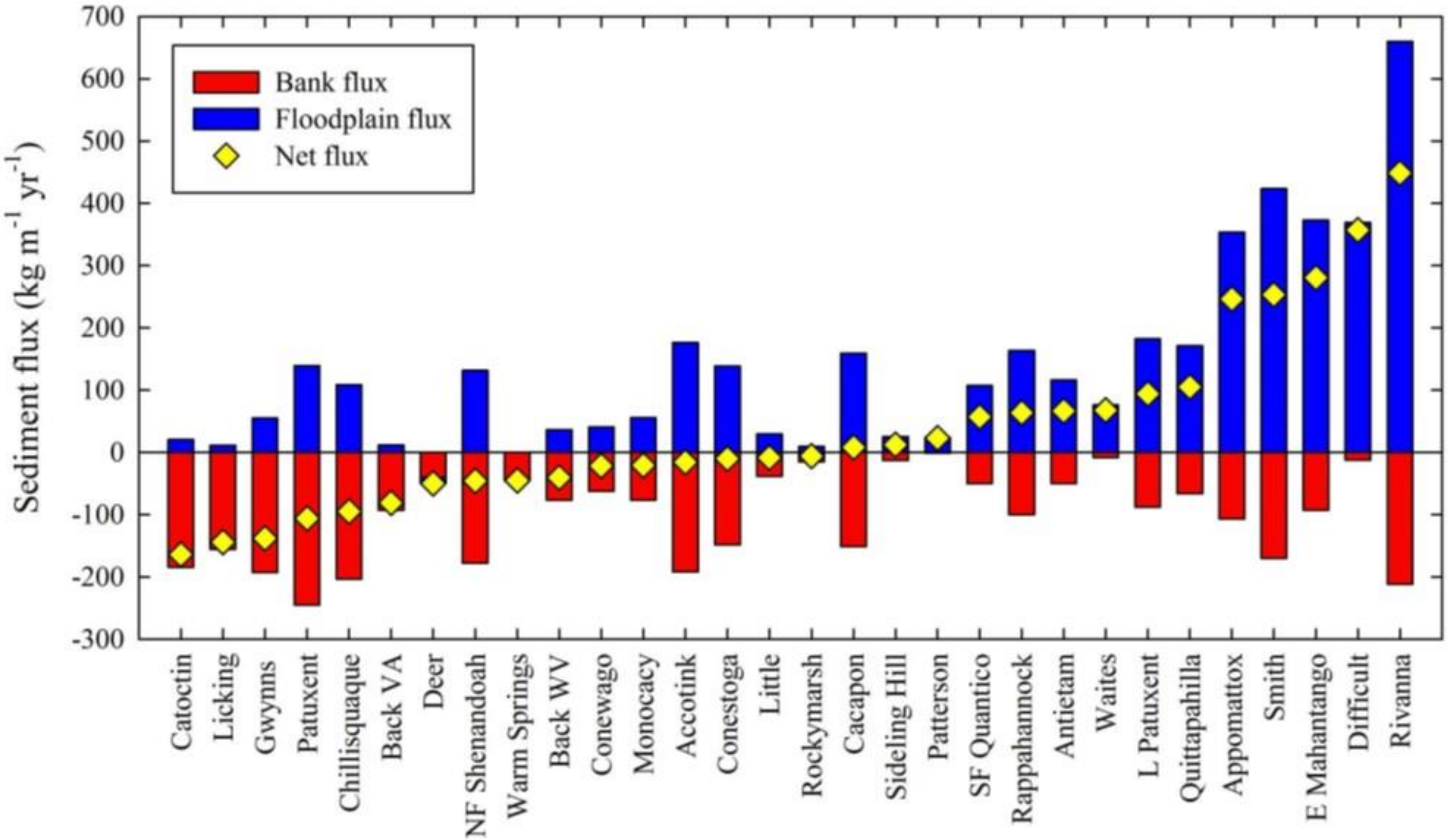


Stream Sediment Effects



Chesapeake Floodplain Network

Greg Noe and others



- No net change

Stream Delivery – Developed

- Center for Watershed Protection Work

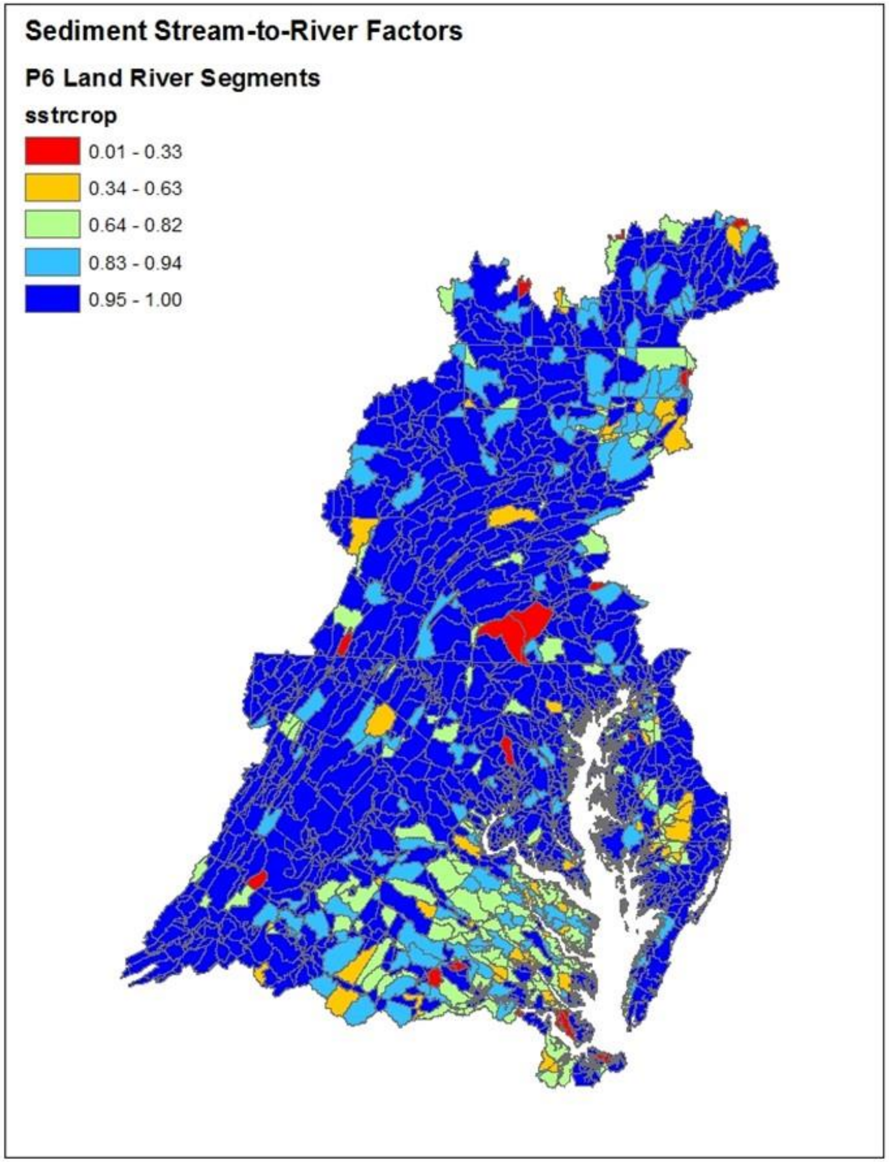
$$\text{Stream Source Ratio} = \frac{\text{Stream Load}}{\text{Total Watershed Load}}$$

$$\text{SSR} = 1.4085 * (\text{fraction Impervious}) + 0.5341 * (\text{fraction CD soils}) - 0.2828$$

Averages about 0.5 for developed areas

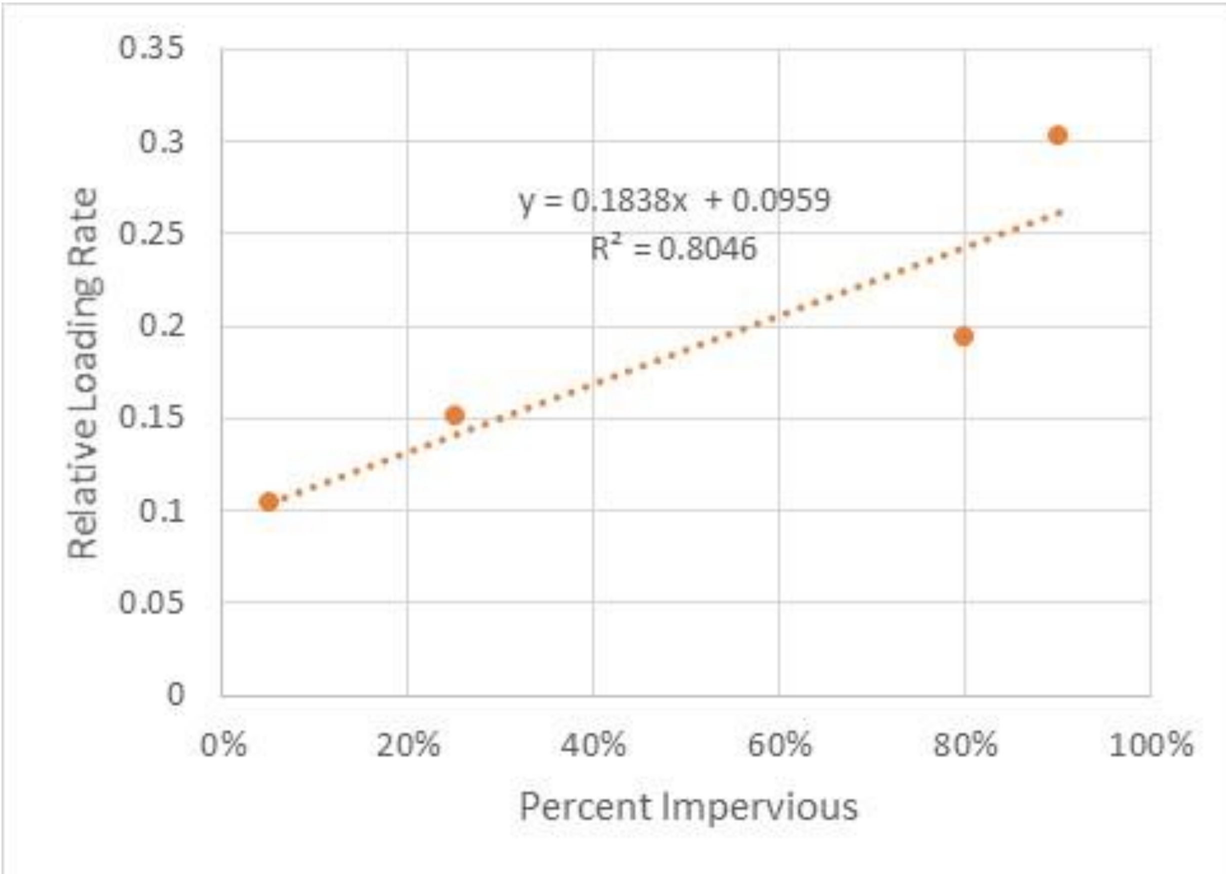
Sediment Sparrow

- Rivers are not a significant sediment sink except
    - Coastal Plain rivers larger than 120 cfs
    - Reservoirs



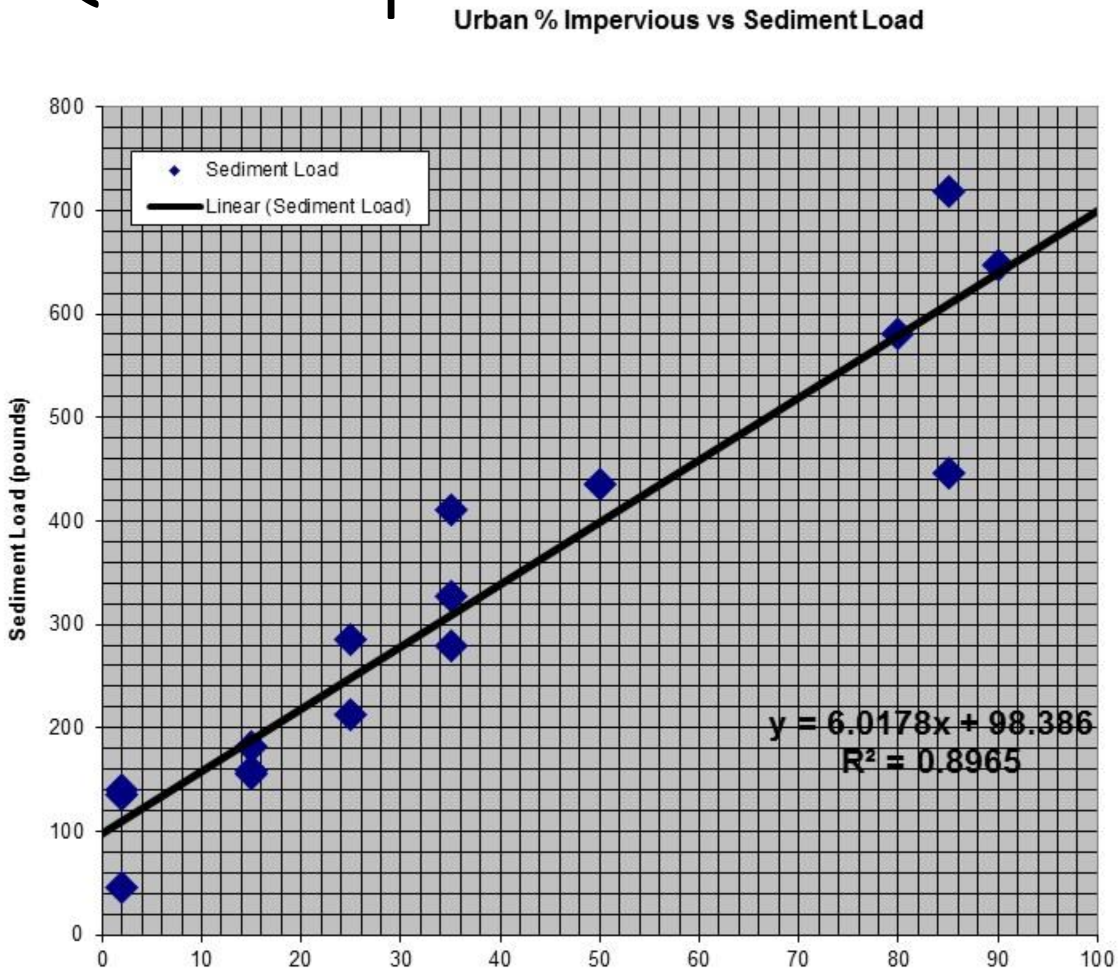
Brakebill, Ator, and Schwarz, 2010

NSQD - Impervious Load



- Impervious is 3x the sediment load **according to *outfall* data** in the NSQD

NSQD - Impervious Load

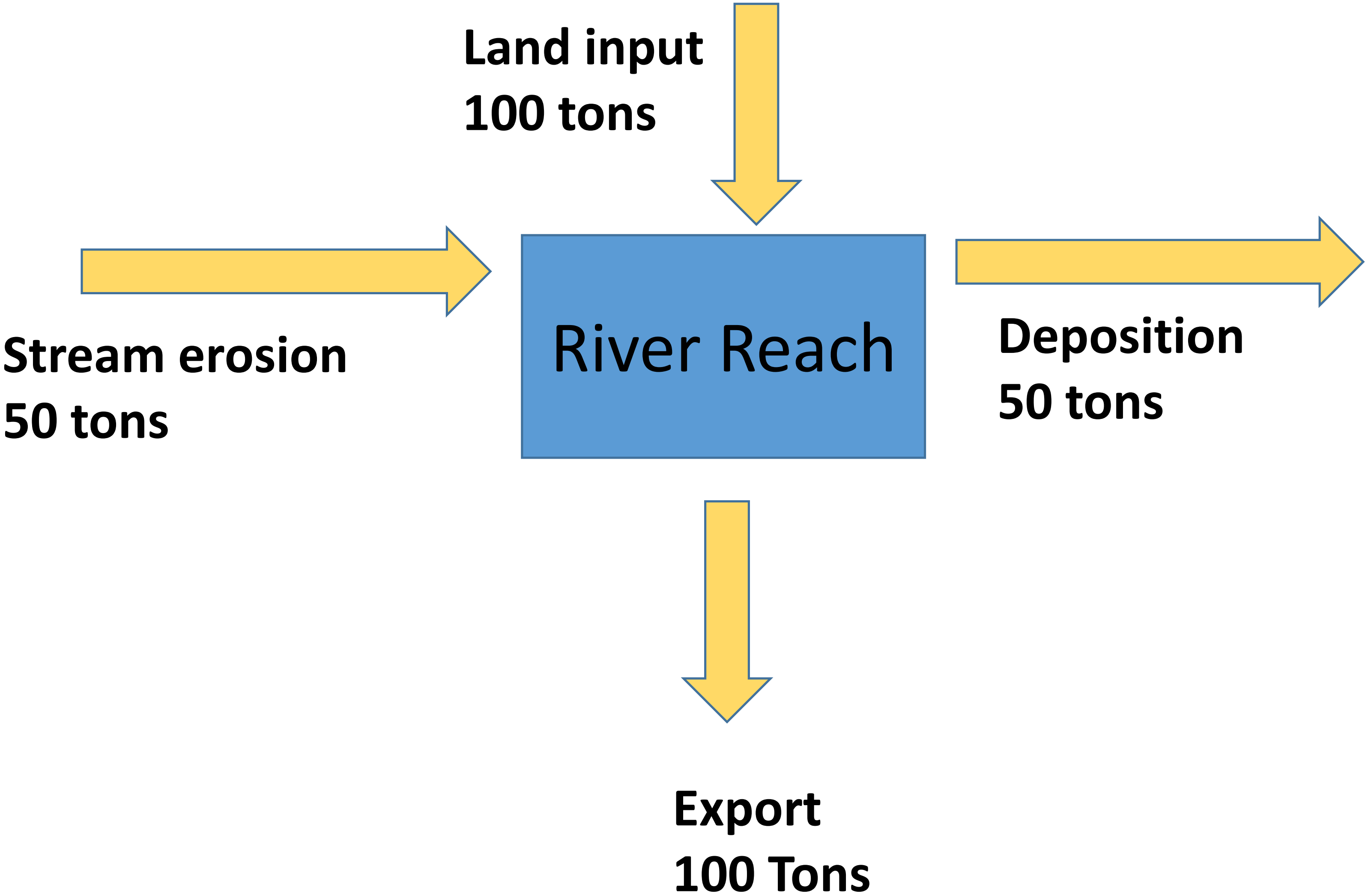


- Impervious is 7x the sediment load **according to *stream* data** in the NSQD

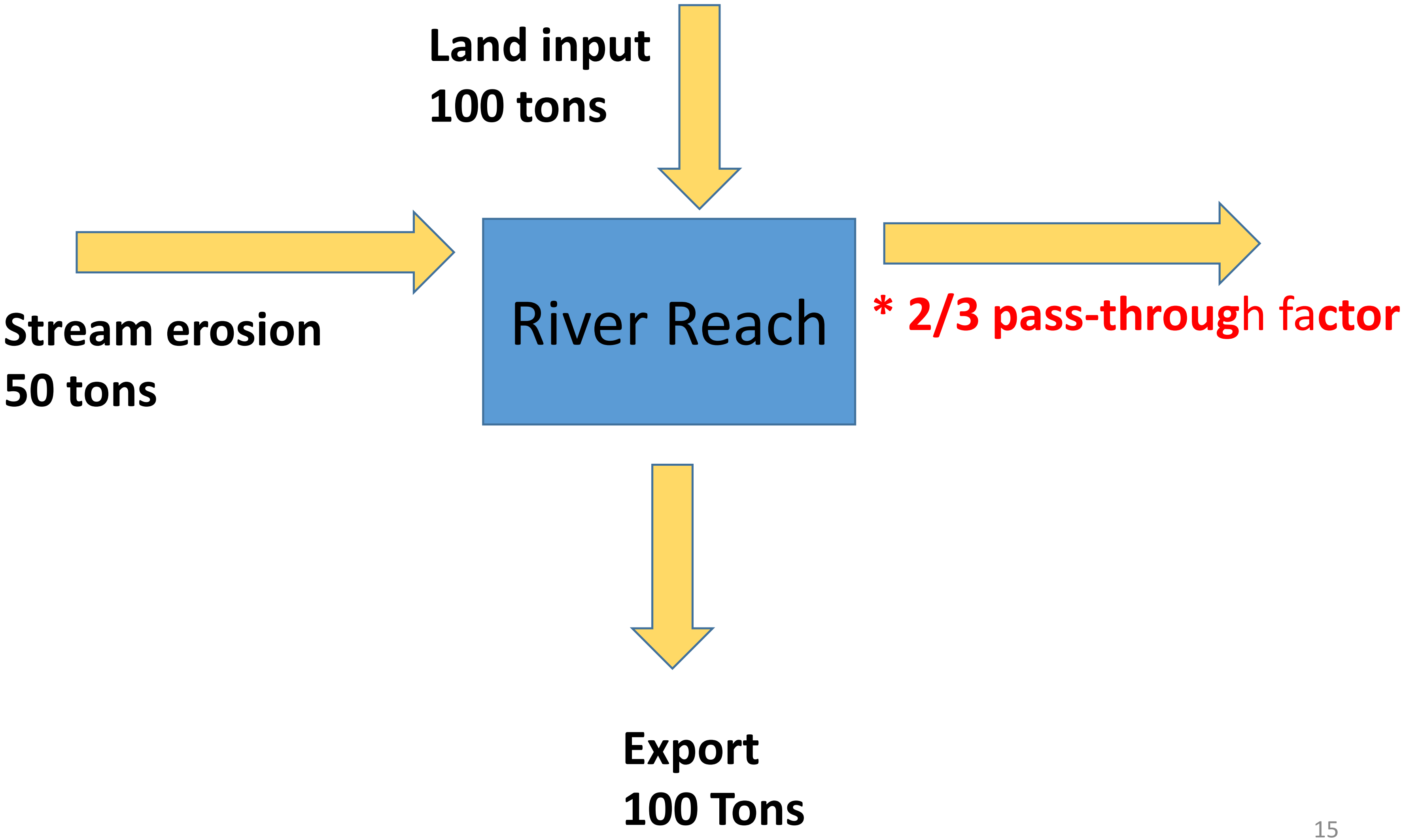
Summary of stream science

- Stream erosion is a significant source everywhere
- Erosion is balanced by floodplain deposition in non-developed areas
    - That doesn’t mean that all of the eroded sediment is deposited!
- Stream erosion is a function of imperviousness in developed areas
- Reservoirs have a deposition effect

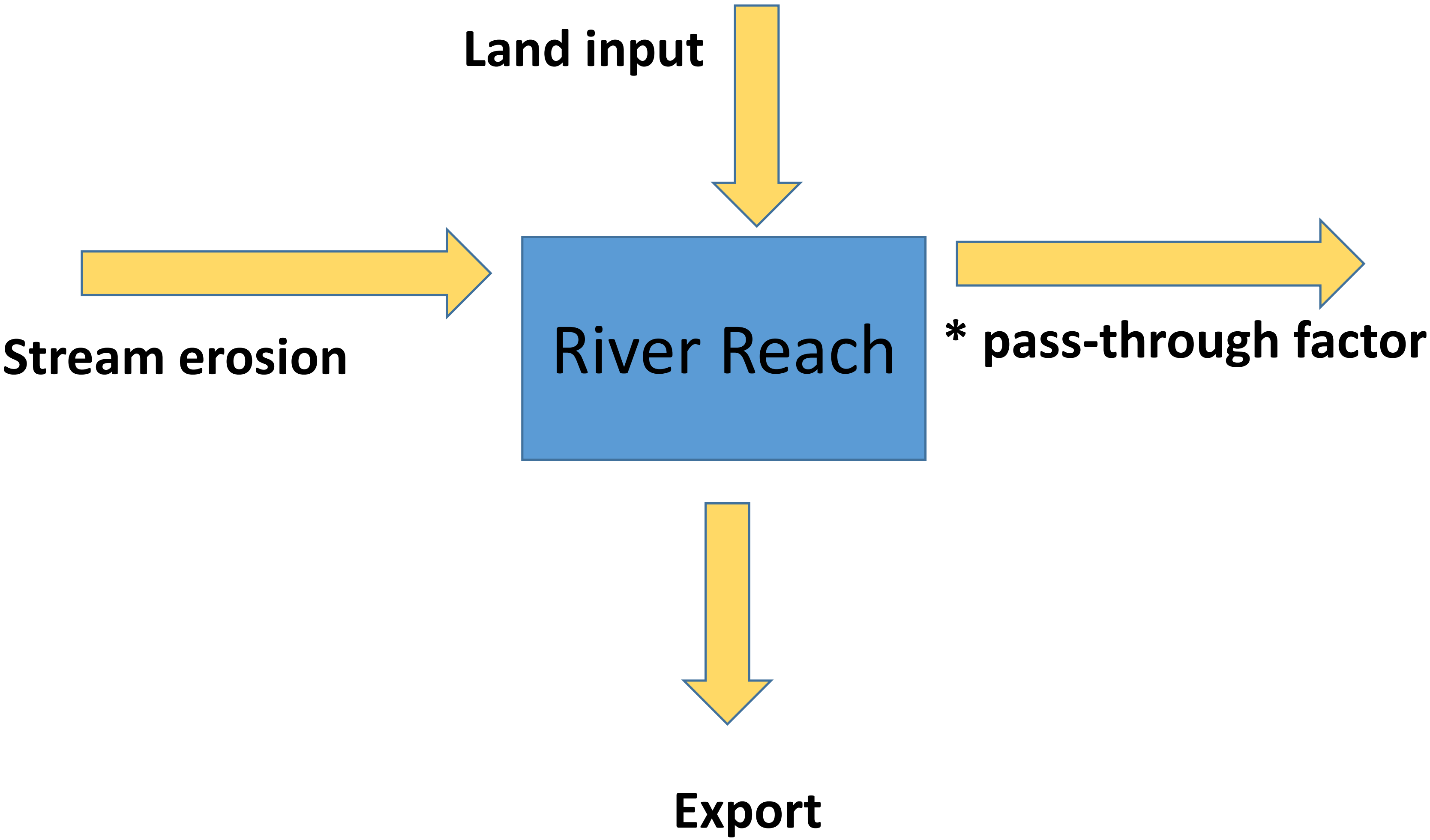
Stream Sediment Conceptual Model



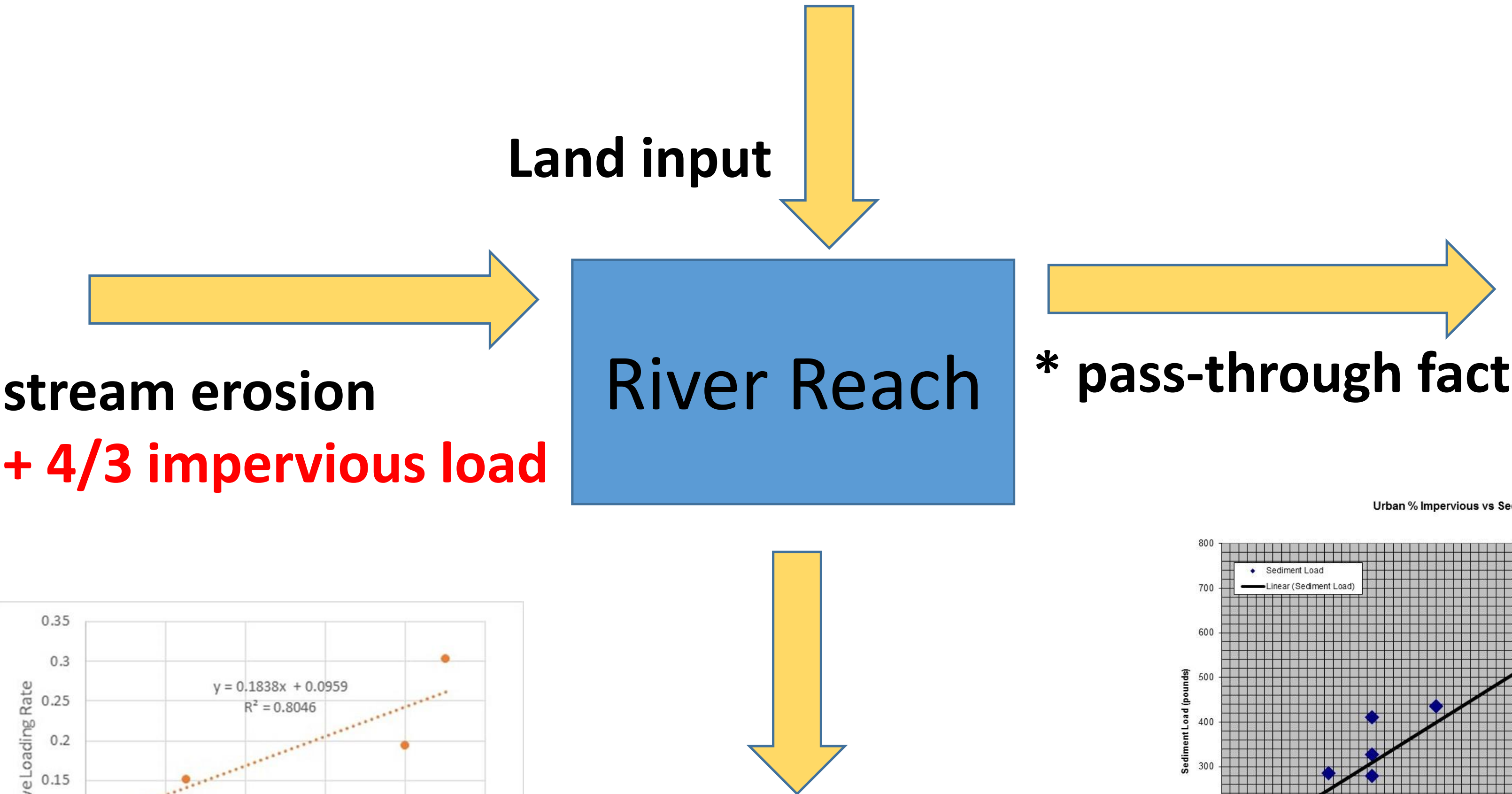
Stream Sediment Conceptual Model

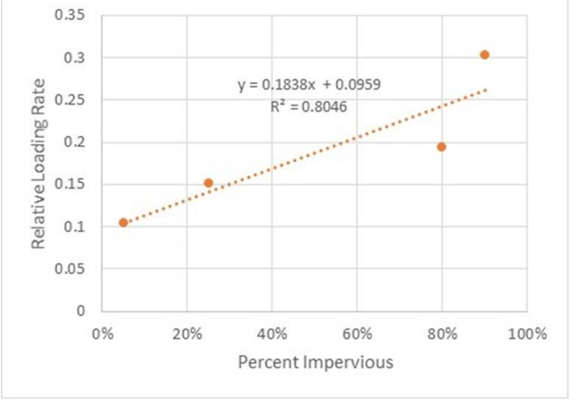


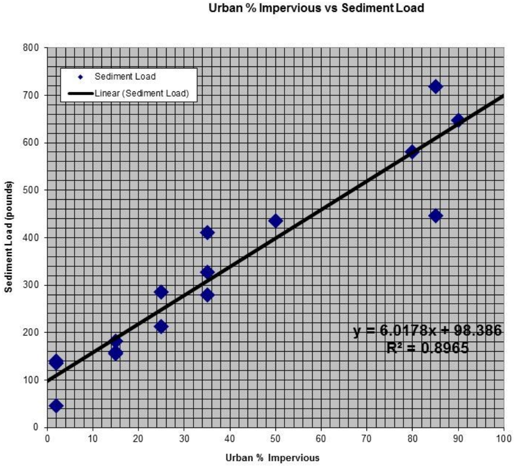
Stream Sediment Conceptual Model



Stream Sediment Conceptual Model







Stream Sediment Conceptual Model

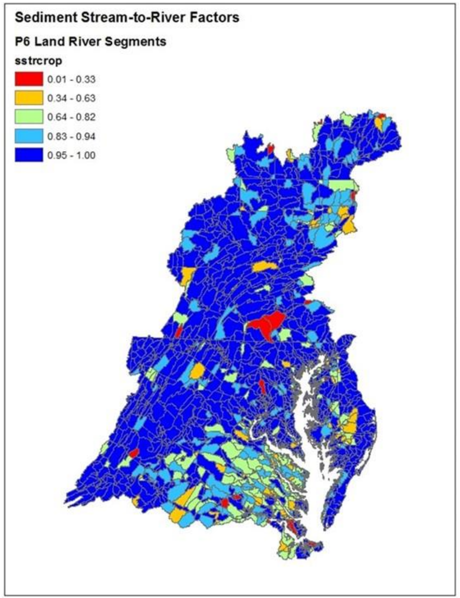
Land input

stream erosion
+ 4/3 impervious load

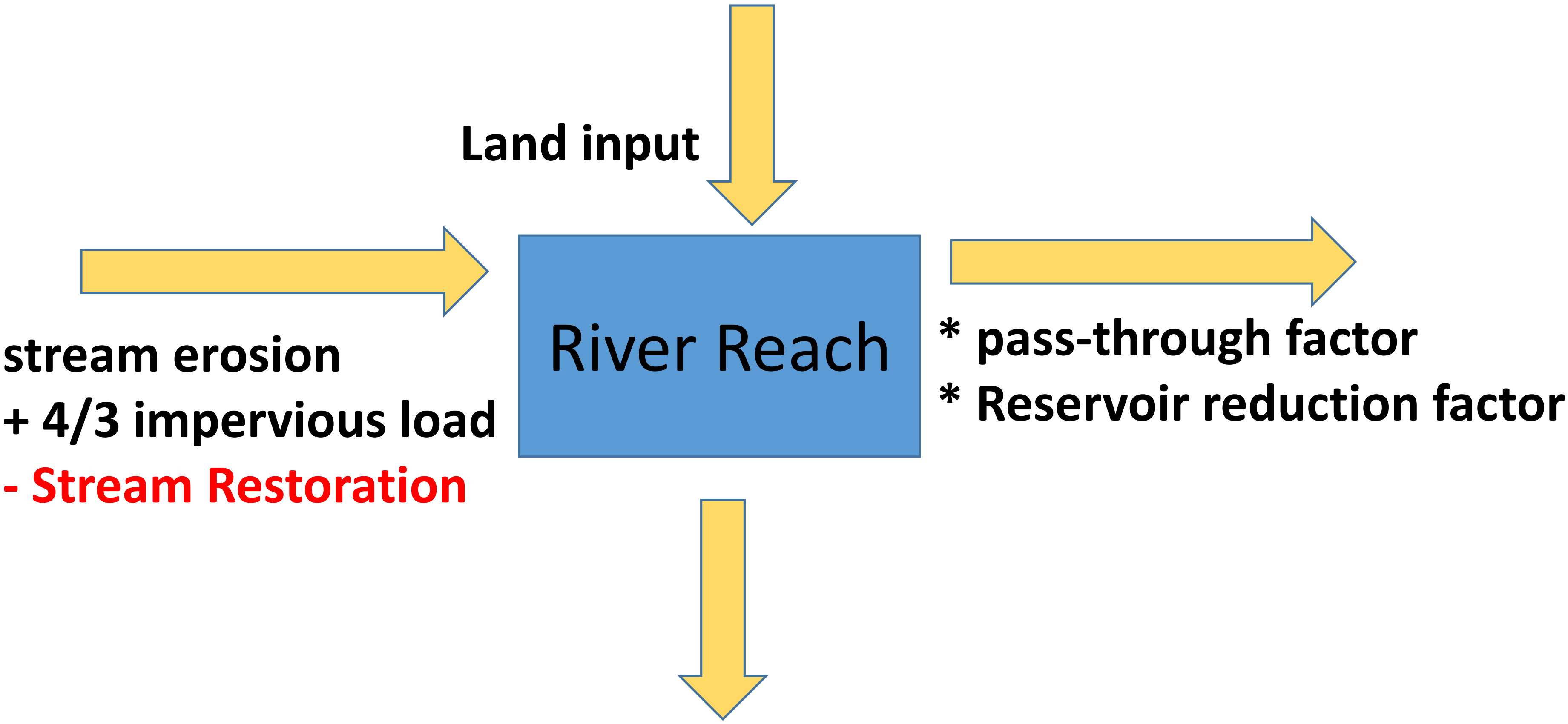
River Reach

*** pass-through factor**
*** Reservoir reduction factor**

Export + Impervious – Reservoir

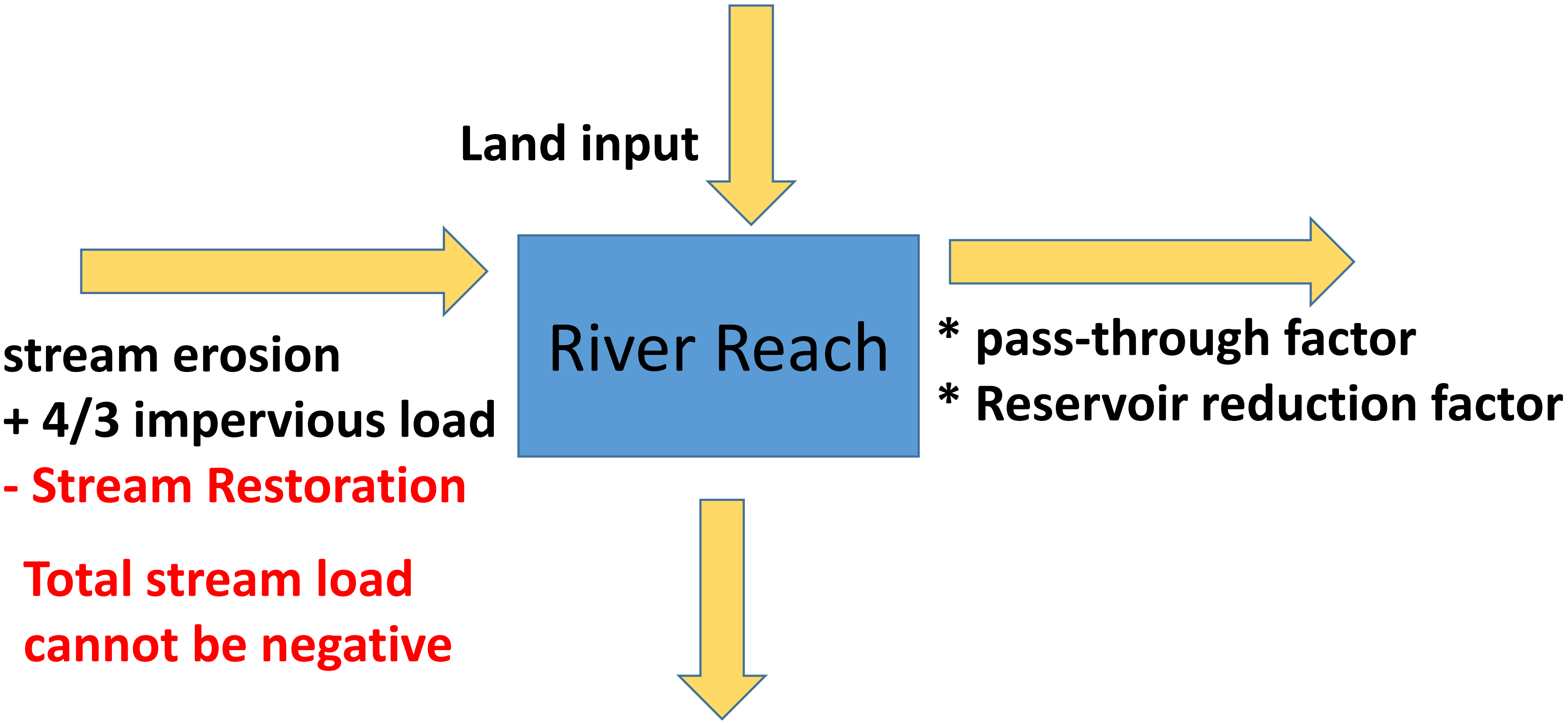


Stream Sediment Conceptual Model



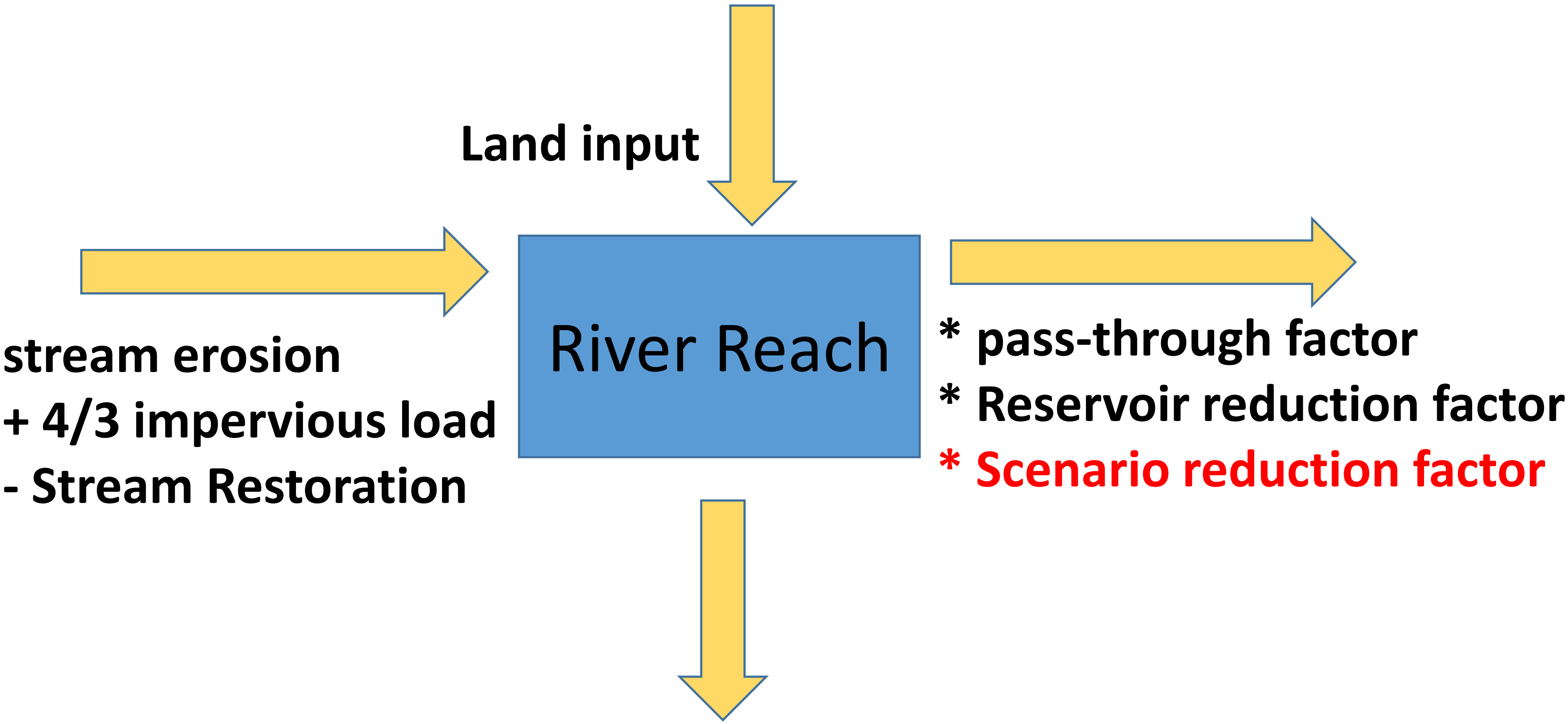
Export + Impervious – Reservoir – Restoration

Stream Sediment Conceptual Model



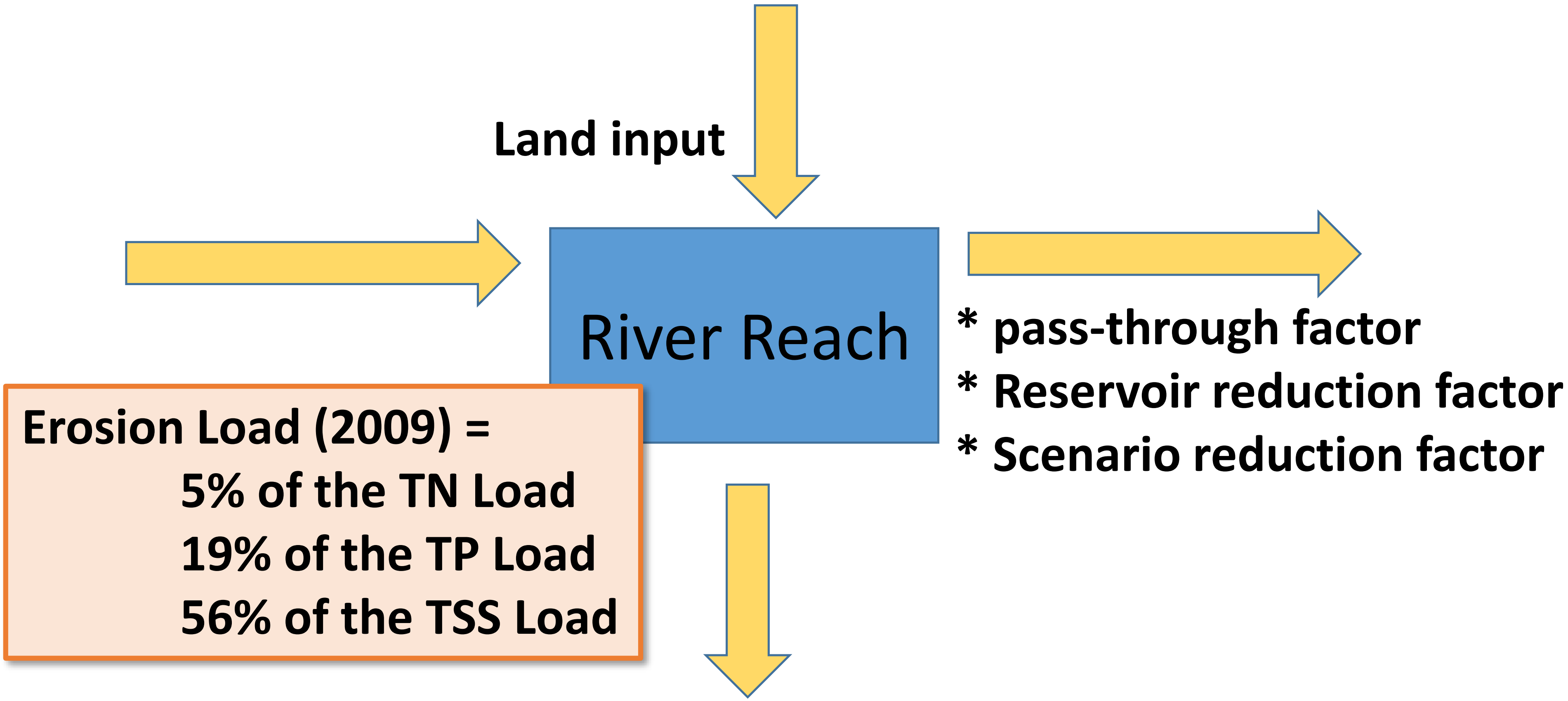
Export + Impervious – Reservoir – Restoration

Stream Sediment Conceptual Model



Export + Impervious – Reservoir – Restoration – Scenario

Stream Sediment Conceptual Model



Export + Impervious – Reservoir – Restoration – Scenario

Summary

- Phase 6 sediment built from detailed analysis
- Stream erosion is treated as a source
- Stream deposition is treated as a reduction percentage
- Stream restoration reduces the stream source and is limited by the total erosion loads available
- Erosion loads are a significant part of the total loads to tidal waters

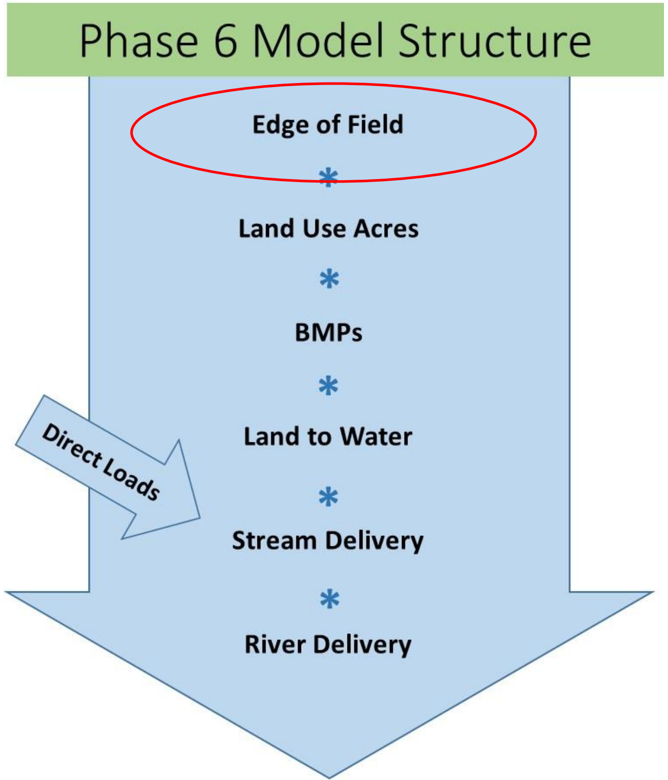
Extra slides

RUSLE => R * K * LS * C * P

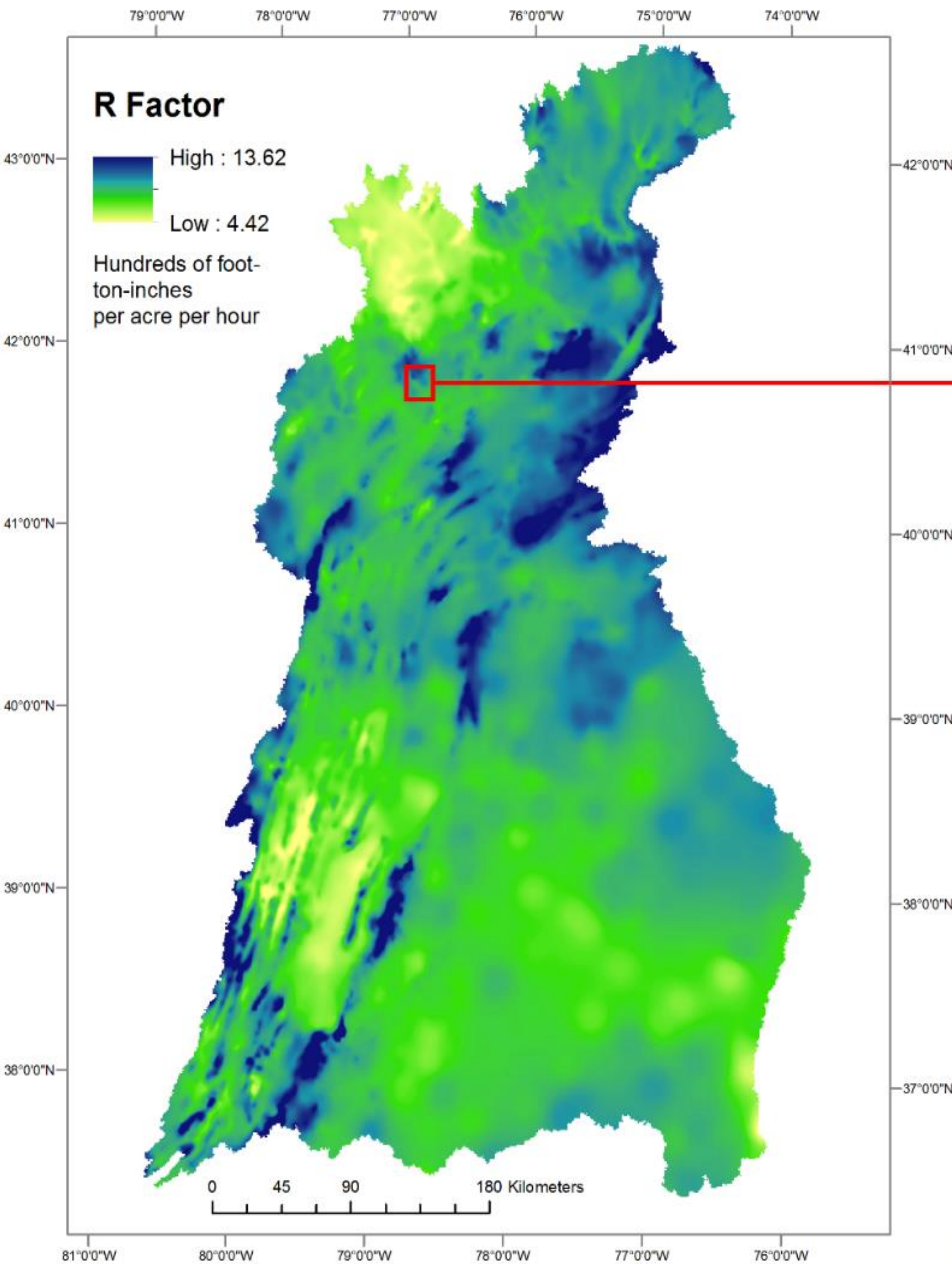
- R = Runoff
- K = Erodibility
- LS = slope length

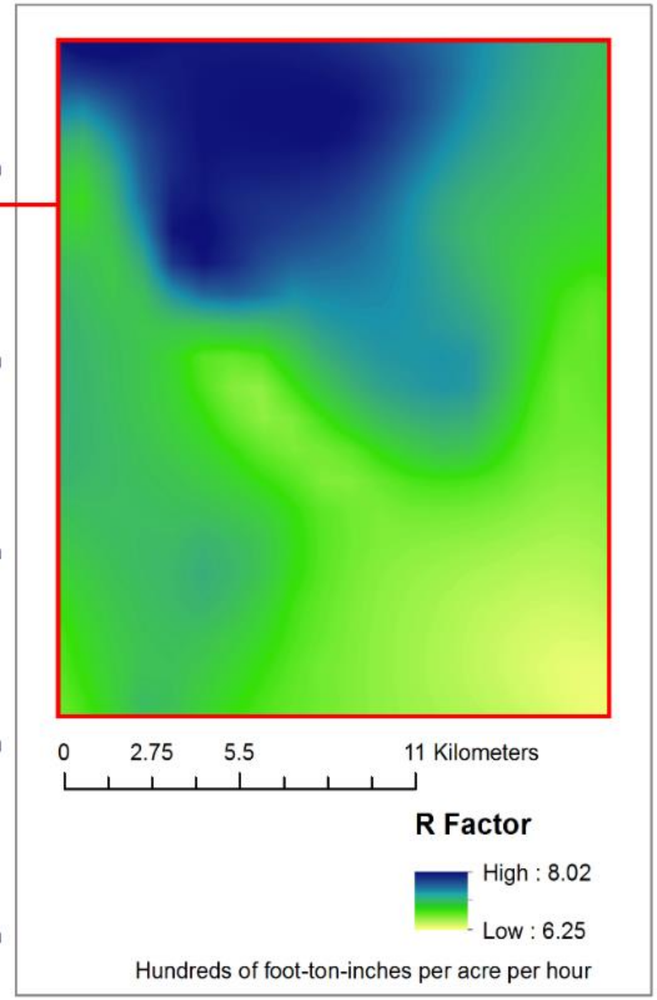
Evaluated at 10 meter resolution (R, K, LS)

- C = Cover
  - By land use and Land-River segment
- P = Practice
  - = 1 since no action loads



Chesapeake Bay Watershed R Factor

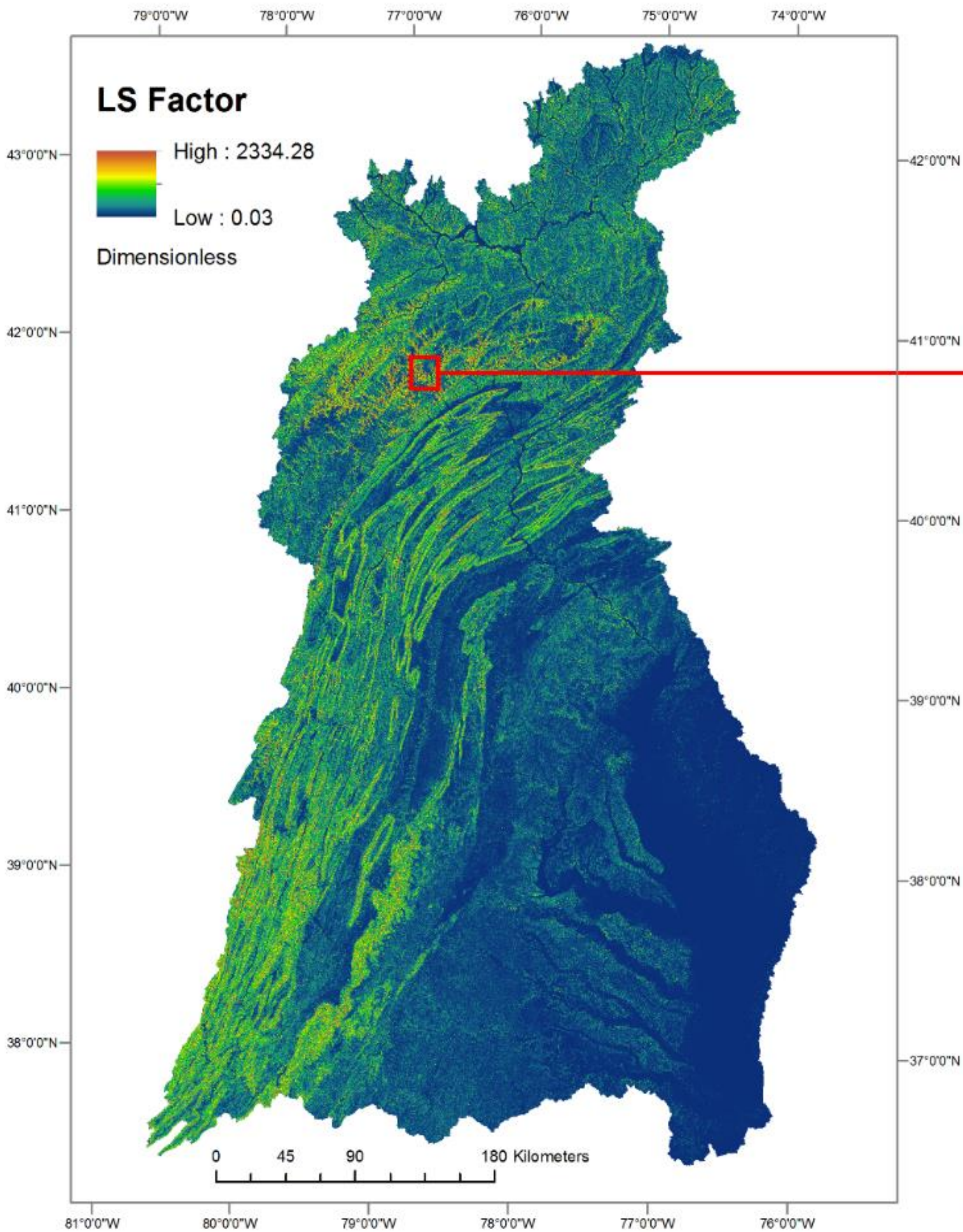


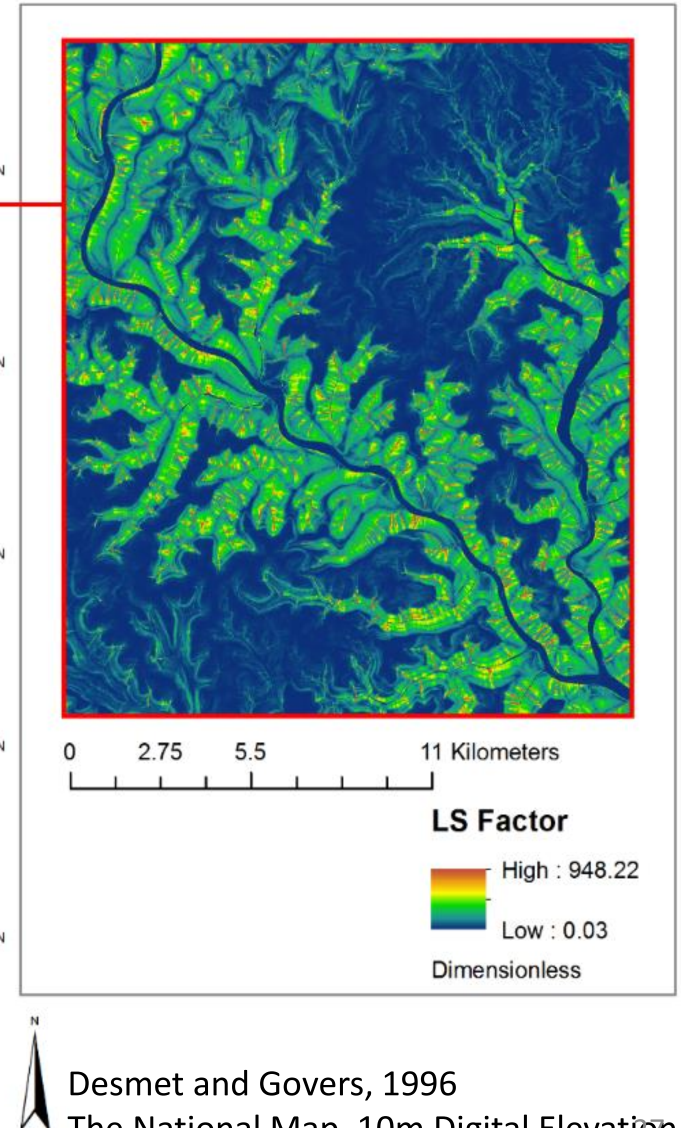


N

30-year Precipitation Normals (800m)
http://www.prism.oregonstate.edu/normals/

Chesapeake Bay Watershed
LS Factor

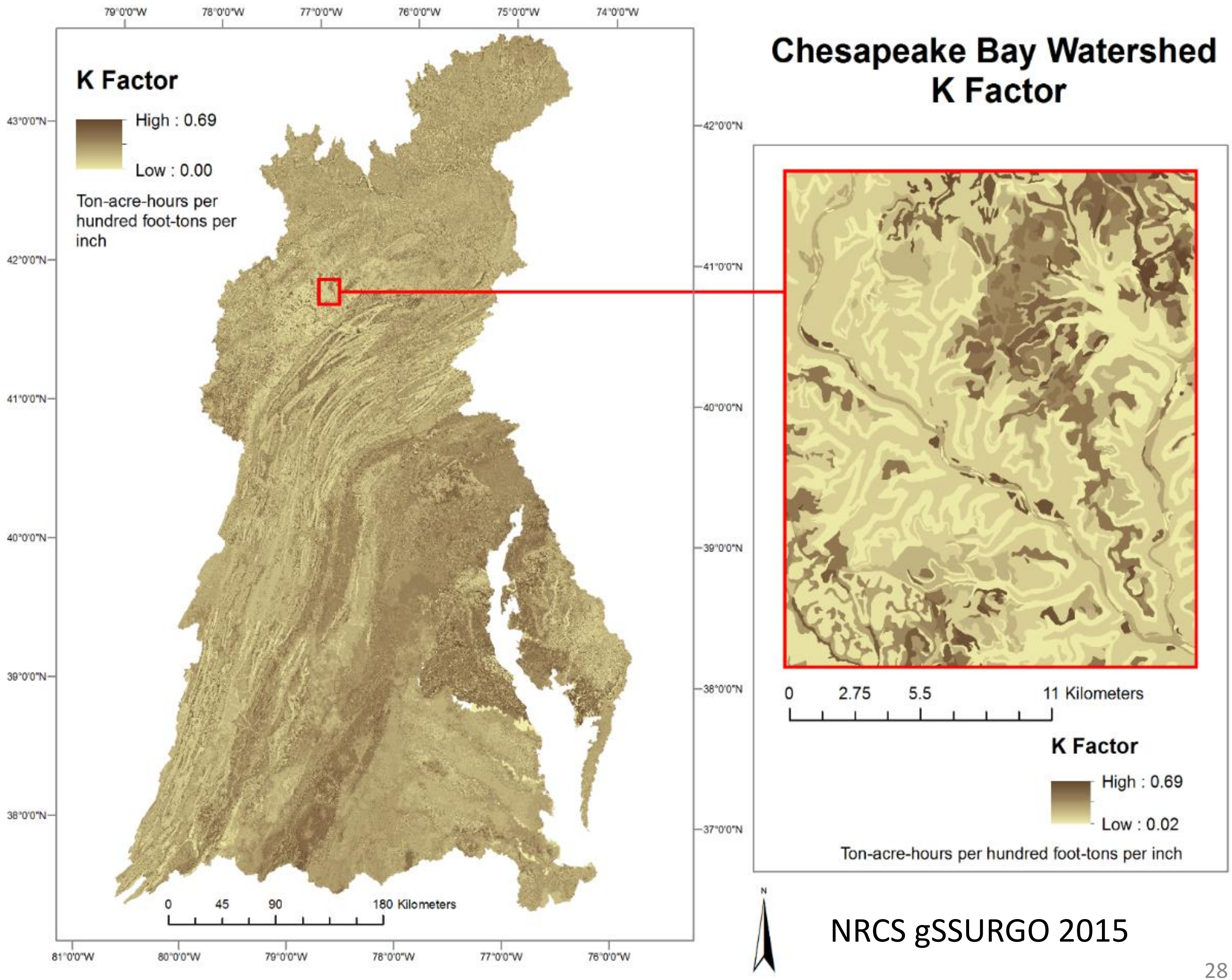




Desmet and Govers, 1996

The National Map, 10m Digital Elevation Model

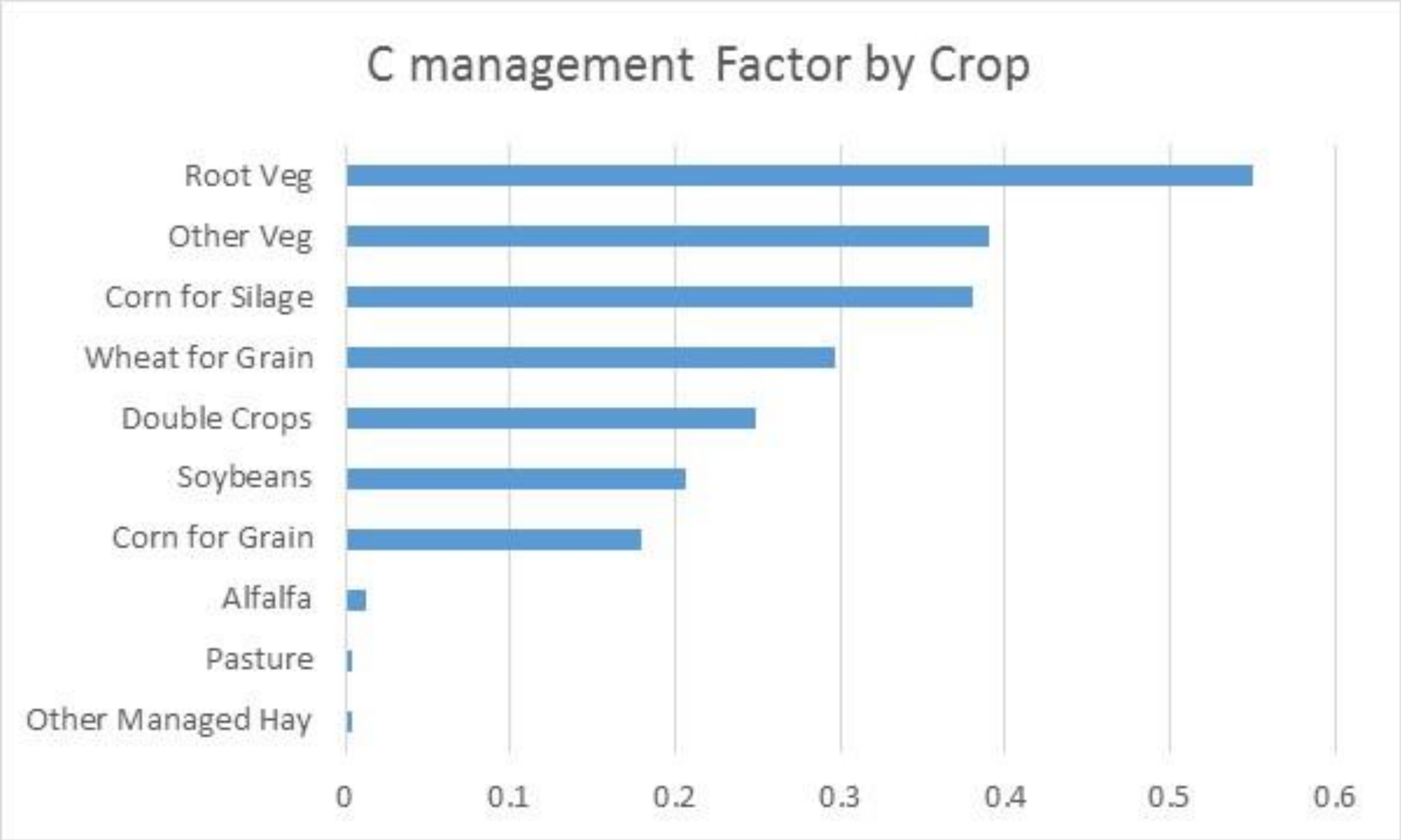
Chesapeake Bay Watershed
K Factor



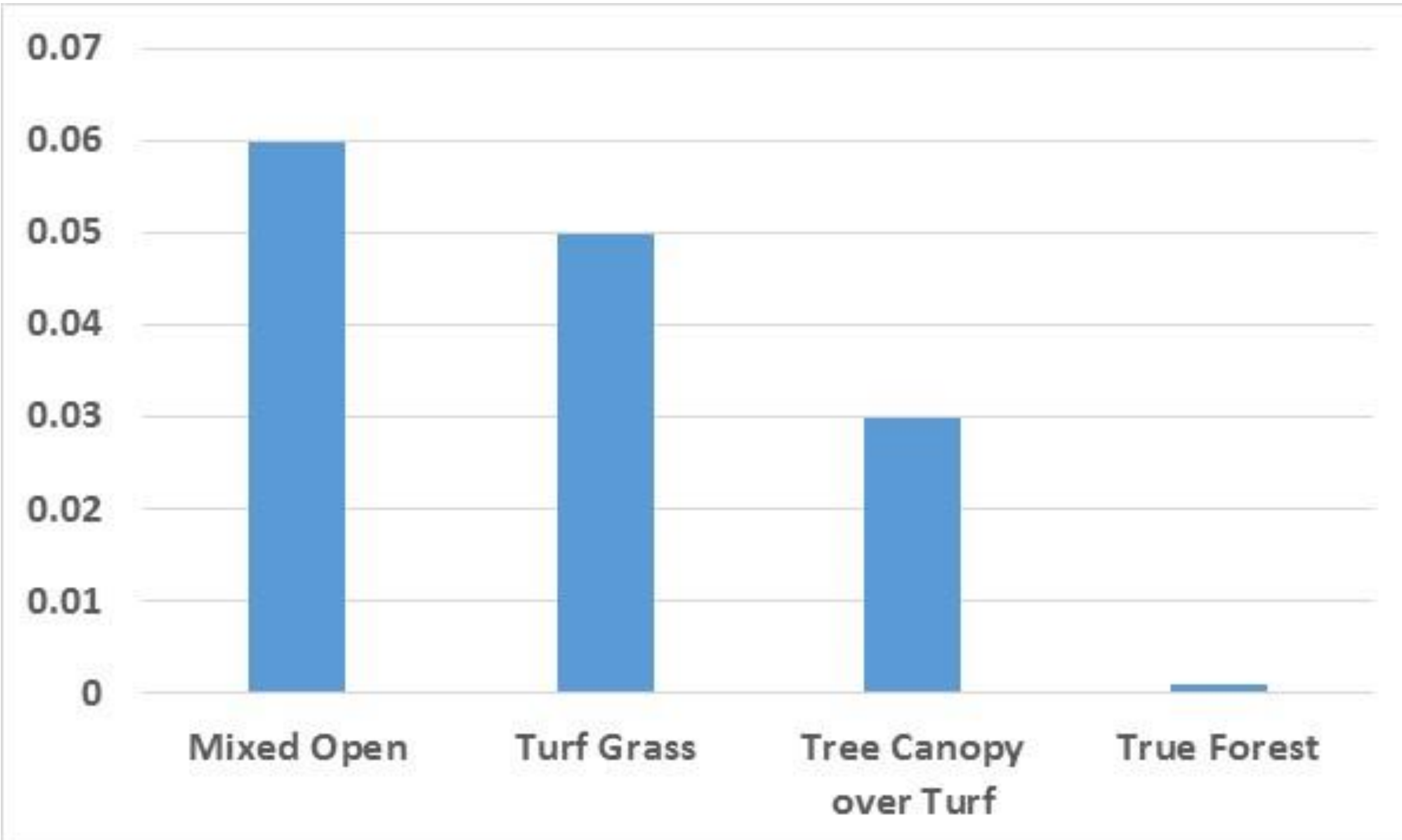
NRCS gSSURGO 2015

Simple average

Agricultural C-management factor



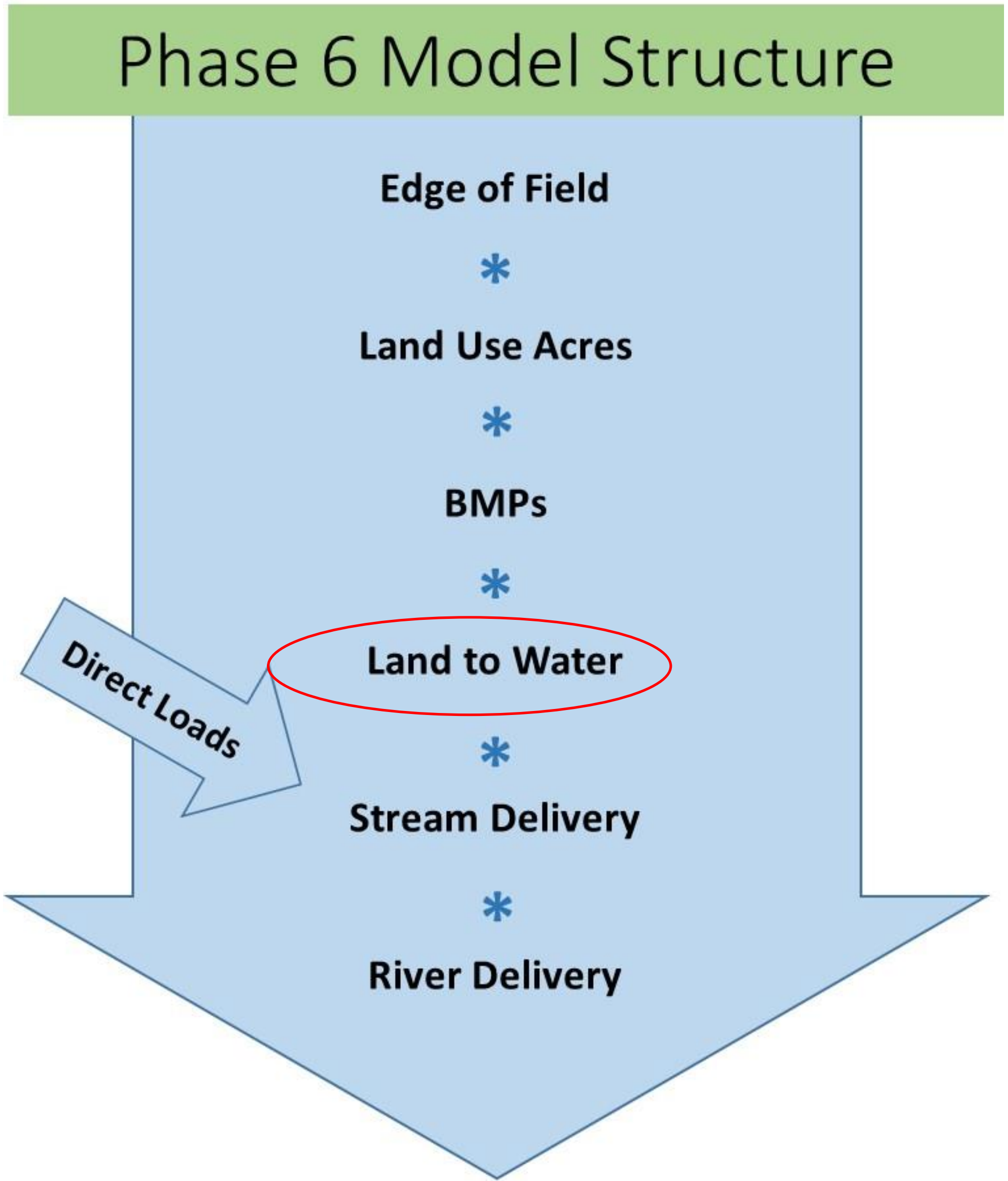
Non-Agricultural C factors



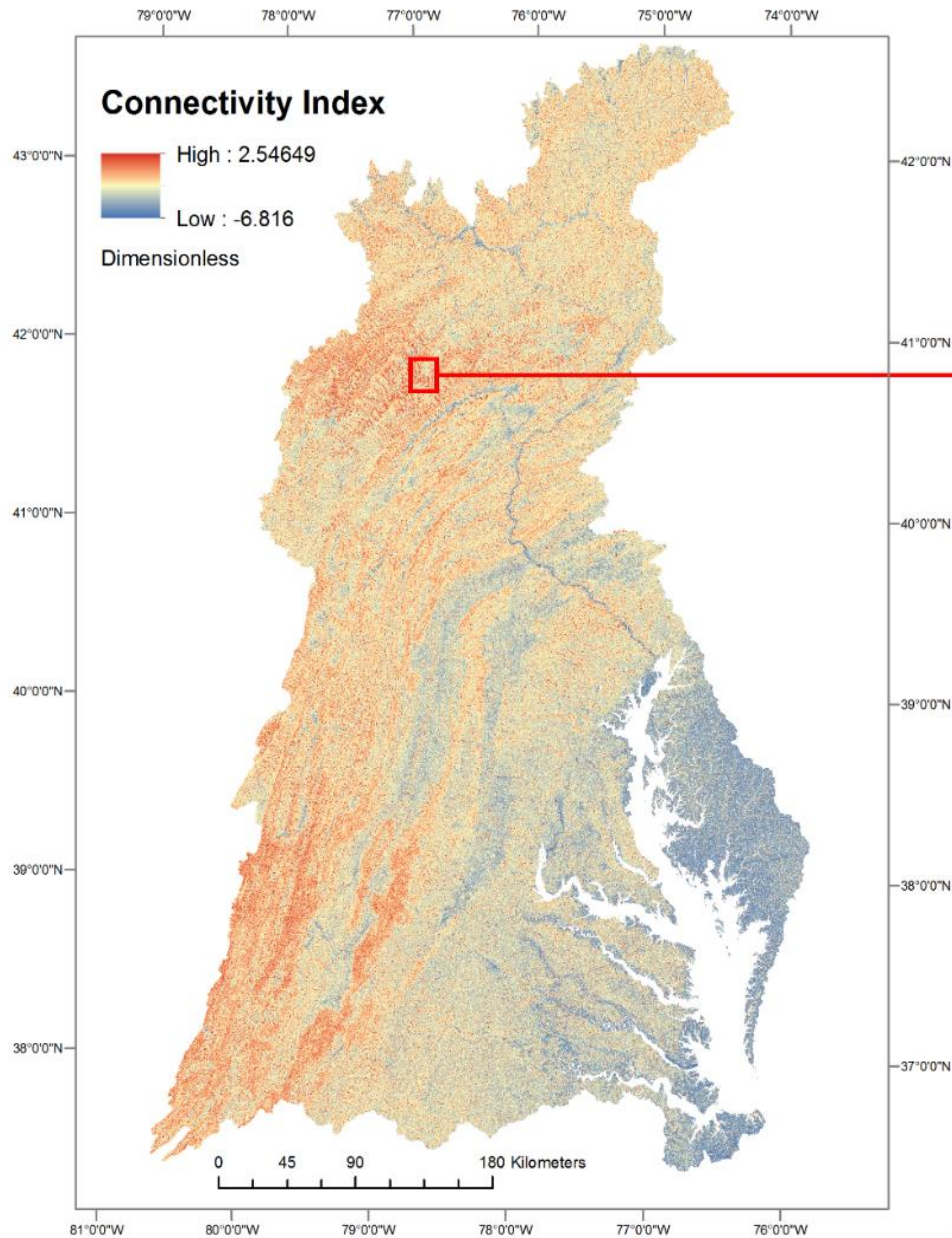
Construction

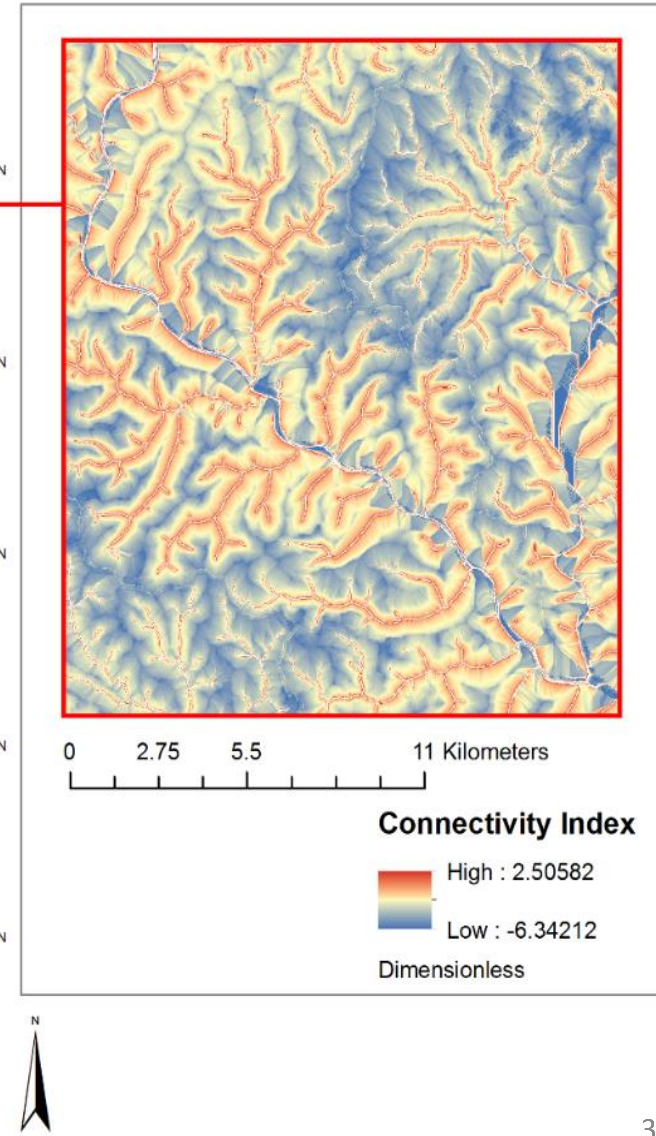
- Construction is set at 12 tons/acre/year as a global average by the Sediment and Erosion Control BMP Panel (Clark and others 2014).
- The local load is a ratio of turfgrass

Sediment Delivery Ratio

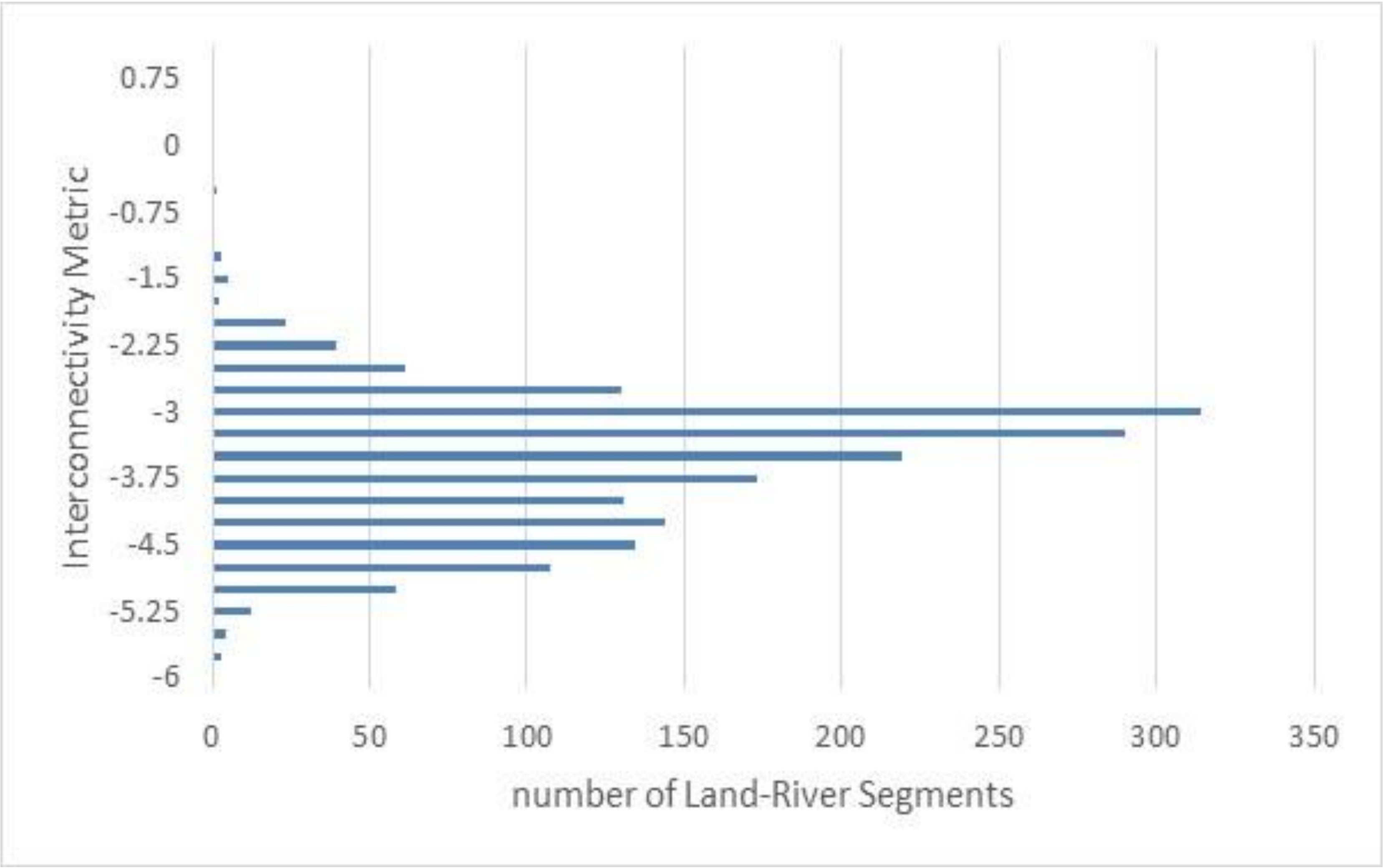


Chesapeake Bay Watershed Connectivity Index





Interconnectivity Metric



Sediment Delivery Ratio