Housatonic River Model Validation CCC Meeting

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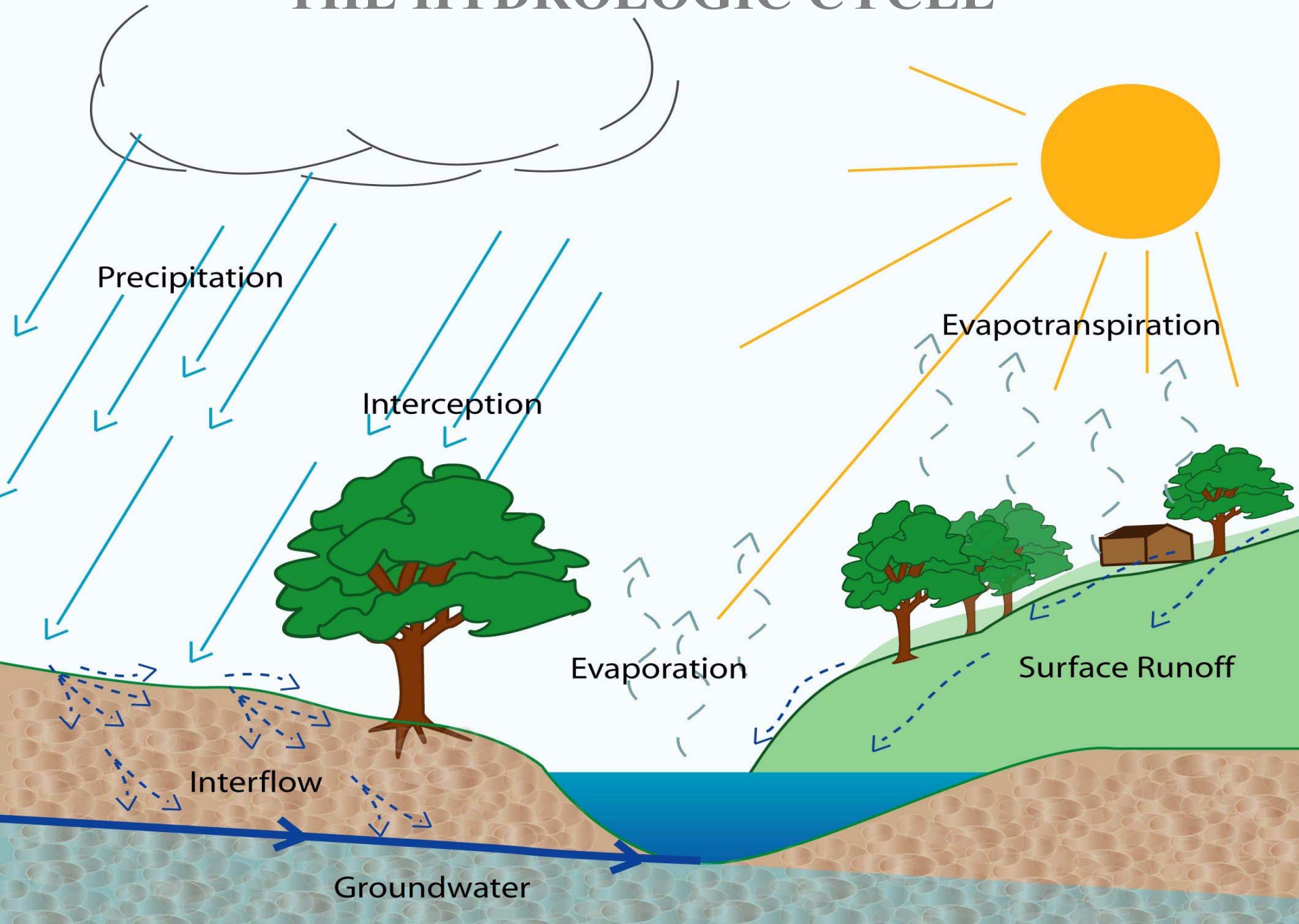
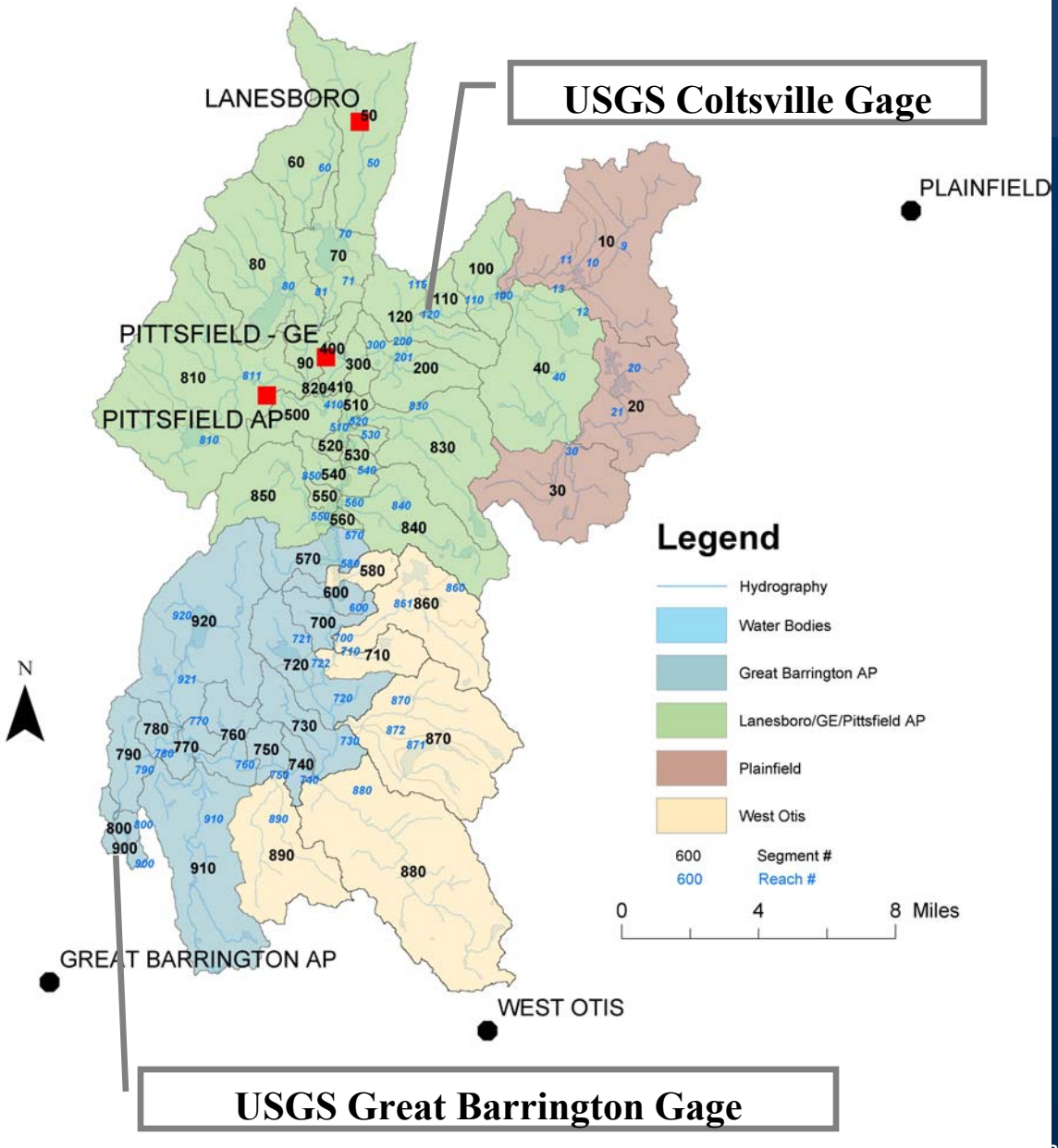
THE HYDROLOGIC CYCLE

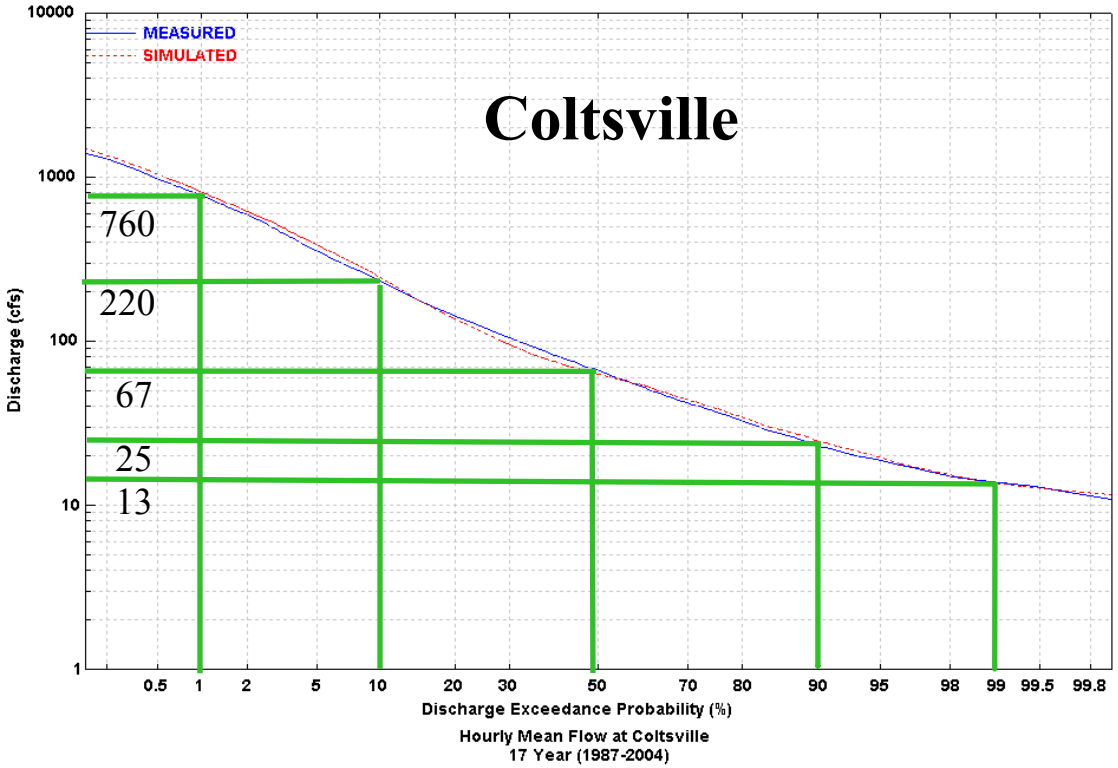


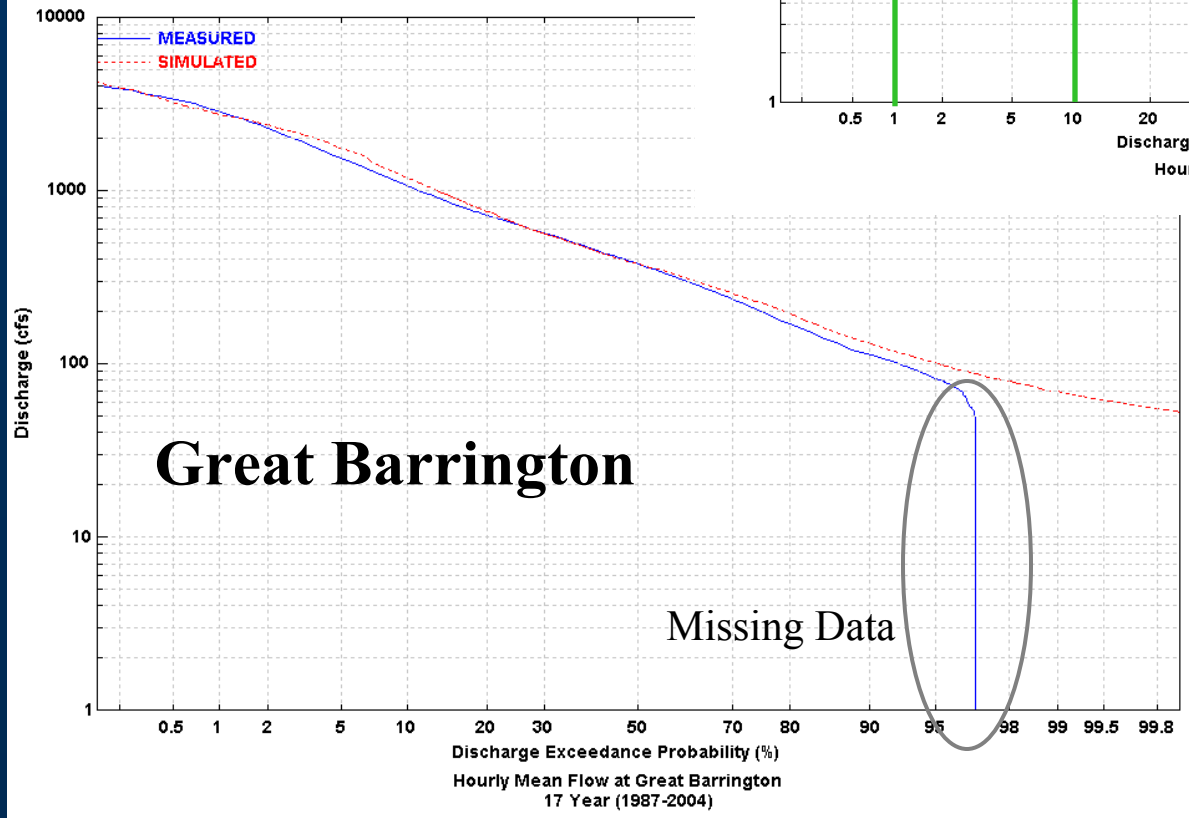
HSPF Segmentation



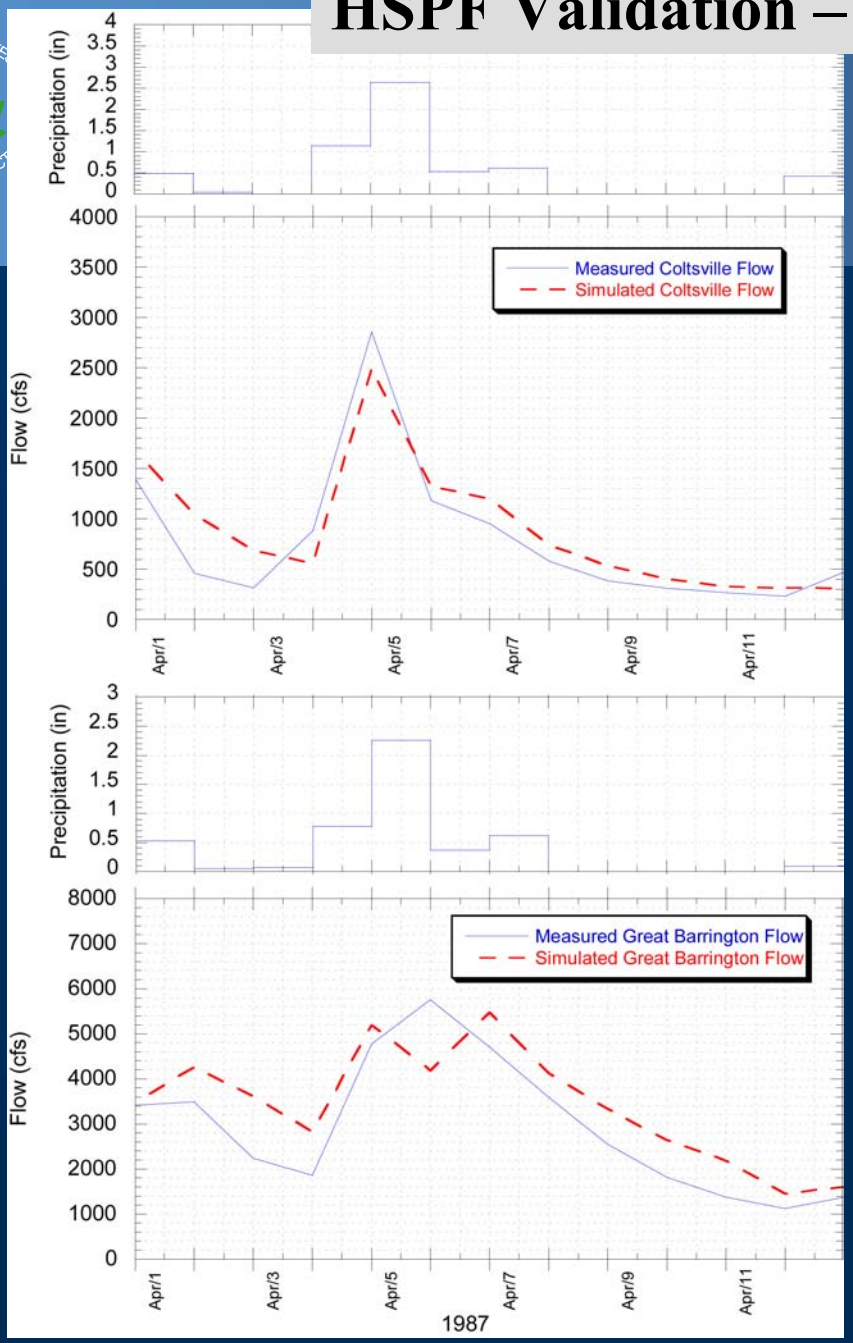
HSPF Validation

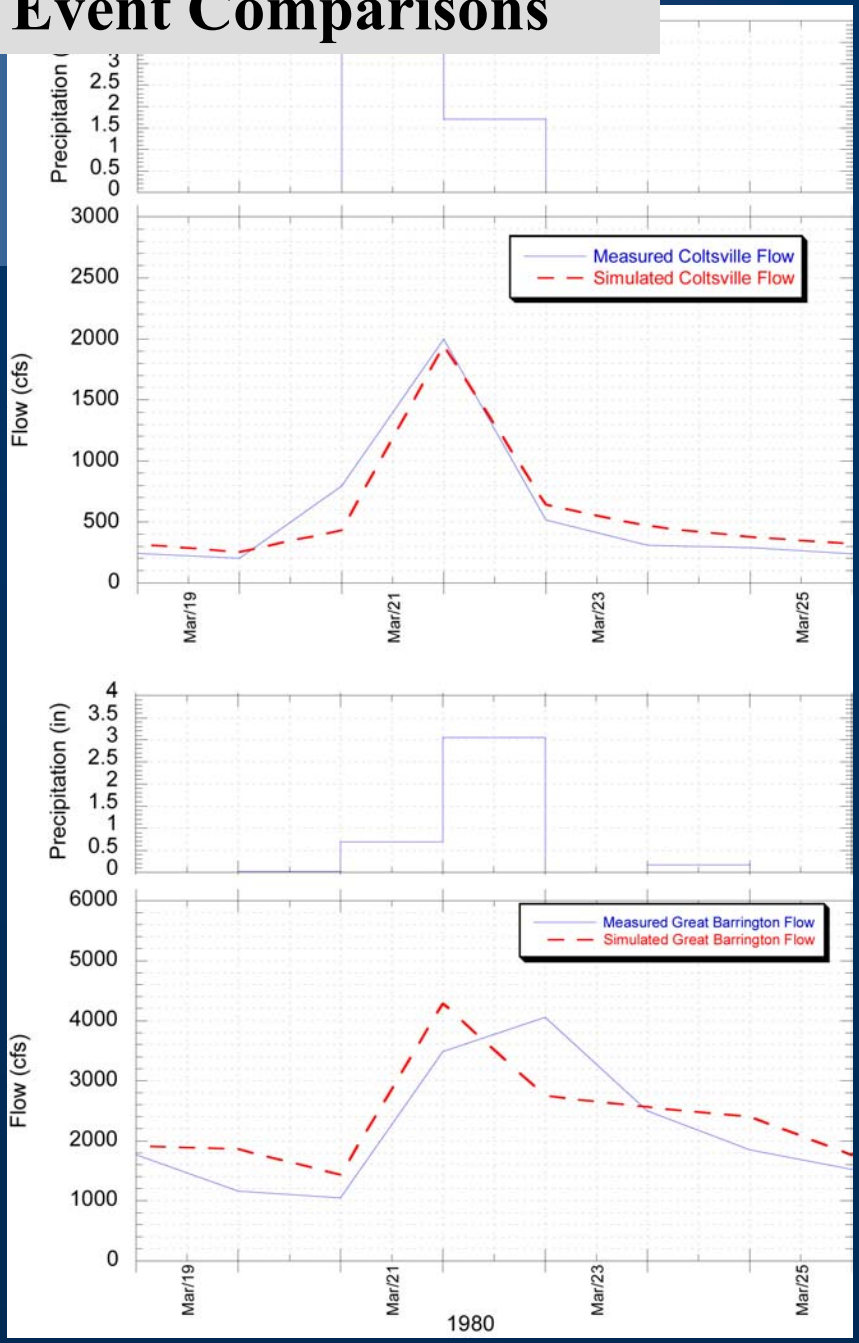
Flow Duration Curves





HSPF Validation – Event Comparisons

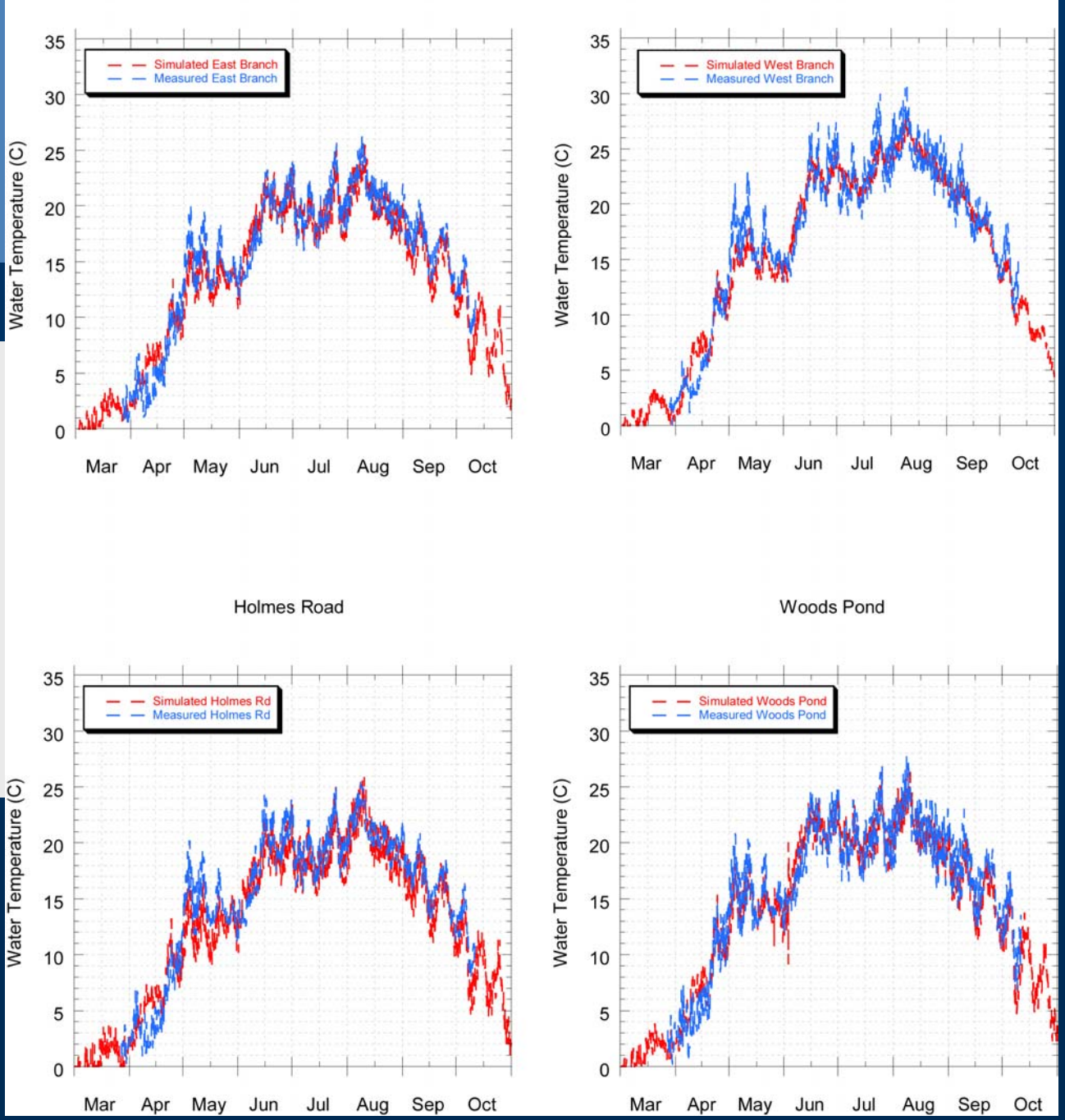


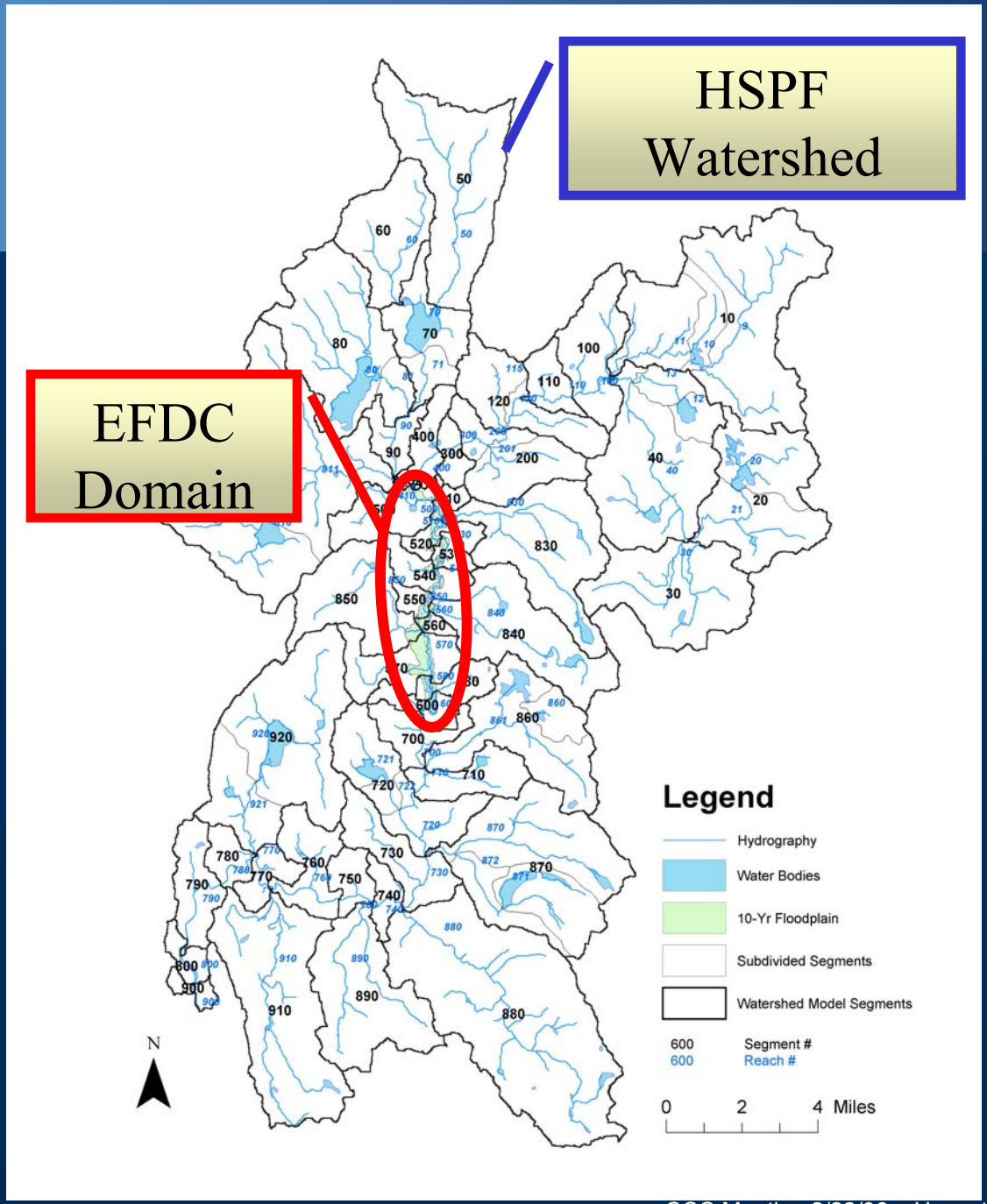


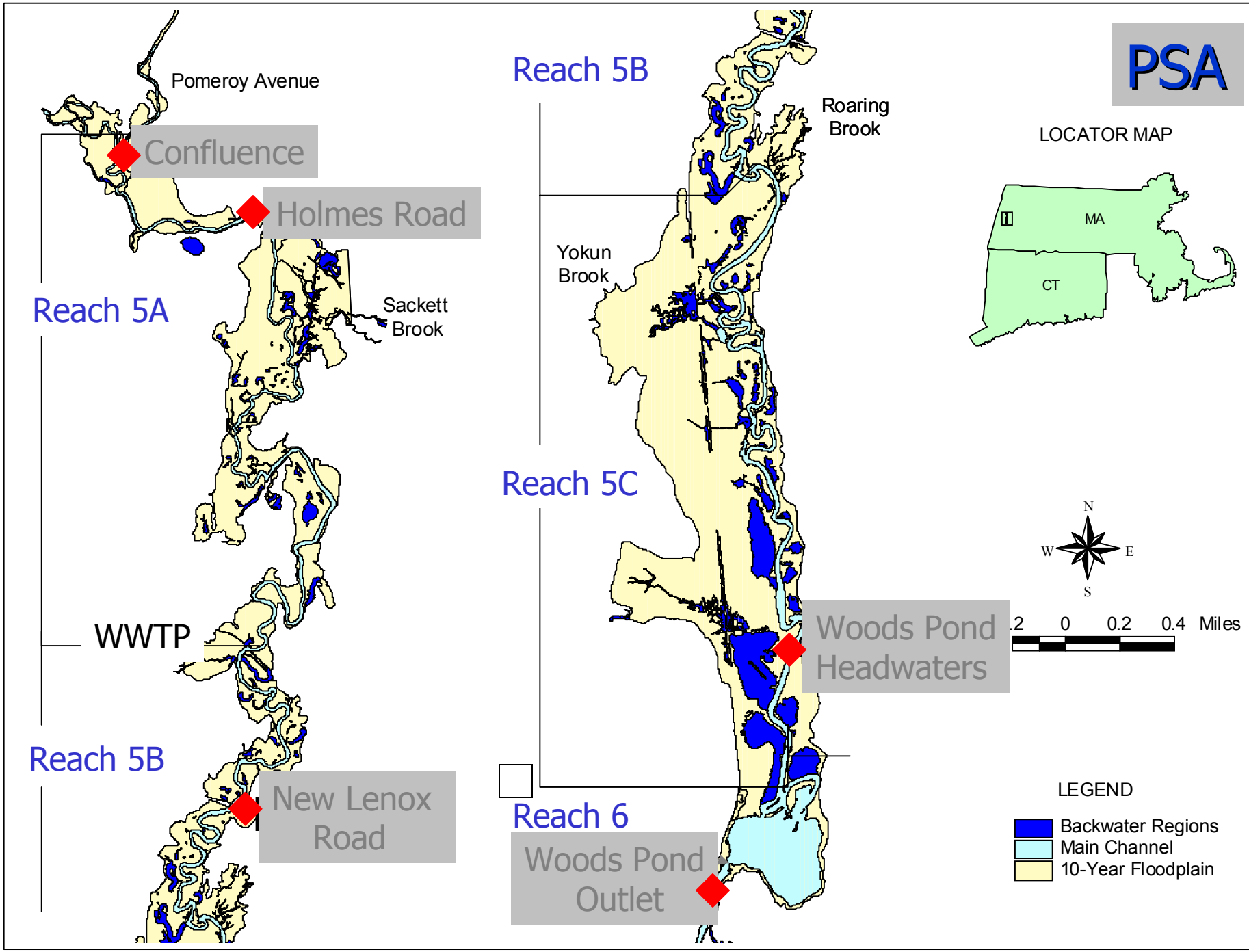
Water Temperature Simulated by HSPF

Blue = Measured

Red = Simulated



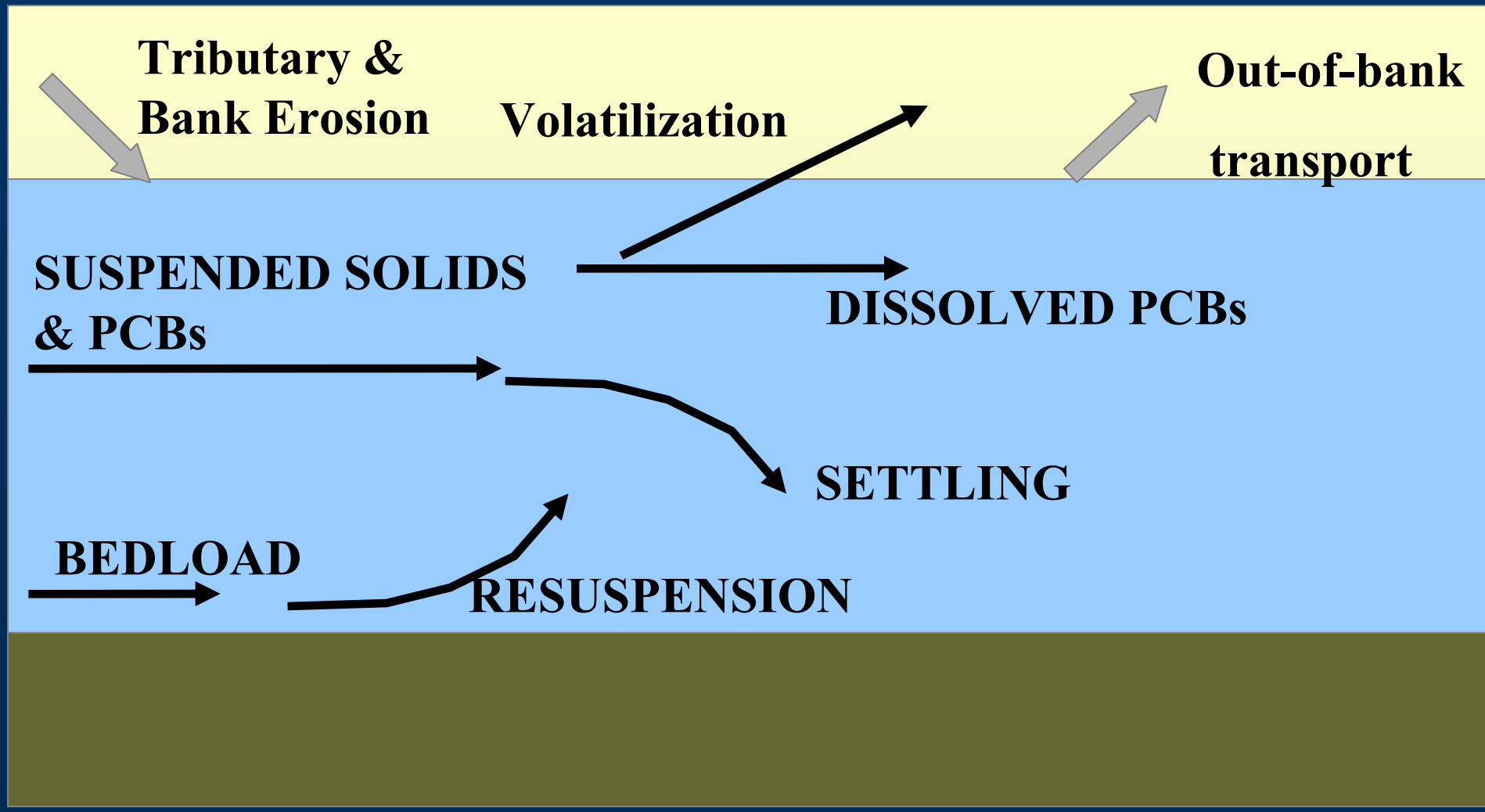

HSPF Watershed
EFDC Domain
Legend
Hydrography
Water Bodies
10-Yr Floodplain
Subdivided Segments
Watershed Model Segments
600 Segment #
600 Reach #
0 2 4 Miles
N


PSA
Pomeroy Avenue
Confluence
Holmes Road
Reach 5A
Sackett Brook
WWTP
Reach 5B
New Lenox Road
Reach 5B
Roaring Brook
Yokun Brook
Reach 5C
Woods Pond Headwaters
Reach 6
Woods Pond Outlet
LOCATOR MAP
MA
CT
N
W
E
S
.2 0 0.2 0.4 Miles
LEGEND
Backwater Regions
Main Channel
10-Year Floodplain

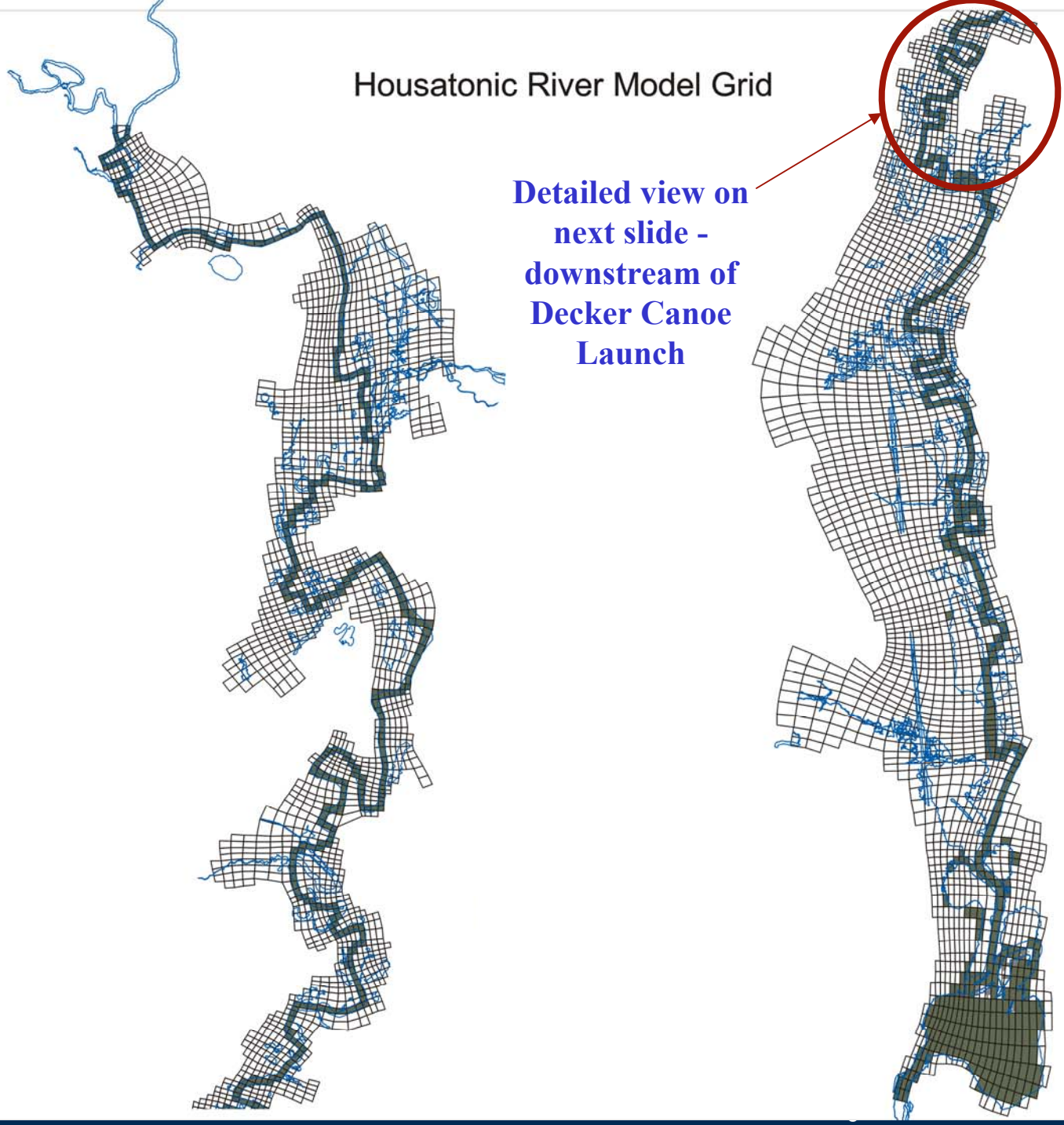
EFDC Components

- Hydrodynamics – Movement of Water
- Sediment Transport – Movement of Solids
- PCB Fate and Transport
  - Partitioning between dissolved and solid phases
  - Transport of dissolved and solid phases

Conceptual Model Diagram

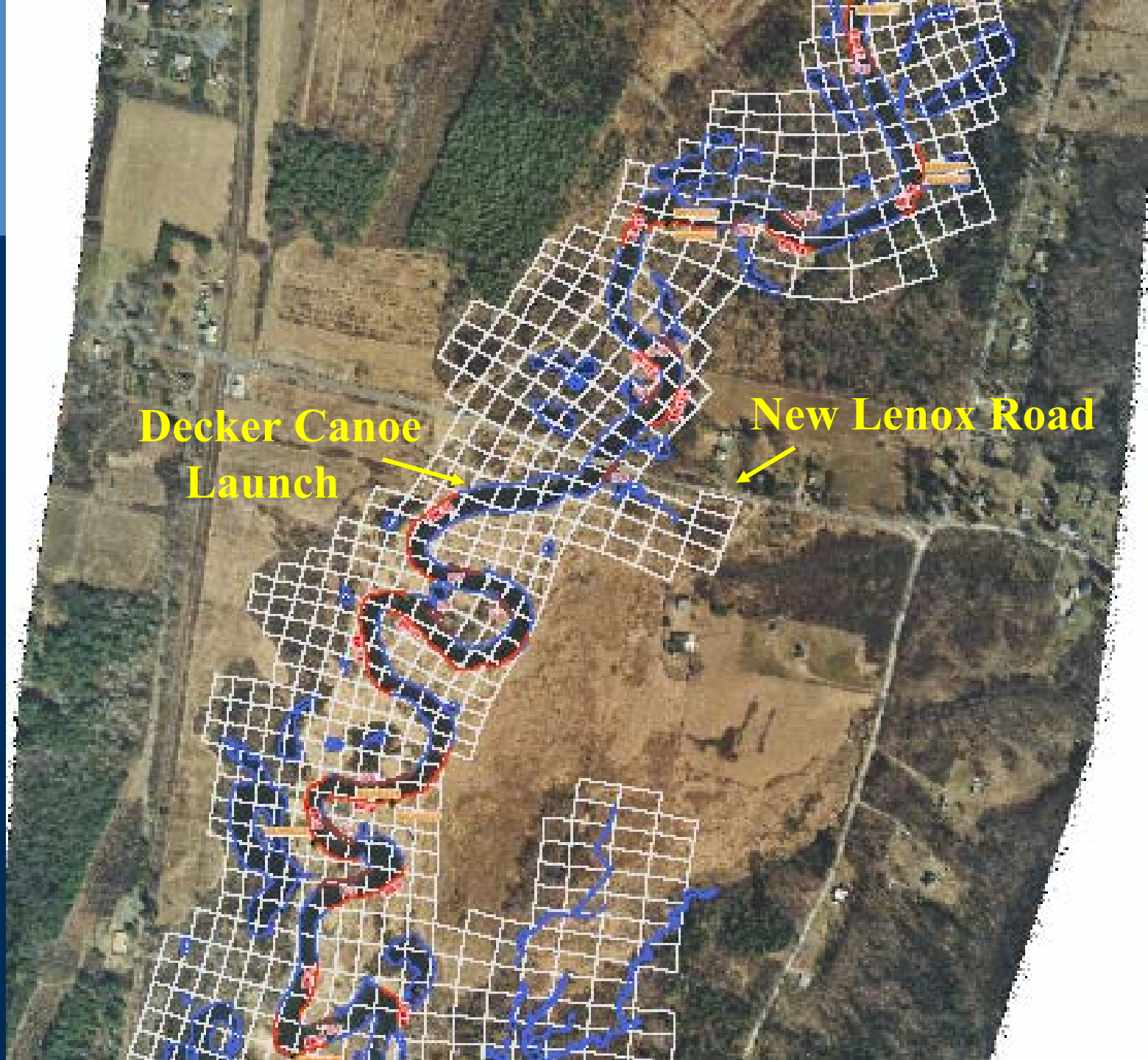


Housatonic River Model Grid



Detailed view on next slide - downstream of Decker Canoe Launch

Example Model Grid



Governing Equations

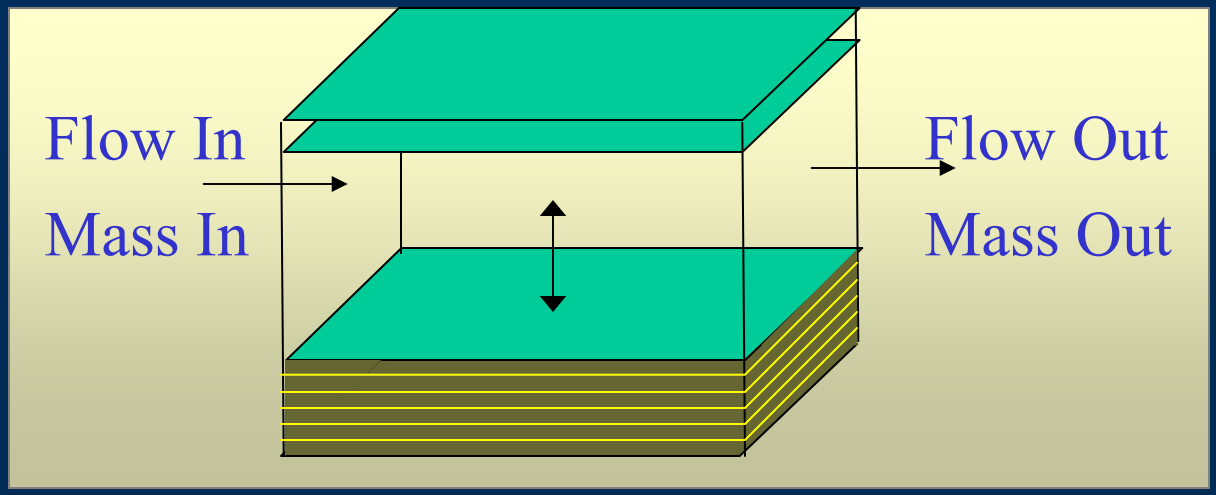
- **CONSERVATION OF MASS**

Hydrodynamic Model

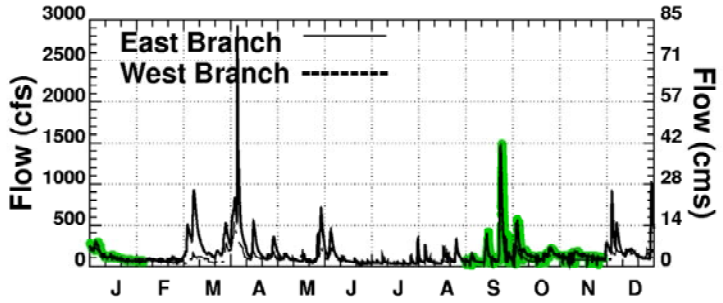
- **Change in Volume (Water Level) = Flow In - Flow Out**

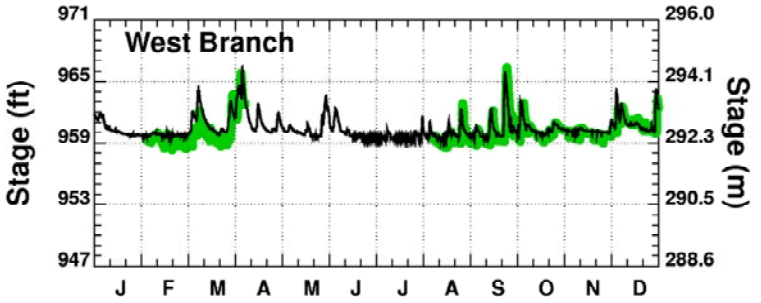
Sediment Transport & PCB Models

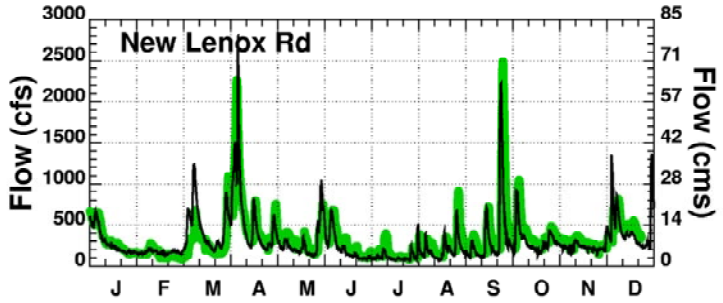
- **Change in Concentration*Volume = Mass In - Mass Out**

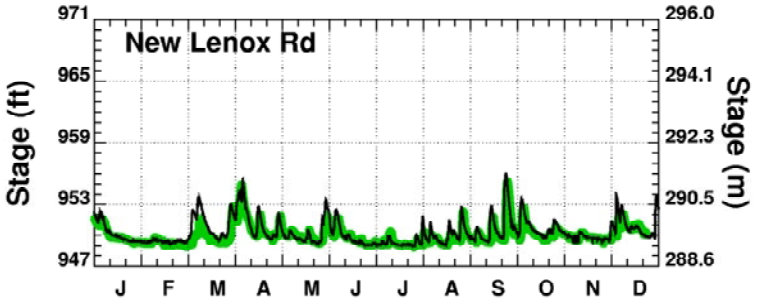


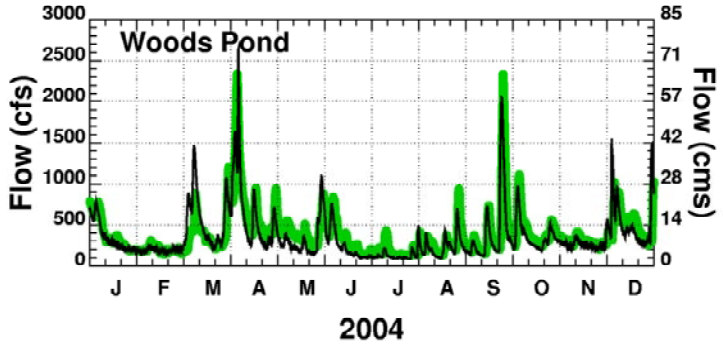
EFDC Hydrodynamic Validation

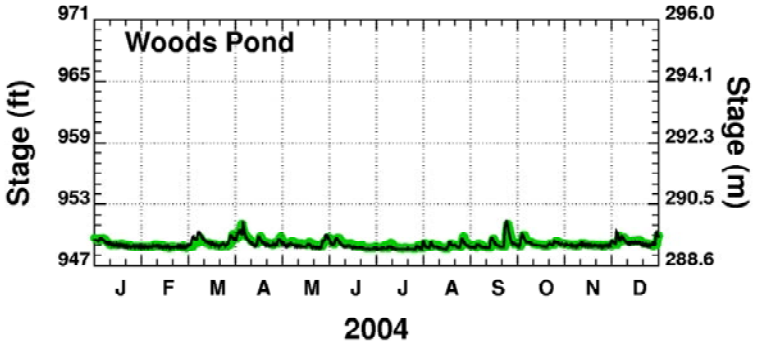










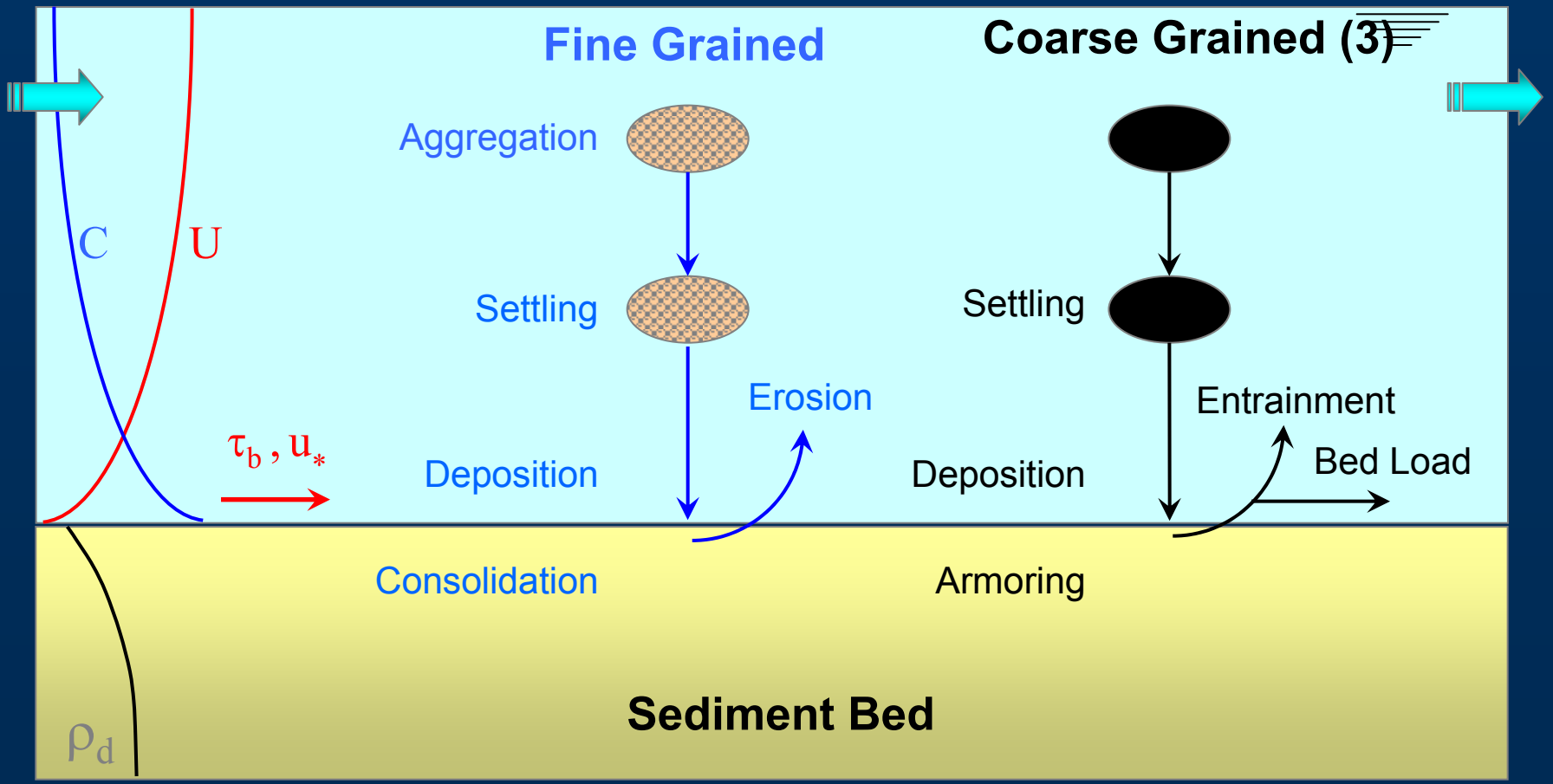


Quantitative Summary of Hydrodynamic Validation

							Regression of Simulated vs. Measured Values		
Station	**No. of Data (n)**	**Model Bias Arith.**	**Model Bias Log**	**Rel. Bias (%)**	**Mean Abs. Error**	**Median Rel. Error (%)**	**Slope**	**Y-Int**	**(r^2)**
Flow (cfs)									
New Lenox Road	18,131	-20.05	0.91	6.39	58.39	-9.04	0.92	4.26	0.89
Woods Pond	20,197	-32.79	1.54	-9.05	66.73	-15.25	1.01	-37.70	0.90
Depth (ft)									
New Lenox Road	18,131	0.27	0.37	4.88	0.30	3.37	1.12	-0.38	0.92
Woods Pond	20,197	-0.05	0.99	-0.57	0.09	-0.73	1.03	-0.30	0.92

Sediment Transport

Sediment Dynamics



Governing Equation

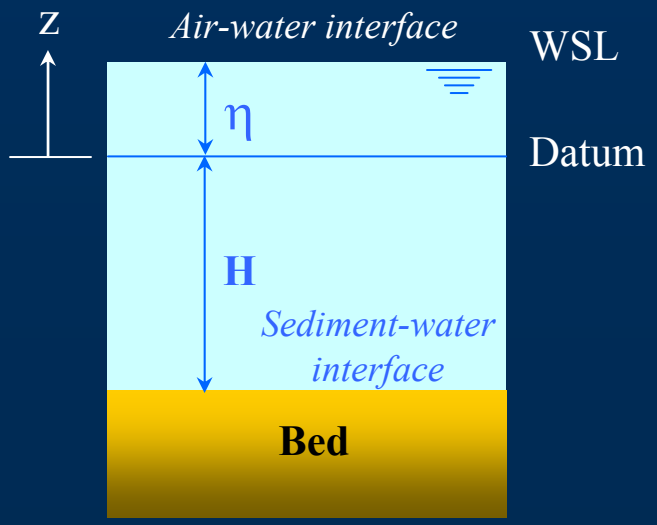
$$\frac{\partial C_k}{\partial t} + \frac{\partial UC_k}{\partial x} + \frac{\partial VC_k}{\partial y} + \frac{\partial (W - W_{s,k})C_k}{\partial z}$$

$$= \frac{\partial}{\partial x}\left(A_H \frac{\partial C_k}{\partial x} \right) + \frac{\partial}{\partial y}\left(A_H \frac{\partial C_k}{\partial y} \right) + \frac{\partial}{\partial z}\left(K_H \frac{\partial C_k}{\partial z} \right)$$

Boundary conditions:

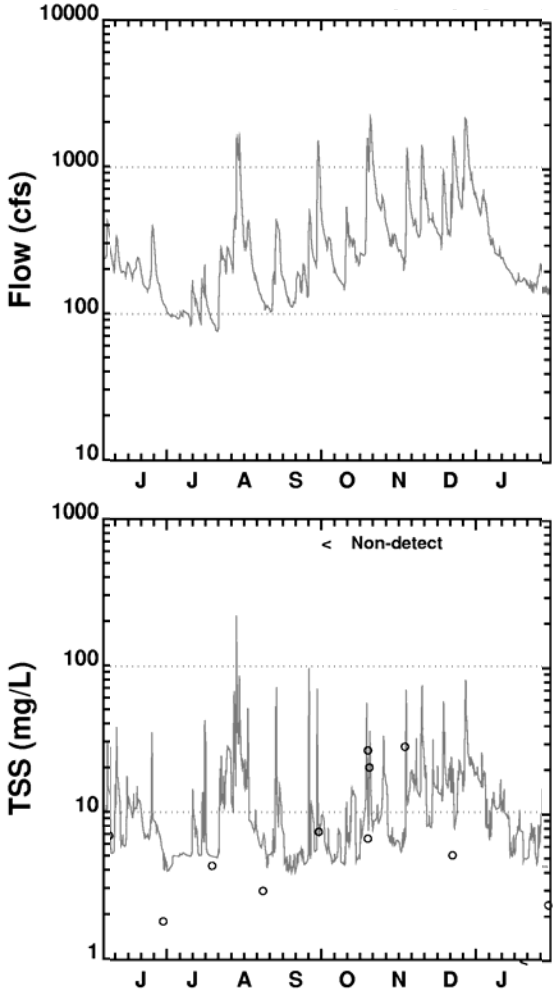
$$K_H \frac{\partial C_k}{\partial z} = 0 \quad , \quad z \to \eta$$

$$K_H \frac{\partial C_k}{\partial z} = E_k - D_k \quad , \quad z \to -H$$

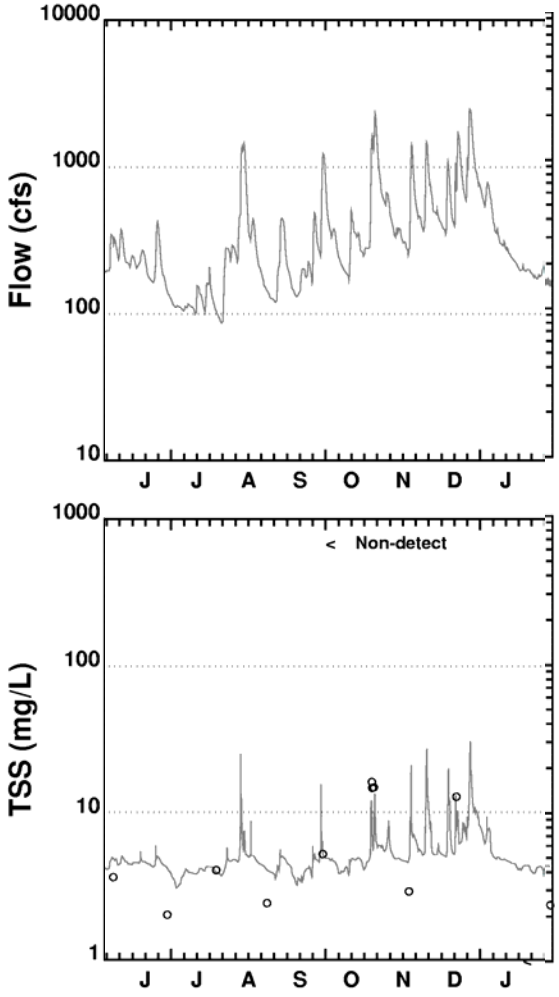


EFDC Sediment Transport Validation

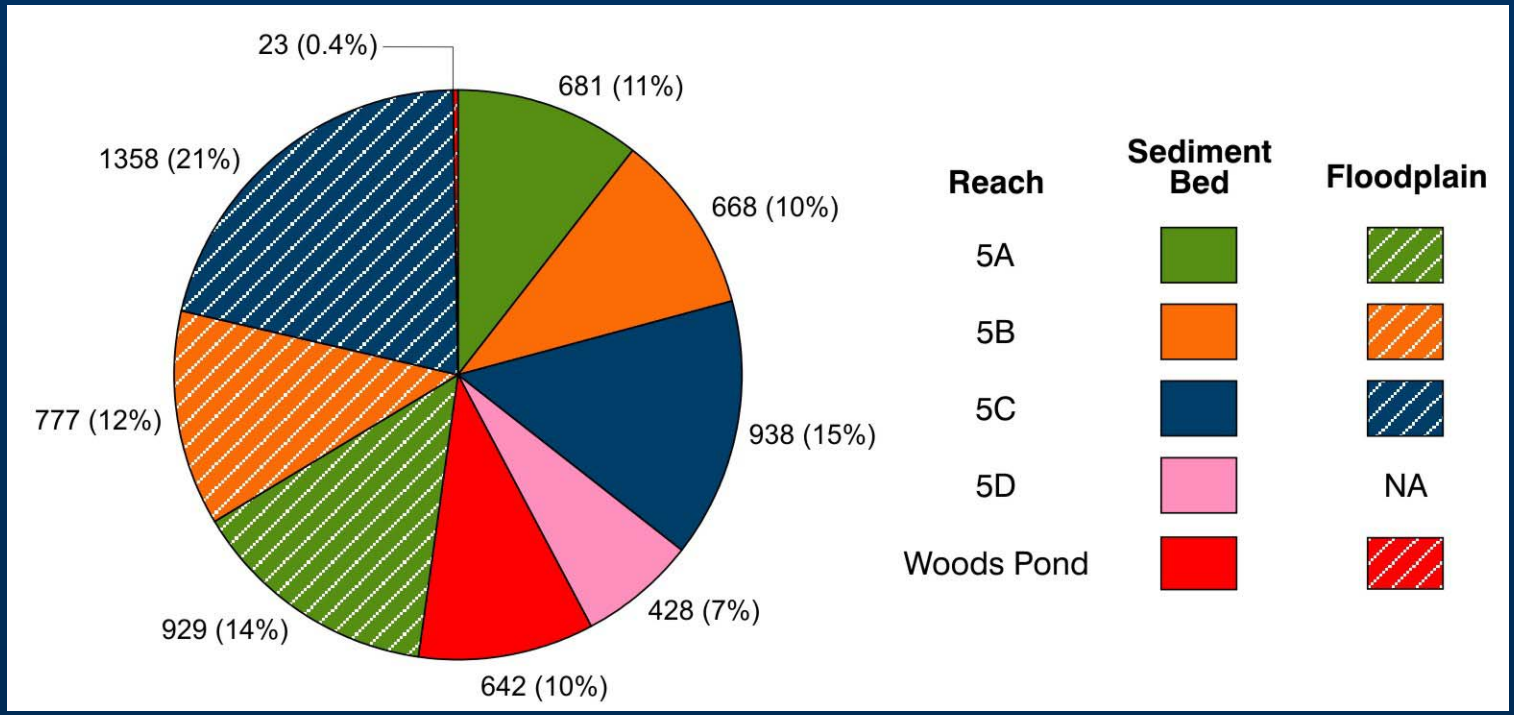
New Lenox Road



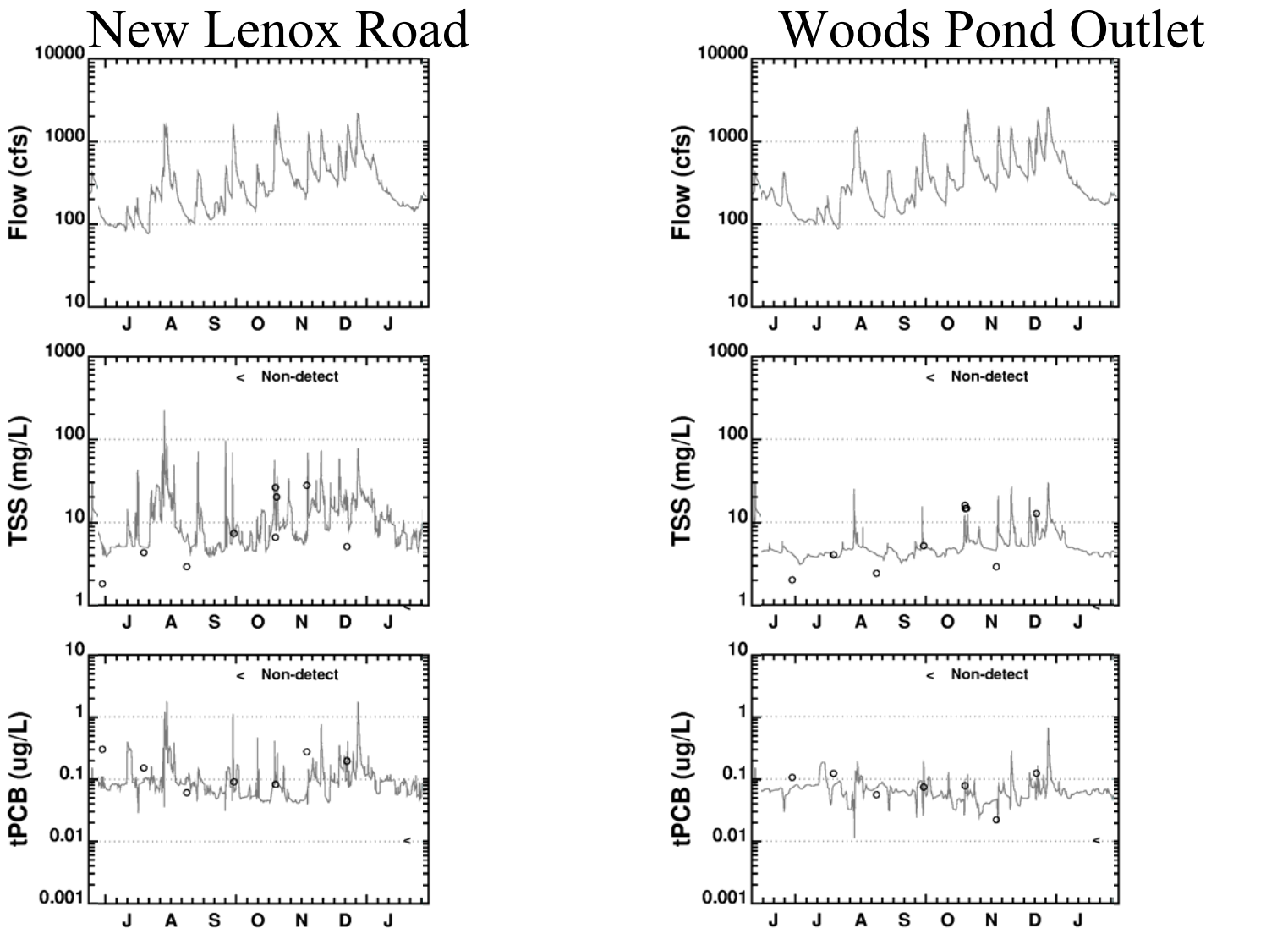
Woods Pond Outlet



Solids Deposition – 1979 - 2004

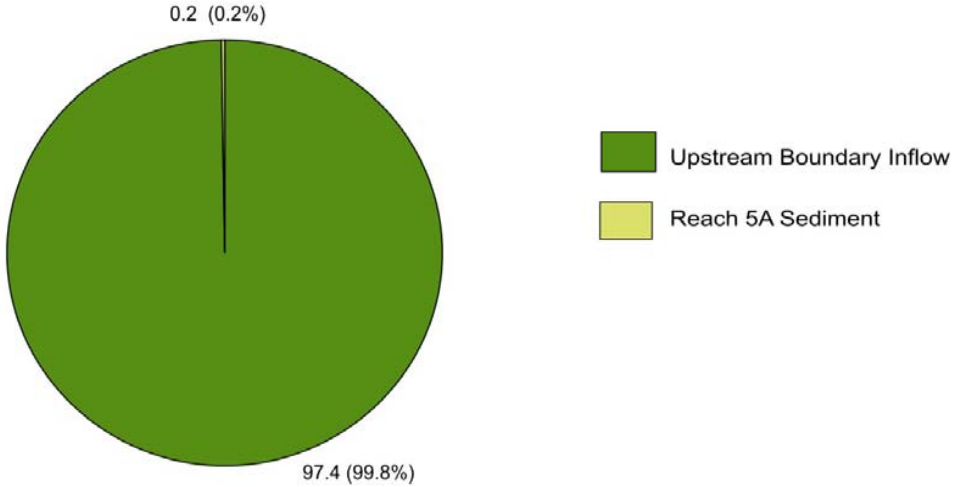


PCB Fate and Transport Validation

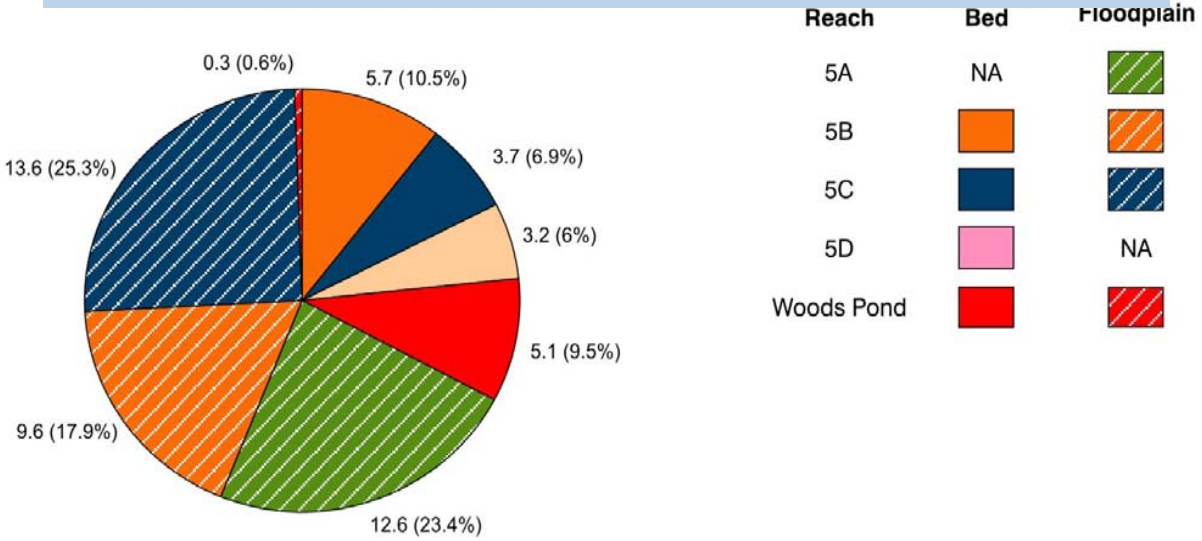


Net Movement of PCBs (1979-2004)

Where Do PCBs Come From - Net



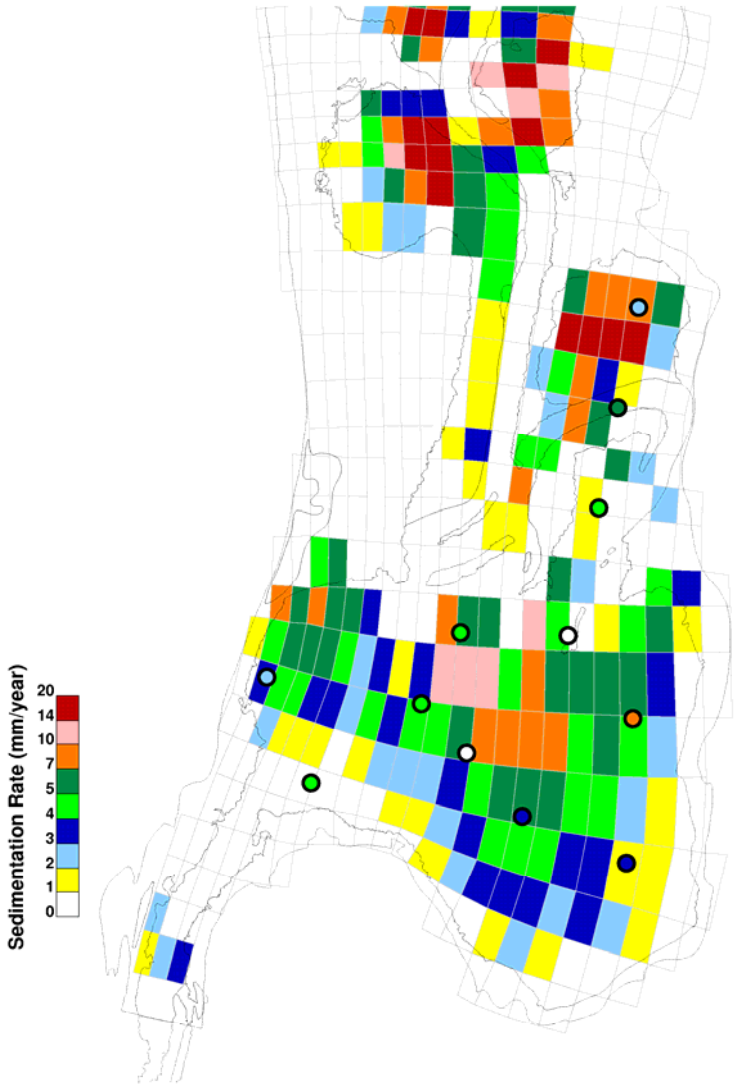
Where Do PCBs Accumulate - Net



Comparison of Model Validation Results with Performance Measures

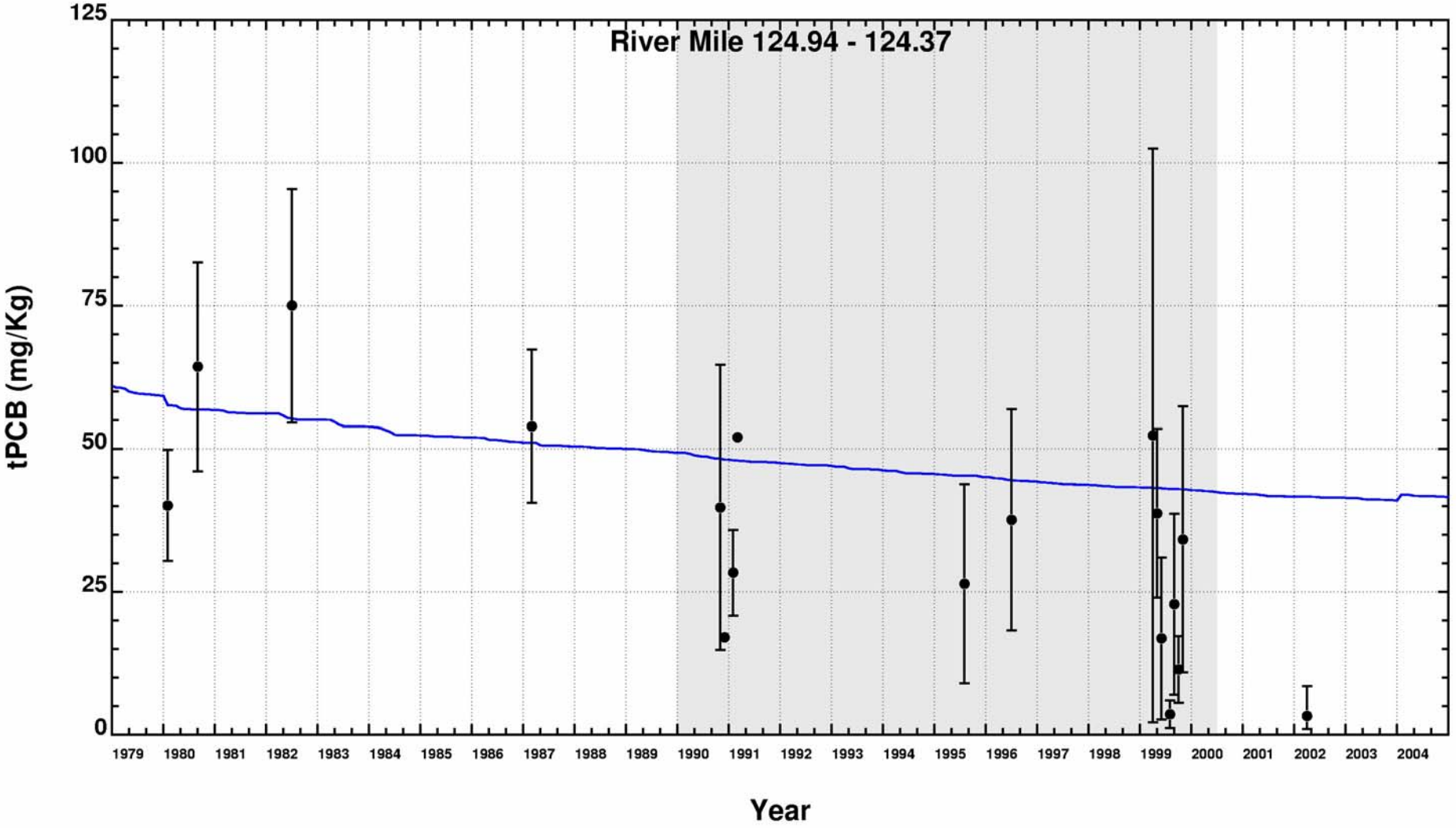
Parameter	Number of Data	Performance Measure (%)	Relative Bias (%)	Median Relative Error (%)
Flow	38,328	± 15	-7.9	-12.9
Depth	38,328	± 10	1.3	0.0
TSS	71	±30	-5.7	-16.6
Water Column PCB	119	±30	-5.6	-16.9

Additional Model-Data Comparisons



Average Rates Derived from Cesium Dating (cm/yr)	Average Simulated rates (cm/yr)	
	At individual core locations/matching grid cells = 0.49	Across all of Woods Pond = 0.40
	Percent Difference	
All Cores Peak Occurrence = 0.39	-25.6	-2.6
1995 Cores Peak Occurrence = 0.49	0.0	18.4
1995 Cores First Occurrence = 0.6	18.3	33.3

PCB Concentrations Over Time in Woods Pond Sediment



Summary

- Model Performance Measures specified in MFD were achieved
- Exposure Concentrations Provided to FCM
  - Dissolved PCBs in the water column
  - Particulate PCBs in the water column
  - Dissolved PCBs in sediment-bed
  - Particulate PCBs in sediment-bed