Housatonic River Model Calibration

Public Meeting

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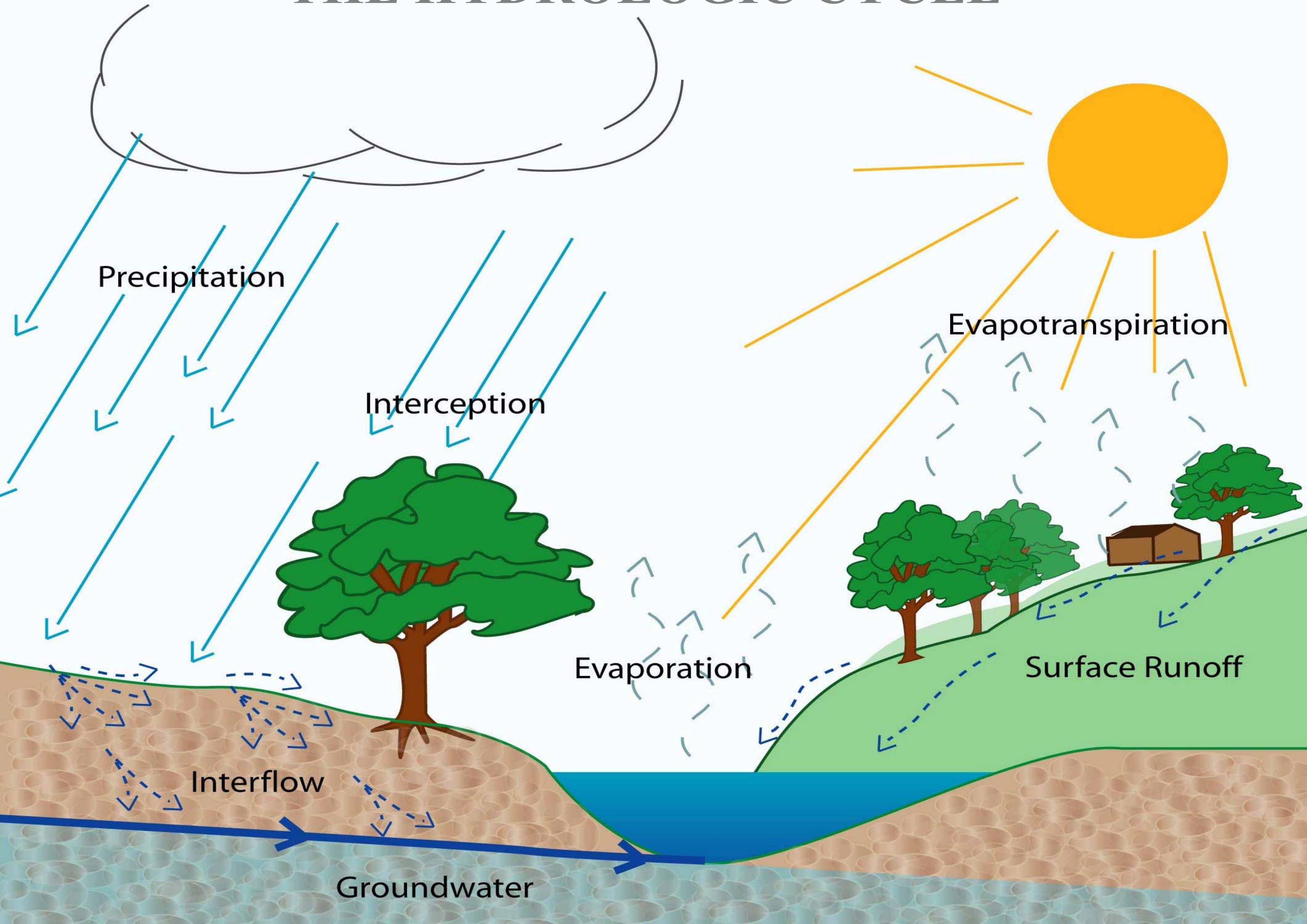
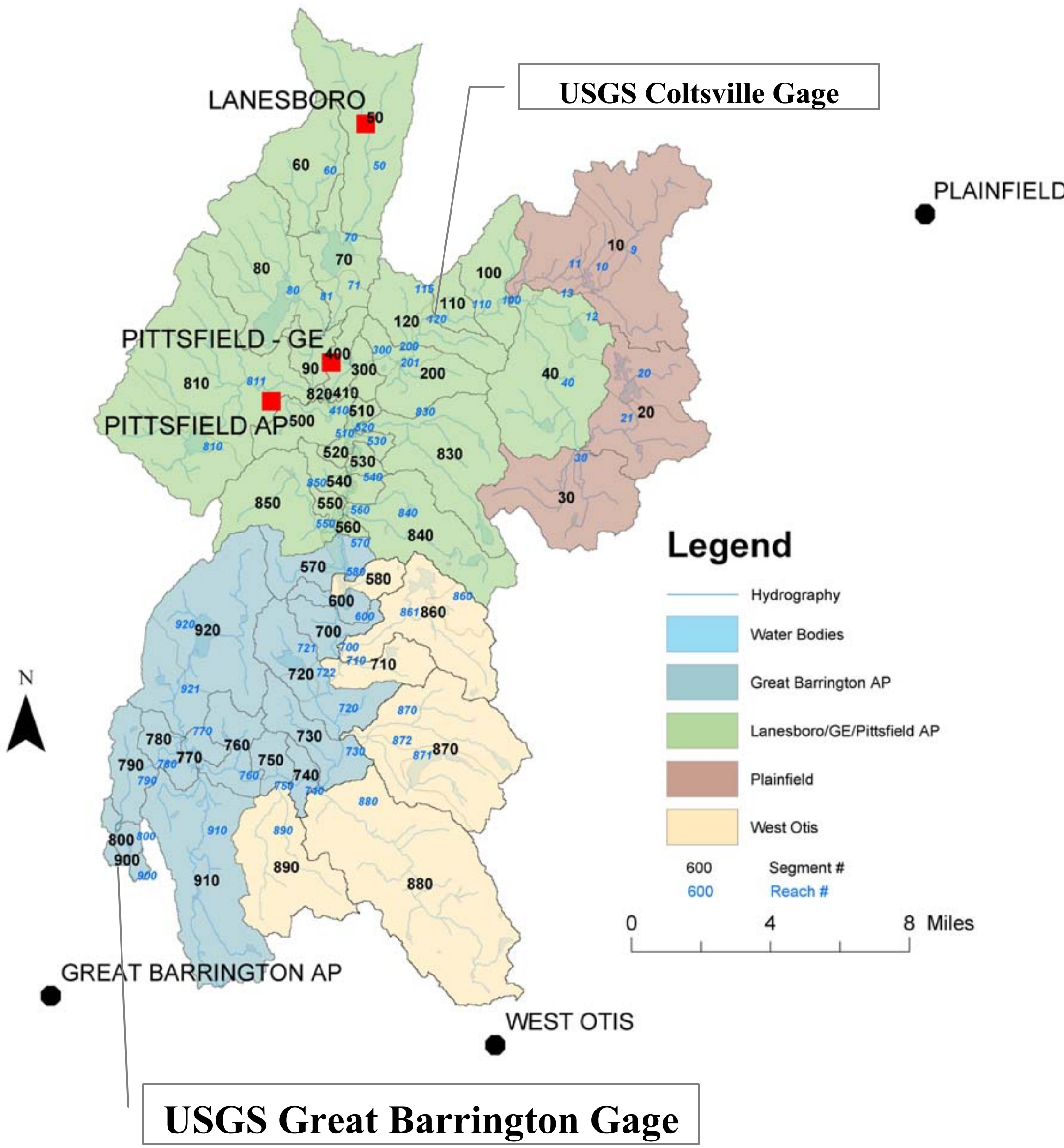
HydroQual, Inc.

January 5, 2005

THE HYDROLOGIC CYCLE



HSPF Segmentation



HYDROLOGY - WATER BALANCE

Water balance equation →

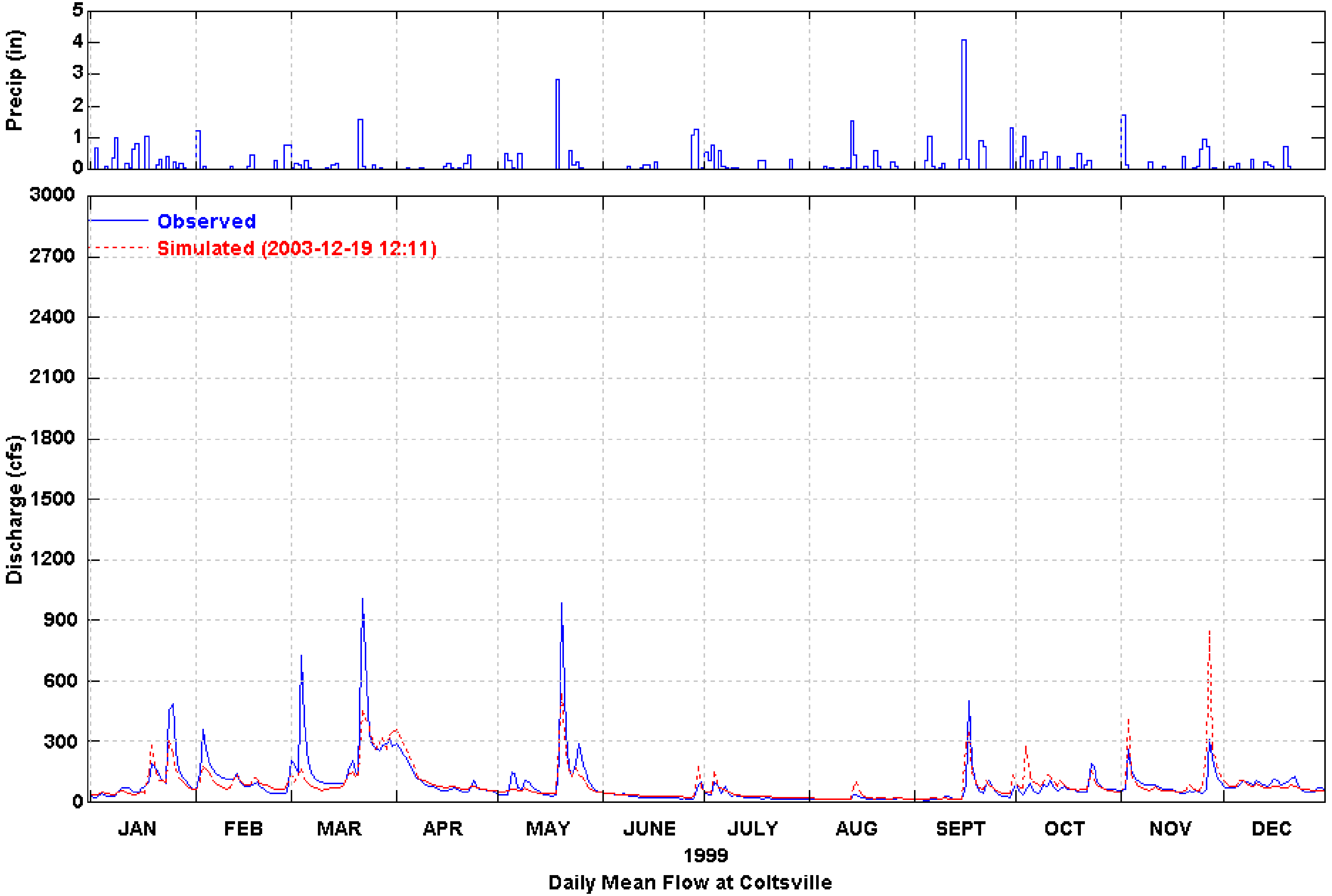
$$R = P - ET - IG - \Delta S$$

where:	R	=	Runoff
	P	=	Precipitation
	ET	=	Evapotranspiration
	IG	=	Deep/inactive groundwater
	ΔS	=	Change in soil storage

Inter-relationships between components

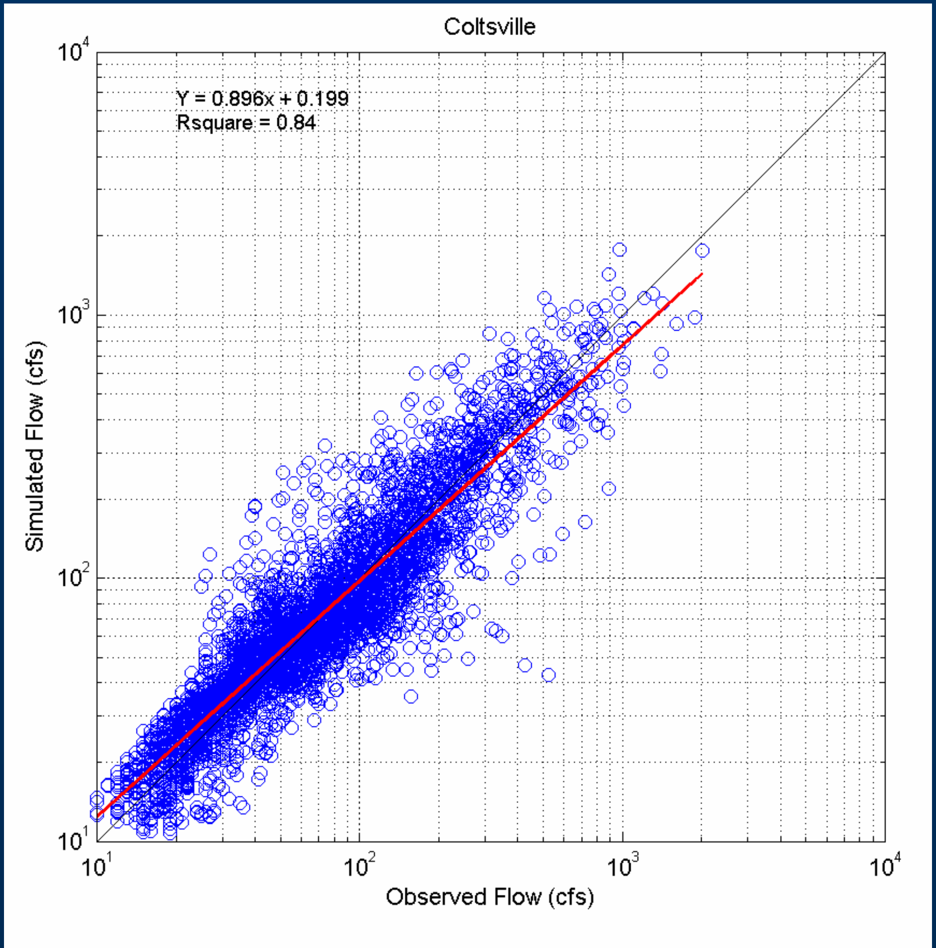
Variation of components with time

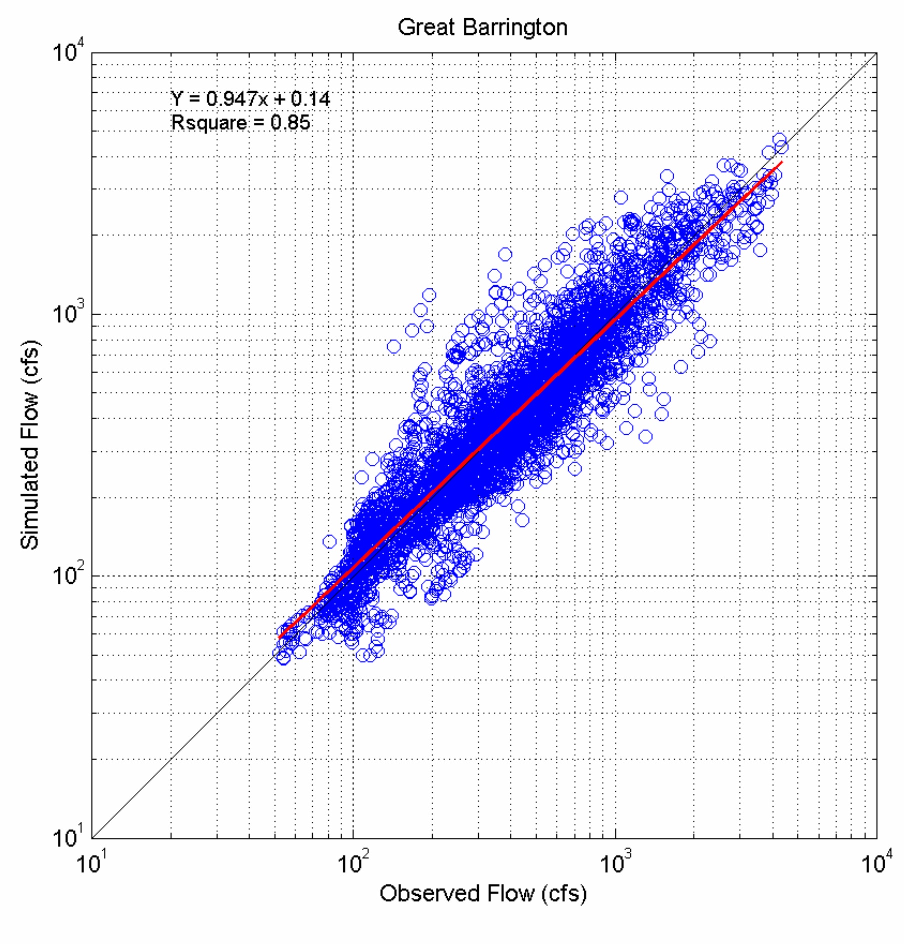
- consideration of soil condition, cover, antecedent conditions, land practices

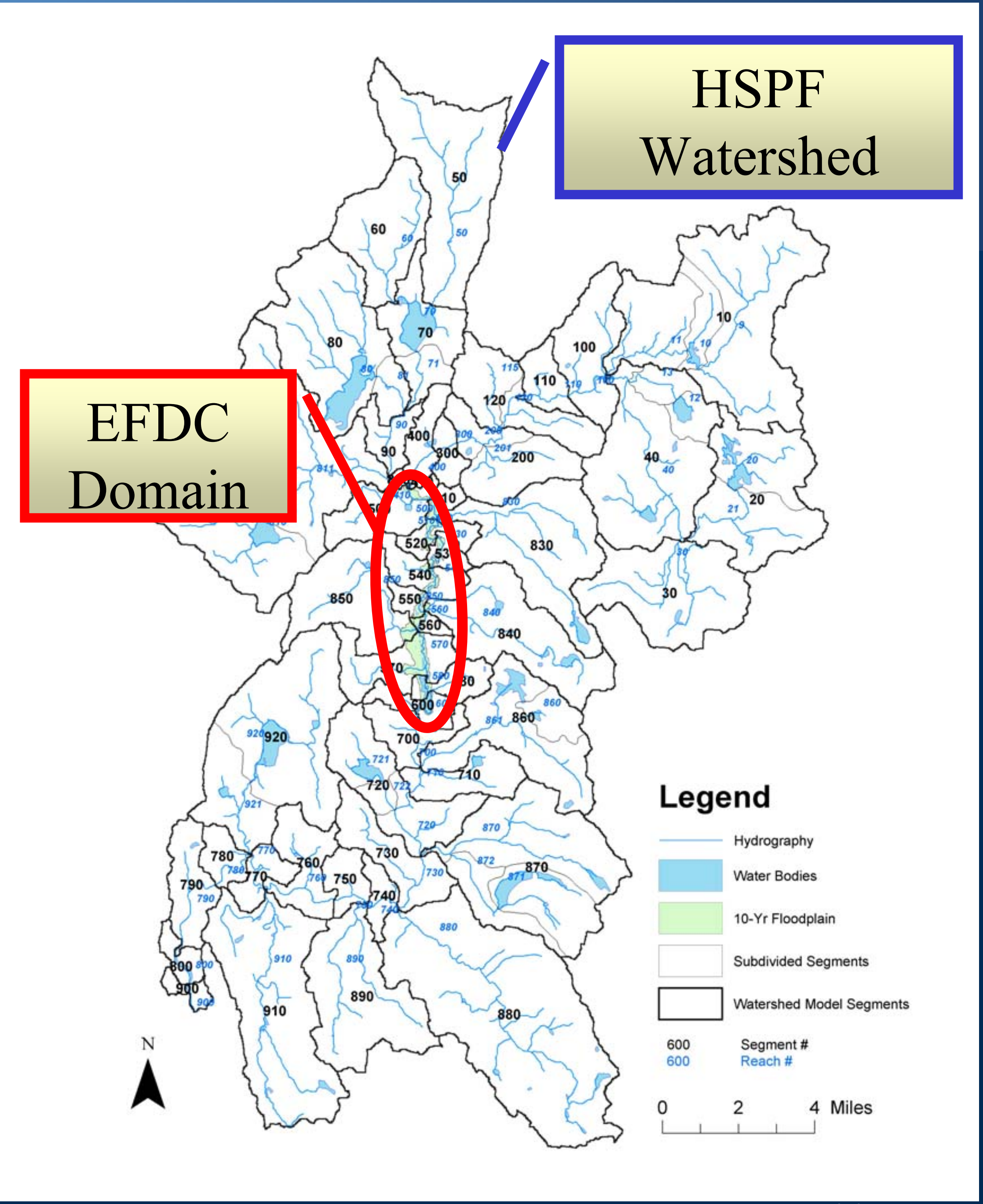


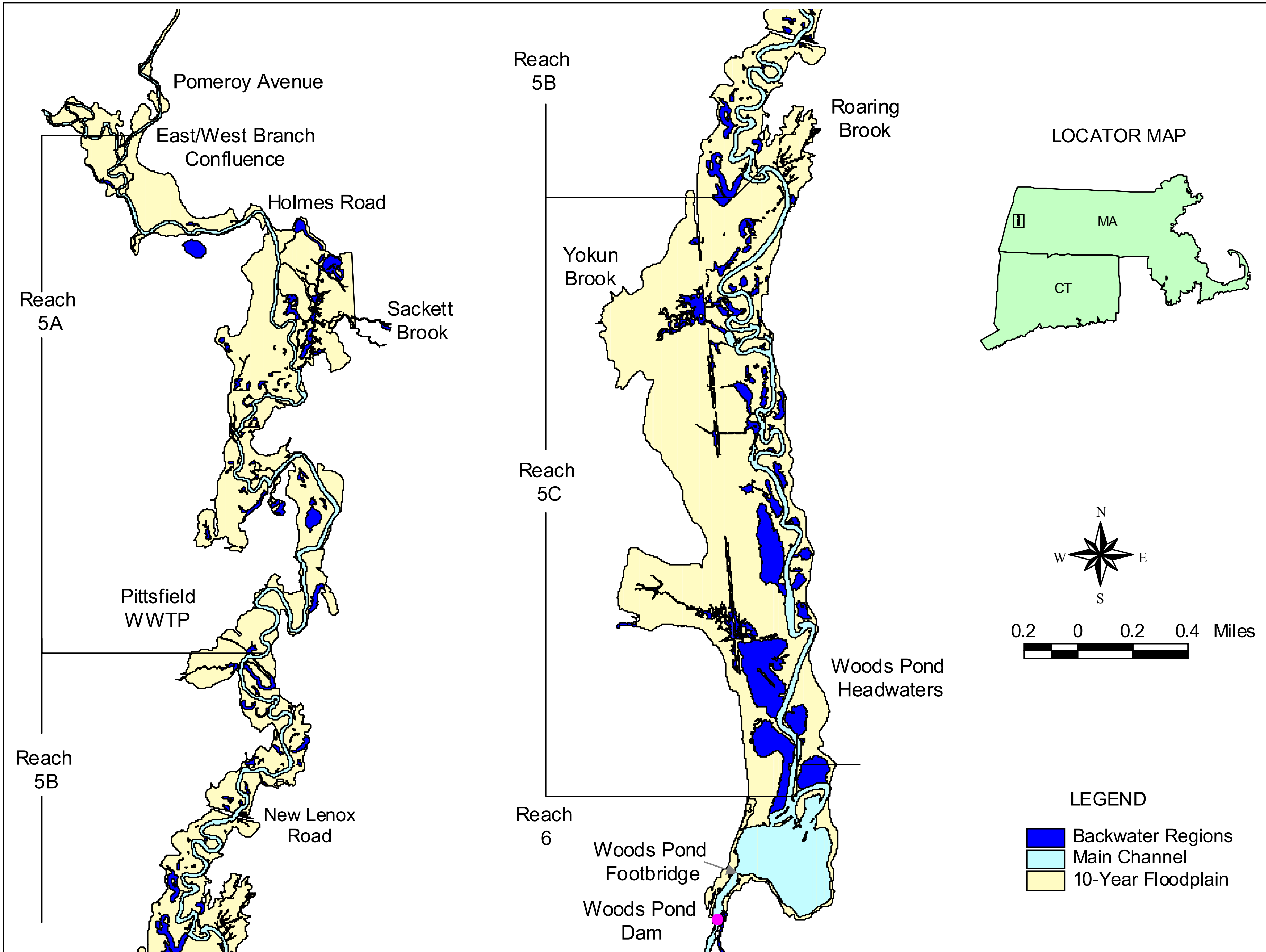
Precip (in)
5
4
3
2
1
0
3000
2700
2400
2100
1800
1500
1200
900
600
300
0
Discharge (cfs)
Observed
Simulated (2003-12-19 12:11)
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
1999
Daily Mean Flow at Coltsville

Simulated Vs. Measured Flows

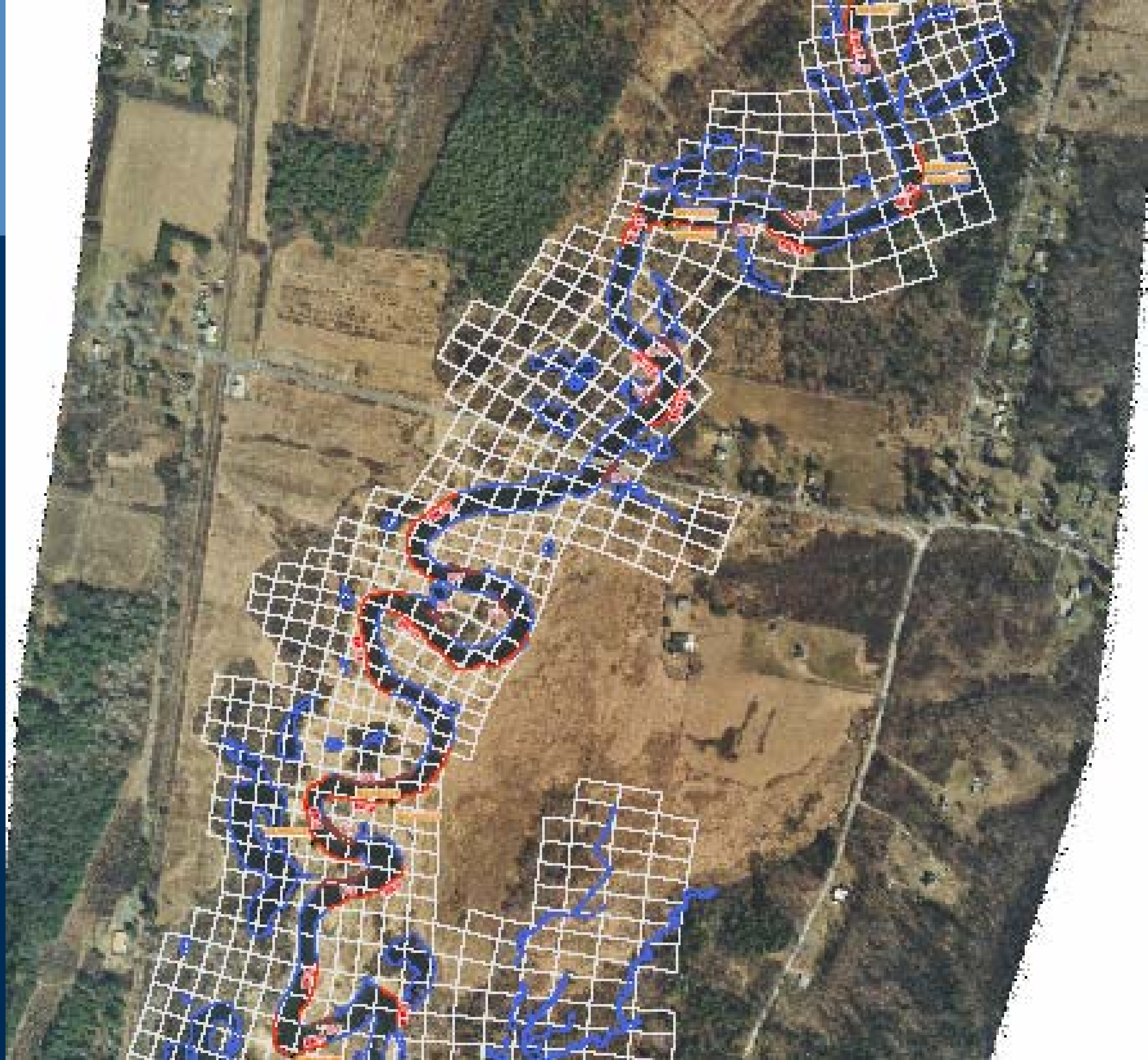





HSPF Watershed
EFDC Domain
Legend
Hydrography
Water Bodies
10-Yr Floodplain
Subdivided Segments
Watershed Model Segments
600 Segment #
600 Reach #
0 2 4 Miles
N

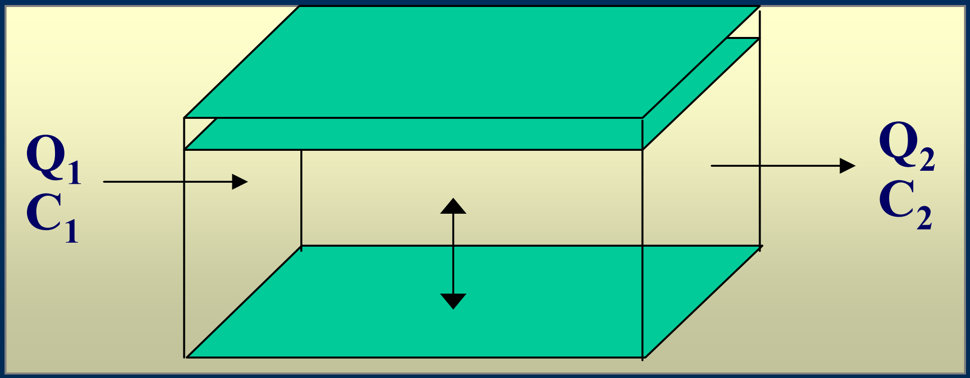

Pomeroy Avenue
East/West Branch Confluence
Holmes Road
Sackett Brook
Reach 5A
Pittsfield WWTP
Reach 5B
New Lenox Road
Reach 5B
Roaring Brook
Yokun Brook
Reach 5C
Woods Pond Headwaters
Reach 6
Woods Pond Footbridge
Woods Pond Dam
LOCATOR MAP
MA
CT
N
W
E
S
0.2
0
0.2
0.4
Miles
LEGEND
Backwater Regions
Main Channel
10-Year Floodplain

Model Grid



Governing Equations

- CONSERVATION OF MASS
  - Change in Volume (Water Level) = Flow In - Flow Out
  - Change in Concentration*Volume = Mass In - Mass Out



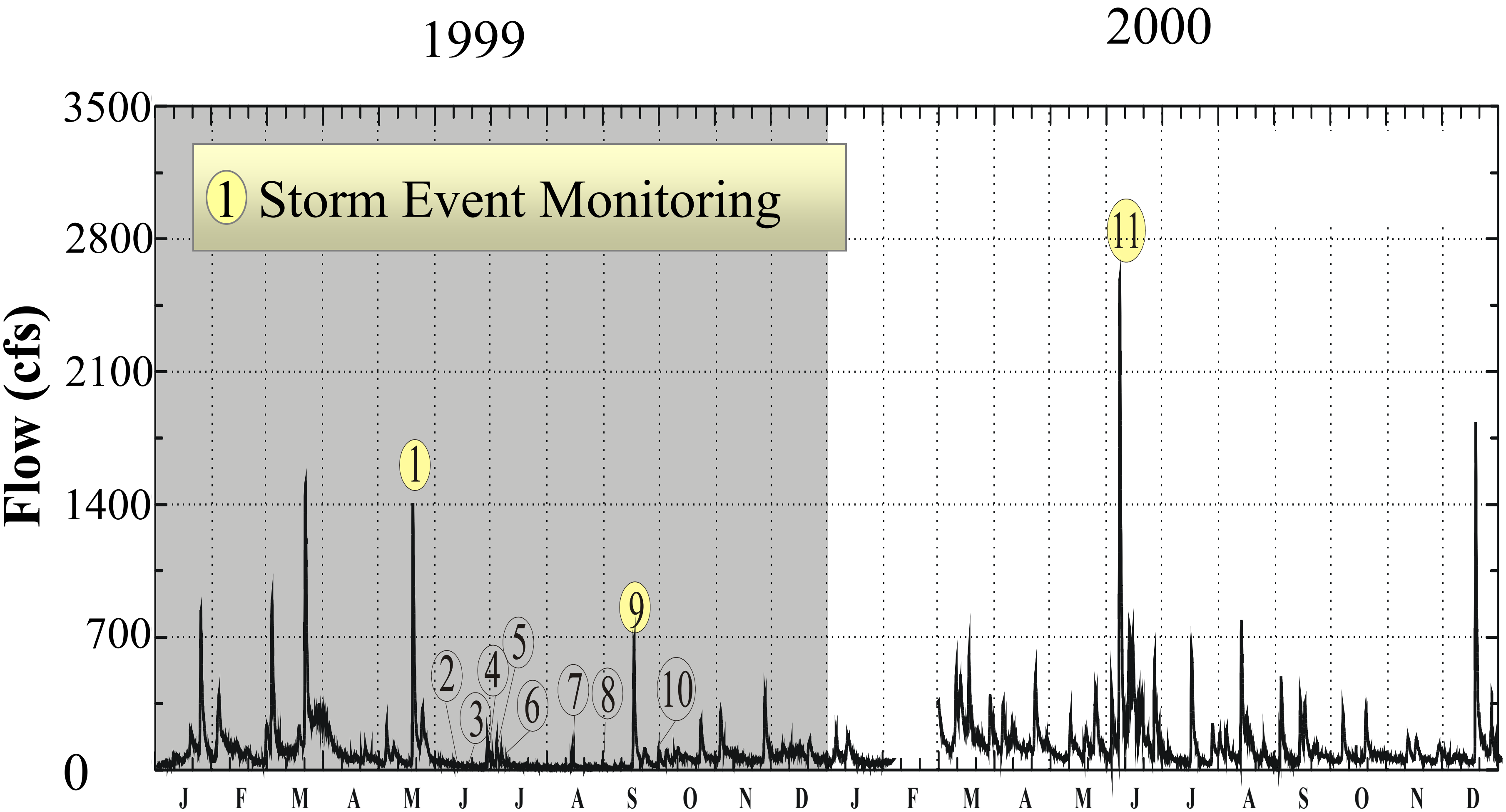
EFDC Components

- 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

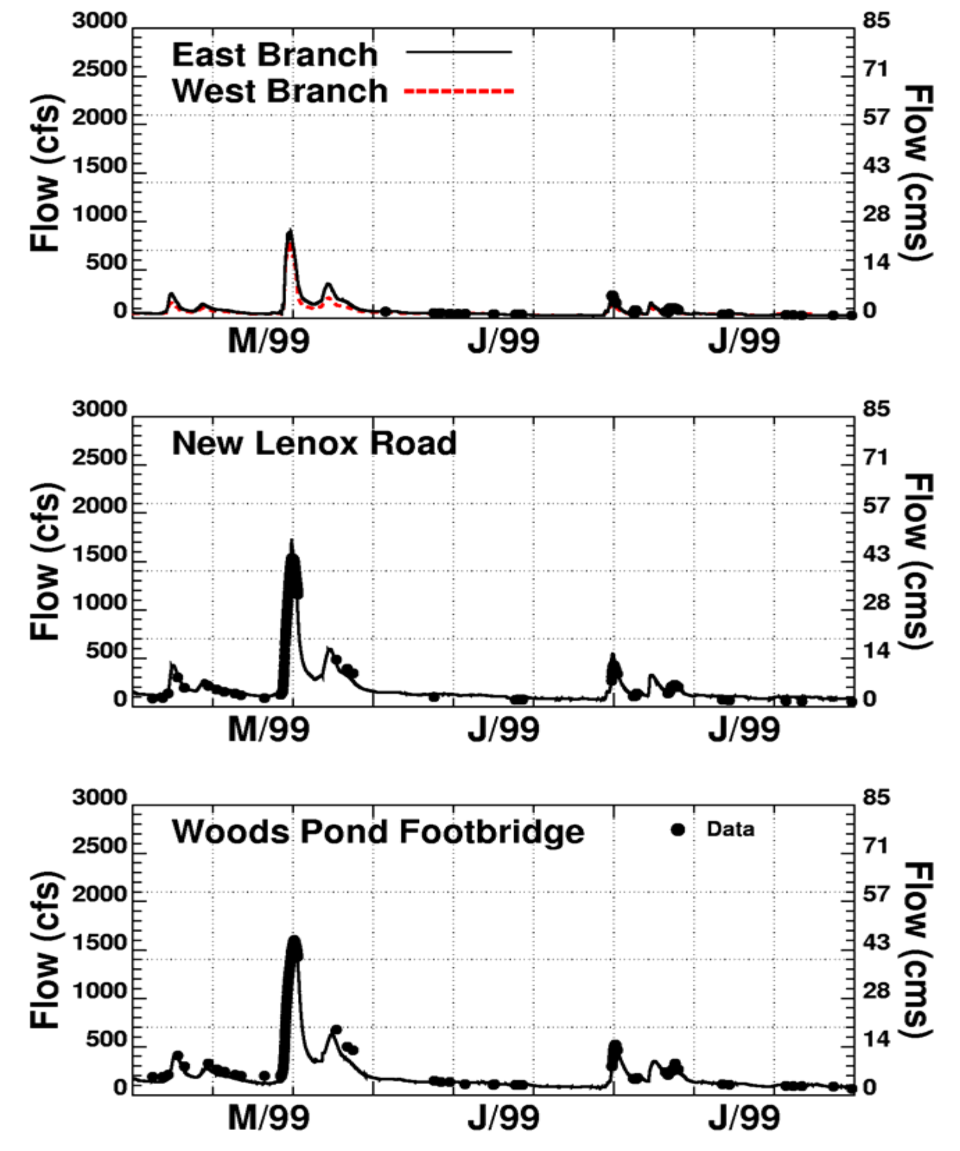
Hydrodynamic Model Inputs

- Inflows
  - Upstream boundaries
  - Tributaries
  - Direct Runoff
- Elevation of river and floodplain
- Geometry of model grid
- Bottom Roughness
- Vegetation on Floodplain
- Macrophytes in river, backwaters, and Woods Pond
- Downstream boundary flow-stage relationship

River Flow During Calibration Period

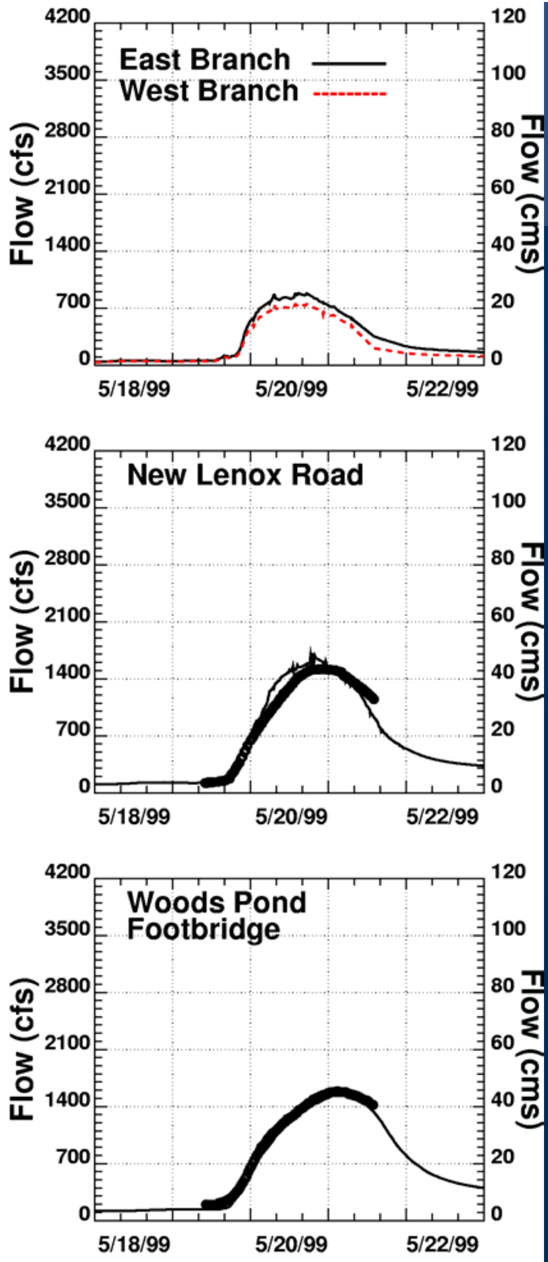


EFDC Hydrodynamic Calibration

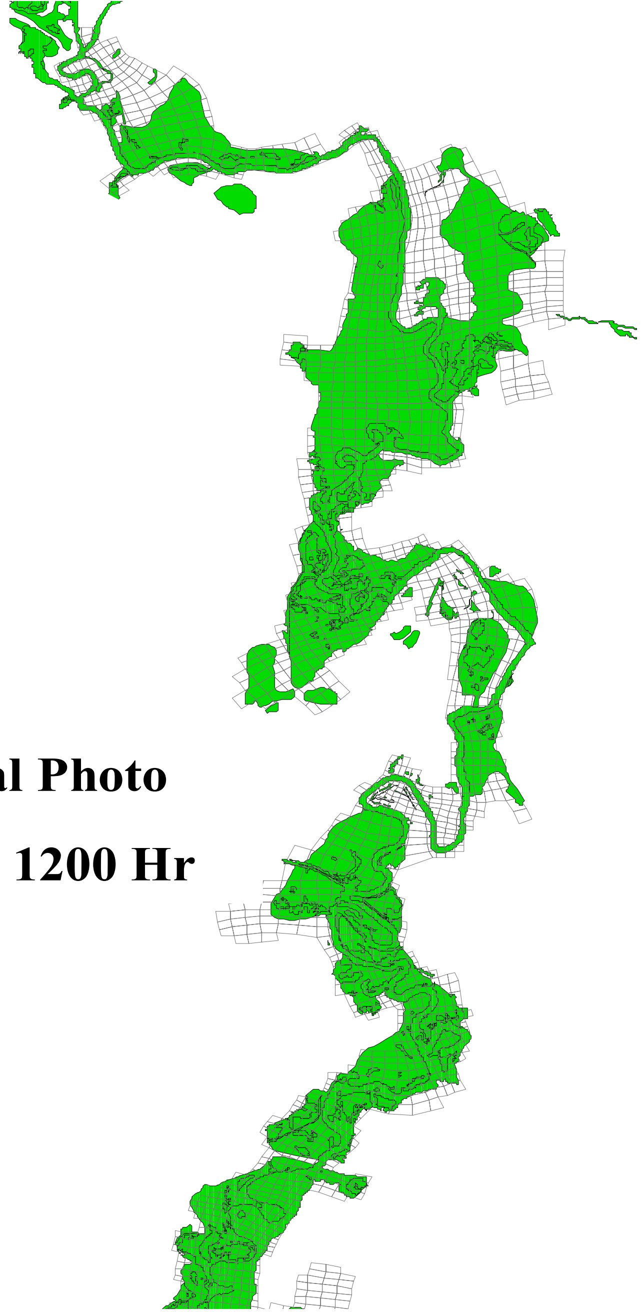


EFDC Hydrodynamic Calibration

May 19-21, 1999

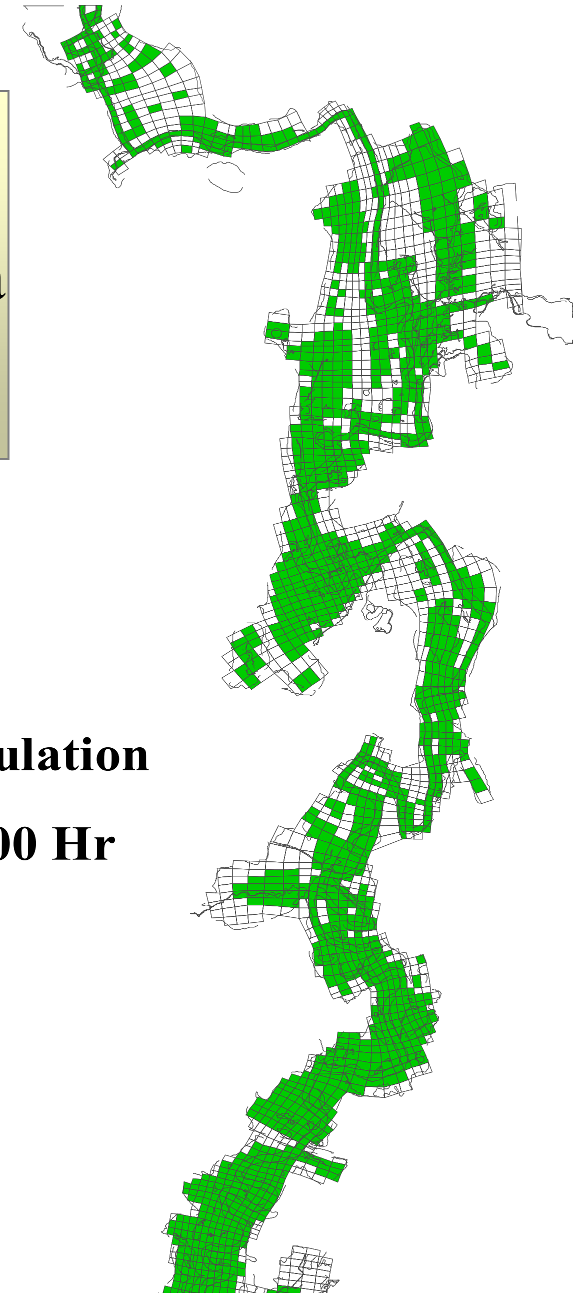


After
Hurricane Bertha
August 1990



Aerial Photo

1015 – 1200 Hr

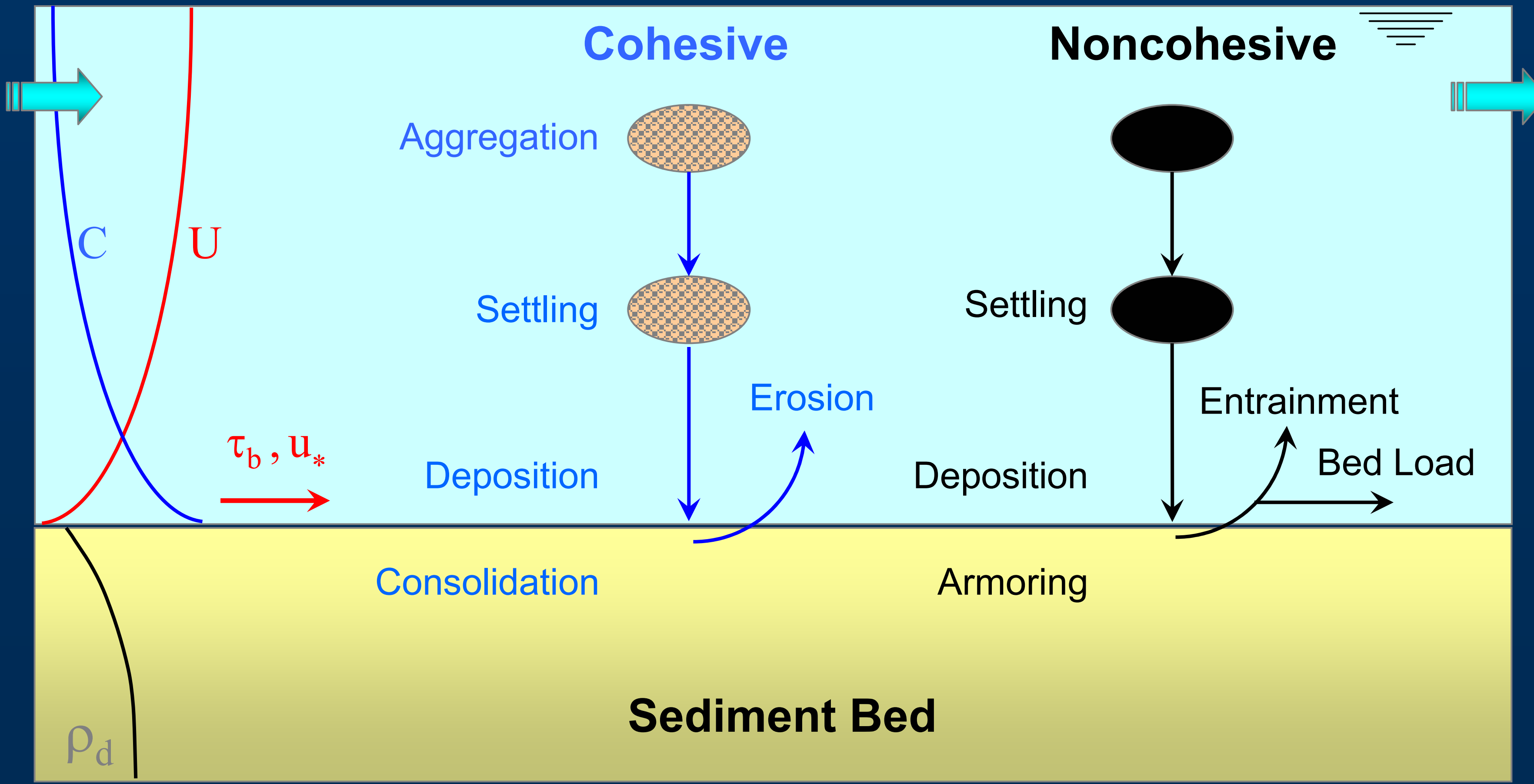


Model Simulation

1000 - 1200 Hr

Sediment Transport

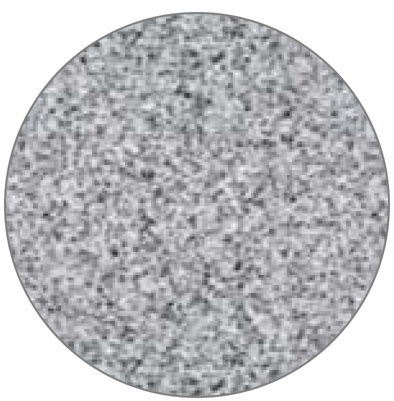
Sediment Dynamics



Cohesive

Non Cohesive 1

Non Cohesive 2



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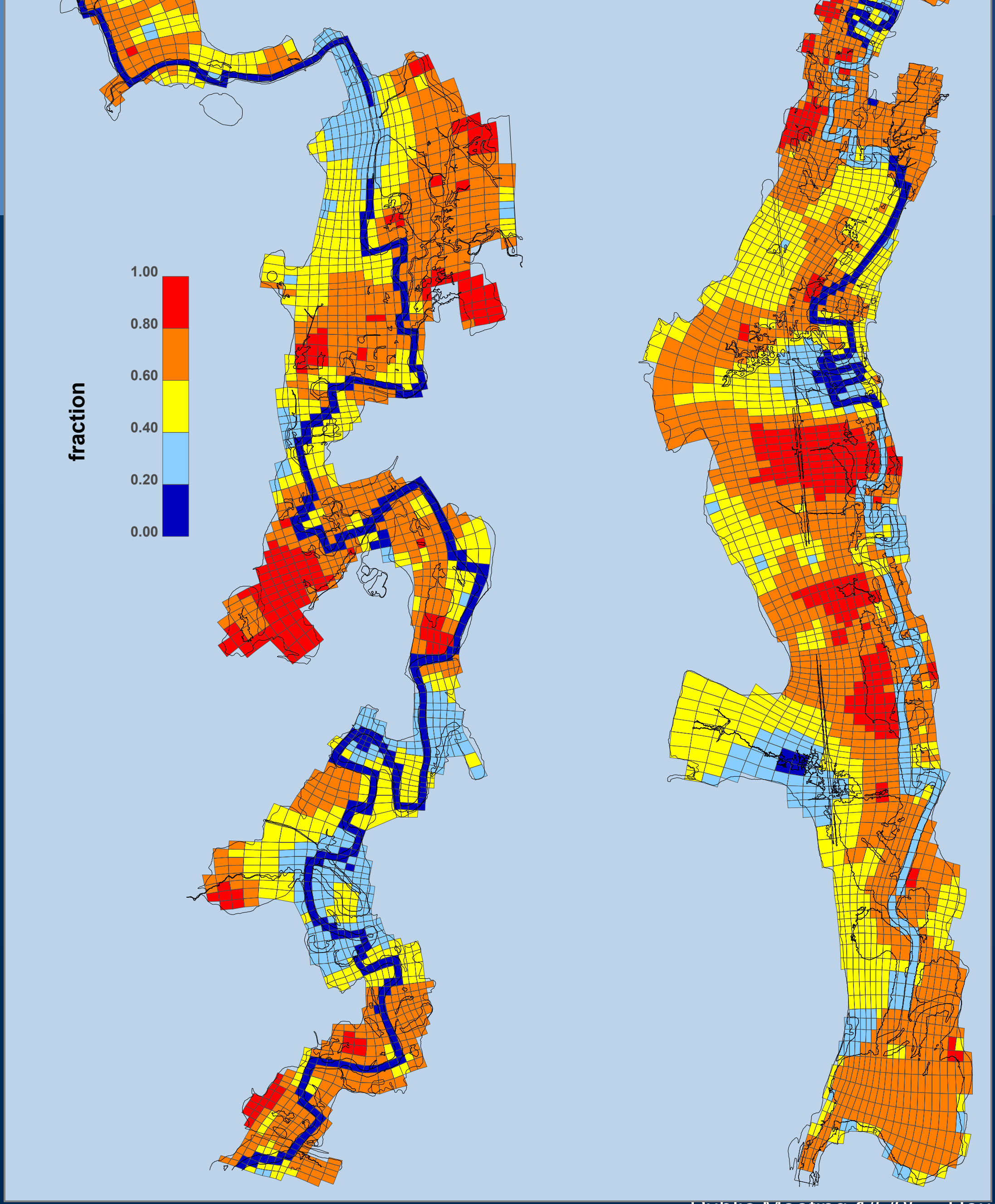
Sediment Transport Model Inputs

- Results of hydrodynamic modeling
- Inputs from:
  - Upstream boundaries
  - Tributaries
  - Direct Runoff
- Sediment and Floodplain soil properties
- Settling functions
- Resuspension functions
- Bedload transport functions

Initial Cohesive Fraction



Governing Equation

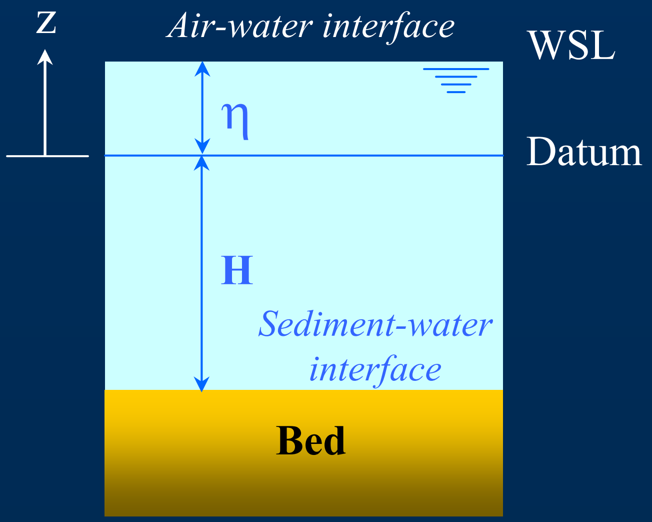
$$\frac{\partial C_k}{\partial t}+\frac{\partial UC_k}{\partial x}+\frac{\partial VC_k}{\partial y}+\frac{\partial (W-W_{s,k})C_k}{\partial z}$$

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

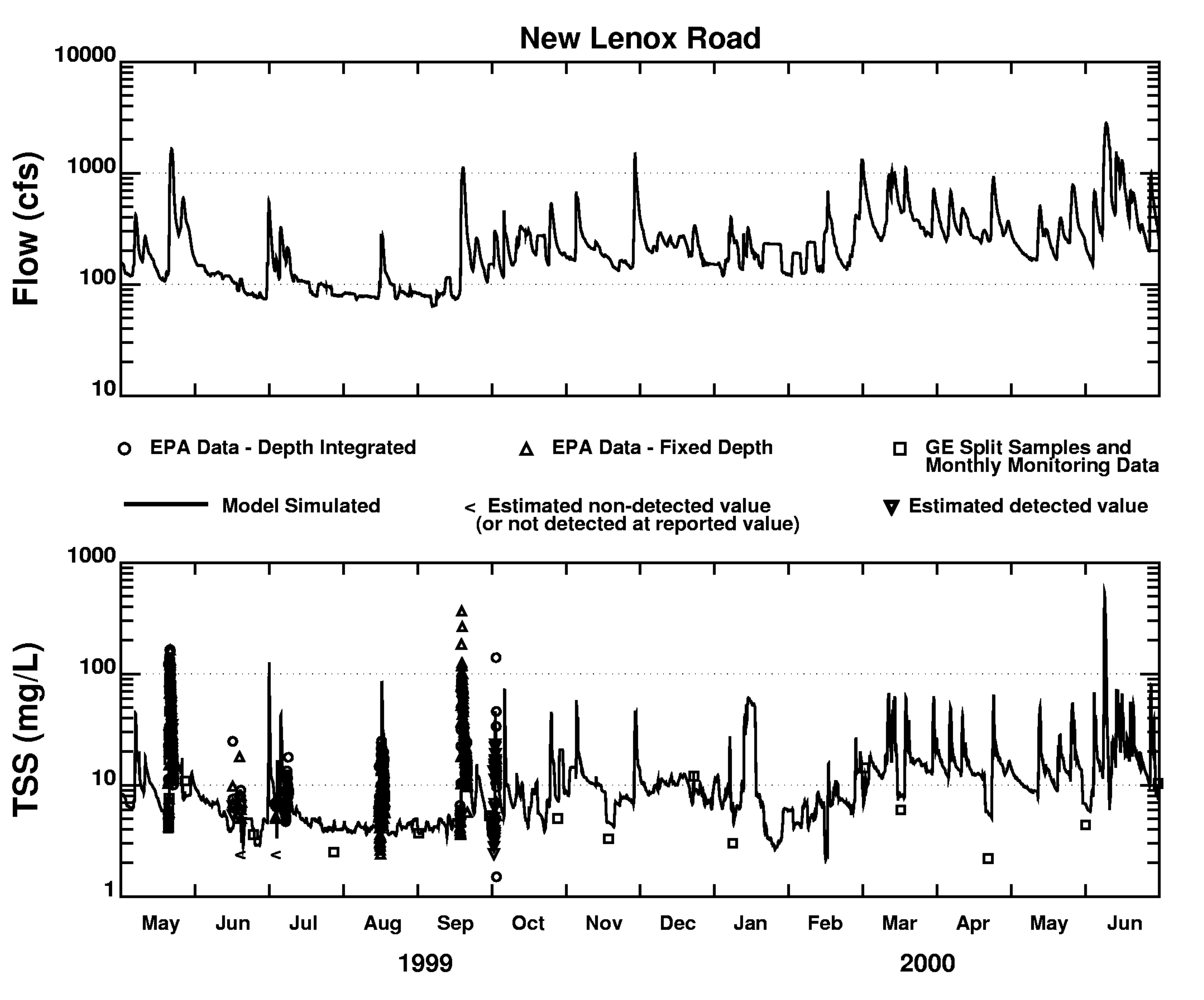
Boundary conditions:

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

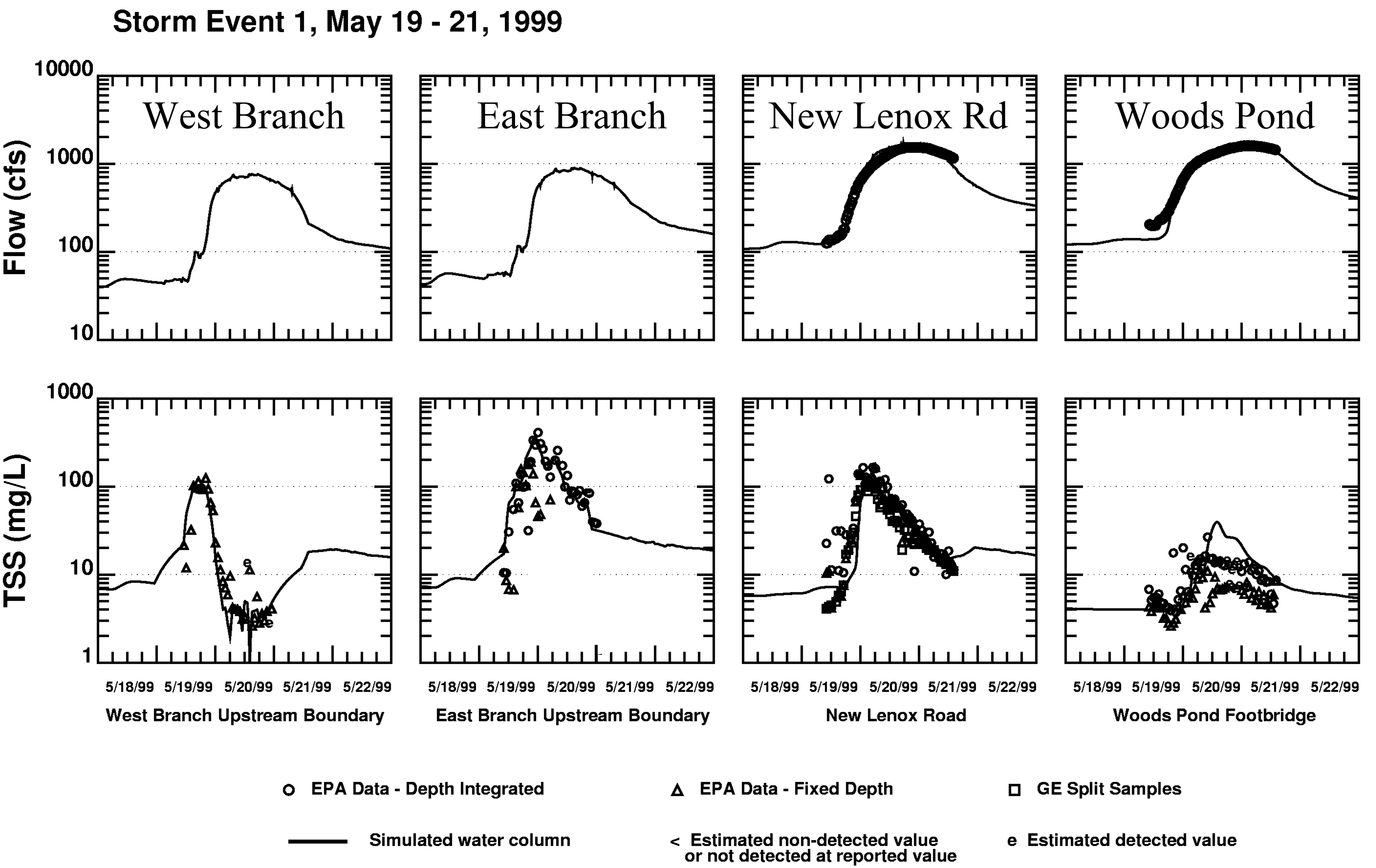
$$K_H\frac{\partial C_k}{\partial z}=E_k-D_k \quad , \quad z\rightarrow -H$$



EFDC Sediment Transport Calibration



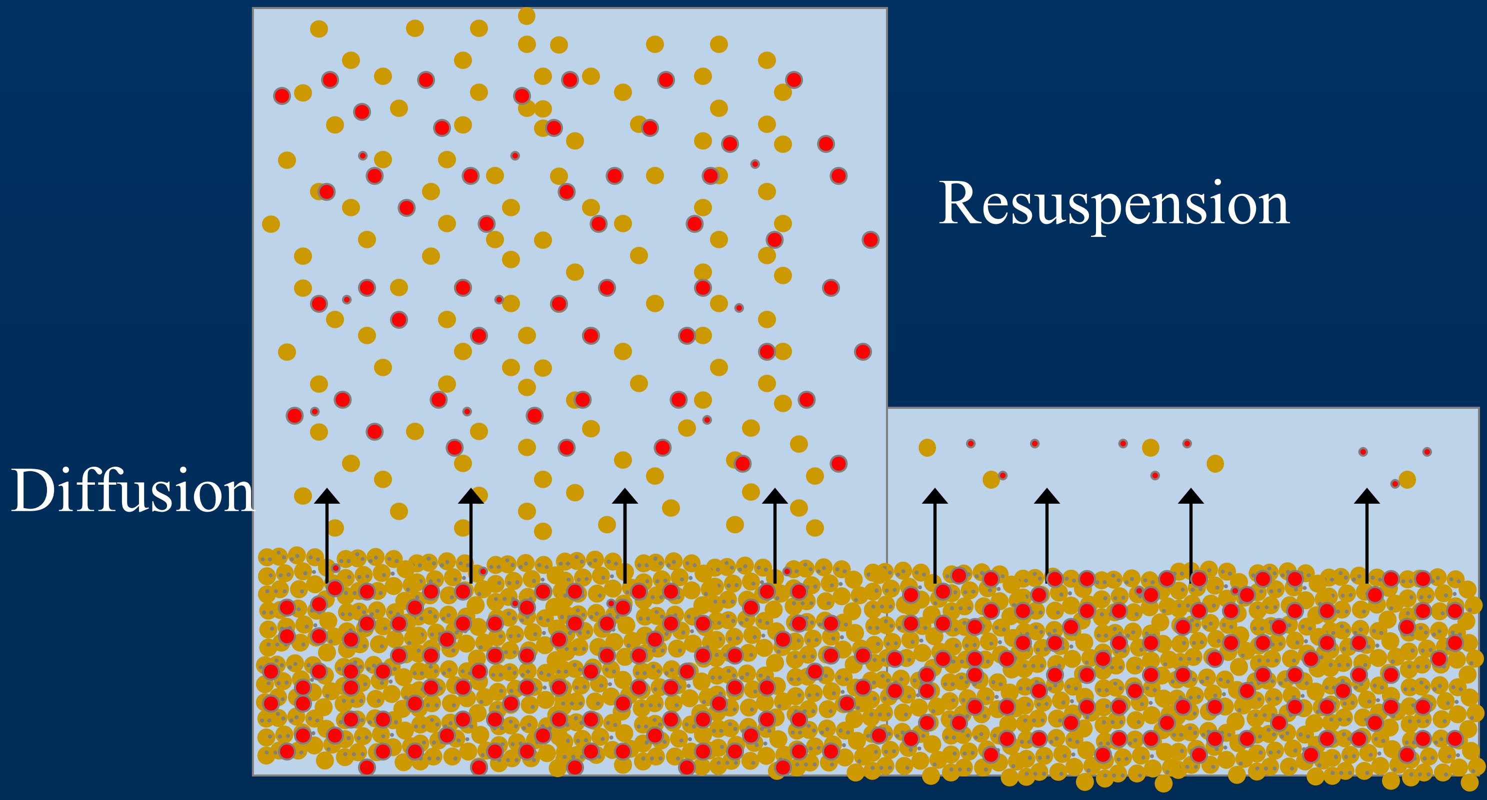
EFDC Sediment Transport Calibration



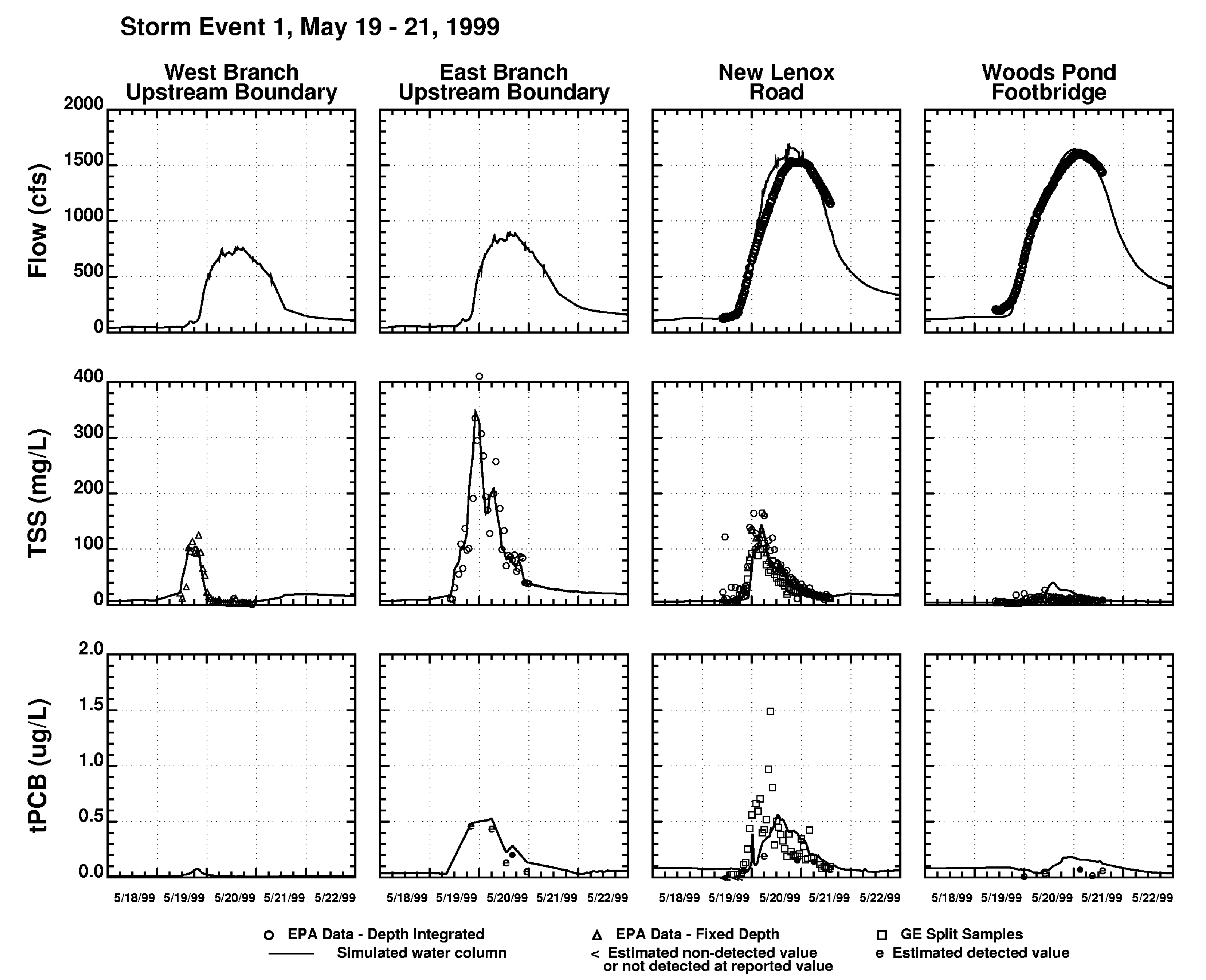
PCB Model Inputs

- Results of hydrodynamic and sediment transport modeling
- Inputs from:
  - Upstream boundaries
  - Tributaries
  - Direct Runoff
- PCB concentrations in sediment and floodplain soil
- Partitioning parameters
- Sediment-water diffusive transfer coefficient

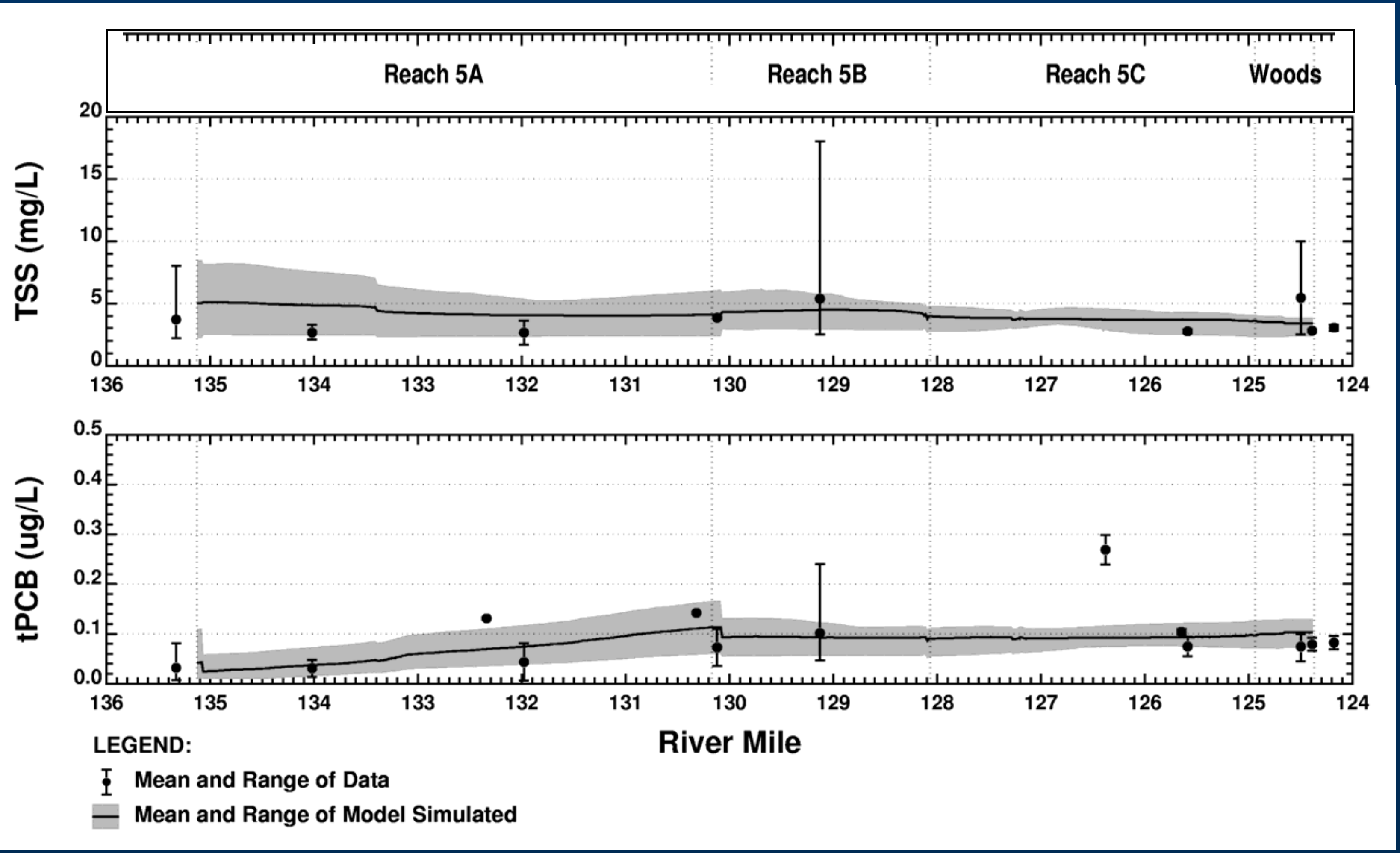
PCB Transport - Sediment-Water



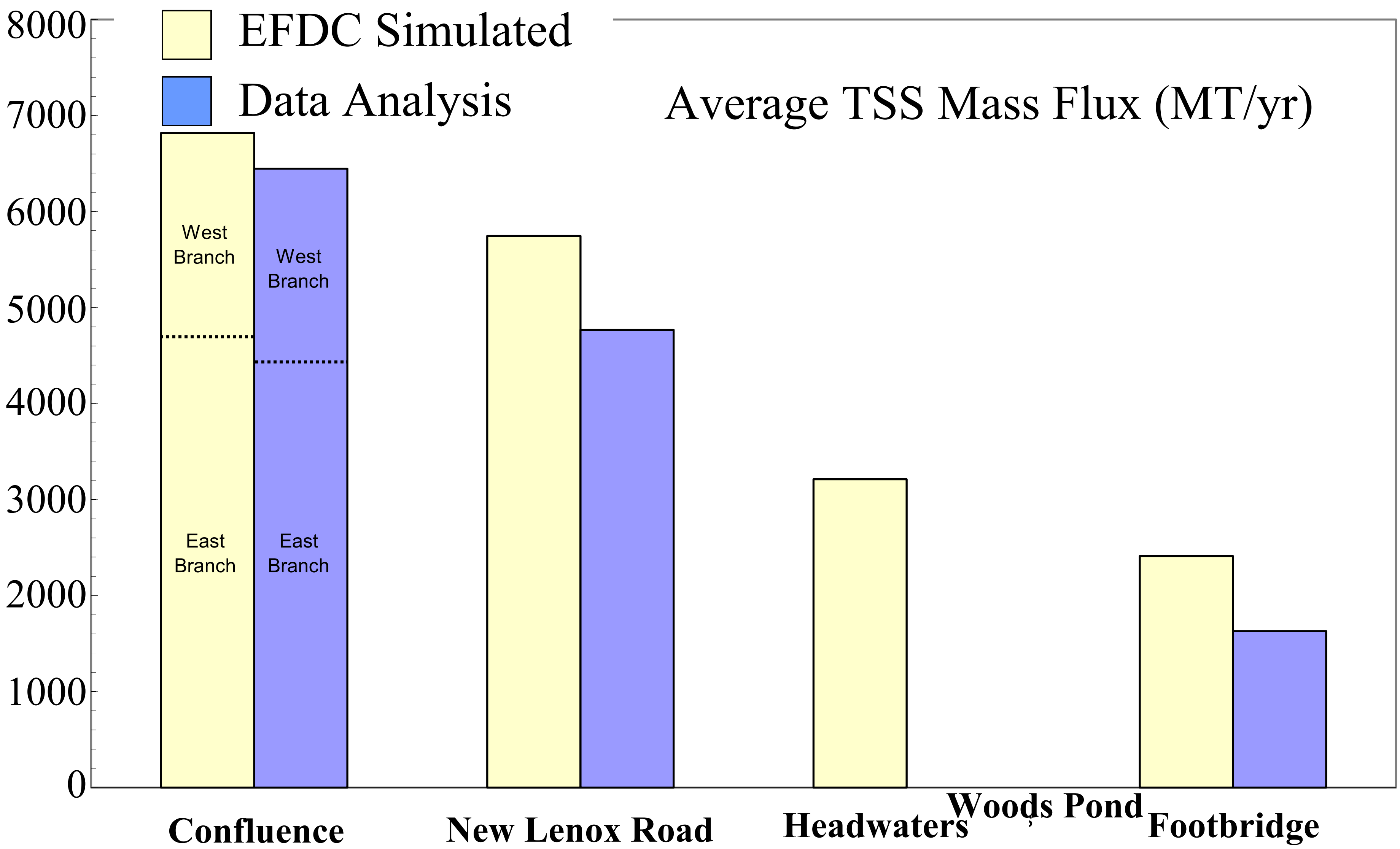
EFDC PCB Calibration – High Flow



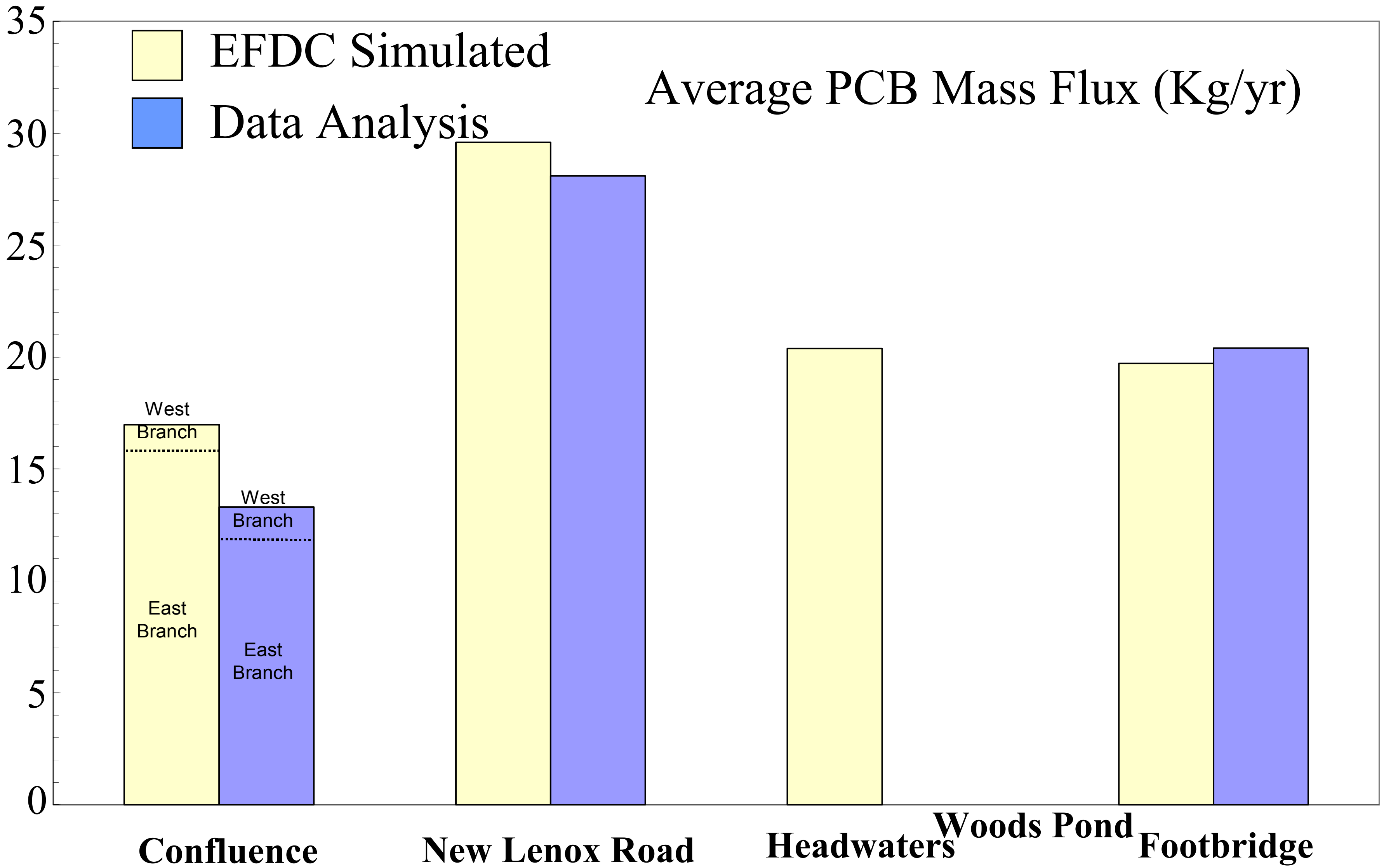
EFDC PCB Calibration – Low Flow



TSS Data Analysis and Model Results

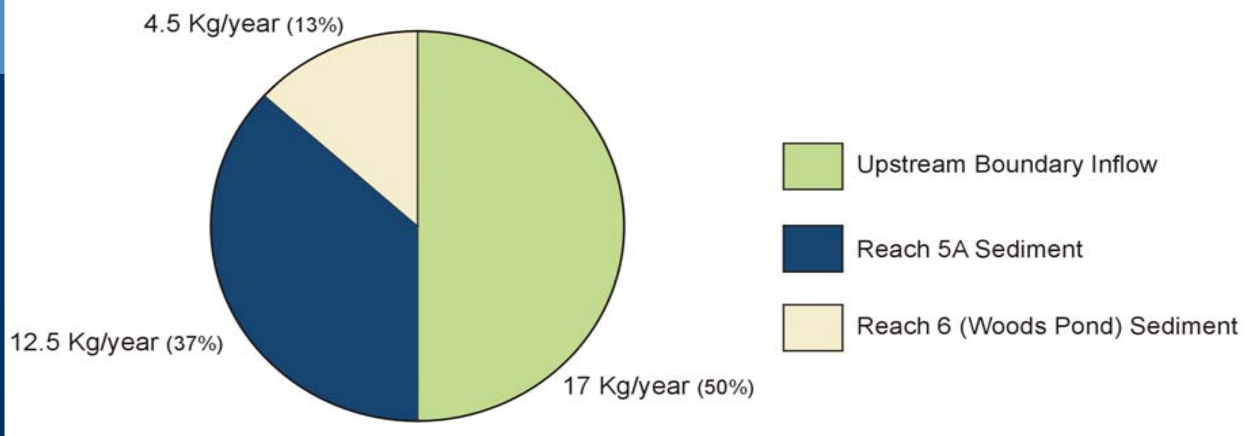


PCB Data Analysis and Model Results

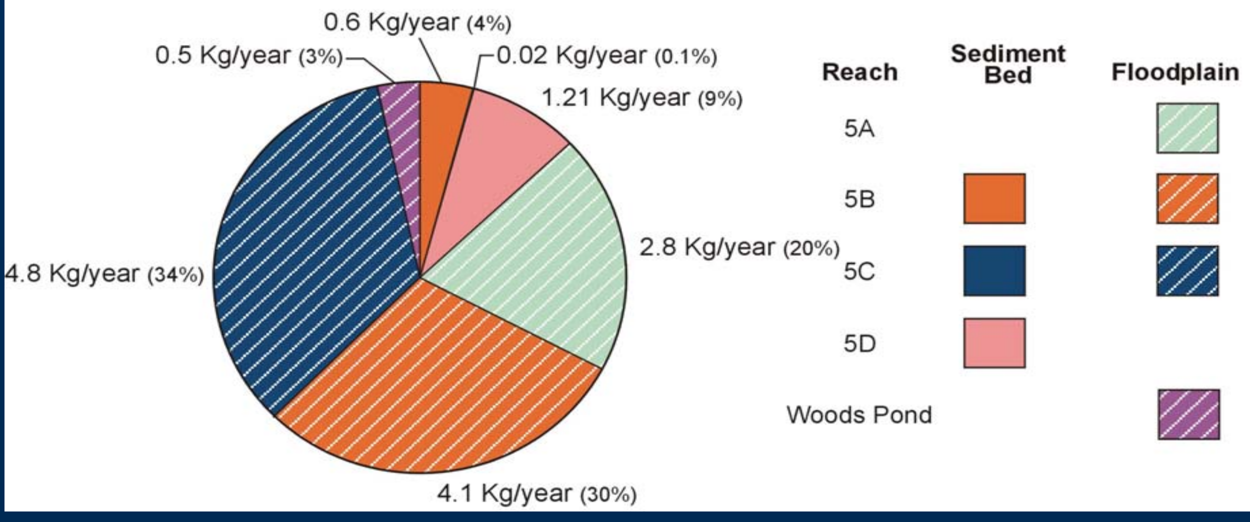


Net Movement of PCBs Over 14 Months

Where Do PCBs Come From - Net



Where Do PCBs Accumulate - Net



Summary

- Model Performance Targets were achieved
- Exposure Concentrations Provided to FCM