

Mercury TMDL Update South River, Virginia

Jack Eggleston



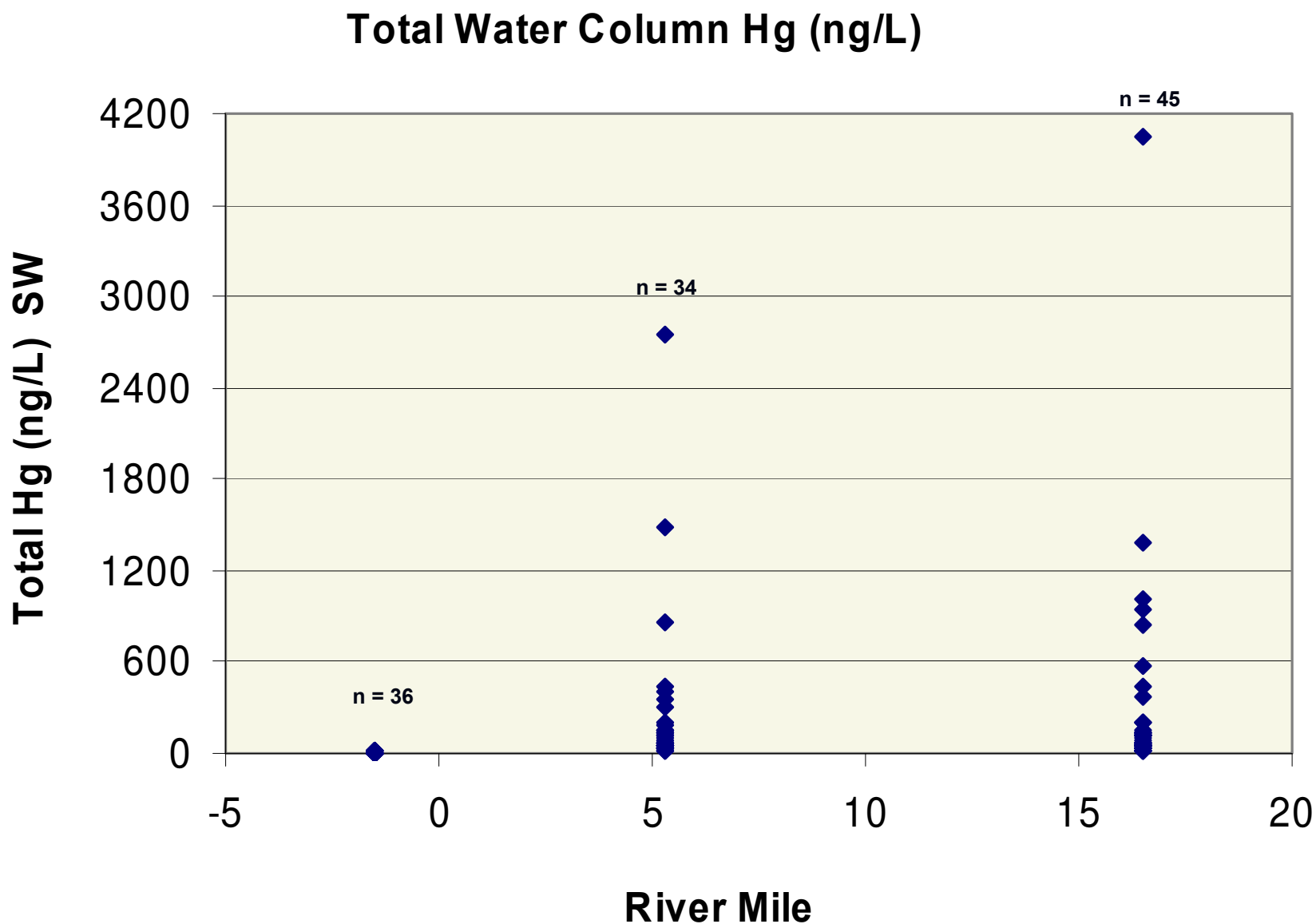
Cooperating Agencies



Goals of the TMDL Project

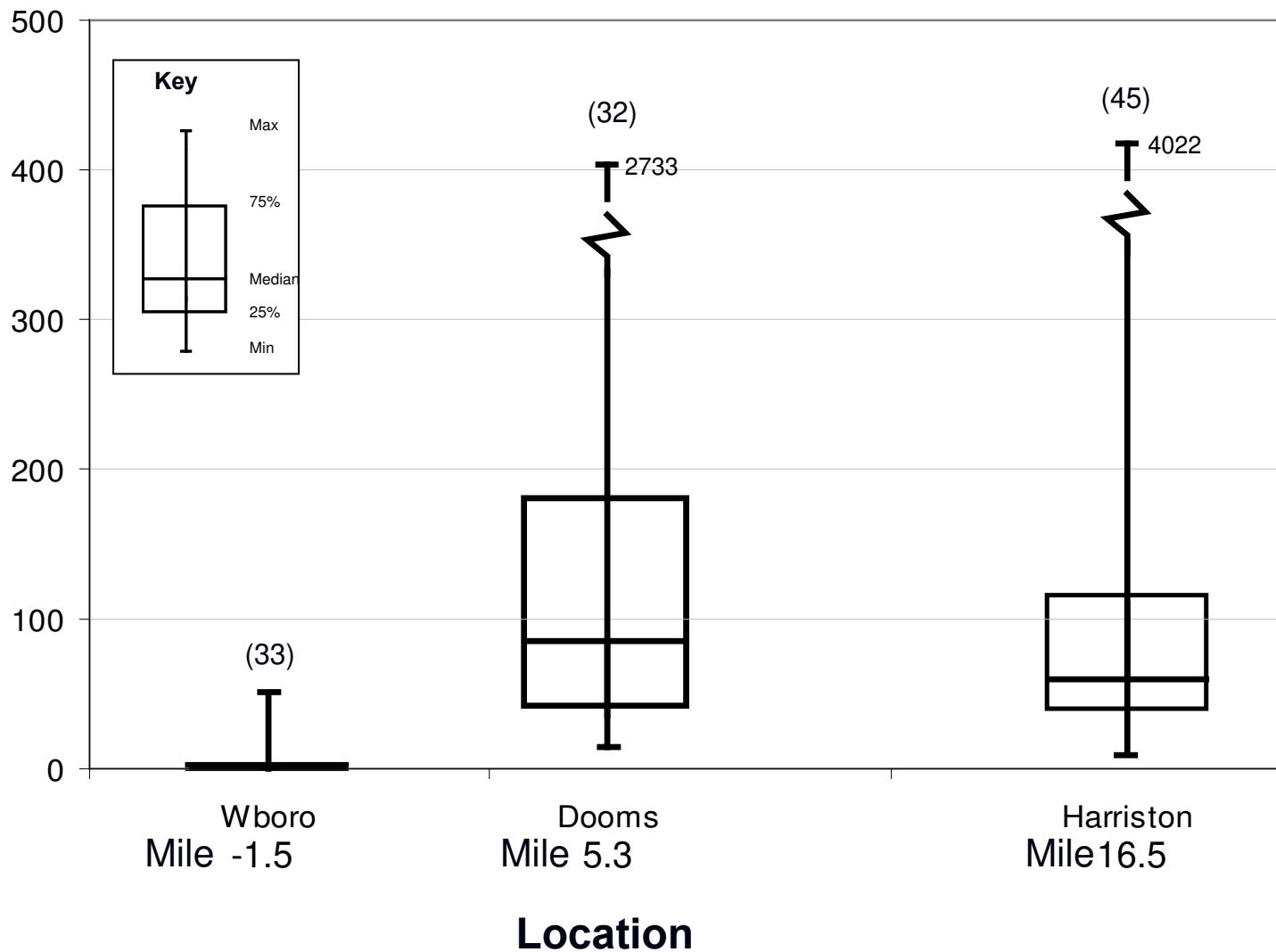
- ✓ • Collect data characterizing mercury (Hg) and methyl-mercury (MeHg) fluxes and production rates in the South River watershed.
- ➔ • Develop numerical models for simulating surface water flows and Hg cycling and transport.
- Using the surface water and contaminant transport models, calculate maximum allowable mercury loads (TMDL) from all point and non-point sources.

Total Hg in South River water column

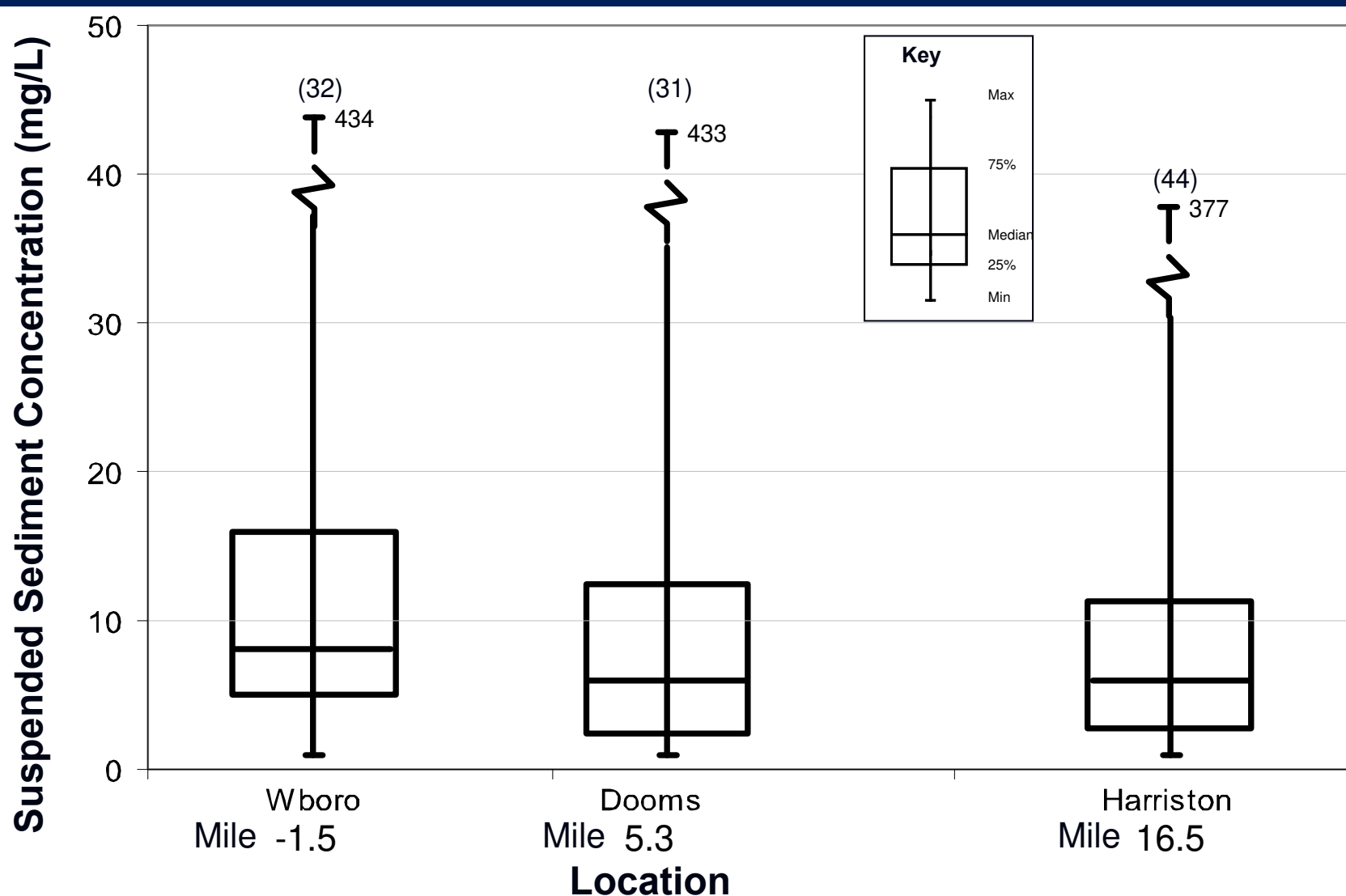


Water Column Hg Concentration – Particulate Phase (ng/L)

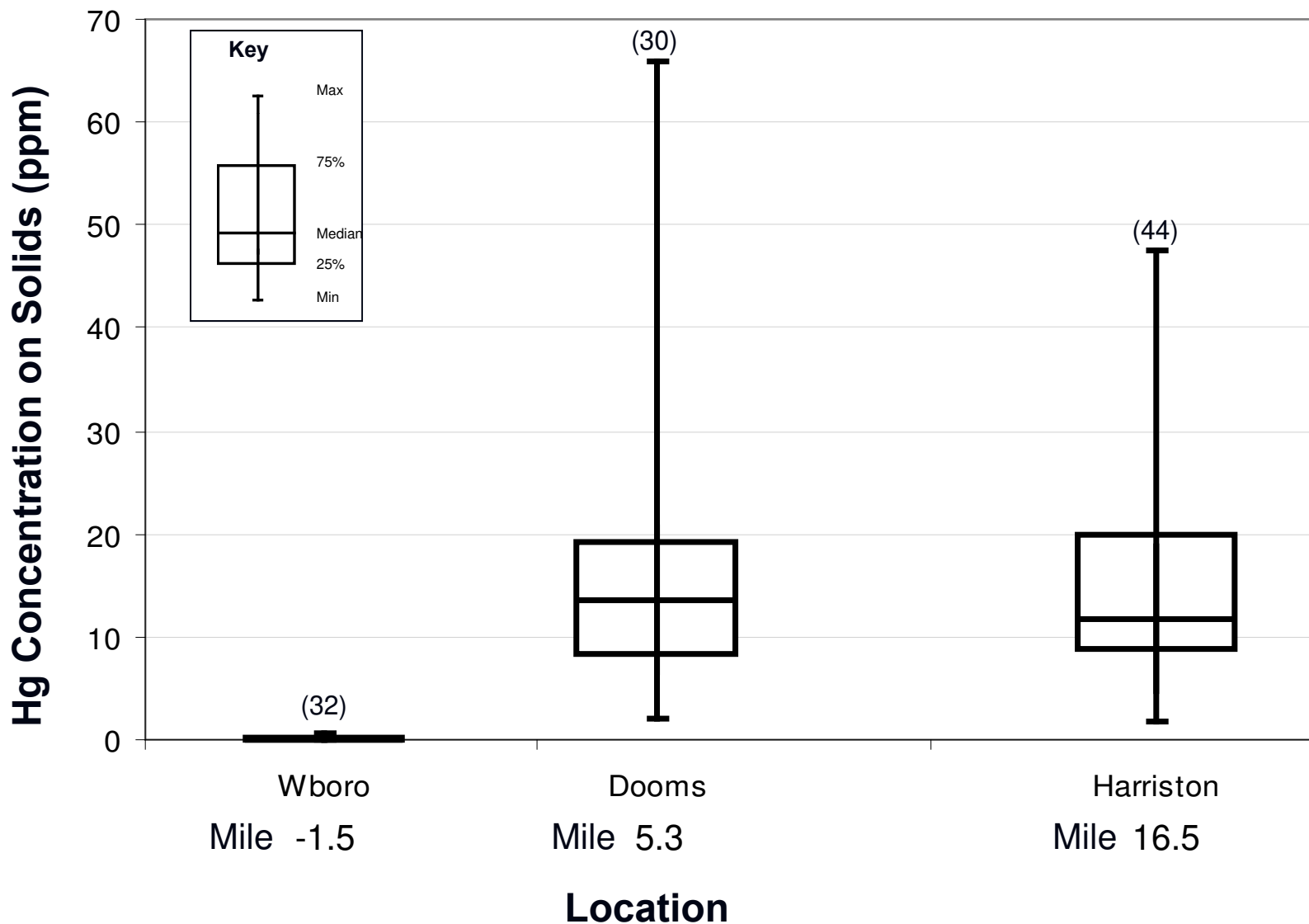
River Hg Concentration – Particulates (ng/L)



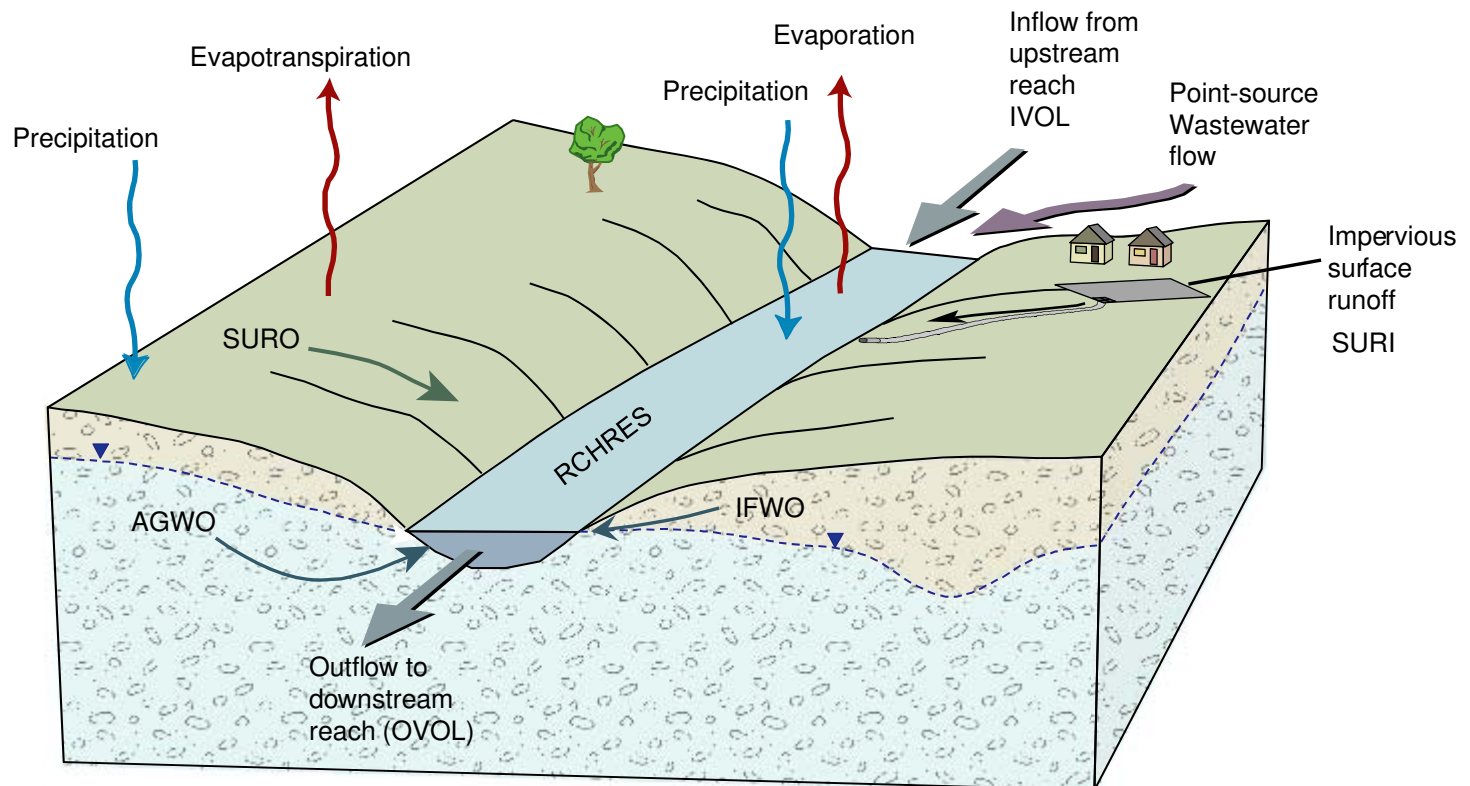
Suspended Sediment Concentrations



Hg Concentration on Suspended Sediment (ppm)



Hydrologic Modeling Framework - HSPF



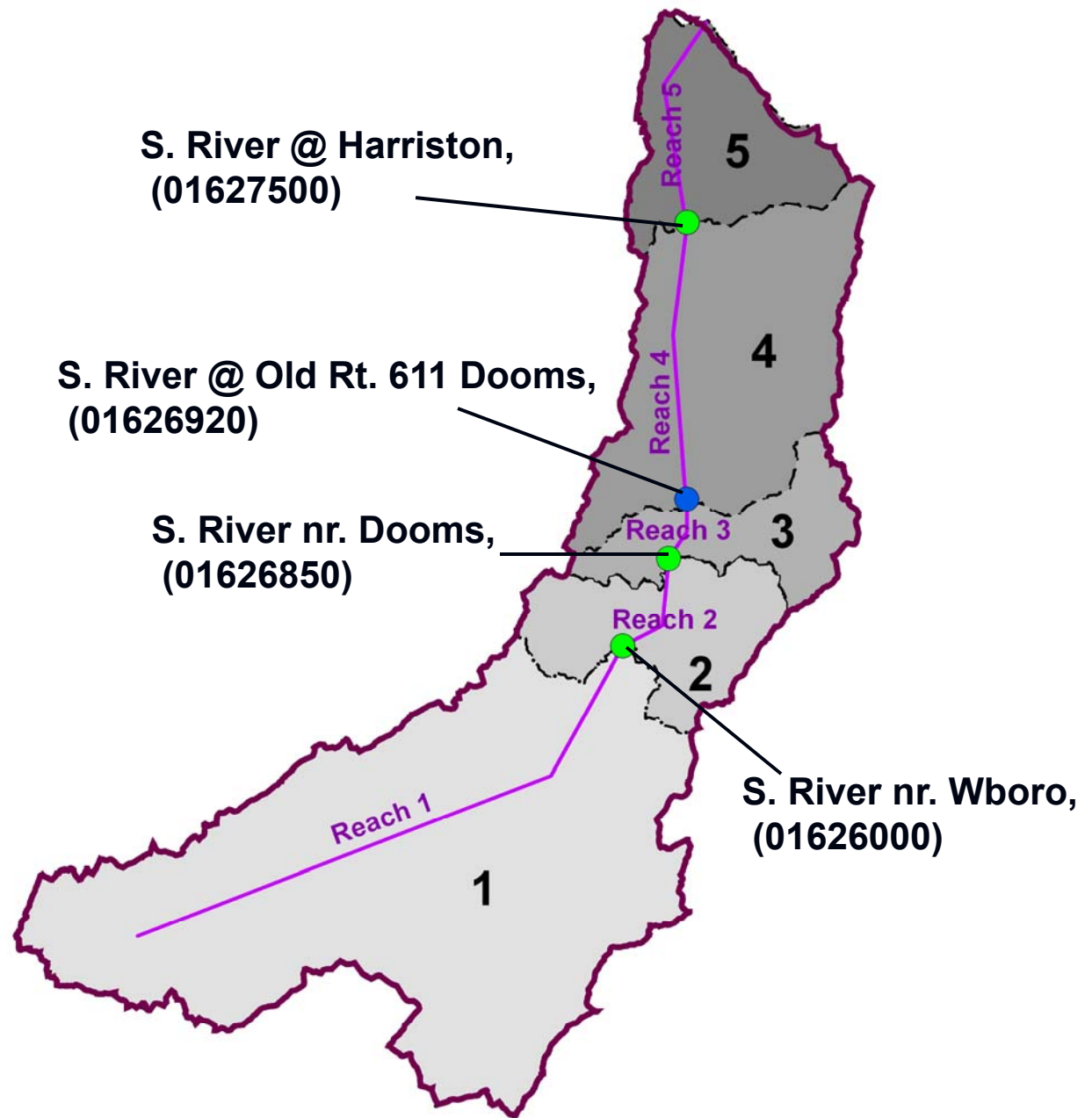
EXPLANATION

SURI—Surface runoff from impervious areas
 SURO—Surface runoff from pervious areas
 IFWO—Interflow
 AGWO—Active groundwater flow (base flow)

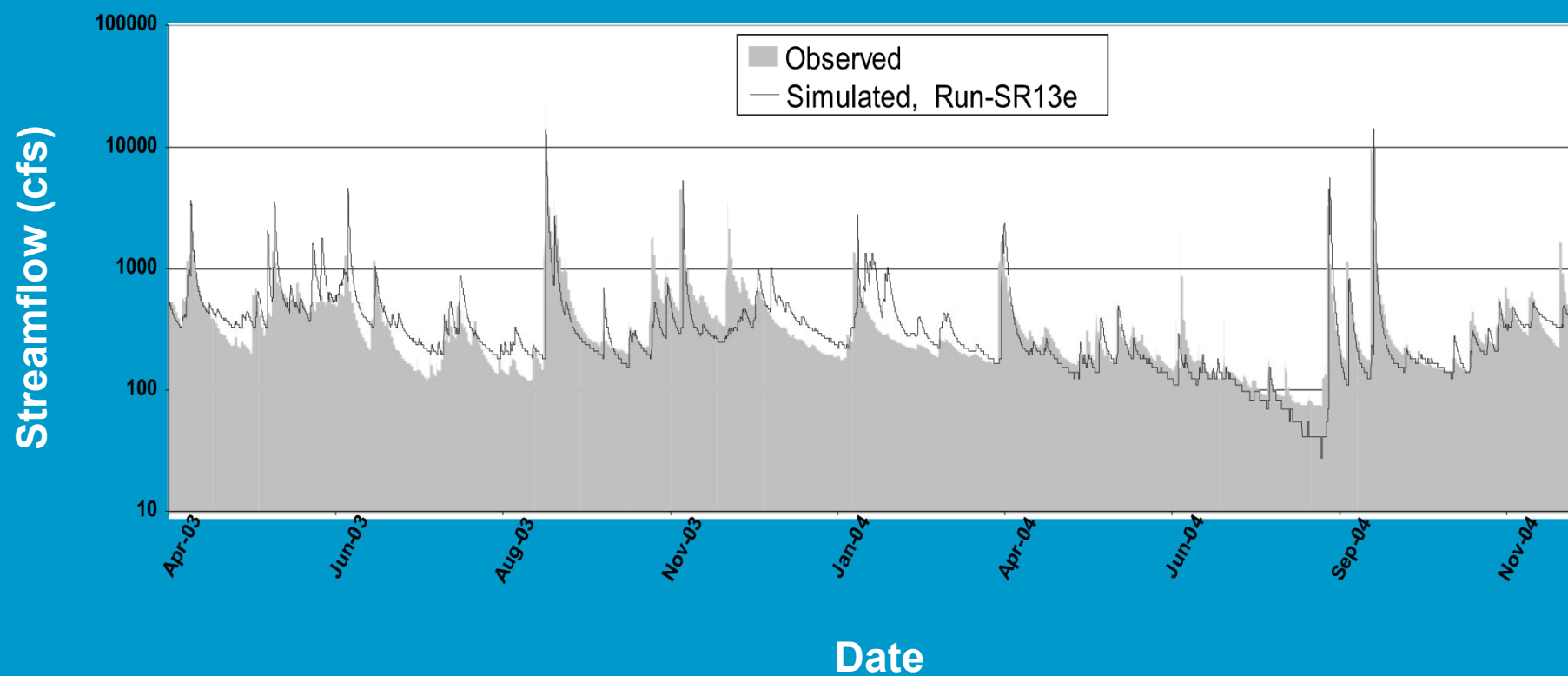
RCHRES—Stream reach or reservoir segment
 IVOL—Inflow volume
 OVO—Outflow volume
 SURI—Surface runoff from impervious areas
 SURO—Surface runoff from pervious areas

Sub-Basin Delineation

Within each subbasin, transport is handled by ~50 different hydrologic response units (HRU) that allow for differences in land use, climatic stresses, and hydrologic parameters such as slope

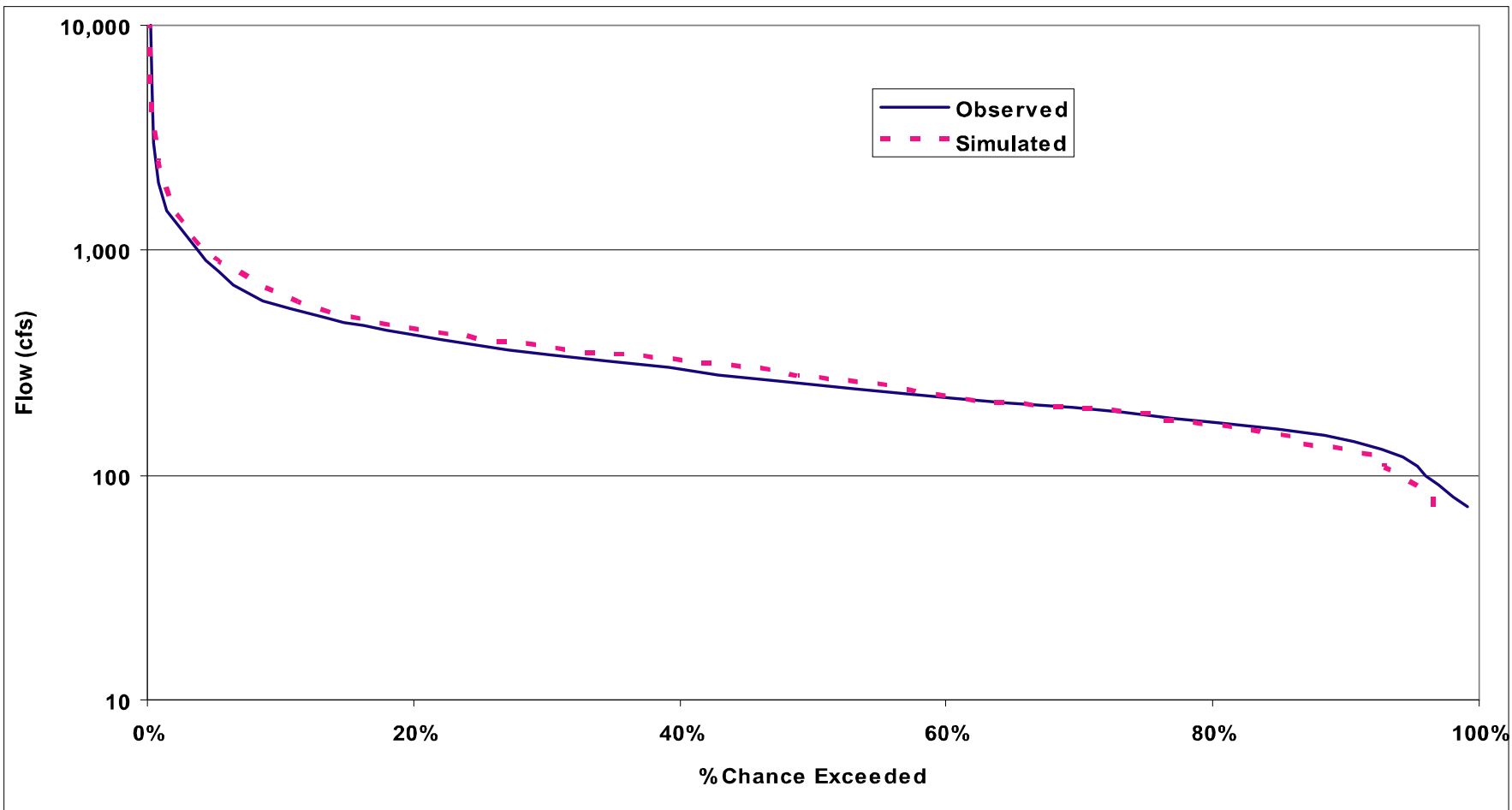


Hourly Streamflow (cfs) – Harriston



Flow Duration Curve – Harriston (01627500)

Run-SR13e



Suspended Sediment Modeling

Goal: Simulate SSC (mg/L) in the river every hour

Purpose: Improve subsequent simulation of mercury transport in the water column

HSPF Sediment Production

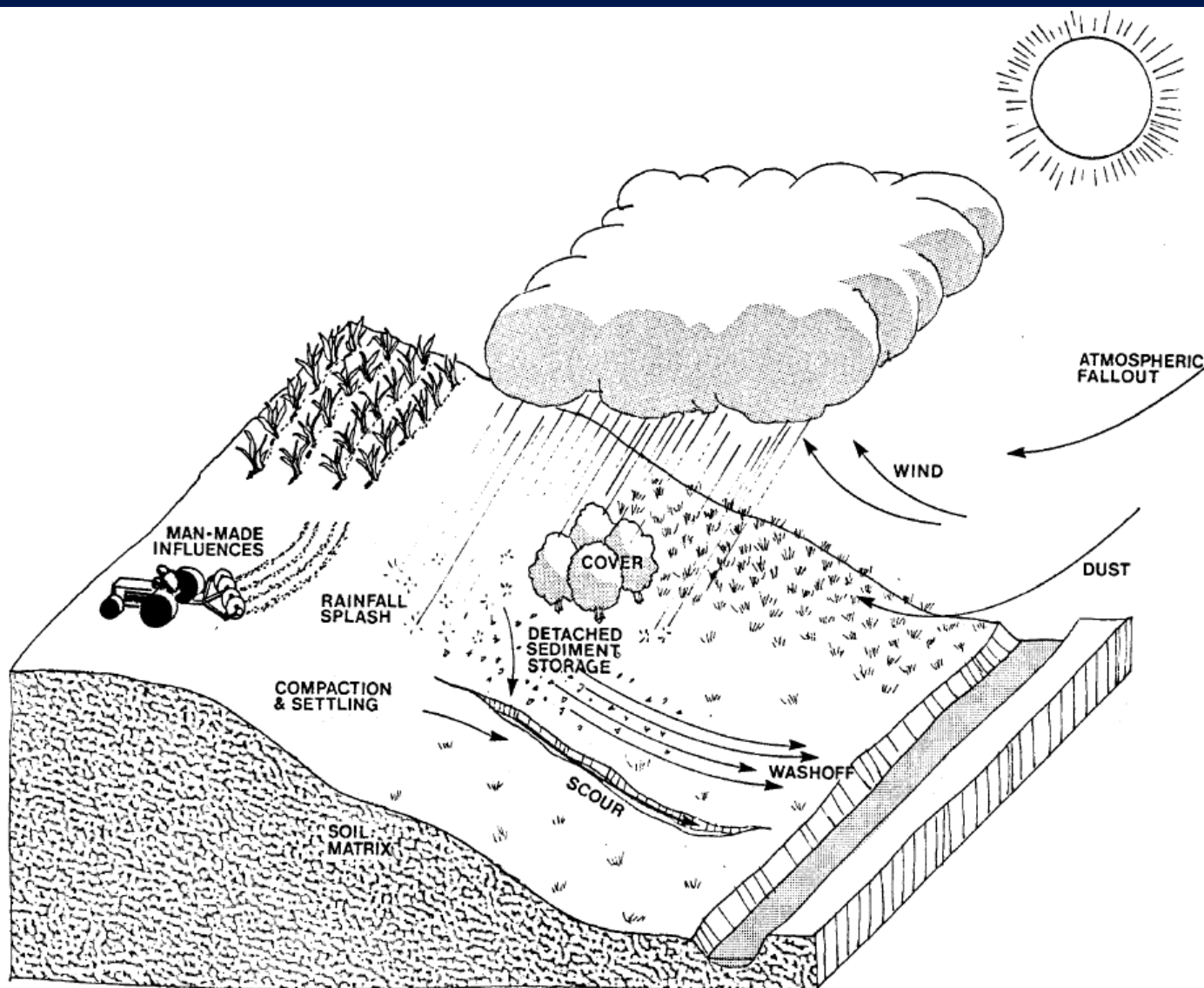


Figure 22: Erosion processes

Suspended Sediment Modeling

- Steps:**
- Develop hourly time-series data for 'Observed' SSC**
 - Parameterize HSPF watershed model**
 - Adjust HSPF model parameters so that simulated SSC matches 'Observed' SSC**

Developing hourly times series data for 'Observed' SSC

Available Data:

Grab Sample Data -

USGS (n=78) SSC Using 1.5 μm filter

DEQ (n=148) TSS Using 0.7 μm filter (used for verification)

Turbidity Data -

correlates strongly with SS

15-minute data from 2005-2007

missing about 10% of period

Discharge Data –

correlates strongly with SS

15-minute streamflow (cfs) data

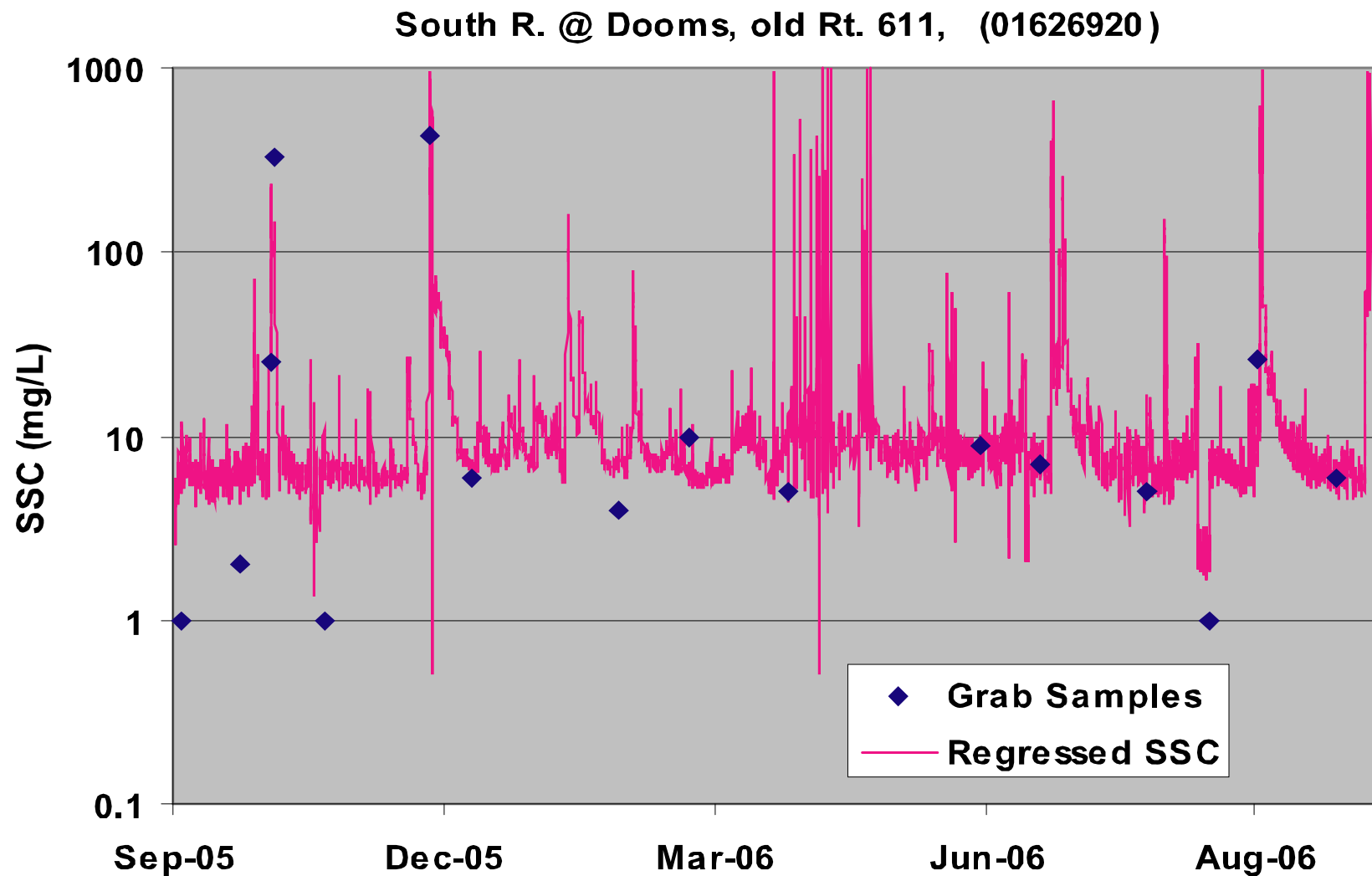
SSC Regression

- Use Linear Regression Model with Independent variables based on Q and Turbidity
- Data from all 3 stations is lumped after adjusting Q for drainage area
- The best multiple regression model is selected from many different potential models based on the following statistics:
 - Adjusted R^2 (R^2_a) - higher is better
 - Mallow's C_p (C_p) - lower is better
 - Variance Inflation Factor (VIF) - lower is better

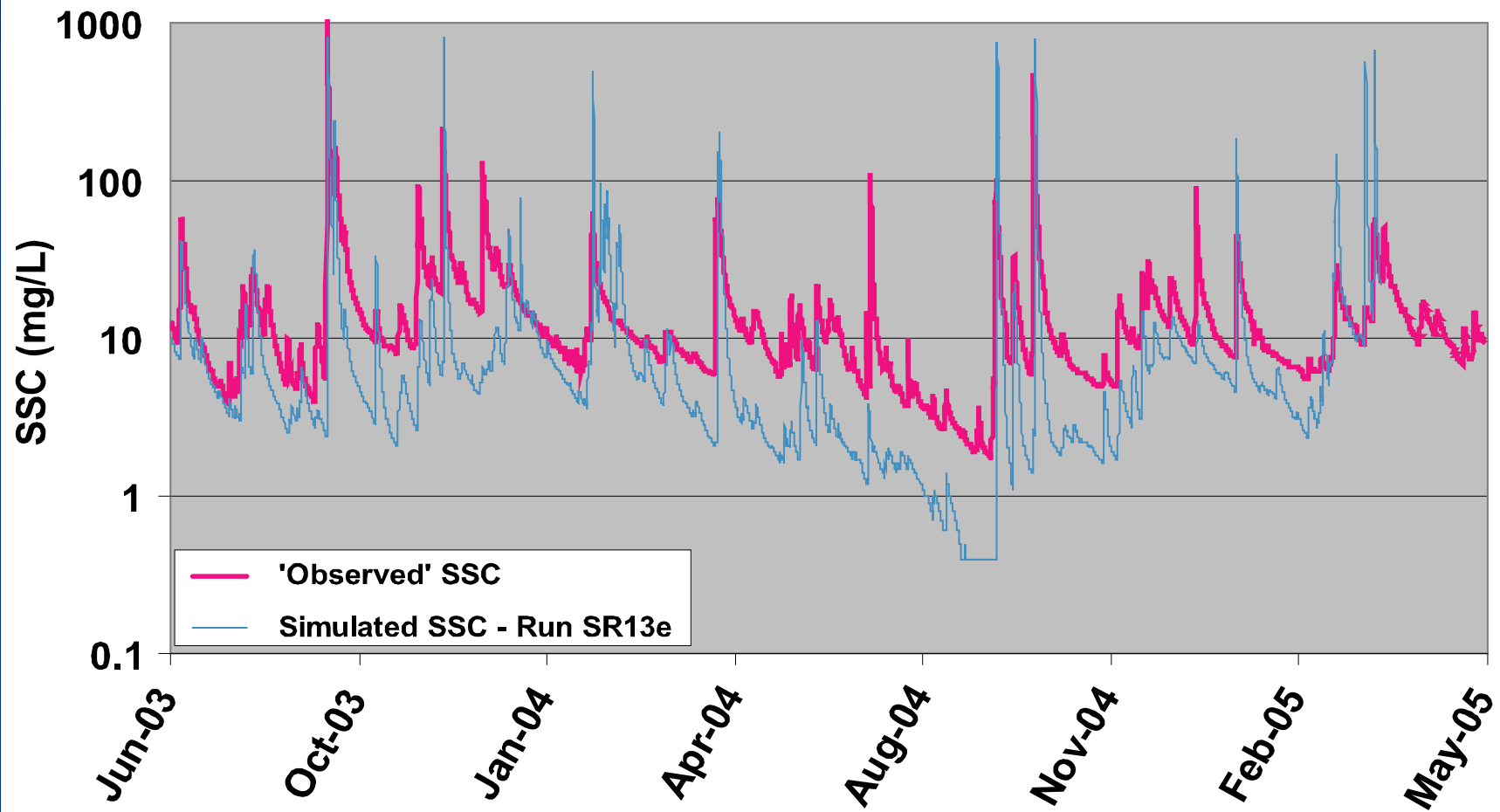
Statistical Analysis

Model #	p	MSE	R ²	AdjR ²	Cp	VIF	Gray indicates variable used in regression				Use?
							Qa	Turb	Qa _{increase}	Qa _{slope}	
1	1	1622.9	0.744	0.744	101.9	-	Gray				No
2	1	888.2	0.896	0.895	22.3	-		Gray			No
3	1	5002.6	0.434	0.426	468.2	-			Gray		No
4	1	8239.8	0.035	0.023	819.0	-				Gray	No
5	2	897.2	0.896	0.894	24.0	3.908	Gray	Gray			No
6	2	706.3	0.918	0.916	3.5	1.002		Gray		Gray	Yes
7	2	1115.3	0.871	0.868	47.3	1.002	Gray		Gray		No/Yes
8	2	857.4	0.901	0.898	19.7	1.689		Gray	Gray		No
9	3	804.2	0.908	0.905	14.9	3.908	Gray		Gray		No
10	3	1123.6	0.872	0.867	48.6	1.378		Gray		Gray	No
11	3	701.2	0.920	0.917	4.0	3.908		Gray		Gray	No
12	4	705.2	0.920	0.916	5.4	3.908			Gray		No

SSC Hourly Timeseries - Dooms



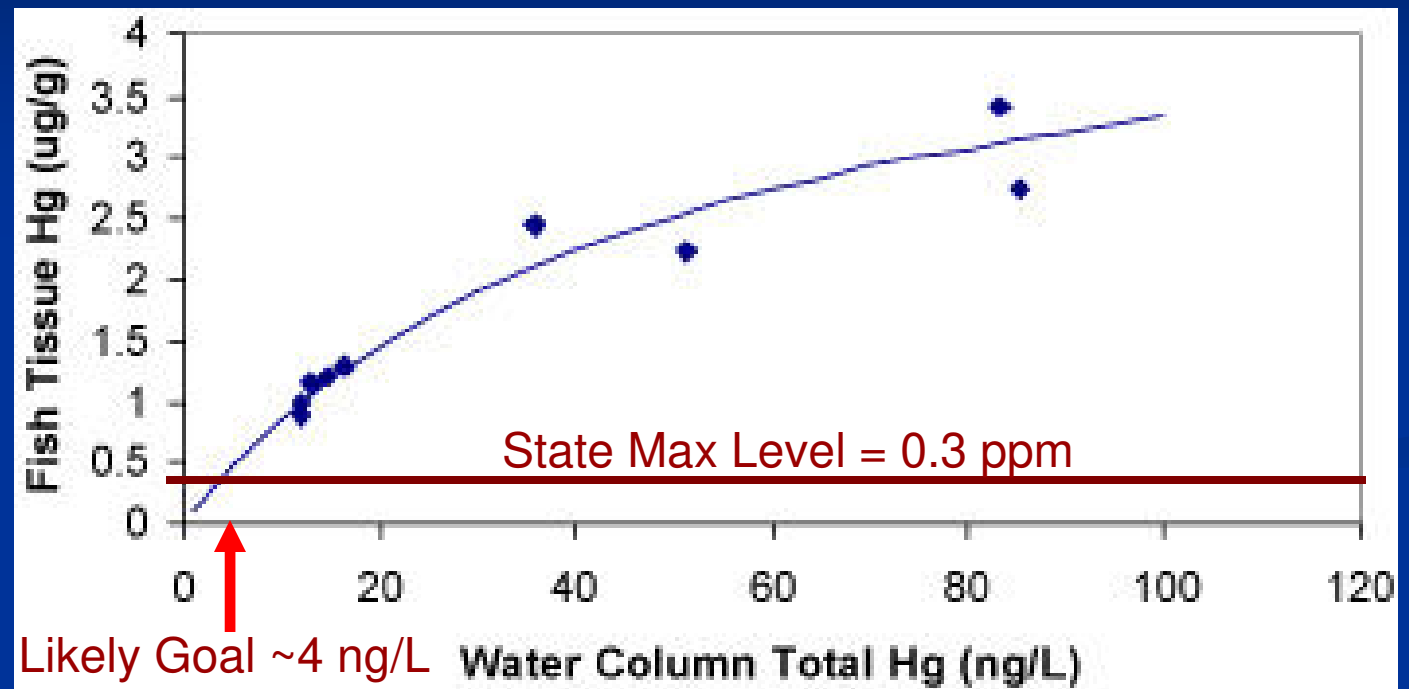
SSC Hourly Timeseries - Waynesboro





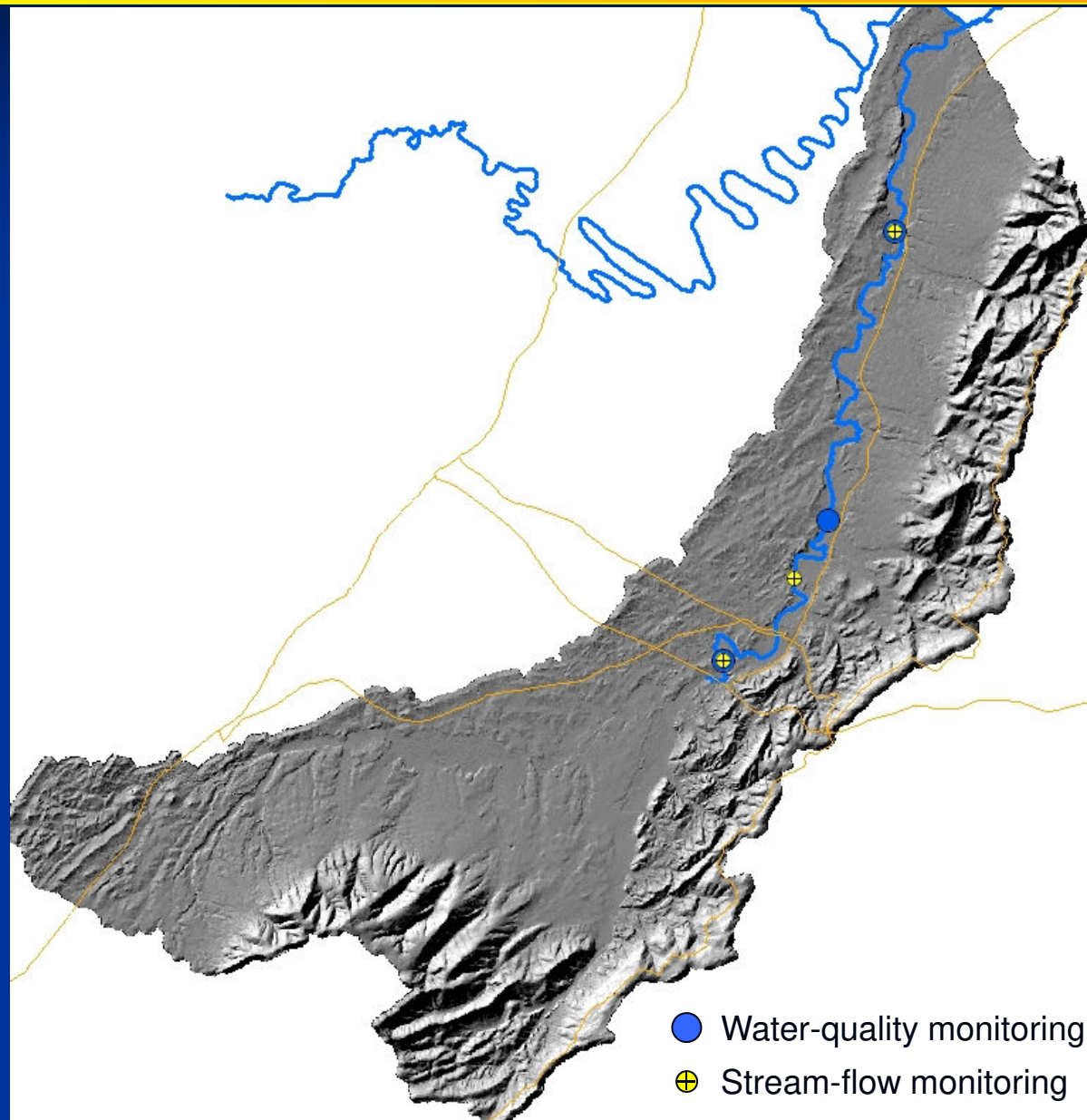
Site-Specific BAF Approach

$$\text{BAF} = \text{Fish [Hg]} / \text{Water [Hg]}$$

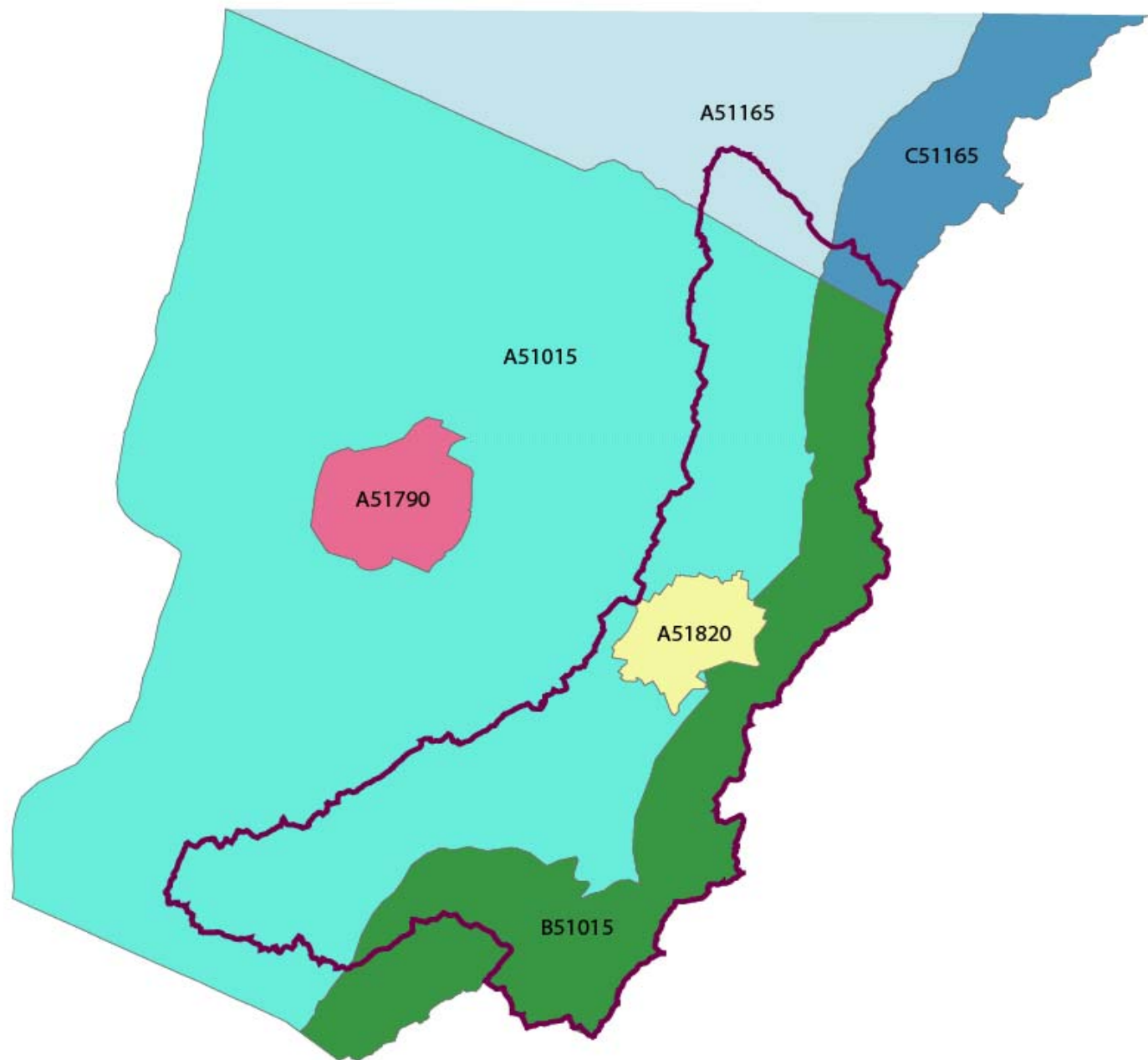


$$\text{Target Water [Hg]} = \text{Target Fish [Hg]} / \text{BAF}$$

South River Monitoring Sites



Land Use, Precipitation, Meteorology



HSPF Susp. Sed. Budgeting

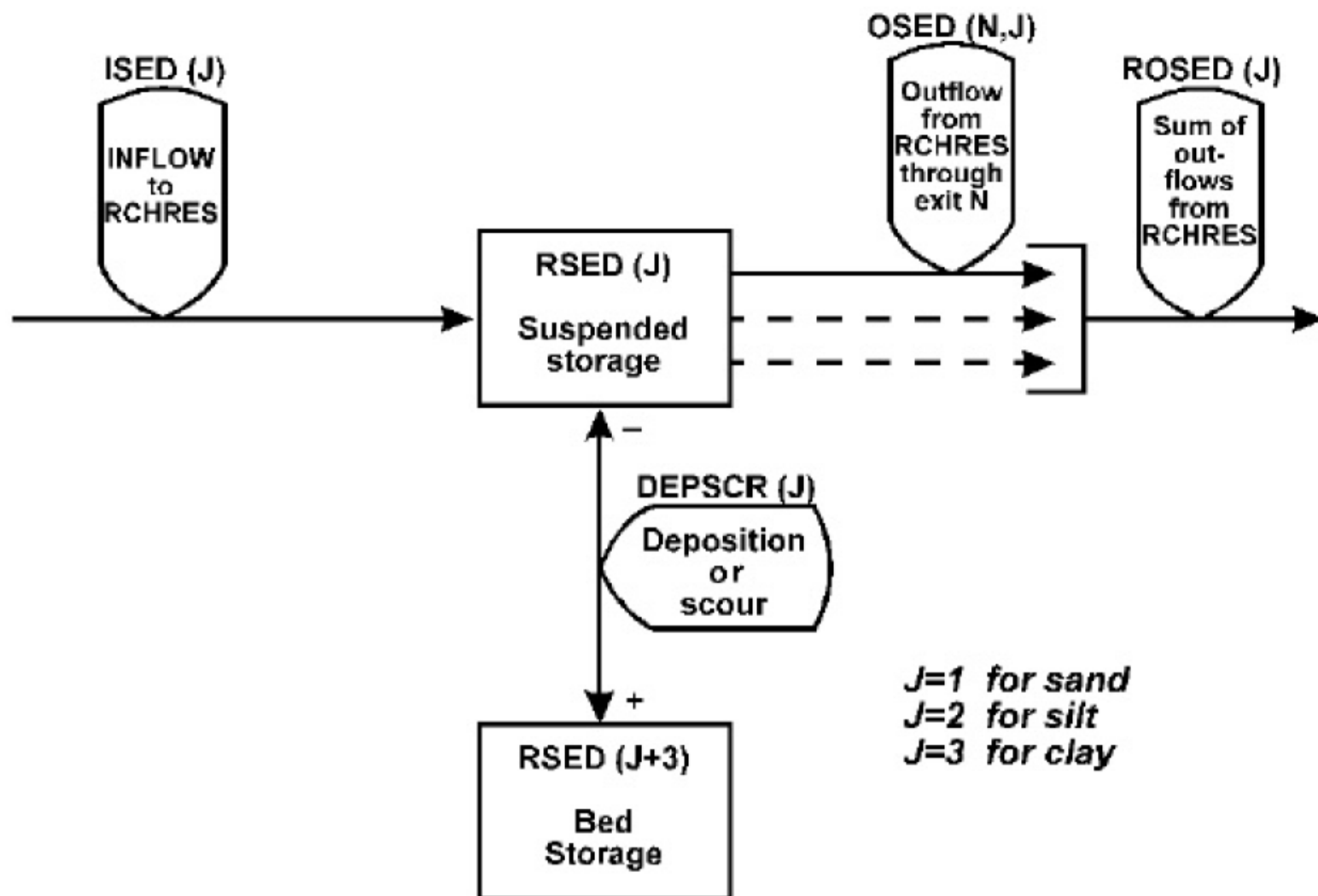


Figure 47: Flow diagram of inorganic sediment fractions in the SEDTRN section of the RCHRES Application Module