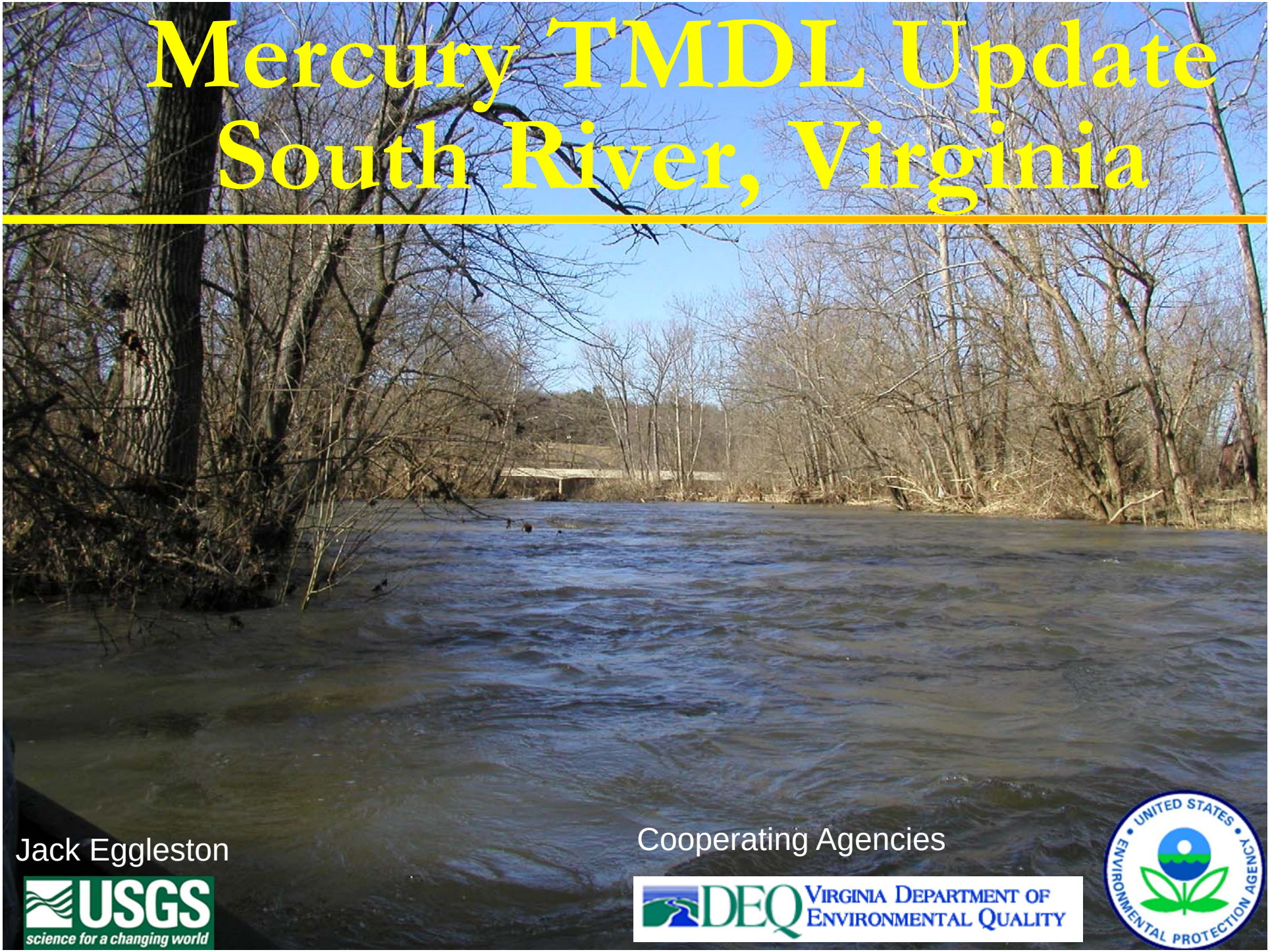
Mercury TMDL Update
South River, Virginia



Jack Eggleston

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Cooperating Agencies

DEQ Virginia Department of Environmental Quality

United States Environmental Protection Agency

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.

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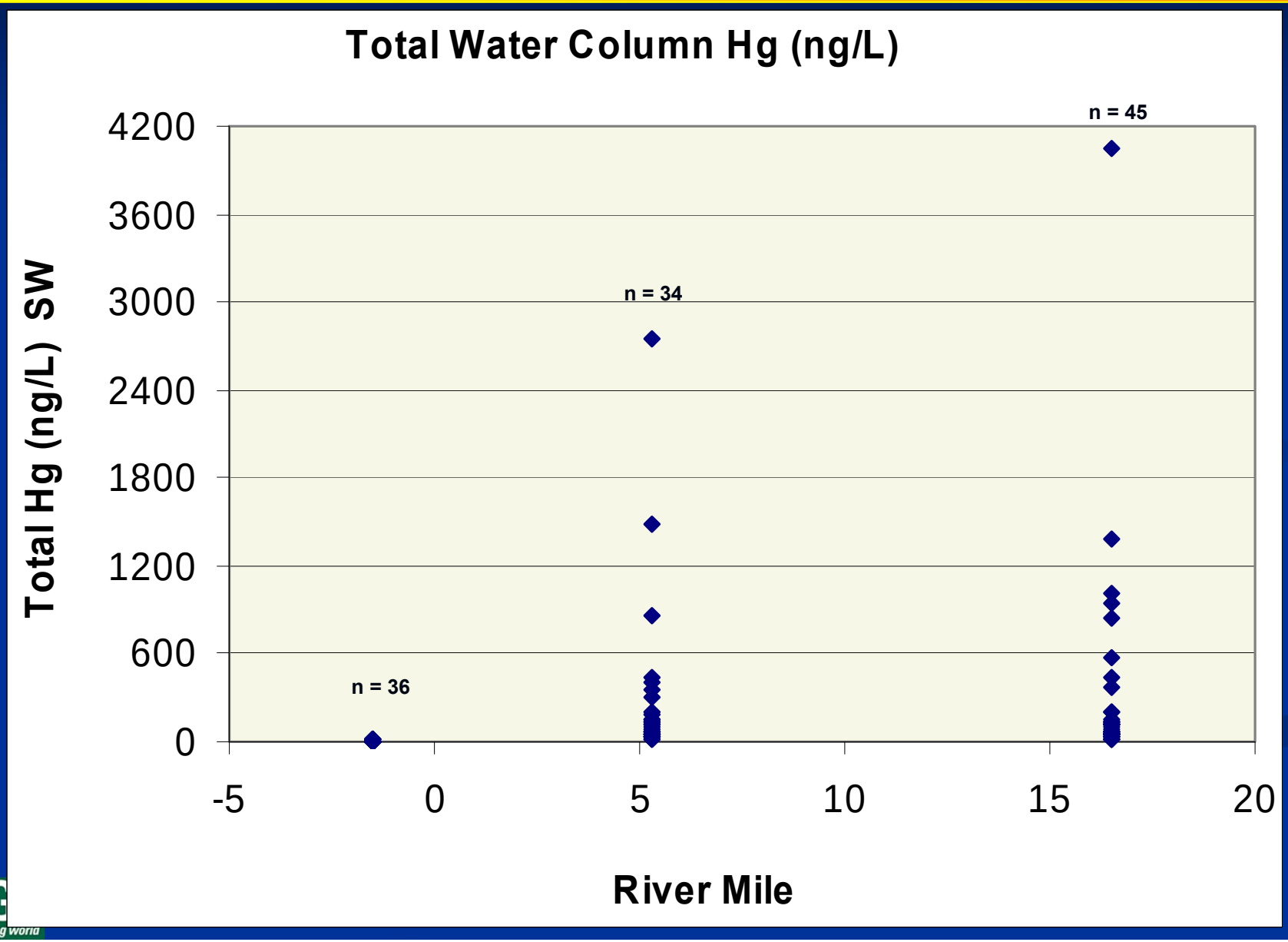
Total Hg in South River water column



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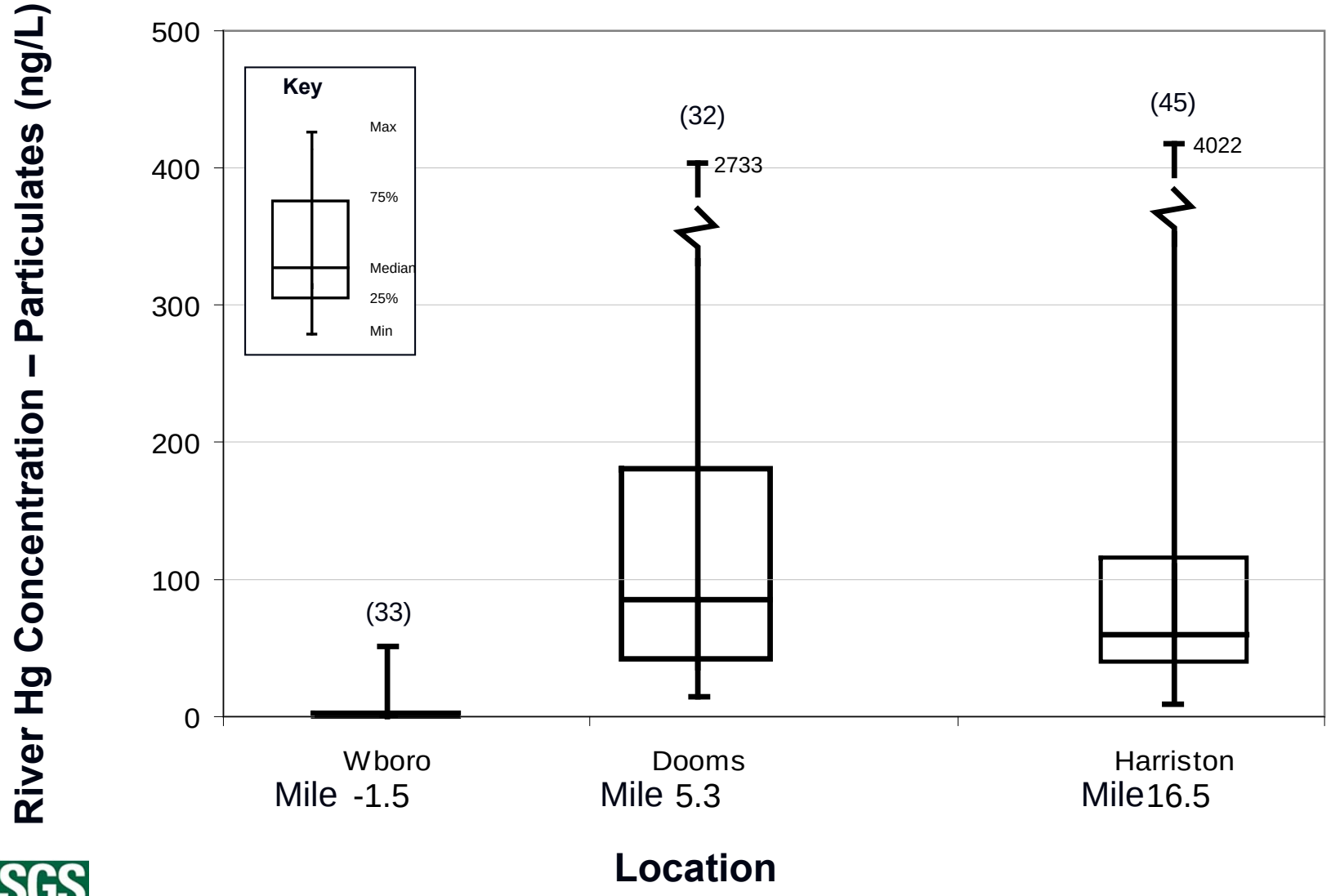
Water Column Hg Concentration – Particulate Phase (ng/L)



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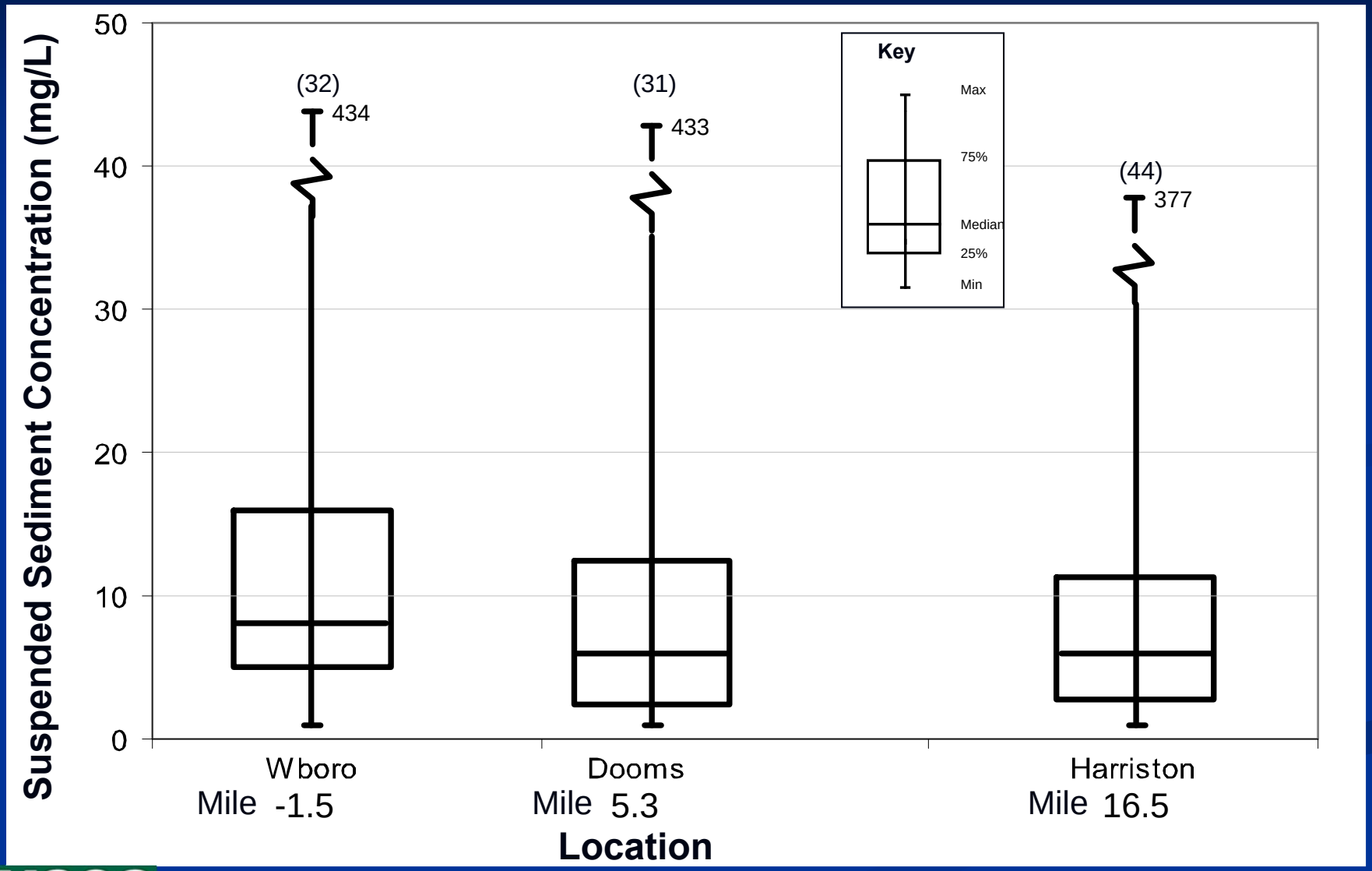
Suspended Sediment Concentrations



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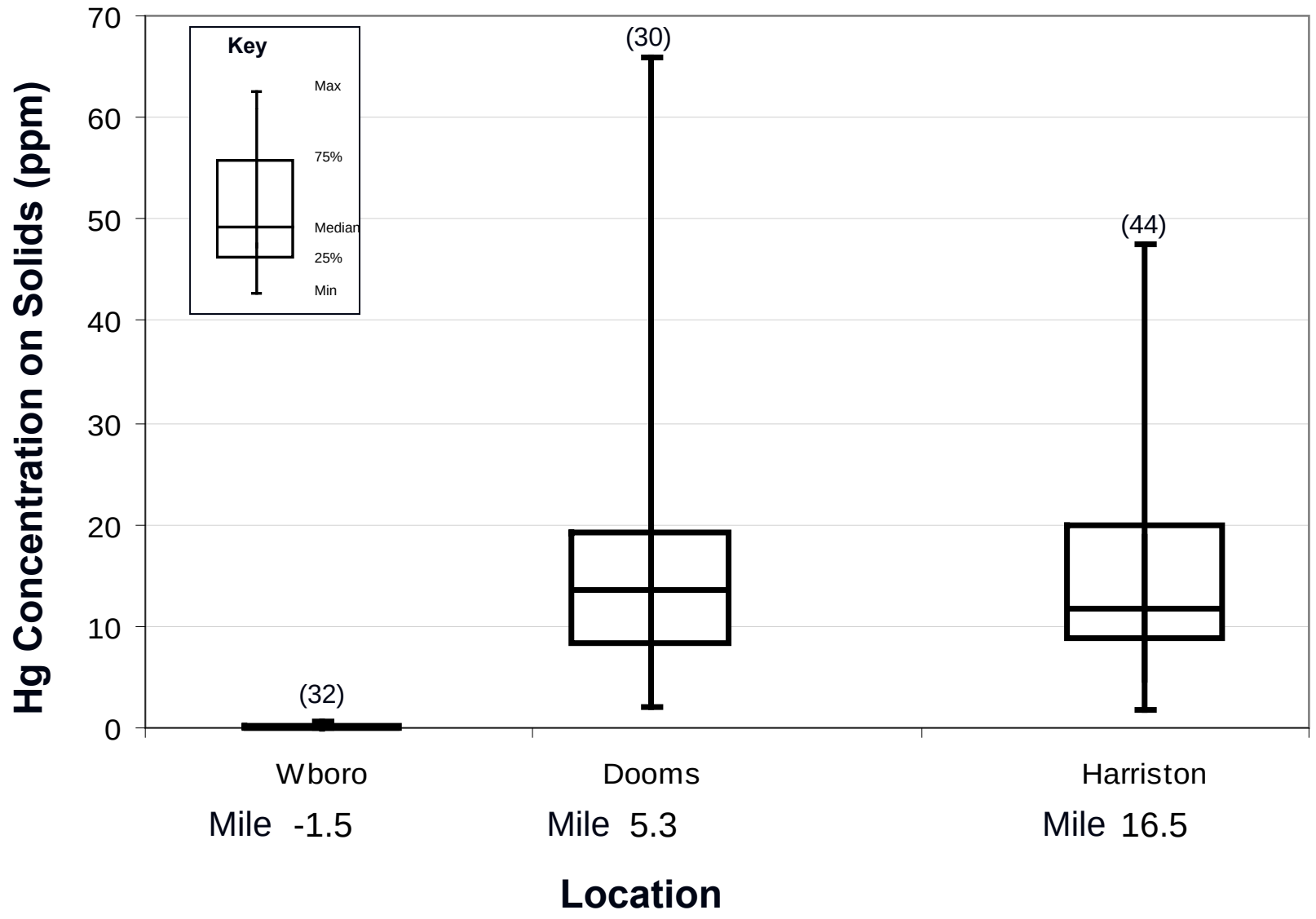
Hg Concentration on Suspended Sediment (ppm)



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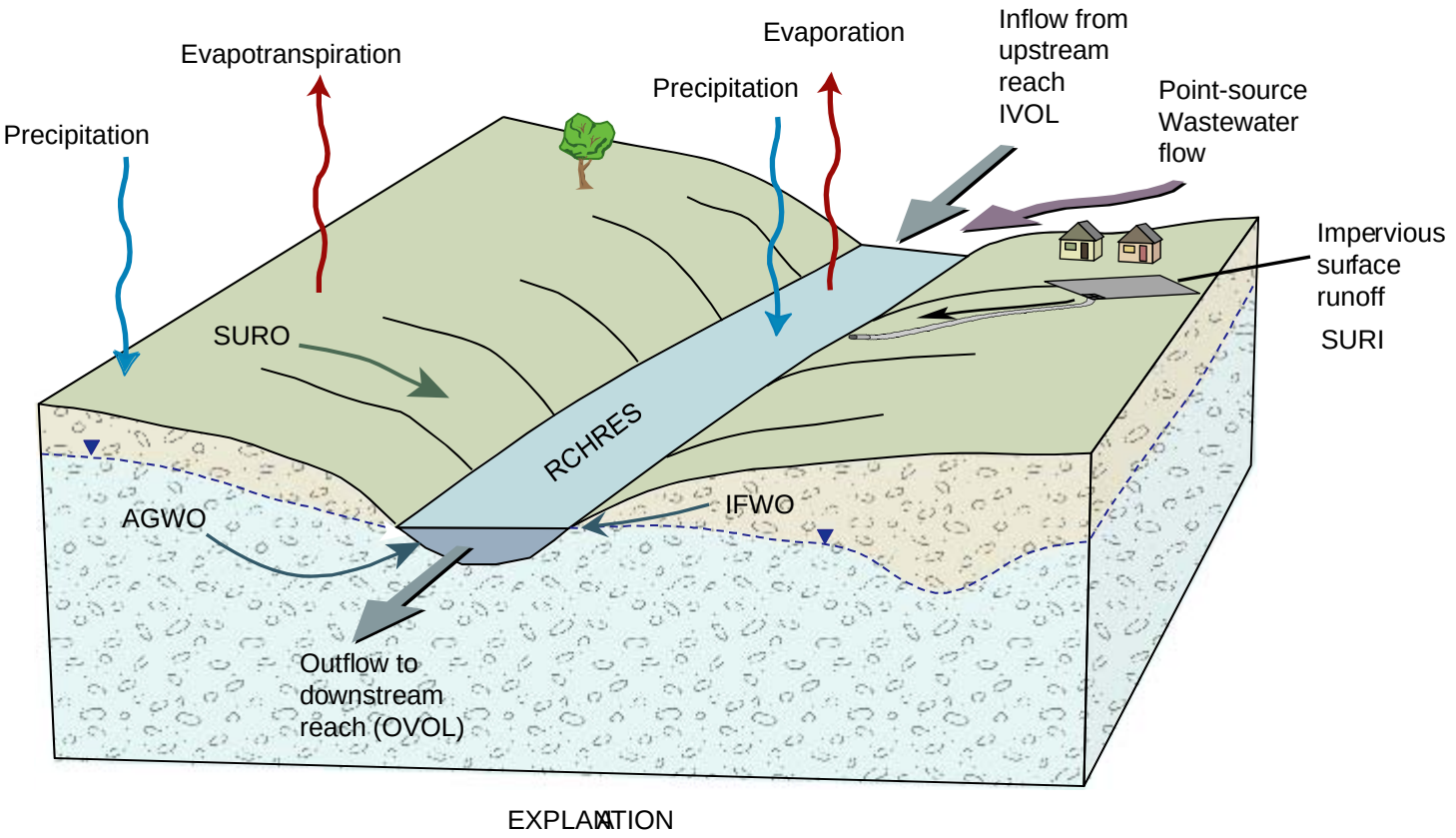
Hydrologic Modeling Framework - HSPF



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

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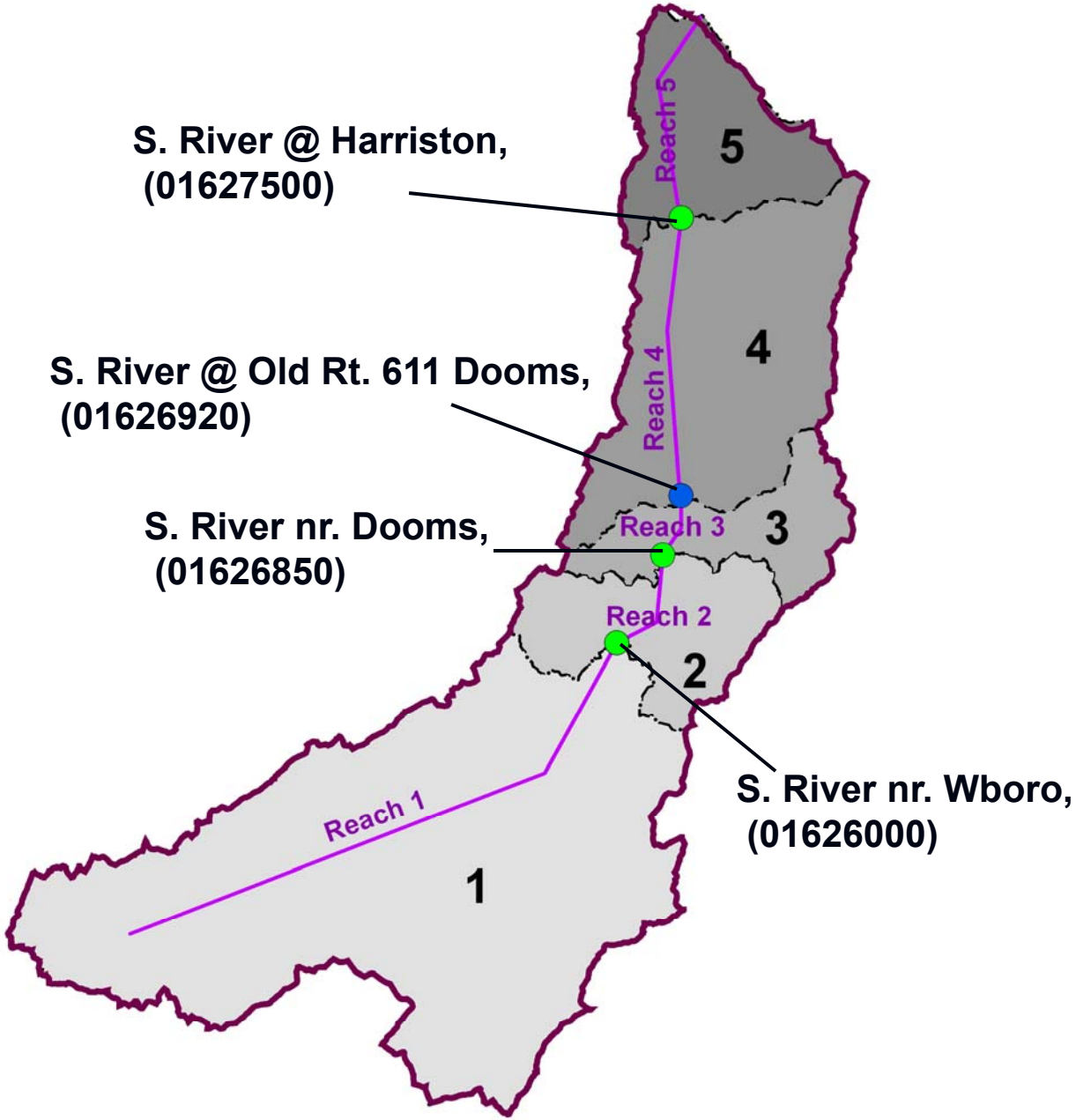
Sub-Basin Delineation

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



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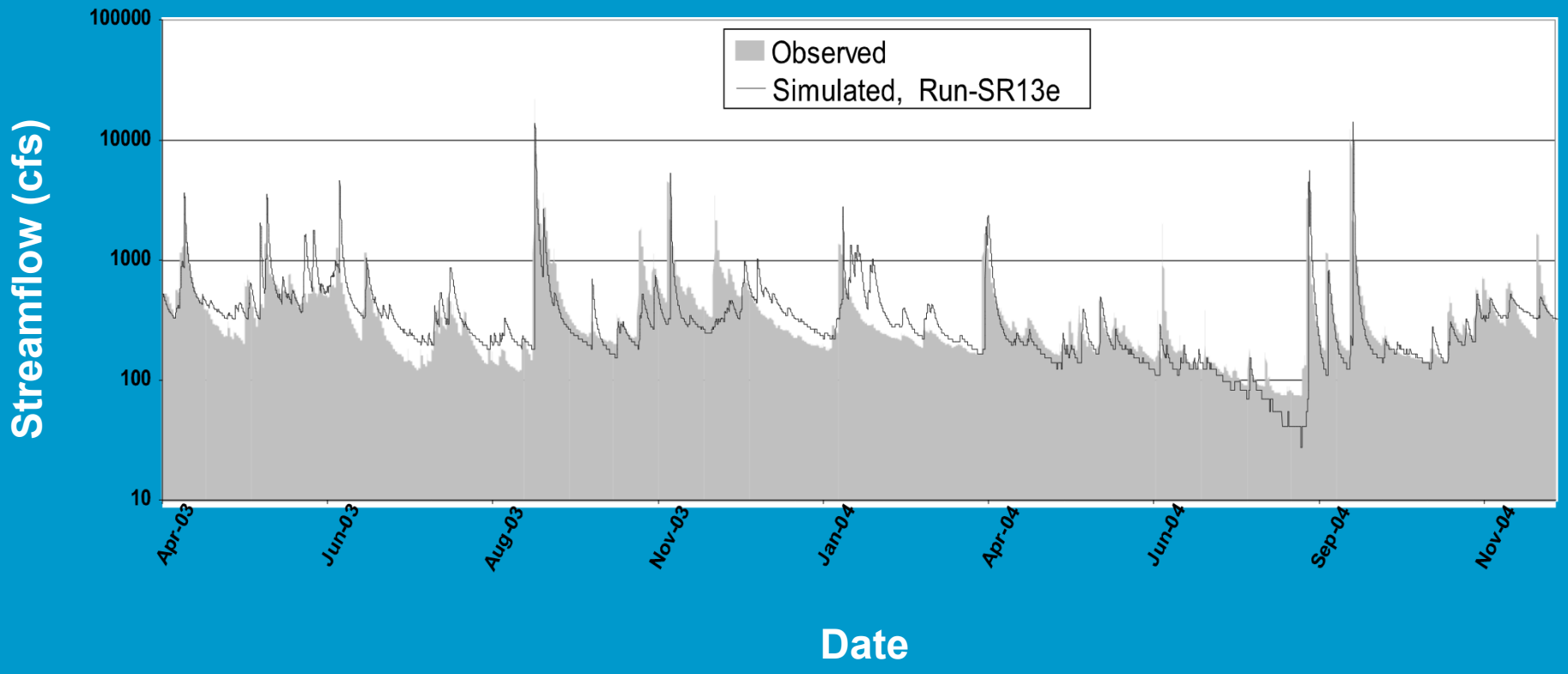
Hourly Streamflow (cfs) – Harriston



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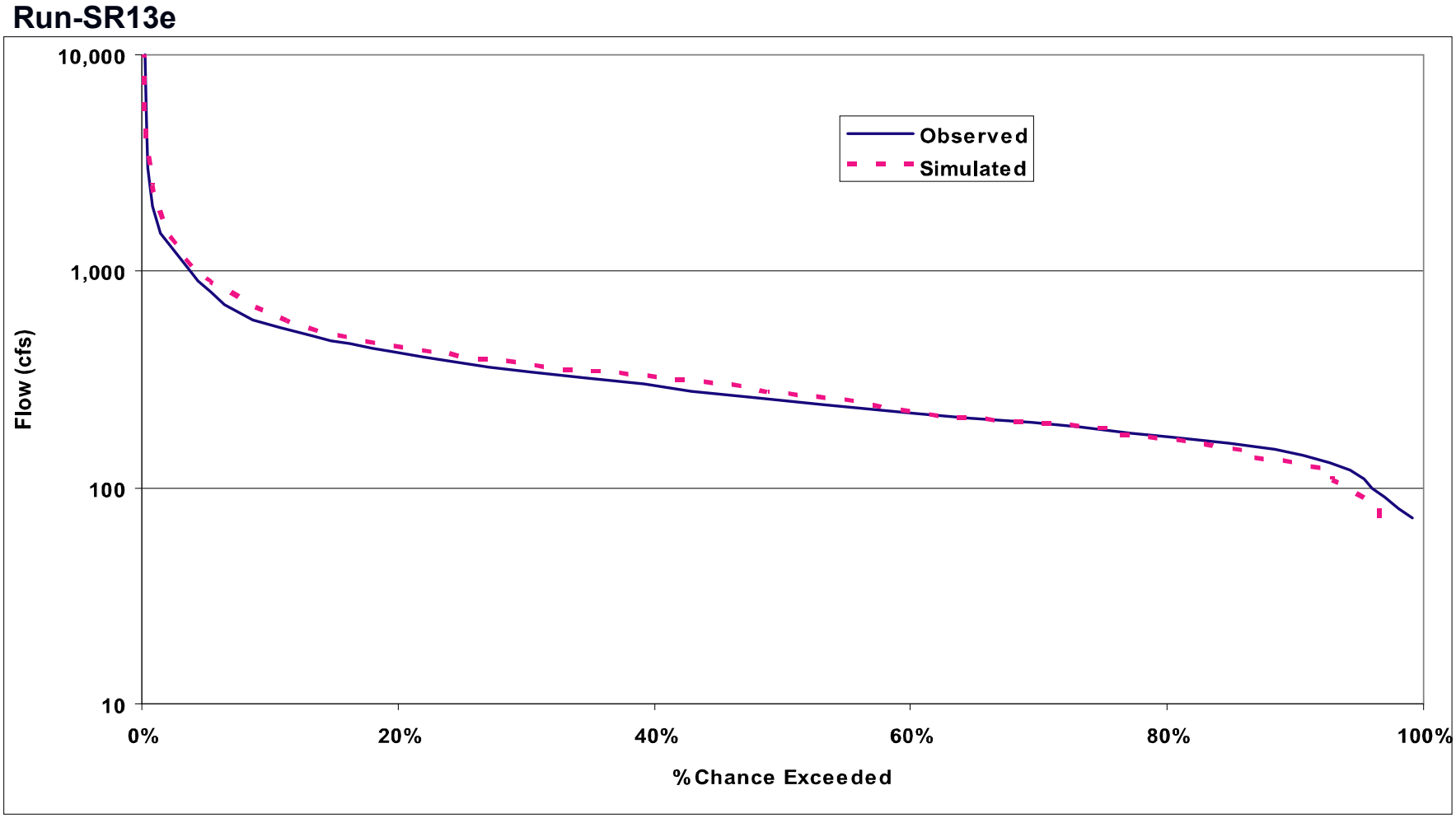
Flow Duration Curve – Harriston (01627500)



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Suspended Sediment Modeling

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

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

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HSPF Sediment Production

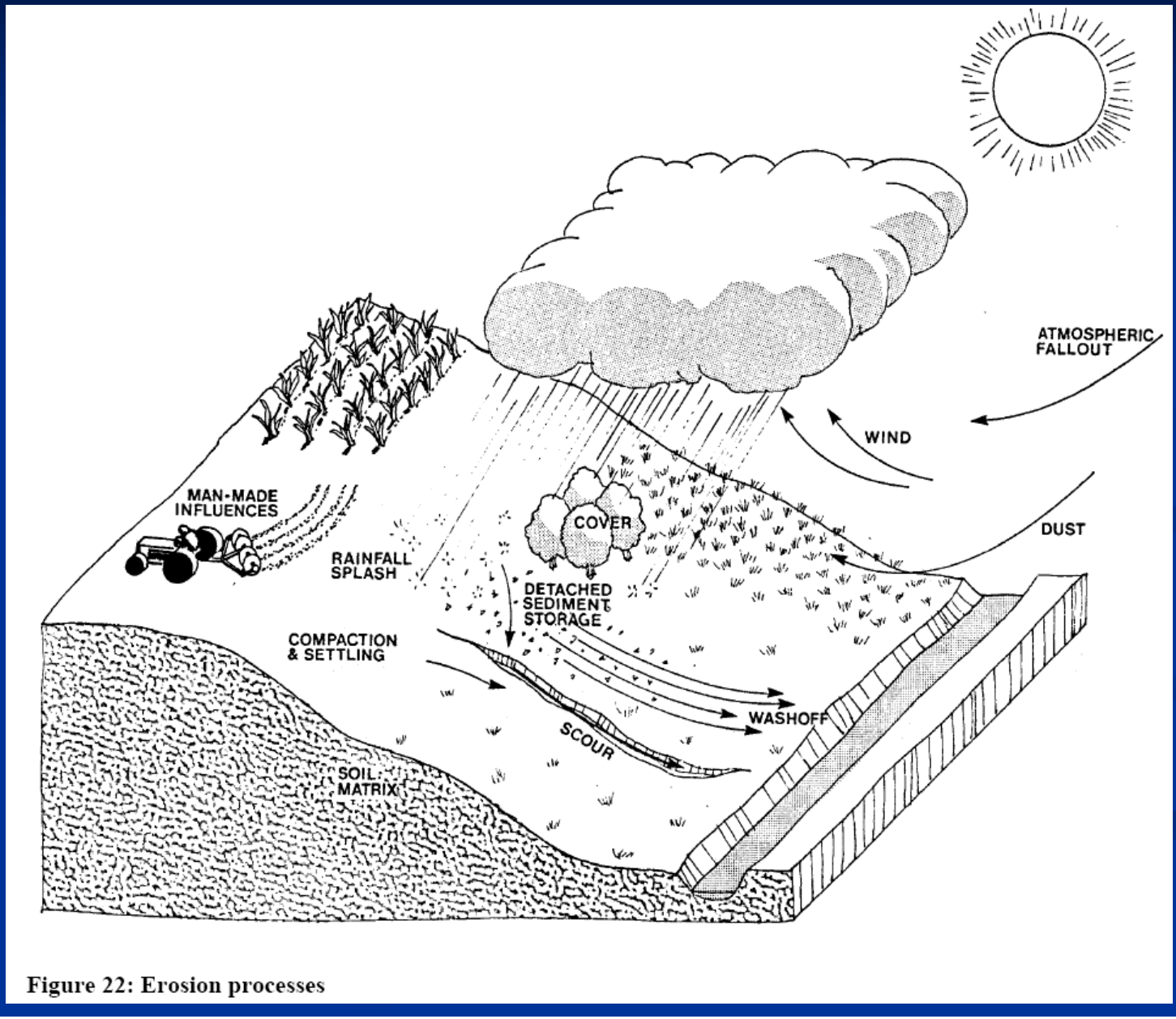

Figure 22: Erosion processes

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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

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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**

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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 Cp (Cp) - lower is better
  - Variance Inflation Factor (VIF) - lower is better

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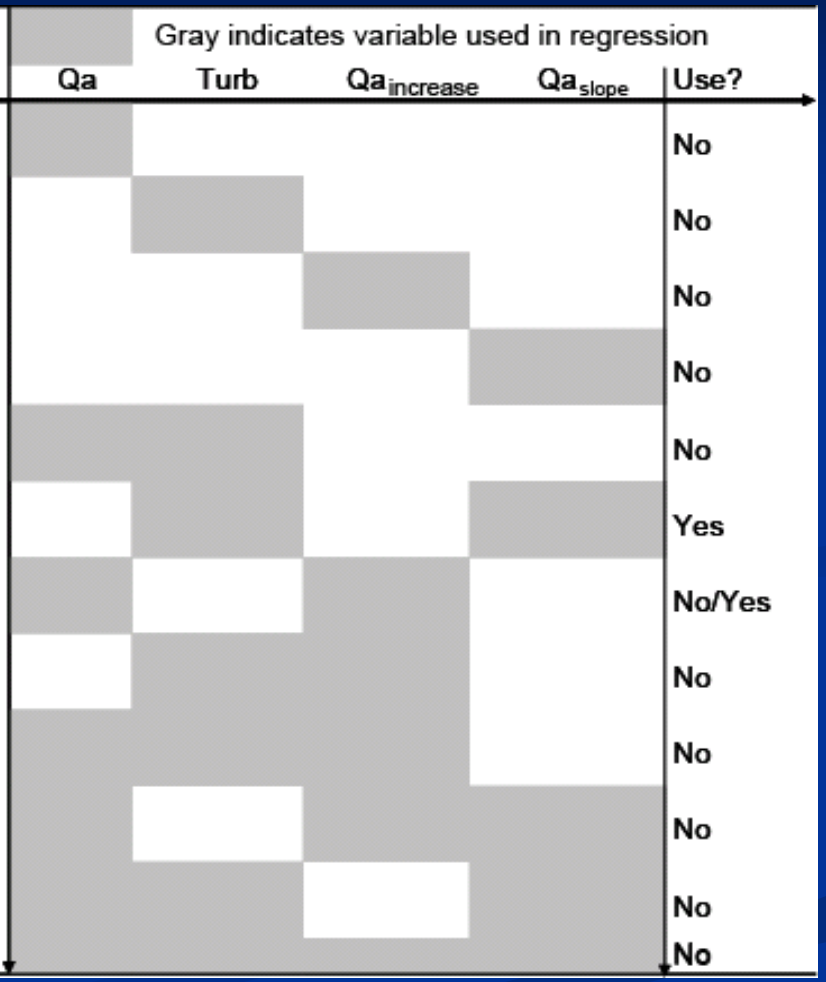
Statistical Analysis

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



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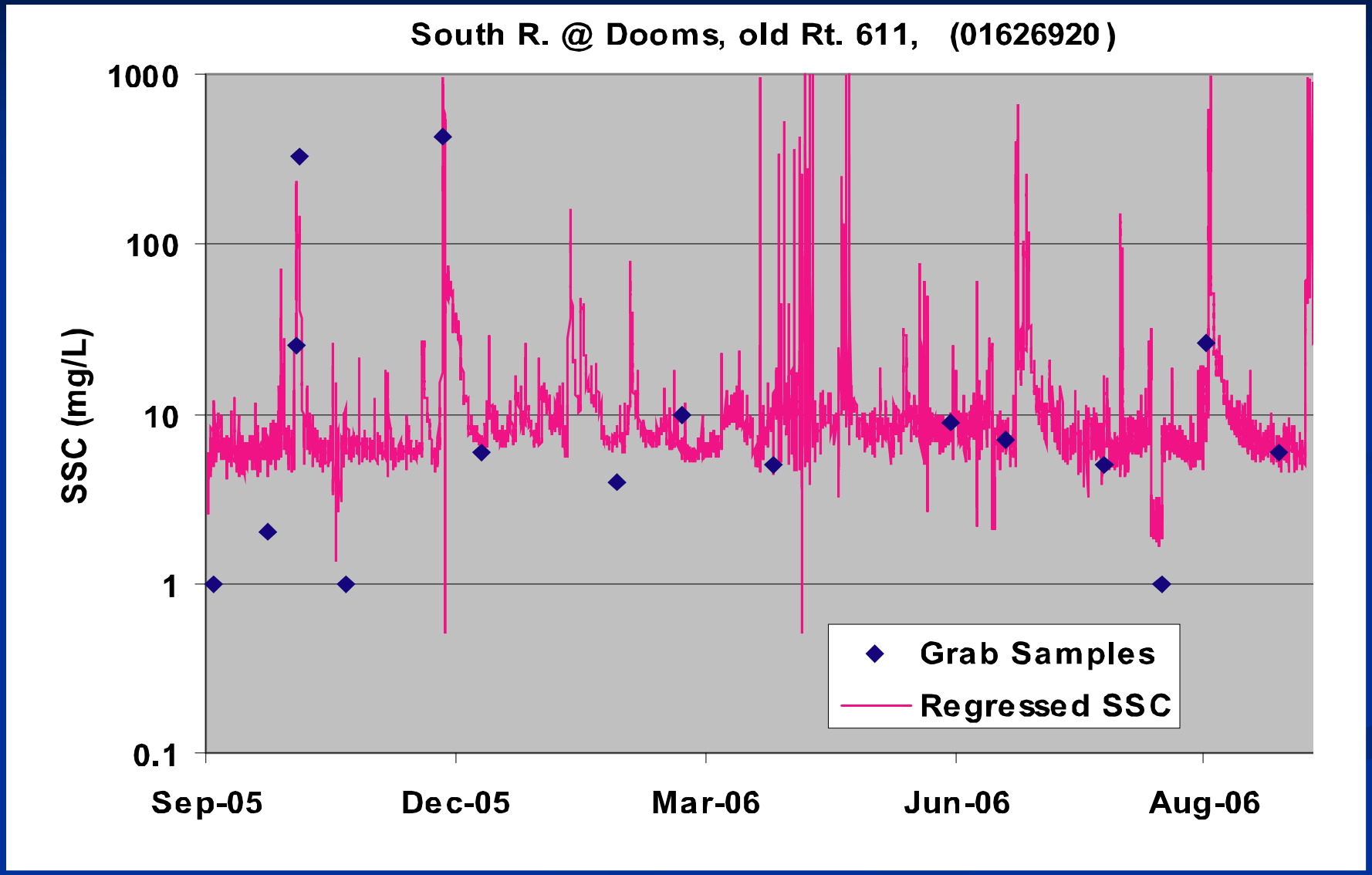
SSC Hourly Timeseries - Dooms



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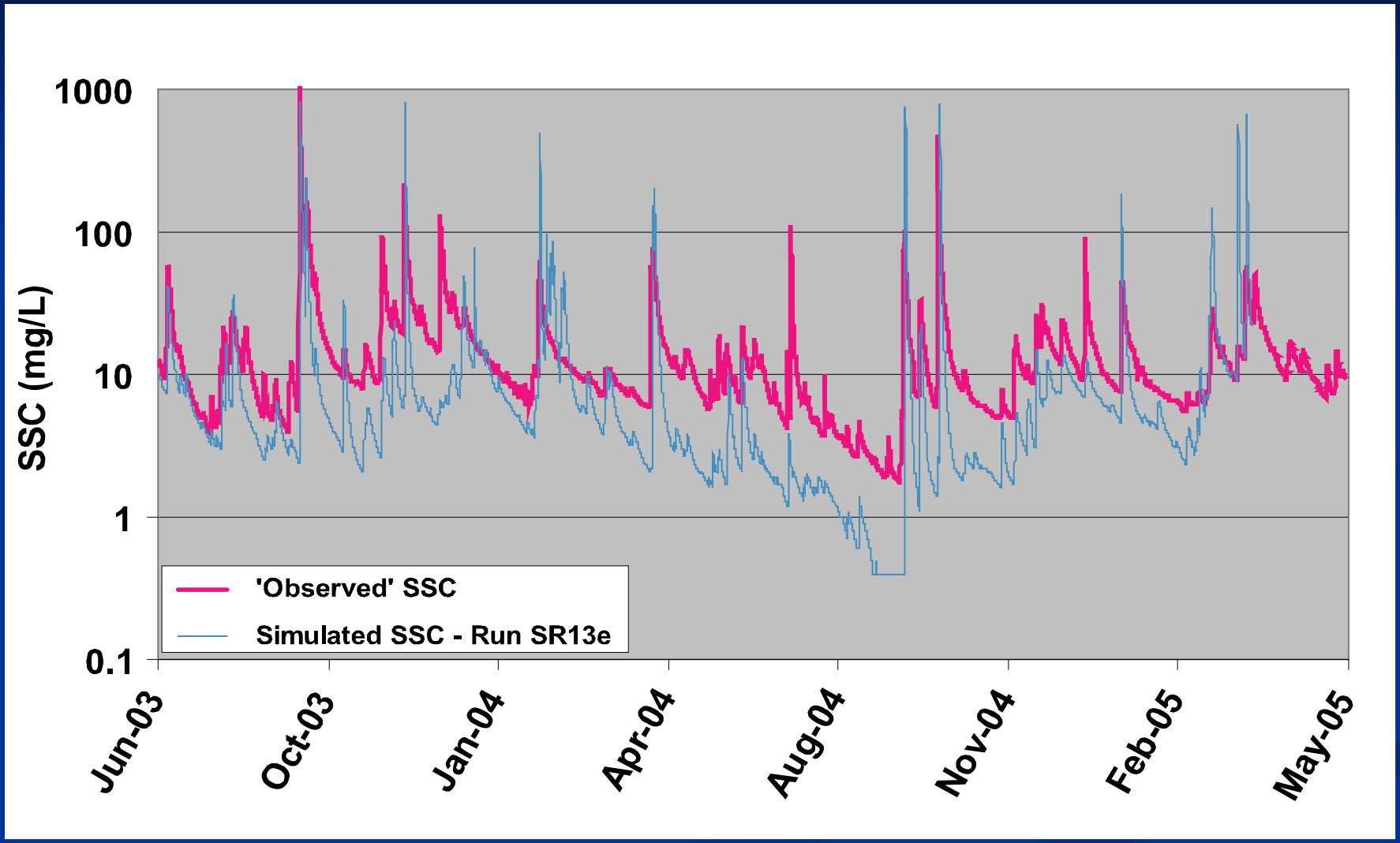
SSC Hourly Timeseries - Waynesboro



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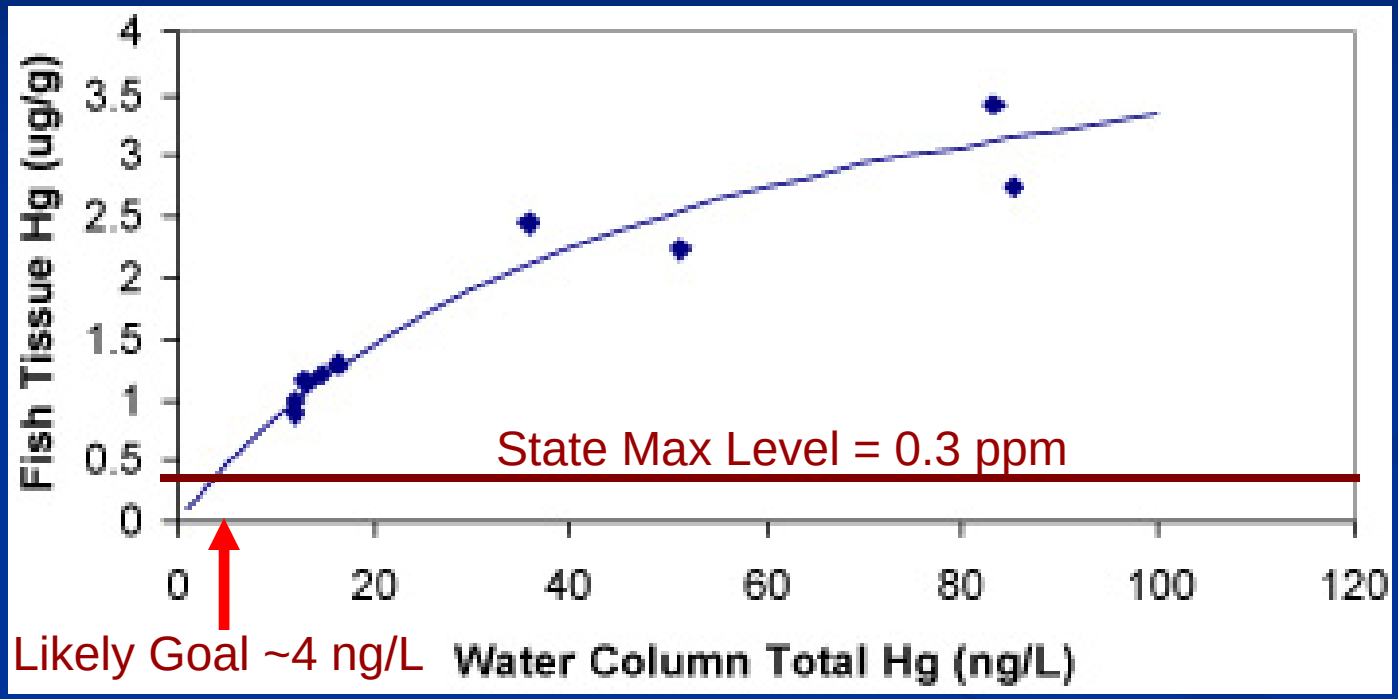
Site-Specific BAF Approach

BAF = Fish [Hg] / Water [Hg]



Target Water [Hg] = Target Fish [Hg] / BAF

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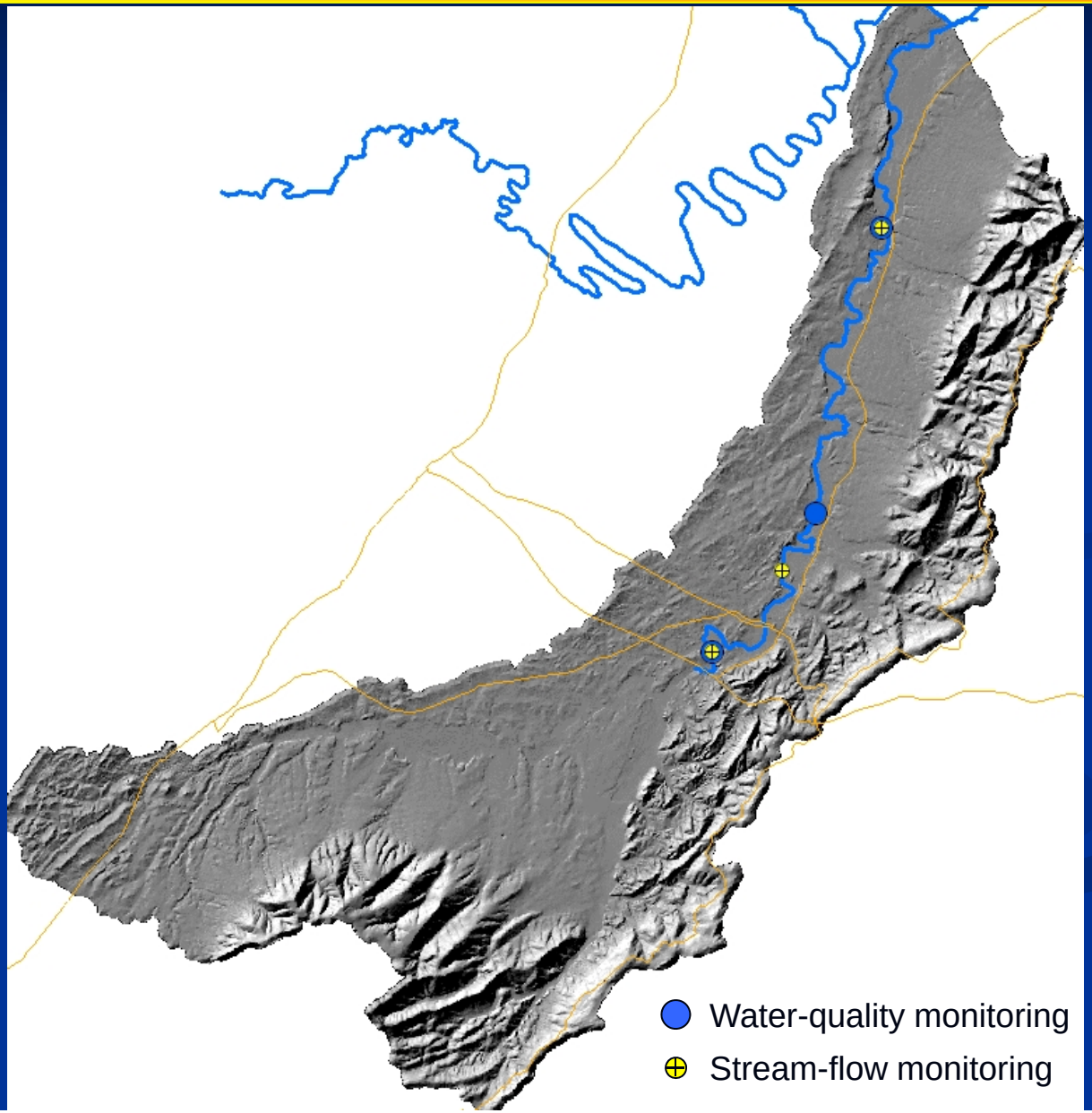
South River Monitoring Sites



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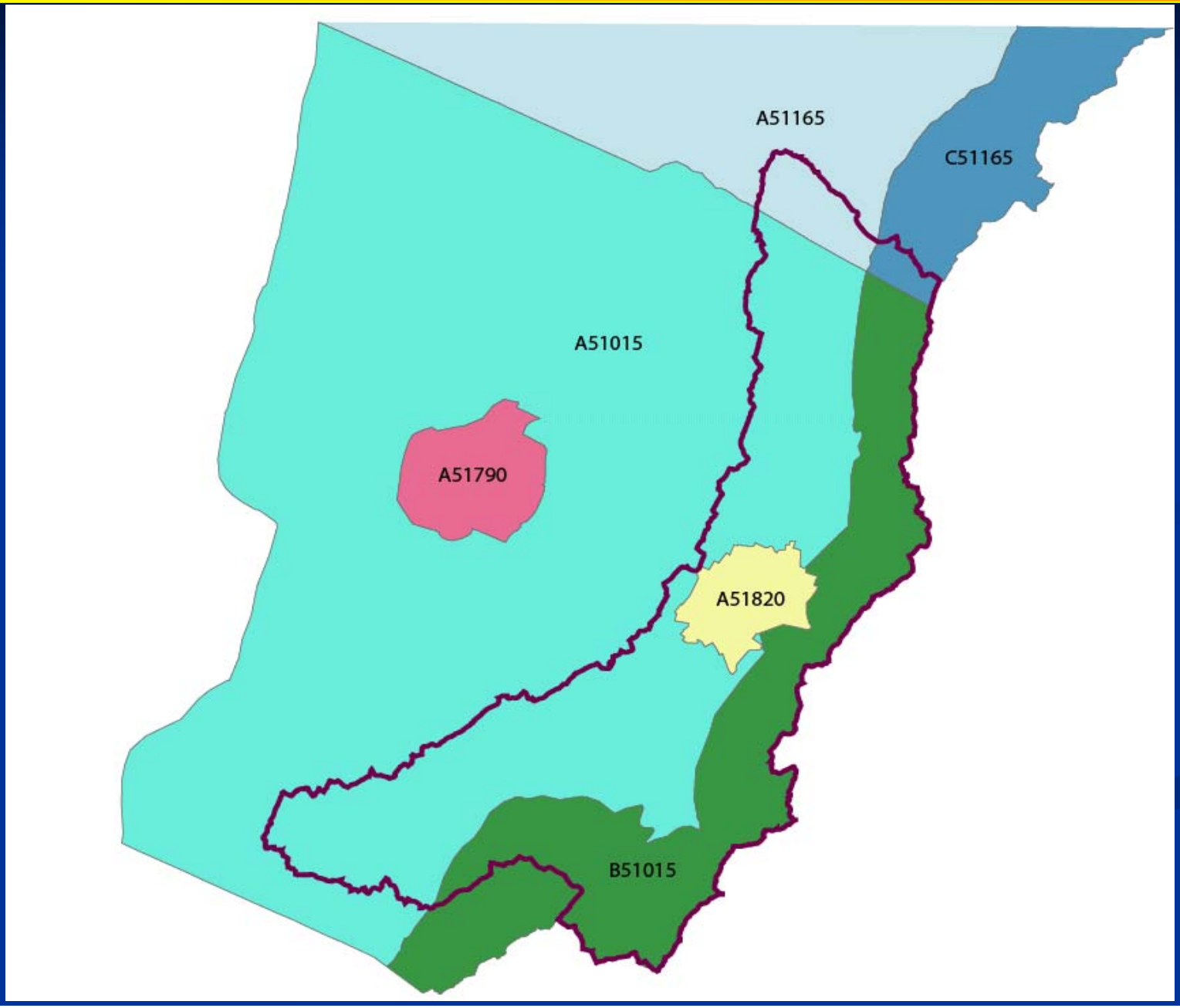
Land Use, Precipitation, Meteorology



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HSPF Susp. Sed. Budgeting

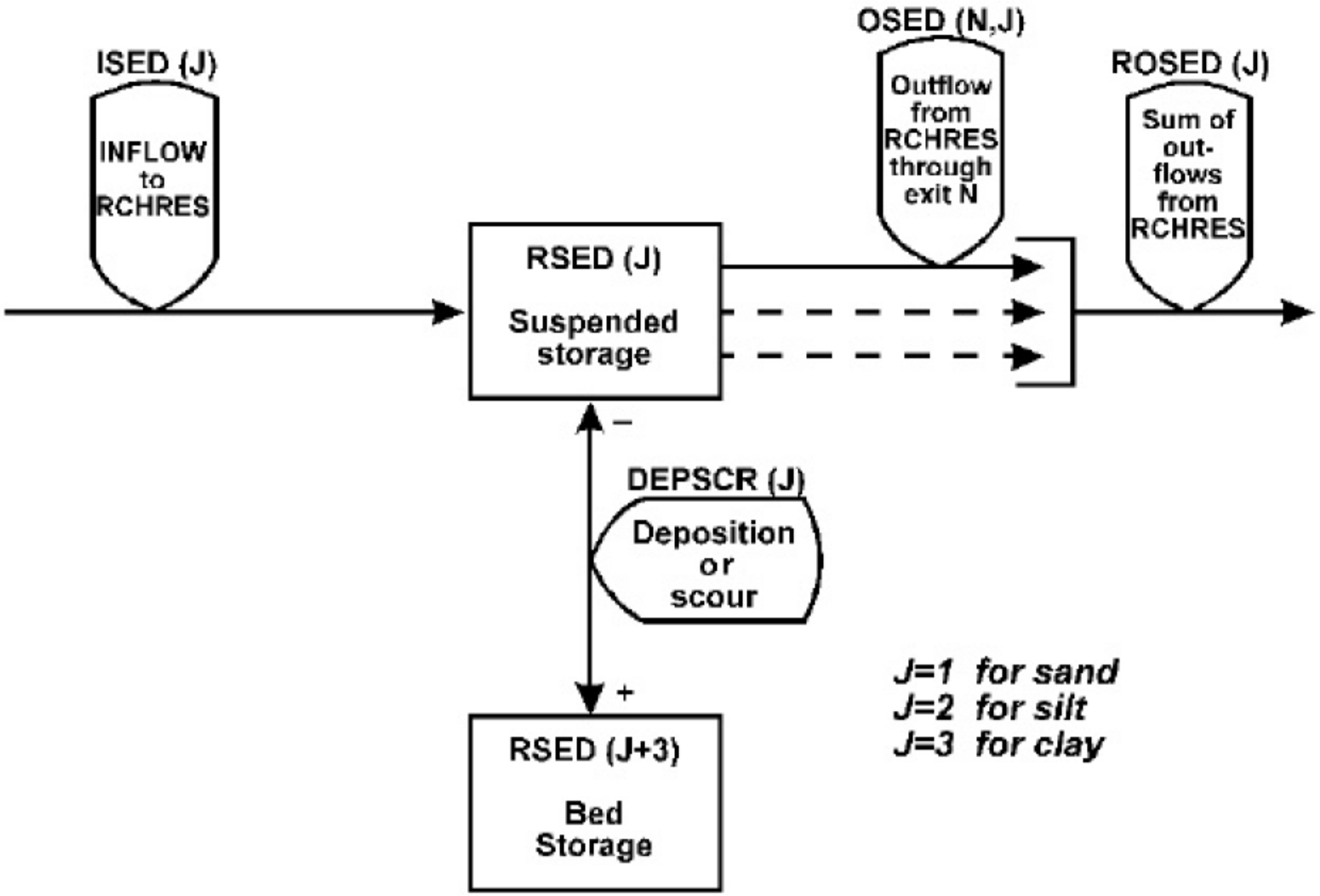

Figure 47: Flow diagram of inorganic sediment fractions in the SEDTRN section of the RCHRES Application Module

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