

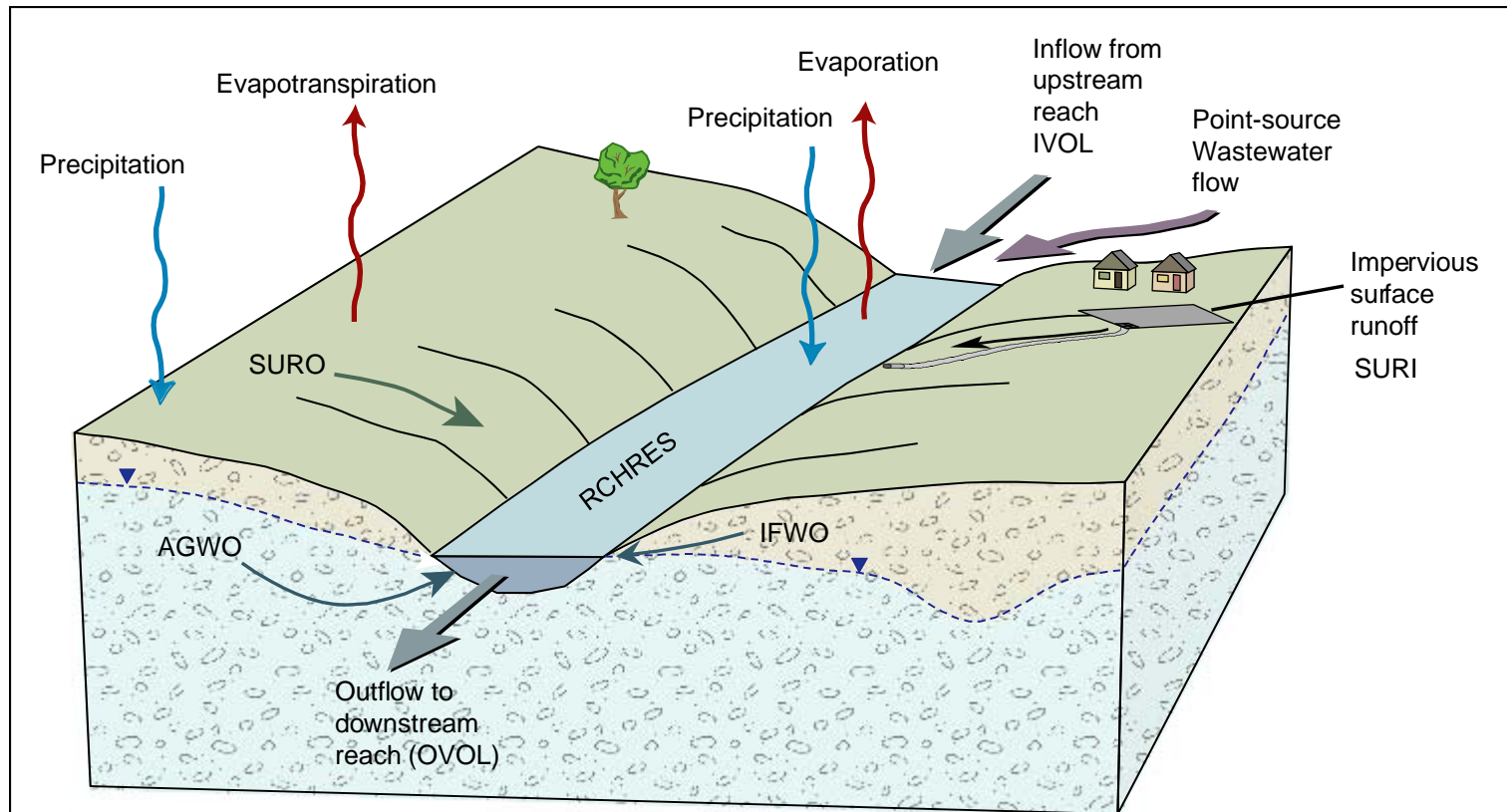
Update on HSPF Watershed Modeling for the TMDL Study



Modeling Sediment Runoff, Mercury Sources, and Downstream Transport



Hydrologic Modeling Framework - HSPF



EXPLANATION

SURI—Surface runoff from impervious areas	RCHRES—Stream reach or reservoir segment
SURO—Surface runoff from pervious areas	IVOL—Inflow volume
IFWO—Interflow	OVO—Outflow volume
AGWO—Active groundwater flow (base flow)	SURI—Surface runoff from impervious areas
	SURO—Surface runoff from pervious areas

Model Structure

Inputs

Timeseries:

Precip
Climatic Variables
Pt. Source Input

Parameters:

Land surface properties
Hydraulic variables
Constitutive relations
Simulation options

Model Calculations

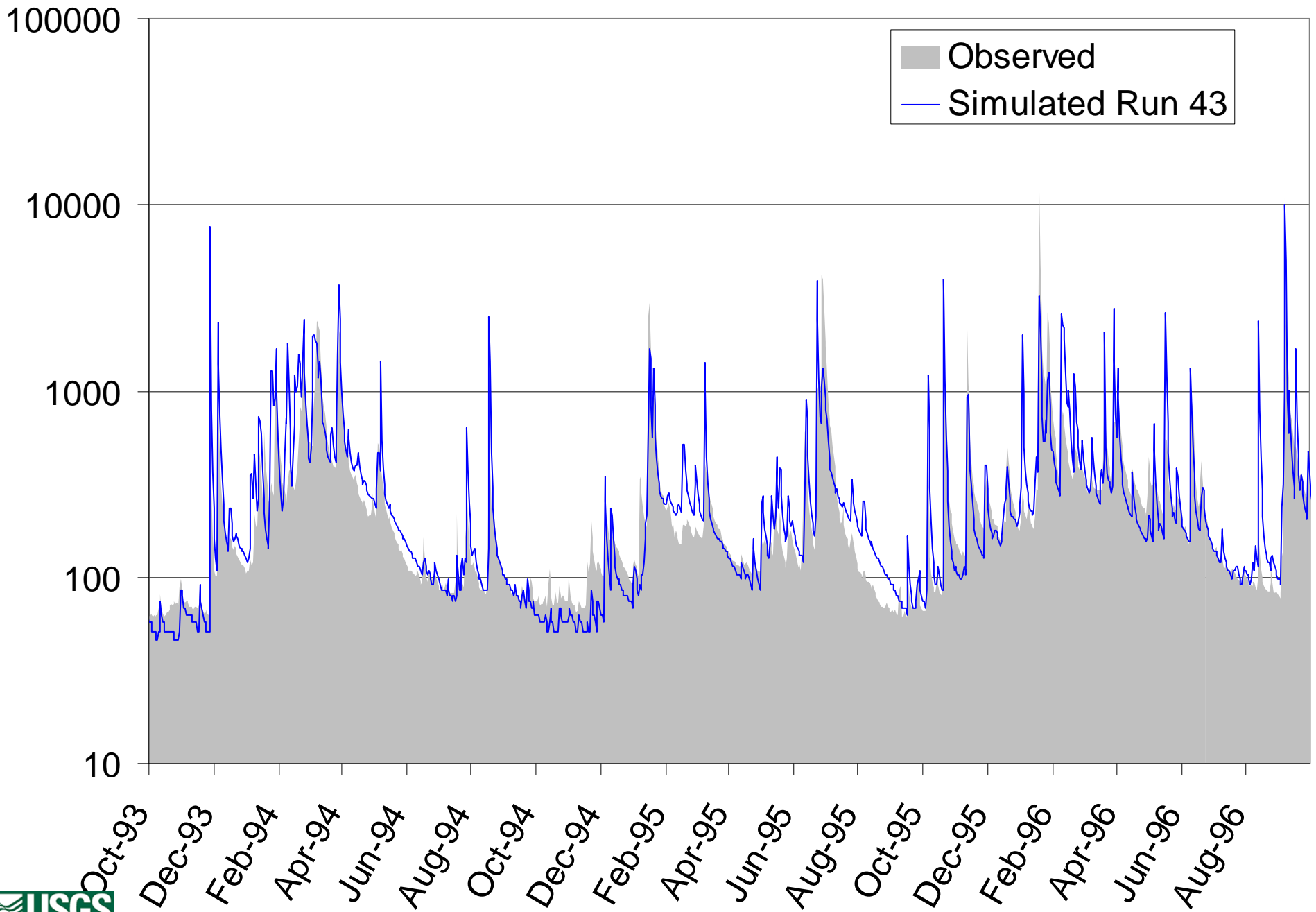
HSPF Model
Hour by Hour
Mass Balance for
Water, Sediment, and Hg

Outputs

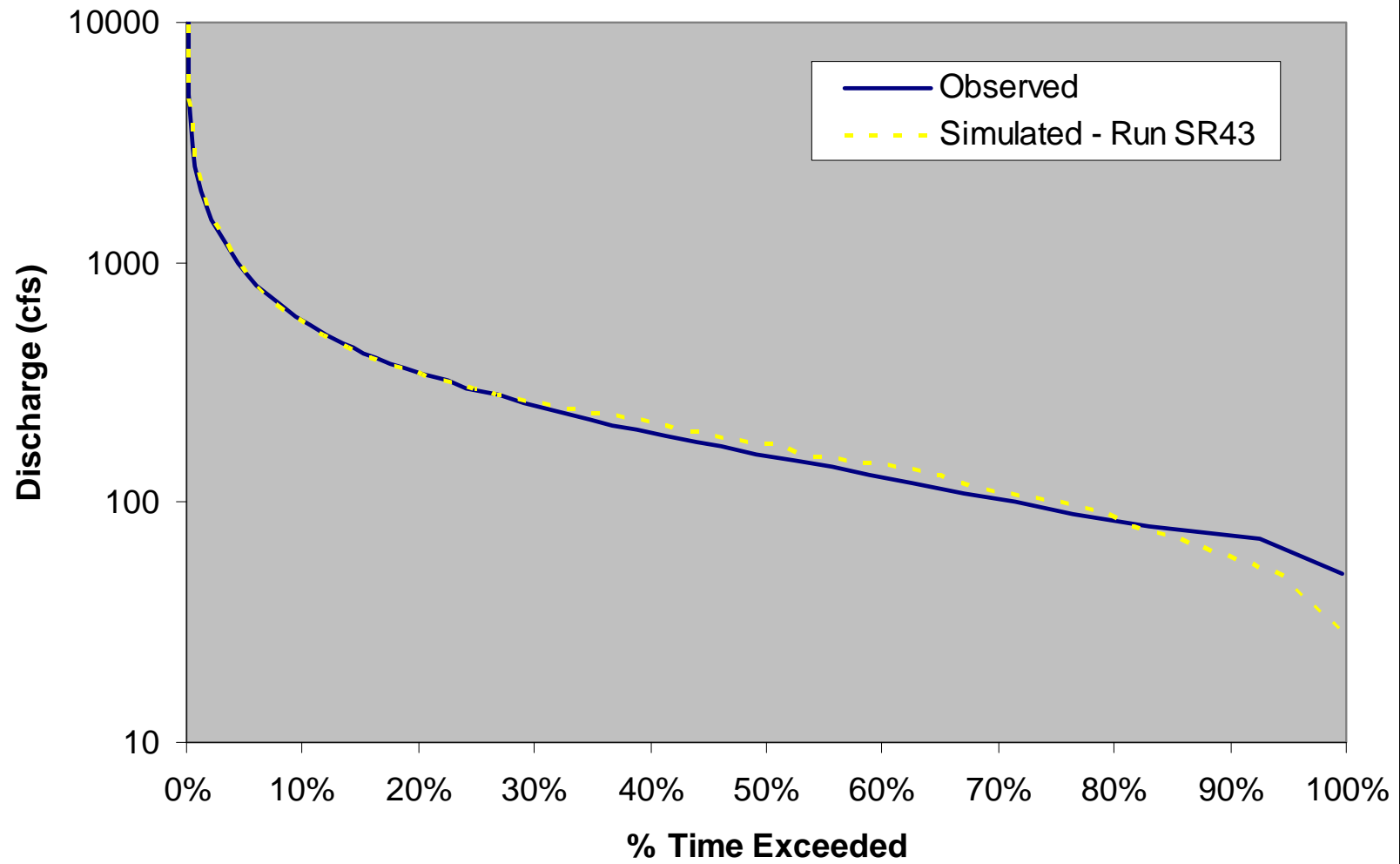
Timeseries:

Fluxes
Water
Sediment
Hg
Storages
Water
Sediment
Hg

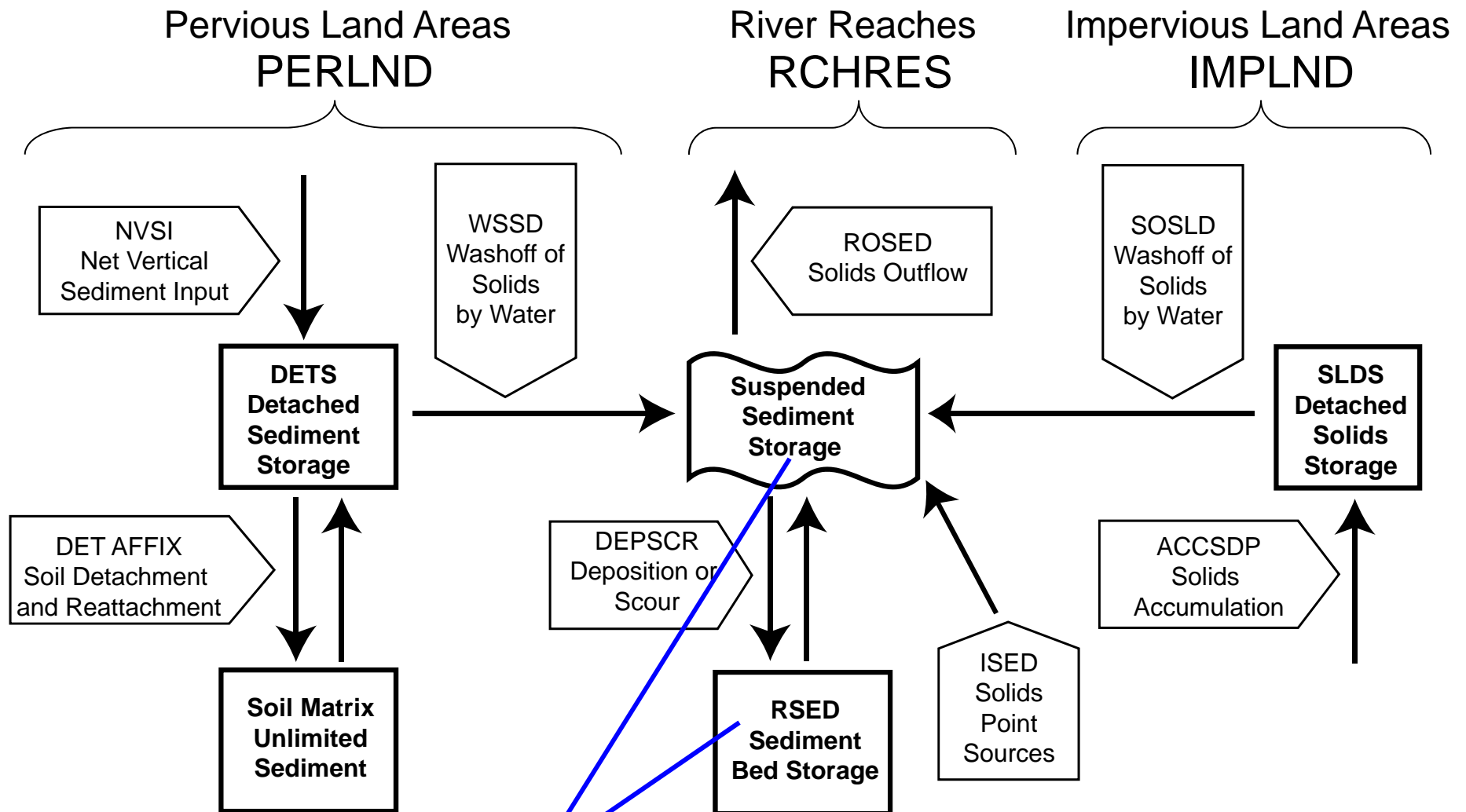
Streamflow @ Harriston (cfs)



Flow Duration - South River @ Harriston

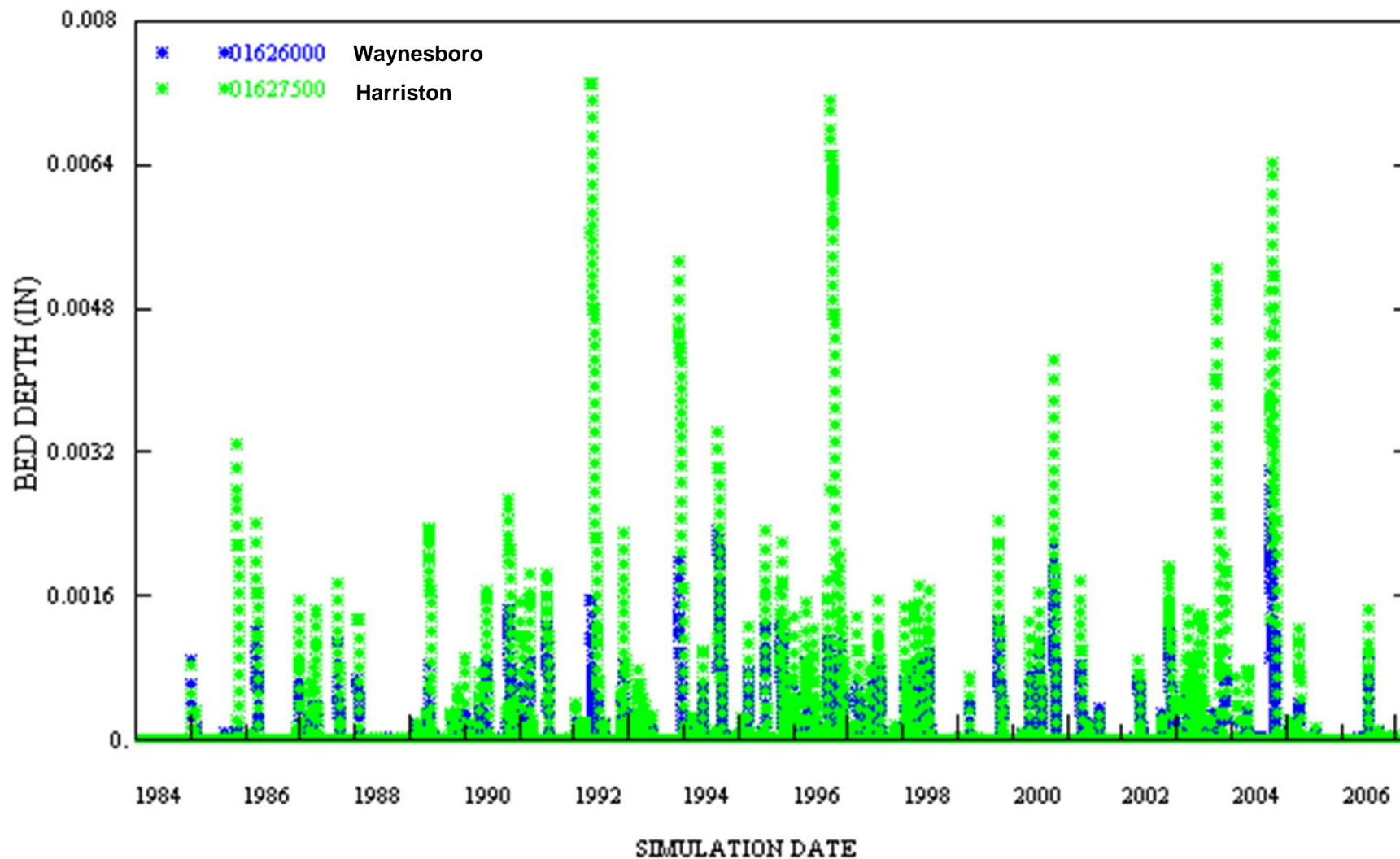


Sediment Fluxes and Storages in the HSPF Watershed Model

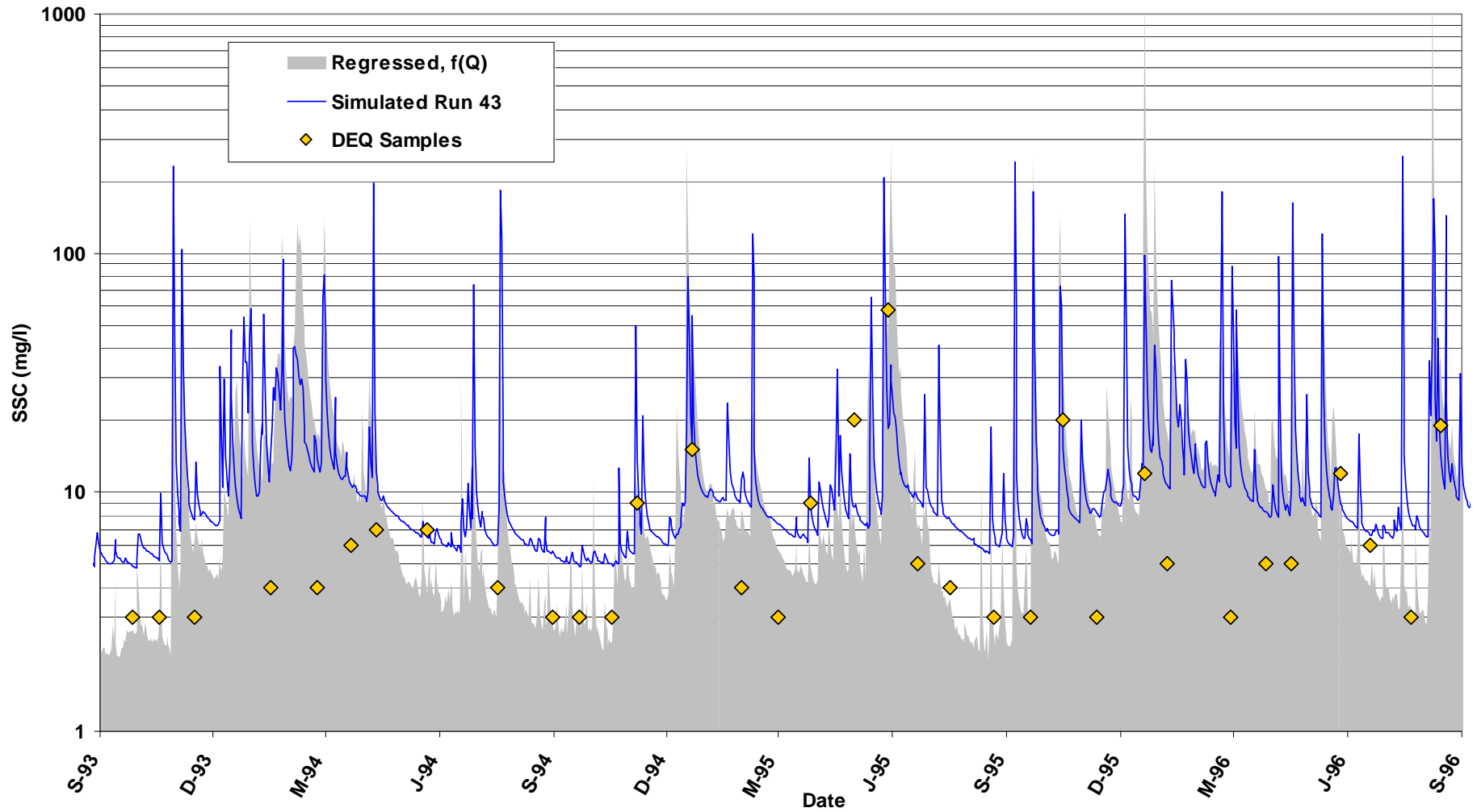


Plotted on Following Slides

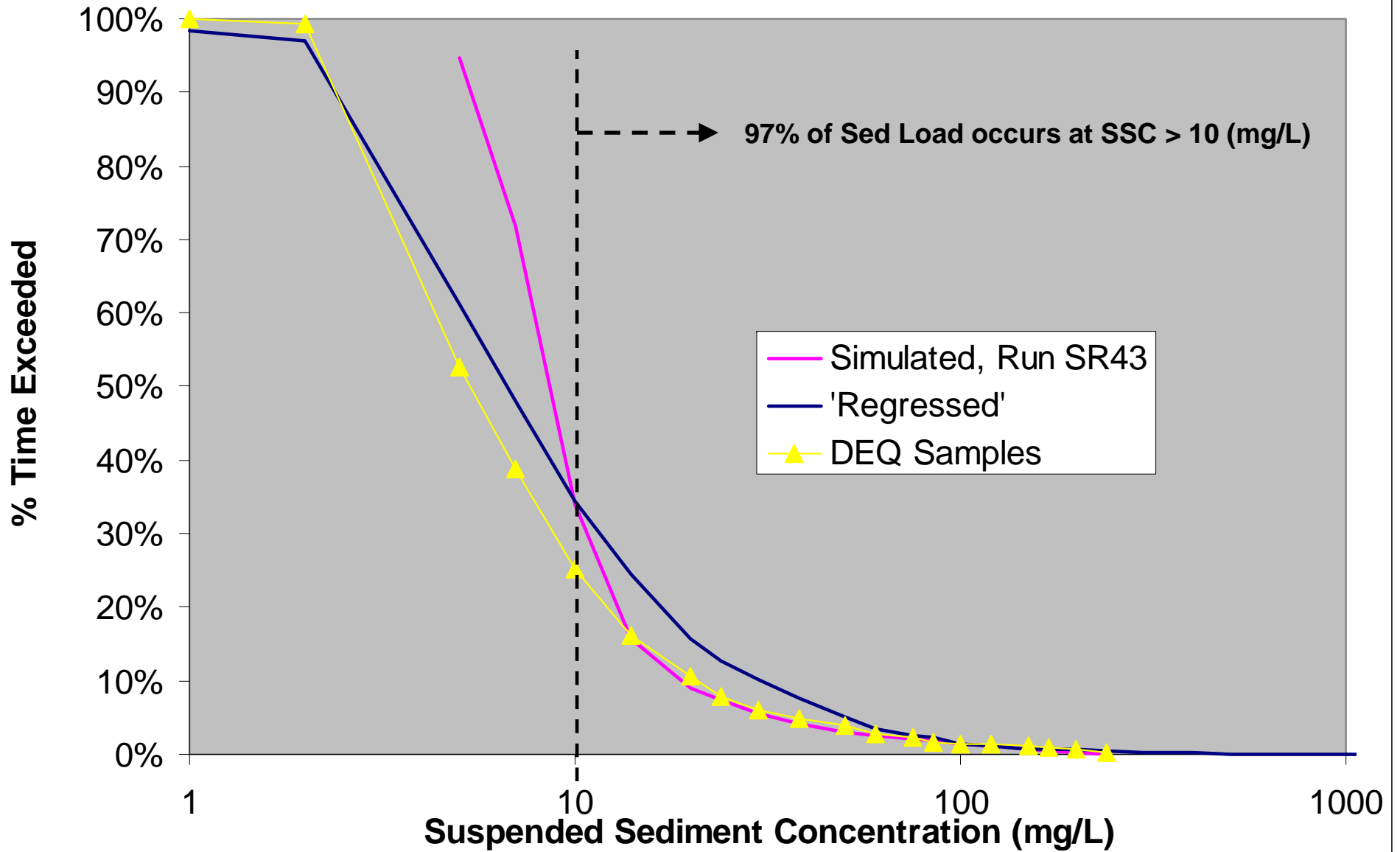
Simulated Depth of Sediment on Channel Bed (Run SR43)



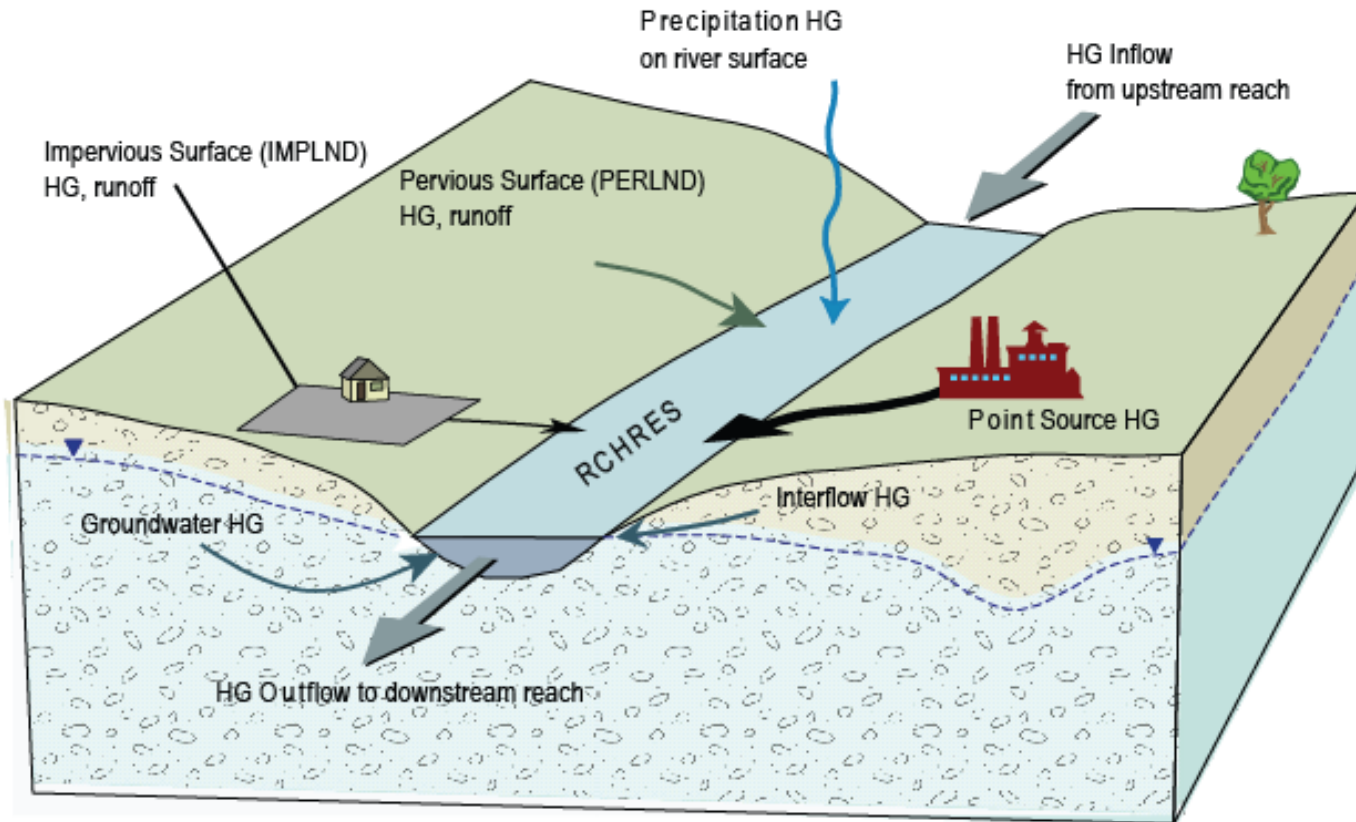
Suspended Sediment Concentration (mg/l) for South R. @ Harriston



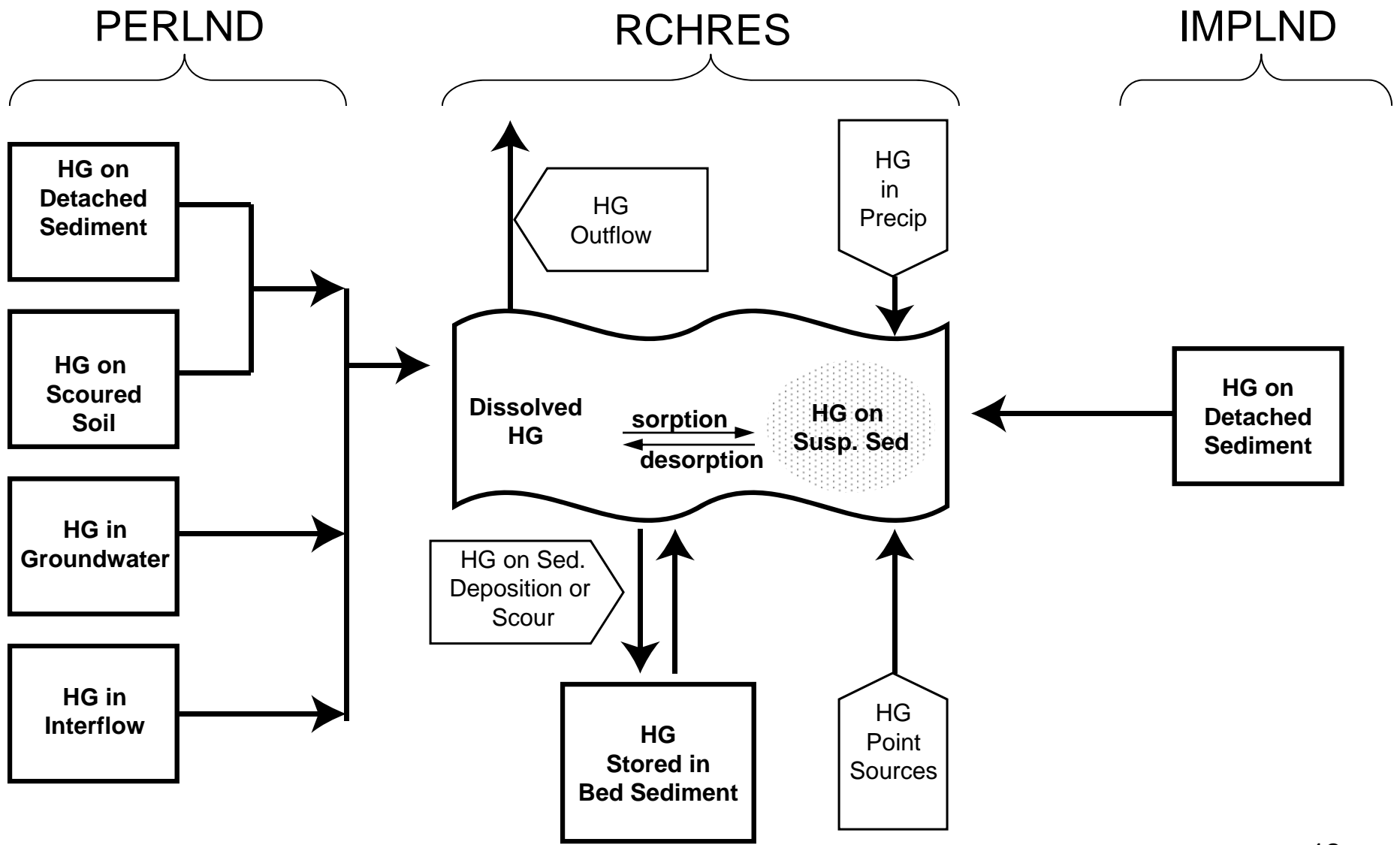
SSC Duration curves, South R. @ Harriston, 1990-2000



Mercury Modeling Framework - HSPF



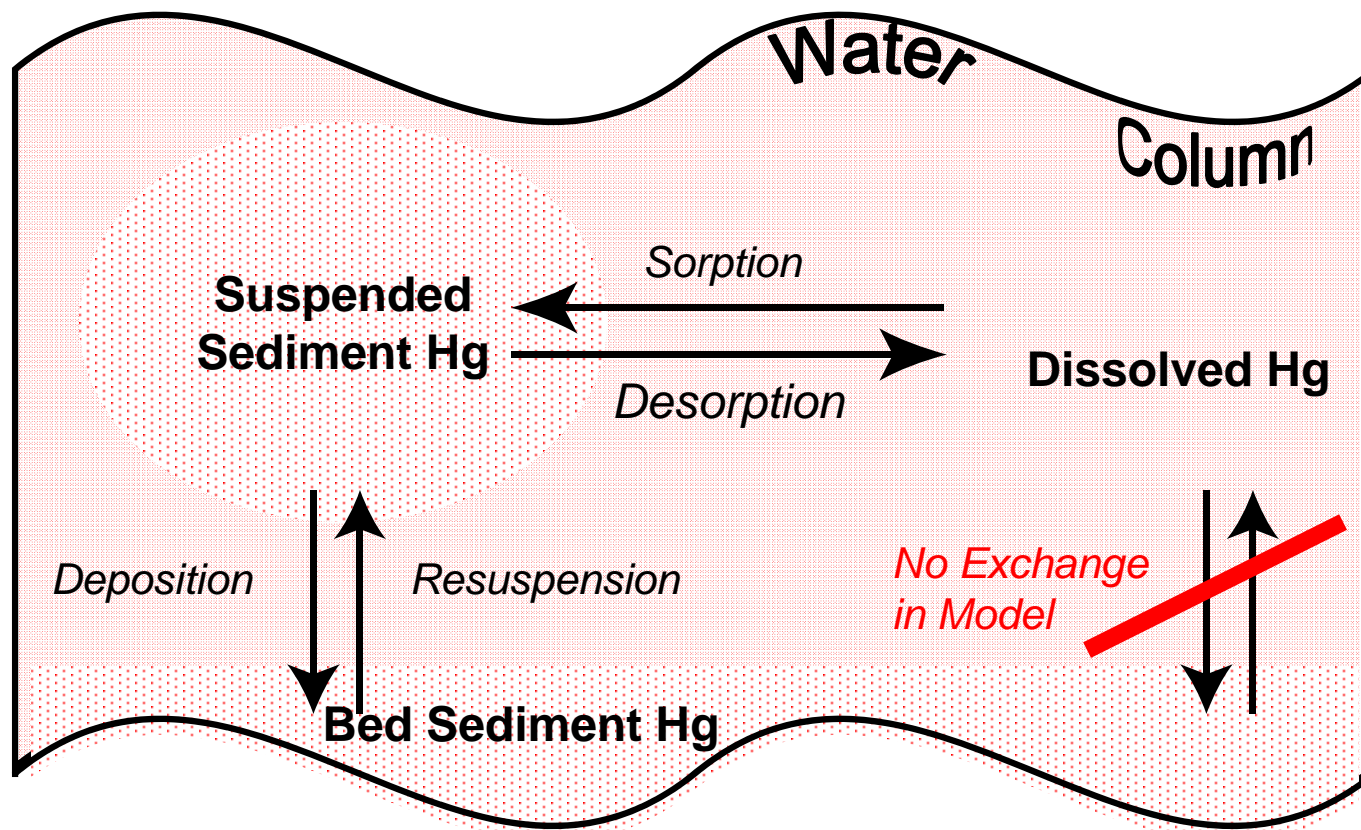
Mercury Storage and Flux in the HSPF Watershed Model



Model Treatment of Sorption/Desorption in the Water Column

In the watershed transport HSPF model:

- Sorption/Desorption follows a linear isotherm
- K_d is not a function of temperature
- $\log(K_d) = 6.0$, based on Mason findings and observed Hg concentration ratios
- Rate parameters are assigned so that sorption equilibrium is reached immediately

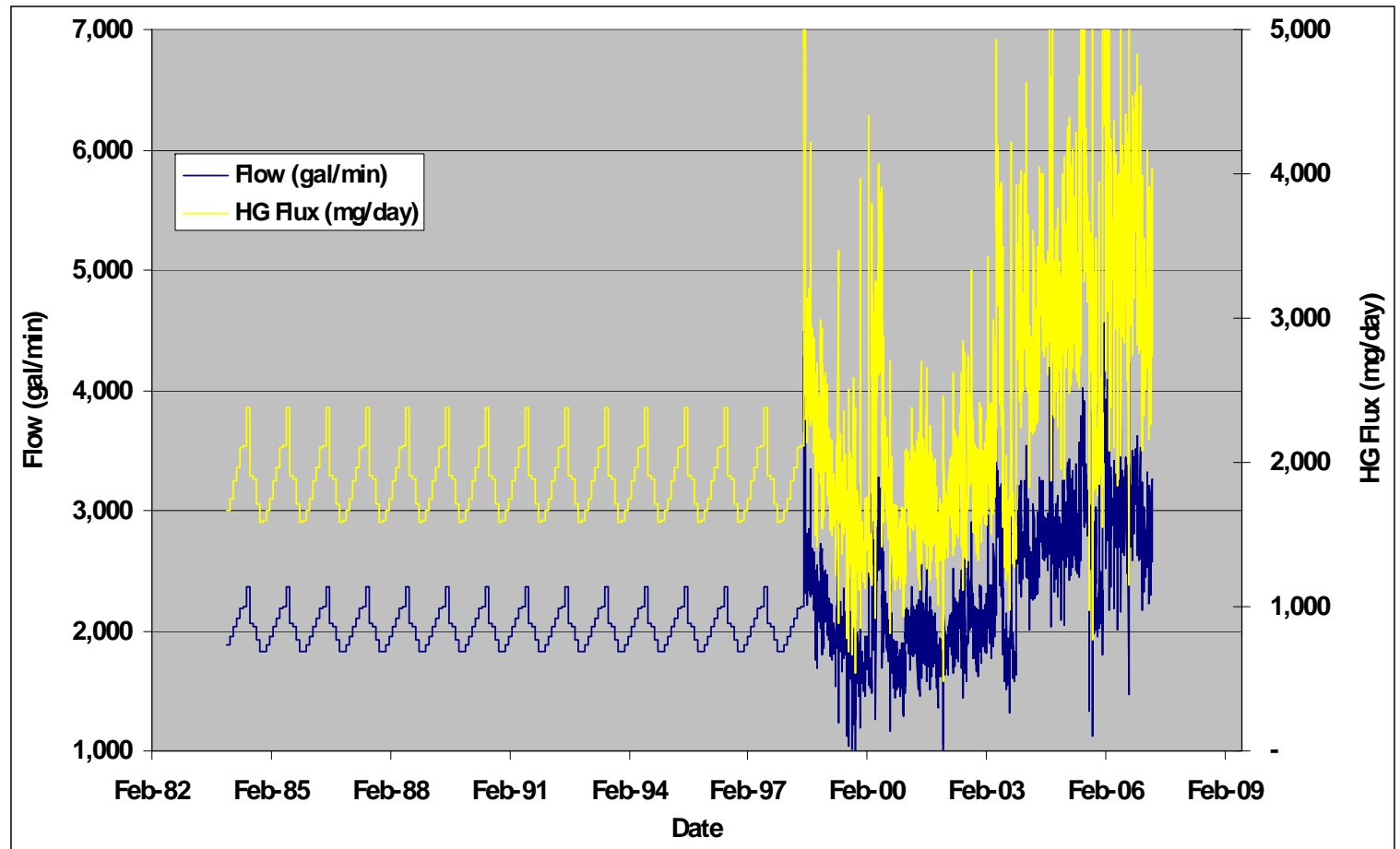


Point Sources Assigned in the HSPF Watershed Model

Point Sources in Model Facility name, downstream order	NPDES			1984-2007	
	Model ID	Model Reach	Permit No	River Mile	Annual Average HG Load (g)
Stuarts Draft WWTP	101	1	VA0066877	38.9	1.1
Loth Spring	222	2	na	25.6	0.2
INVISTA/ former DuPont	-	-	-	25.0	925.9 (total)
outfall 001	201	2	VA0002160	"	767.7
outfall 003	203	2	VA0002160	"	2.9
outfall 004	204	2	na	"	0.5
outfall 008	208	2	na	"	87.1
outfall 009	209	2	na	"	10.1
outfall 010	210	2	na	"	10.2
outfall 011 (before 08/02)	211	2	VA0002160	"	109.0
outfall 011 (after 08/02)	"	"	"	"	44.1
outfall 012	212	2	na	"	0.0
outfall 013	213	2	na	"	0.5
outfall 014	214	2	na	"	0.5
Frew Pond, Baker Spring	221	2	na	"	0.8
Plant Site GW Discharge	231	2	na	"	1.5
Waynesboro WWTP	241	2	VA0025151	23.5	35.5
Genicom	301	3	VA0002402	21.9	0.1
Alcoa	501	5	VA0001767	4.4	85.6
Total Annual Point Source Hg Load (g)					1048.4

Plant Site Outfall 001, Model Input Time series, Flow and Hg Flux

DATA Used	Flow	Tss	Hg
Baseflow Conditions	Jan 1984 - Jun 1998, monthly avg values (1998-Aug 2002) 1998-2007, daily data (Invista)	Baseflow average of 24,527 ug/L "	Baseflow average of 2,278 ng/L "
Stormflow Conditions	1984-1998, monthly average flows, 1998-2007, daily data (Invista)	Stormflow average of 20,270 ug/L "	Stormflow average of 393 ng/L "





That's all folks

Table 2. Discharge rates, suspended solids concentrations, and mercury concentrations for point sources in the South River watershed model.

Point Sources		Discharge (cfs)			Suspended Solids Concentration (TSS or SSC), mg/L			Total unfiltered Hg concentration (THG), ng/L		
Facility Name	Model ID	Data Source	Model value assignment		Data Source	Model value assignment		Data Source	Model value assignment	
			Periods with Data	Periods w/o data		Periods with Data	Periods w/o data		Periods with Data	Periods w/o data
Stu Draft STP	101-103	VPDES monthly 2001-2007	monthly observed values	avg monthly values	VPDES monthly 2001-2007	monthly observed values	Average monthly values	periodic samples, n=1	-	THG = 0.7 ng/L
Loth Spring	201-203	None	-	Estimate = 25% of FPBS	None	-	Use FPBS average TSS = 9 mg/L	None	-	Use FPBS average THG = 4.1 ng/L
INVISTA Outfalls		Invista, DuPont, VPDES			Invista, DuPont, VPDES			DuPont, DEQ		
001	211-213	daily 1998-2007	daily observed values	avg monthly values	periodic samples, n=45	-	Baseflow TSS average = 2.6 mg/L Stormflow TSS average = 3.4 mg/L	periodic samples, n=41	-	Regression on Flow
003	231-233	periodic measurements	-	Regression on daily river flow	periodic samples, n=31	-	Baseflow TSS average = 4.5 mg/L Stormflow TSS average = 6.9 mg/L	periodic samples, n=40	-	Baseflow THG average = 41.2 Ng/L Stormflow THG average = 61.6 Ng/L
004	241-243	periodic measurements	-	Regression on daily river flow	periodic samples, n=13	-	Baseflow TSS average = 1.1 mg/L Stormflow TSS average = 25.7 mg/L	periodic samples, n=8	-	Baseflow THG average = 15.5 Ng/L Stormflow THG average = 42.1 Ng/L
006		Ignored based on insignificant contribution			Ignored based on insignificant contribution			Ignored based on insignificant contribution		
008	281-283	periodic measurements	-	Regression on daily river flow	periodic samples, n=26	-	Baseflow TSS average = 6.3 mg/L Stormflow TSS average = 32 mg/L	periodic samples, n=31	-	Baseflow THG average = 298.4 Ng/L Stormflow THG average = 134.9 Ng/L
009	291-293	periodic measurements	-	Baseflow = 0 Stormflow simulated by HSPF	periodic samples, n=4	-	No Baseflow, Stormflow average TSS = 7.2 mg/L	periodic samples, n=4	-	No Baseflow, Stormflow average THG = 81.9 ng/L
010	221-223	periodic measurements	-	Baseflow = 0 Stormflow simulated by HSPF	periodic samples, n=3	-	No Baseflow, Stormflow average TSS = 46.8 mg/L	periodic samples, n=4	-	No Baseflow, Stormflow average THG = 228.4 ng/L
011	271-273	Daily 1998-2002 and Overflow event monitoring 2005-2006	daily observed values	avg monthly values	periodic samples, n=28	-	Baseflow TSS average = 24.5 mg/L Stormflow TSS average = 20.3 mg/L	periodic samples, n=37	-	Baseflow THG average = 2278 ng/L Stormflow THG average = 393 ng/L
012	274-276	None	-	Baseflow = 0 Stormflow simulated by HSPF	None	-	set = 010 conc. at given time and flow	None	-	set = 010 conc. at given time and flow
013	277-279	Overflow event monitoring 2001-2006	Only individual overflow events	avg annual overflow volume	None	-	set = 001 conc. for stormflow events	None	-	set = 001 conc. for stormflow events
014	224-226	Overflow event monitoring 2001-2006	Only individual overflow events	avg annual overflow volume	None	-	set = 001 conc. for stormflow events	None	-	set = 001 conc. for stormflow events
FPBS	204-206	periodic measurements	-	Average plus seasonal variation of ± 29%	periodic samples, n=3	-	Average TSS = 9 mg/L	periodic samples, n=3	-	Average THG = 4.1 ng/L
GW Disch.	207-209	Darcian flux gw levels (7 wells), slug test K	-	Average flux	None	-	Assume TSS = 0	periodic samples, n=32	-	Average THG = 6.9 ng/L
Wboro STP	261-263	VPDES monthly 2001-2007	monthly observed values	avg monthly values	VPDES monthly 2001-2007	monthly observed values	Average monthly values	periodic samples, n=1	-	THG = 7.6 ng/L
Genicom	301-303	VPDES monthly 2001-2007	monthly observed values	avg monthly values	None	-	Assume TSS = 0	periodic samples, n=1	-	THG = 0.2 ng/L
Alcoa	501-503	VPDES monthly 2001-2007	monthly observed values	avg monthly values	VPDES monthly 2001-2007	monthly observed values	Average monthly values	periodic samples, n=1	-	THG = 18.3 ng/L