2011 Storm Impacts on Nutrients and SS

Focus; March
April
September

Danville
Top right 9/10/11
Bottom left 9/13/11

Bottom Right
Conestoga parking lot
9/12/11

Site Location	Drainage Area (Sq. Mi.)	Water/ Wetland	Urban	Ag	Forest
Towanda	7,797	2	5	22	71
Lewisburg	6,847	1	5	10	84
Marietta	25,990	2	7	19	72

Where

- Towanda – Mostly NY
- Lewisburg – West Branch
- Marietta – Above Dams

What

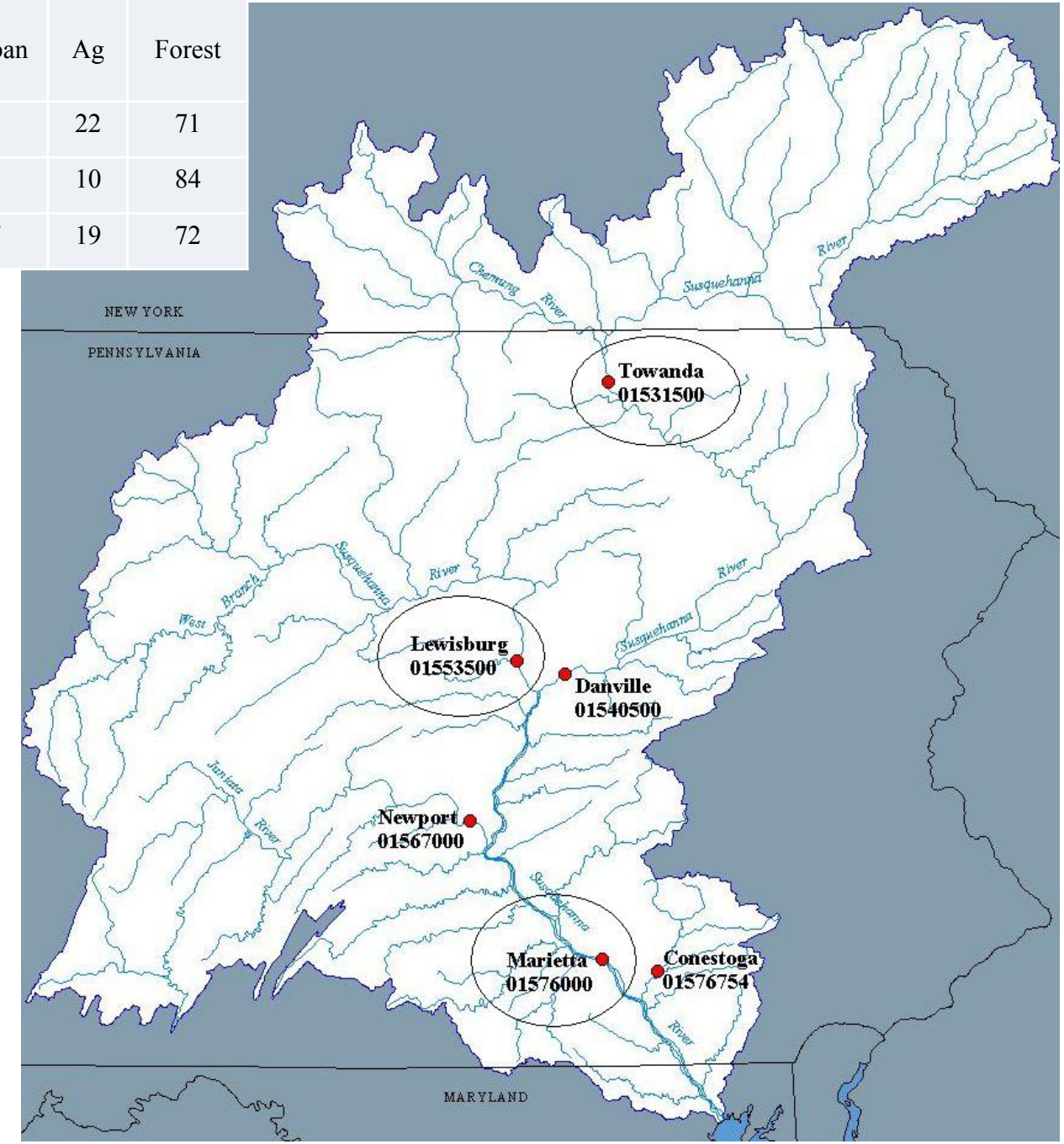
- Precipitation
- Flows
- Loads – TN, TP, SS
- Yields – TN, TP, SS
- Average Concentrations
  - TN, TP, SS

When

- March, April, September
- 6-day peak flow period

How

- Estimator
- Calculations



Calculations

Average Concentration

Monthly load and Average monthly flow

=> Average monthly concentration (mg/L)

6-Day loads over peak of storm events

Annual mean concentration and daily mean flow

=> Loads for time period

Problem

Using average concentration for all days
High flow days have higher concentration

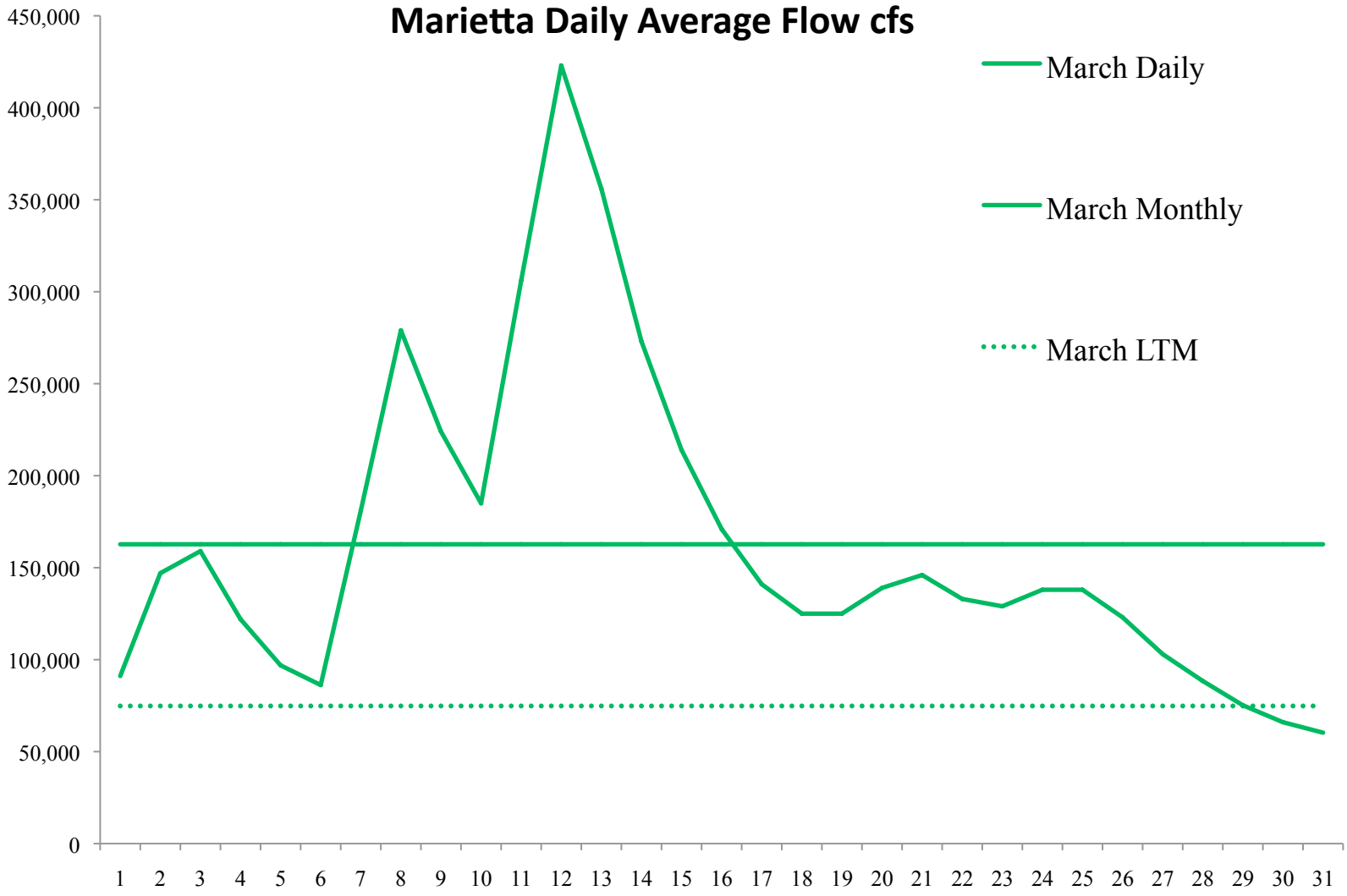
=> estimates will be lower than actual loads

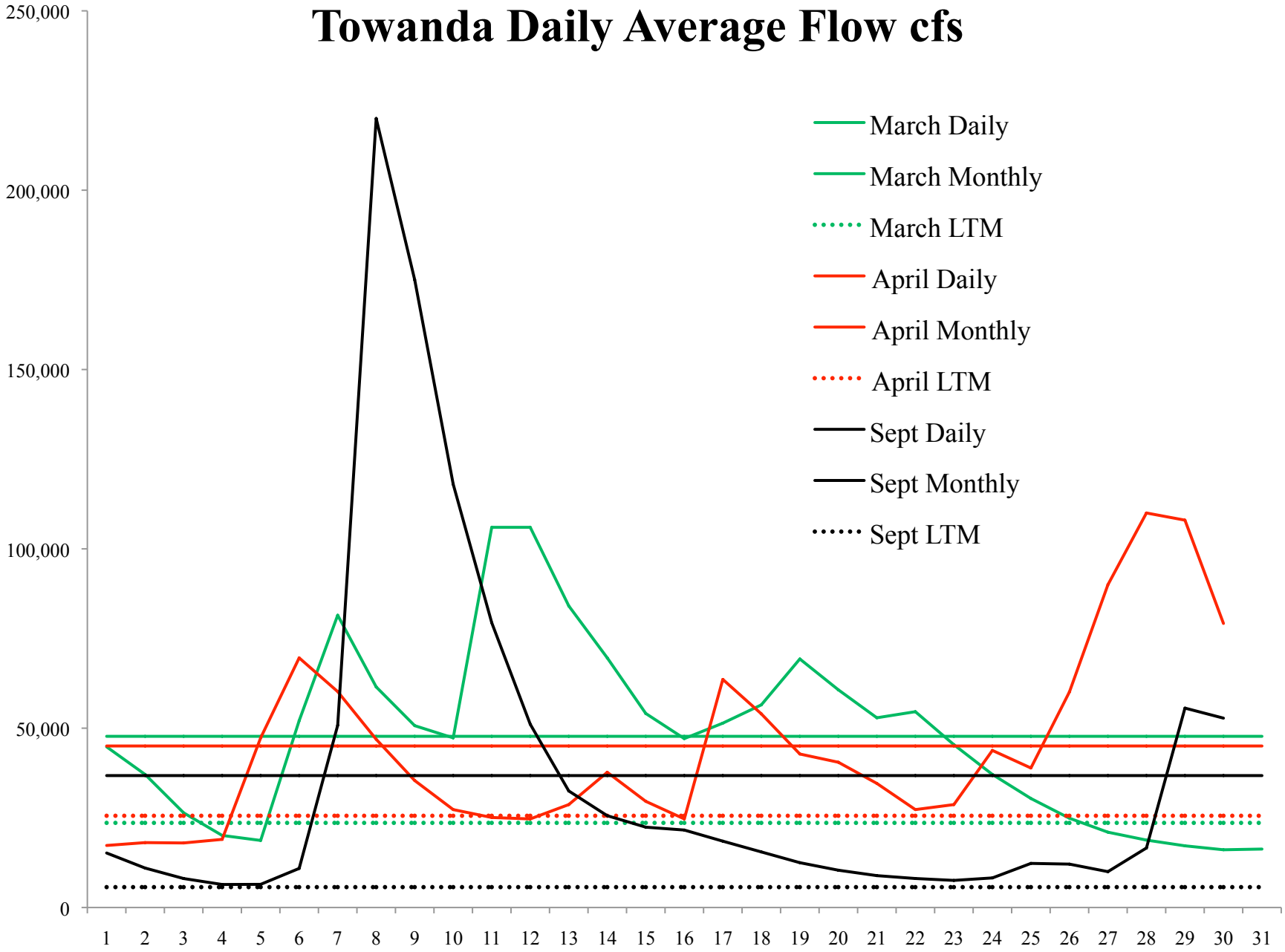
Precip Inches	March		April		September	
	2011	Departure	2011	Departure	2011	Departure
NY	4.15	1.28	7.75	4.41	10.55	7.13
PA	5.85	2.52	8.26	4.76	12.60	9.07

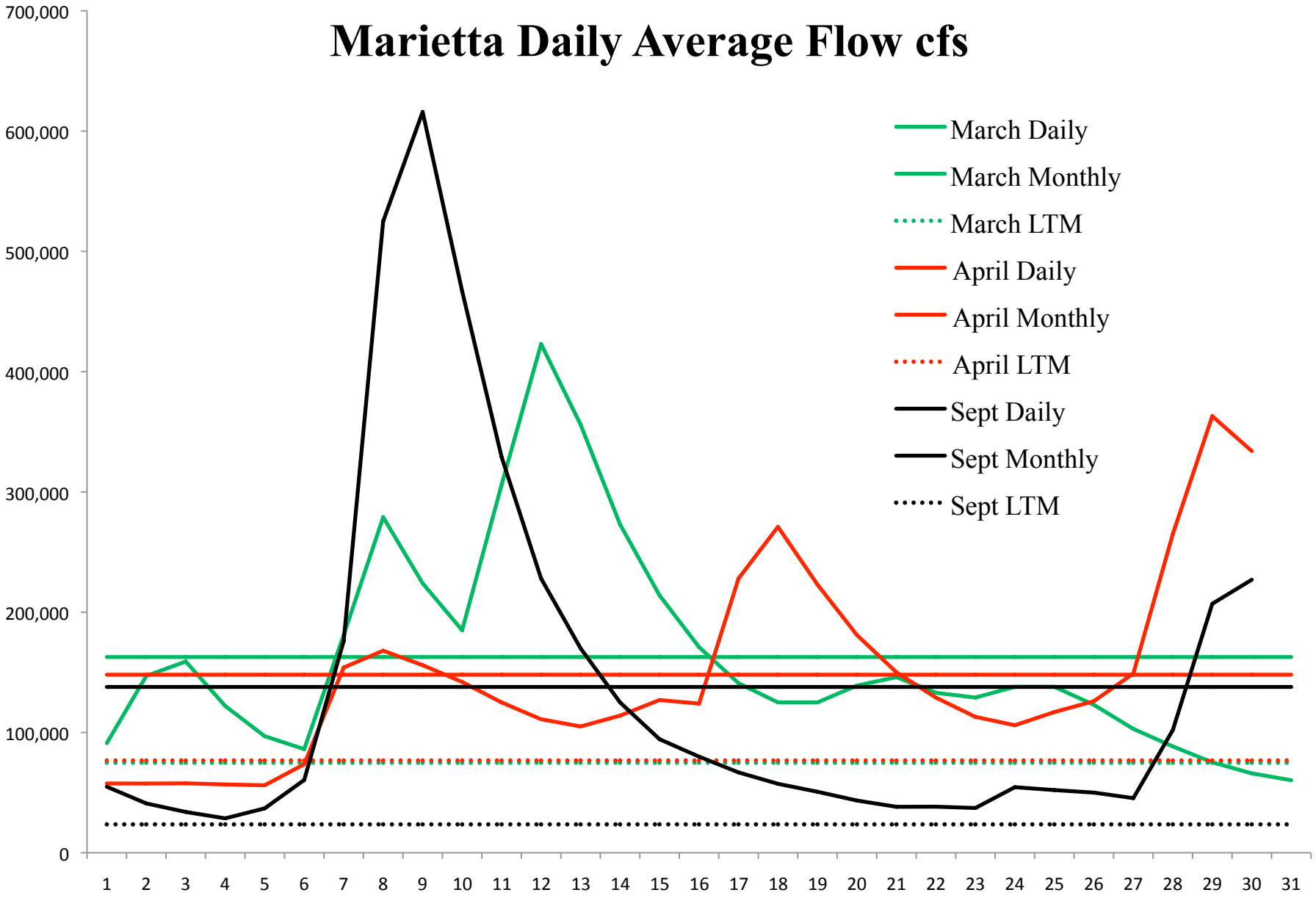
Source data at: http://www.erh.noaa.gov/marfc/Precipitation/Departures/

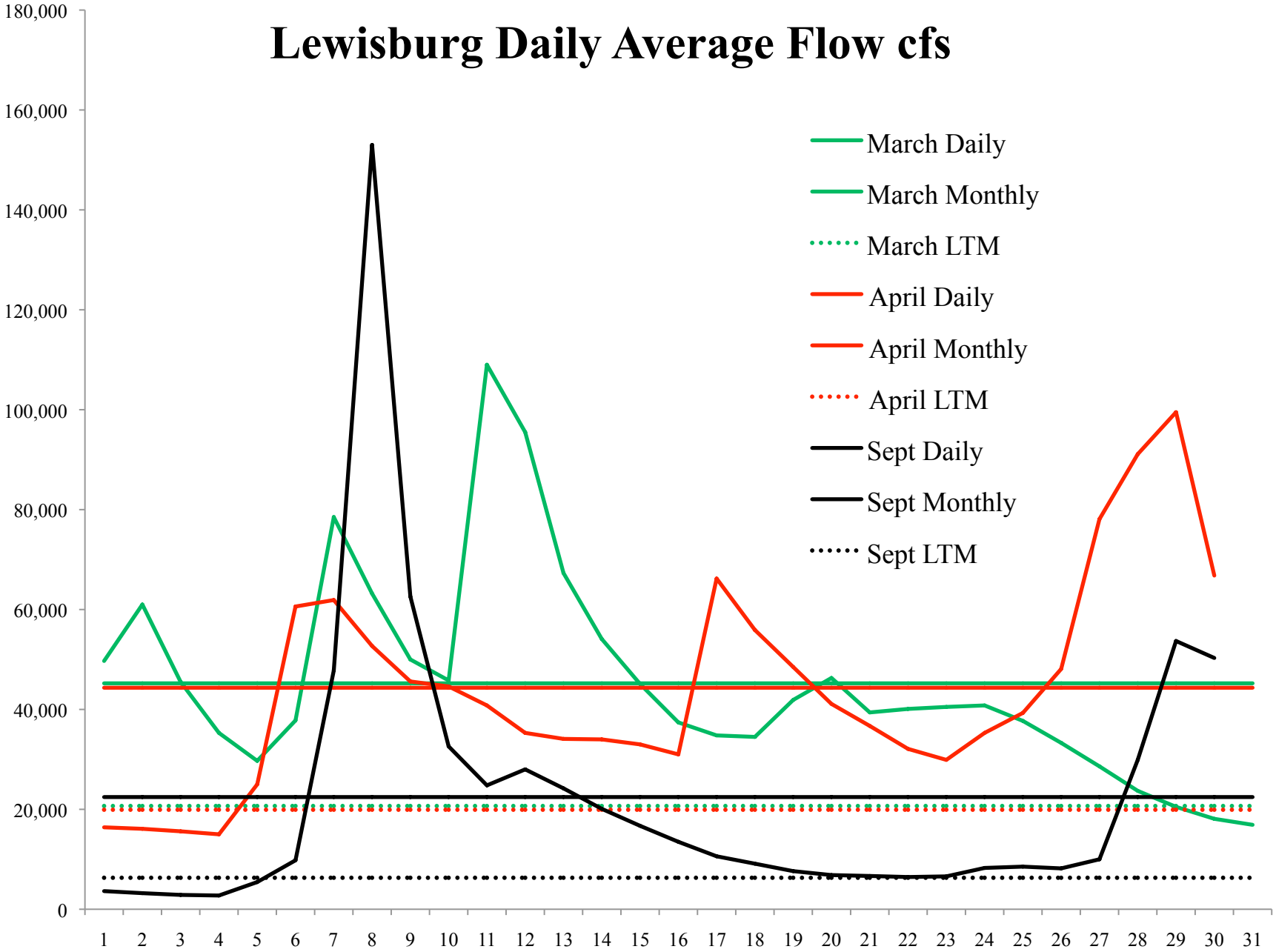
Flow (cfs) Towanda	Daily High	2011 Monthly Average	Monthly LTM	Monthly % of LTM
March	124,000	47,732	23,601	202%
April	128,000	45,037	25,582	176%
September	250,000	36,785	5,687	647%

Daily Average Flow, Monthly Average, and LTM (cfs)




Towanda Daily Average Flow cfs
250,000
200,000
150,000
100,000
50,000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
March Daily
March Monthly
March LTM
April Daily
April Monthly
April LTM
Sept Daily
Sept Monthly
Sept LTM


Marietta Daily Average Flow cfs
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
March Daily
March Monthly
March LTM
April Daily
April Monthly
April LTM
Sept Daily
Sept Monthly
Sept LTM


Lewisburg Daily Average Flow cfs
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
March Daily
March Monthly
March LTM
April Daily
April Monthly
April LTM
Sept Daily
Sept Monthly
Sept LTM

Loads in Tons during March, April, September of 2011

Tons	Ave. Monthly Flow		TN		TP		Sed	
Towanda	2011	LTM	2011	LTM	2011	LTM	2011	LTM
3	47,732	23,601	4,033	2,353	367	186	578,135	214,944
4	45,037	25,582	3,447	2,473	399	227	818,977	348,303
9	36,785	5,687	2,361	318	816	44	5,020,671	81,079

Yields (lbs/ac) during March, April, September of 2011

Lbs/ac	Ave. Monthly Flow		TN		TP		Sed	
Towanda	2011	LTM	2011	LTM	2011	LTM	2011	LTM
3	47,732	23,601	1.62	0.94	0.147	0.075	232	86
4	45,037	25,582	1.38	0.99	0.160	0.091	328	140
9	36,785	5,687	0.95	0.13	0.327	0.018	2,012	32

Suspended Sediment

SS Tons	Towanda		Marietta		Lewisburg	
	2011	LTM	2011	LTM	2011	LTM
March	578,135	214,944	2,342,739	517,595	224,833	103,006
April	818,977	348,303	2,363,189	586,536	244,027	114,509
September	5,020,671	81,079	12,014,186	364,647	248,851	39,242

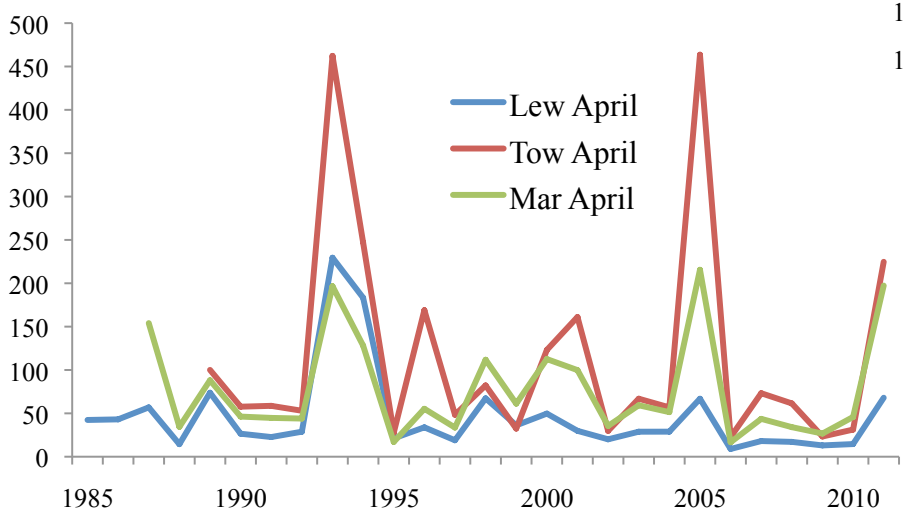
2011 6-Day Loads	**Towanda**		
	Ave Flow	Daily High	SS Tons
March 10-15	77,850	124,000	182,501
April 25-30	81,033	128,000	294,713
Sept 7-12	115,717	250,000	3,158,767

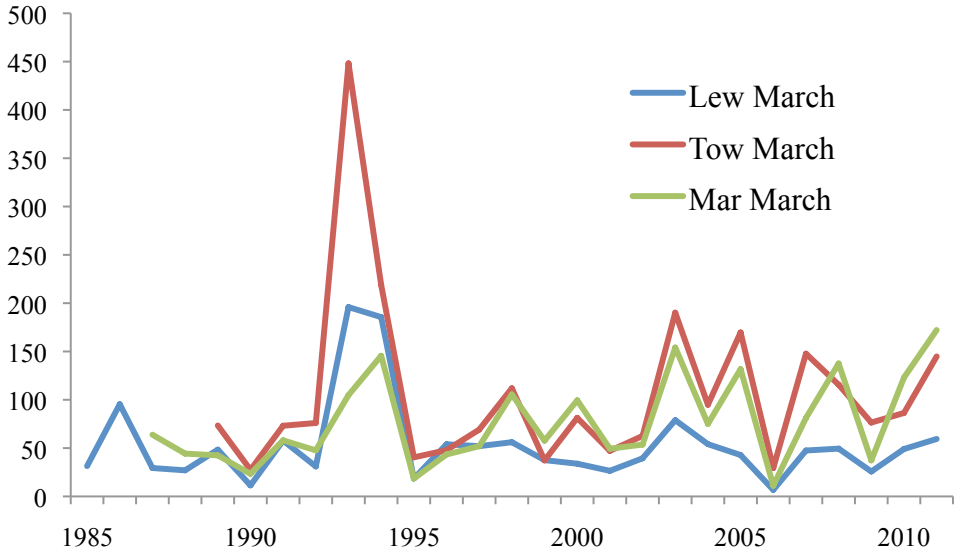
2011 6-Day Yields	**Towanda**		
	Ave Flow	Daily High	SS lbs/ac
March 10-15	77,850	124,000	73
April 25-30	81,033	128,000	118
Sept 7-12	115,717	250,000	1,266

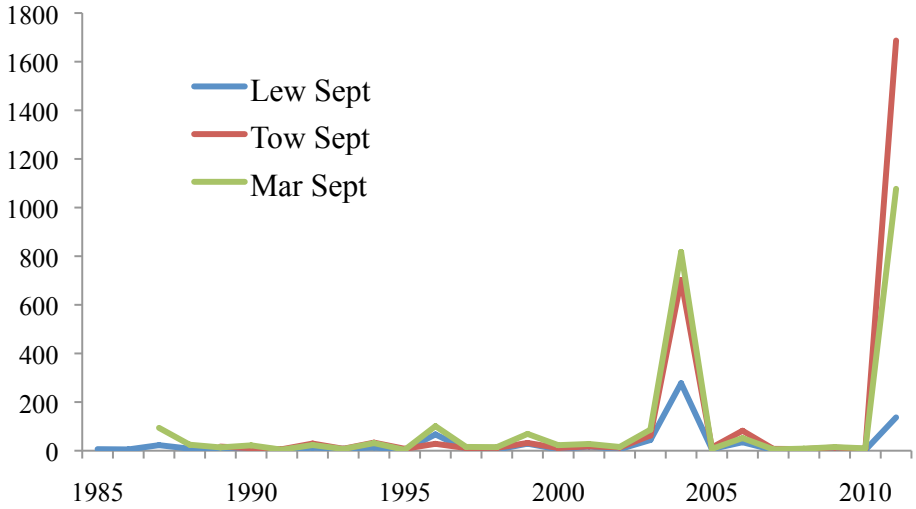
Ave. Concentrations in mg/L during March, April, September of 2011

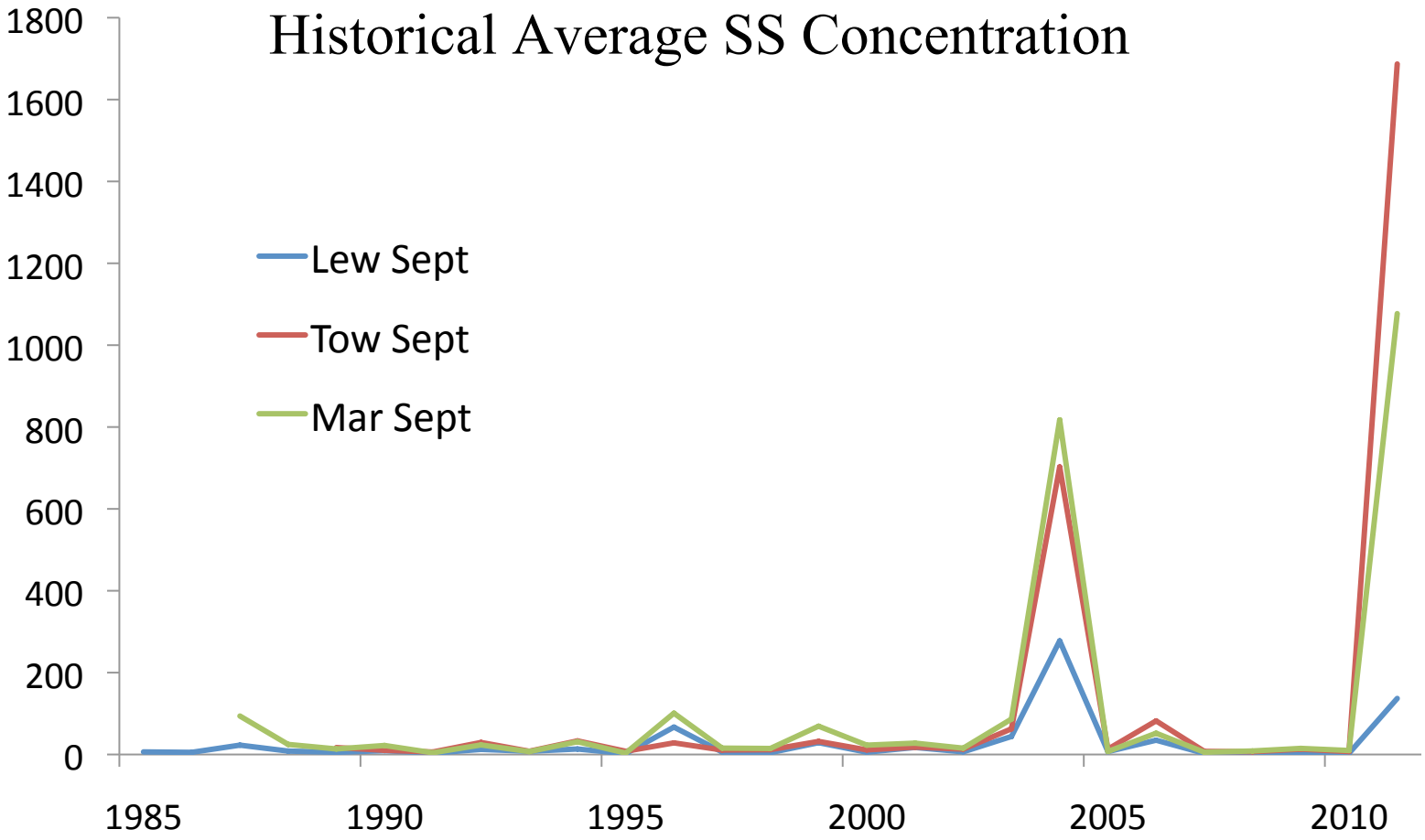
mg/L	Ave. Monthly Flow		TN		TP		Sed	
Towanda	2011	LTM	2011	LTM	2011	LTM	2011	LTM
3	47,732	23,601	1.01	1.19	0.092	0.095	145	109
4	45,037	25,582	0.95	1.19	0.110	0.110	225	168
9	36,785	5,687	0.79	0.69	0.274	0.095	1,687	176

Historical SS Average Concentration









September Marietta					
Year	Days	Ave Flow	High daily Ave.	Ave. [ ]	SS Tons
2004 - Ivan	18-23	295,167	497,000	817	3,904,184
2011- Lee	7-12	390,167	616,000	1,077	6,800,111

Take Home

High individual flow events versus high average flow

- Monthly loads versus daily loads
- Dramatic deviations from LTM problematic?

Timing seems to be more critical

- Ivan and Lee during end of summer
  - versus
- Early spring events

??Questions/Comments??

Columbia, PA South of Route 462 aka Marietta Site
9/10/11