

Mercury Loading From the Plant Outfalls:

**A Look at the First Year of Phase III
Outfall Sampling**



Background

- In 2005, DEQ requested additional baseflow and stormflow data from the plant outfalls to better characterize Hg contributions for the TMDL Study
- Dupont agreed to do this sampling as part of Phase III RCRA Investigation

Phase III Design Summary

Dates	12/05 - 3/07
Outfalls	001, 003, 004, 006, 008, 009, 010, 011, 101
Frequency	Monthly baseflow; Quarterly stormflow
Sample Type	24-hr baseflow and 3-hr stormflow composites for THg; Grabs for DissHg
Number of Samples	56 baseflow composites; 68 baseflow grabs; 24 stormflow composites; 34 stormflow grabs

Phase III Monitoring Results: Total Hg Conc.

Outfall	Baseflow Conc. (ng/L)			Stormflow Conc. (ng/L)		
	min	max	average	min	max	average
001	20.40	100.10	46.95	25.89	261.80	101.24
003	4.51	200.00	34.83	1.10	311.60	123.78
004	13.90	36.85	22.38	7.05	129.00	42.44
006	12.20	21.97	15.99	11.60	32.55	22.08
008	6.49	2492.00	236.37	21.19	591.10	192.65
009				30.20	153.60	81.93
010				87.36	449.00	237.97
011	38.81	23808.00	2521.86	44.00	2410.00	634.67
101	1.10	78.21	12.92	5.84	52.62	23.30

- With the exception of 006, Hg concs. in external outfalls are higher than in South River along the plant reach (18 ng/L avg at Const. Park)
- High concentrations in 011 and 008
- WW treatment fairly good at removing mercury (101 lowest avg. conc.)

Phase III Monitoring Results: Diss. Hg Conc.

Outfall	Baseflow Conc. (ng/L)			Stormflow Conc. (ng/L)		
	min	max	average	min	max	average
001	13.18	41.21	24.99	2.43	17.70	10.67
003	2.99	32.80	6.84	5.85	108.00	35.87
004	7.14	18.00	11.21	2.38	4.72	3.50
006	4.06	6.54	5.30	2.53	30.07	16.30
008	4.17	15.60	9.35	10.19	19.25	14.05
009				4.86	40.31	15.71
010				16.01	61.31	39.57
011	7.00	46.14	21.22	16.00	219.00	67.32
101	0.65	3.23	1.20	1.02	2.30	1.66

- Diss Hg concentrations in external outfalls are higher than in South River along the plant reach (1.9 ng/L avg at Constitution Park)
- Highest dissolved conc. in 001
- Fraction of dissolved to total Hg in 001 is 53% (typically 10% in South River)

Phase III Monitoring Results: Total Hg Loads

Outfall	Baseflow Loading (g/d)			Stormflow loading (g/d)		
	min	max	average	min	max	average
001	0.25	1.49	0.75	0.76	8.30	2.86
003	<.001	0.03	<.001	<.001	0.41	0.10
004	<.001	<.001	<.001	<.001	0.01	<.001
006	<.001	<.001	<.001	<.001	<.001	<.001
008	0.01	0.85	0.11	0.01	2.83	0.59
009				<.001	0.08	0.03
010				0.04	0.11	0.07
Sum	0.26	2.37	0.86	0.81	11.73	3.65
011	<.001	119.78	12.23	0.39	6.89	3.09
101	<.001	0.25	0.04	0.02	0.28	0.10

- Total Hg loads range from 0.26 to 2.4 g/d under baseflow and from 0.81 to 12 g/d under stormflow
- Outfall 001 by far contributes the largest portion of the load, but 008 also contributes a significant portion
- Loading from 011 could be very large if discharged to the river

Phase III Monitoring Results: Diss. Hg Loads

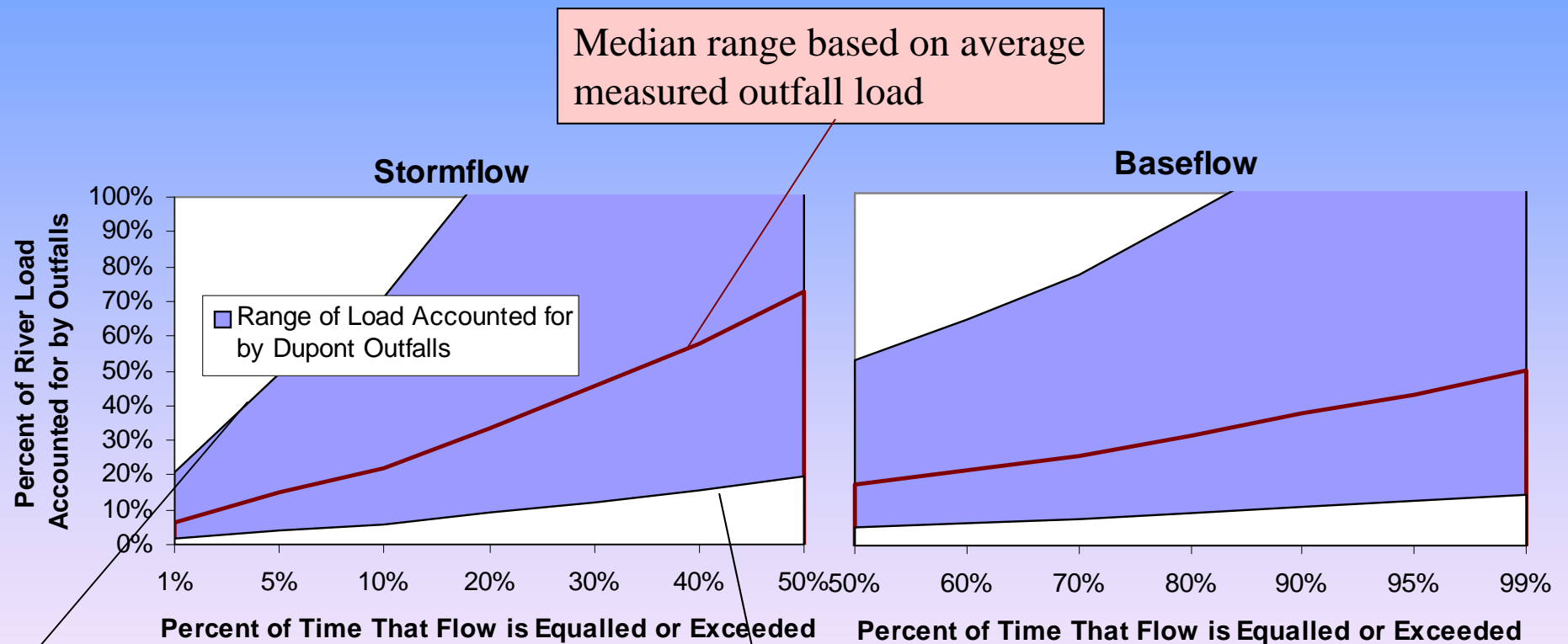
Outfall	Baseflow Loading (g/d)			Stormflow loading (g/d)		
	min	max	average	min	max	average
001	0.22	0.78	0.41	0.07	0.62	0.27
003	<.001	0.01	<.001	<.001	0.09	0.03
004	<.001	<.001	<.001	<.001	<.001	<.001
006	<.001	<.001	<.001	<.001	<.001	<.001
008	<.001	0.03	0.01	<.001	0.05	0.03
009				<.001	0.03	0.01
010				0.01	0.01	0.01
Sum	0.22	0.81	0.42	0.08	0.80	0.35
011	0.03	0.21	0.08	0.07	0.09	0.08
101	<.001	0.01	<.001	<.001	0.01	0.01

- Dissolved Hg loads range from 0.22 to 0.81 g/d under baseflow and from 0.08 to 0.80 g/d under stormflow
- Outfall 001 by far contributes the largest portion of the load

How Do These Loads Compare to Hg Loads in the South River?

- Loading analysis was performed along the plant reach to determine the percentage of mercury in the South River that could be accounted for by current plant outfalls
- Mercury loads at Constitution Park were estimated across the flow frequency distribution
 - Flows estimated from Waynesboro gauge +10% + 20 cfs (for springs, outfall, and Rockfish Run)
 - Mercury estimated at average value (18 ng/L total Hg; 1.9 ng/L diss Hg)
- Mercury loads at Constitution Park were compared to outfall loadings under stormflow for upper end of flow frequency curve and baseflow for lower end of flow frequency curve

Outfall Contributions to Total Hg Loads at Constitution Park

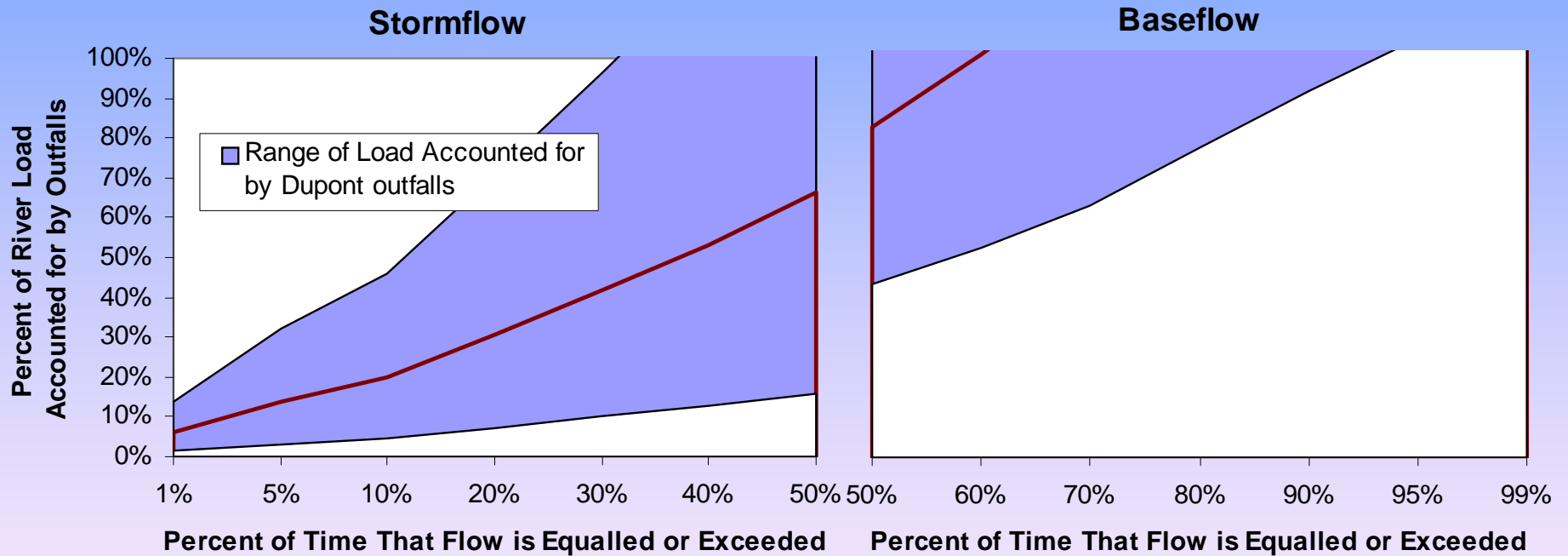


Upper end of range based on maximum measured outfall load

Lower end of range based on minimum measured outfall load



Outfall Contributions to Dissolved Hg Loads at Constitution Park



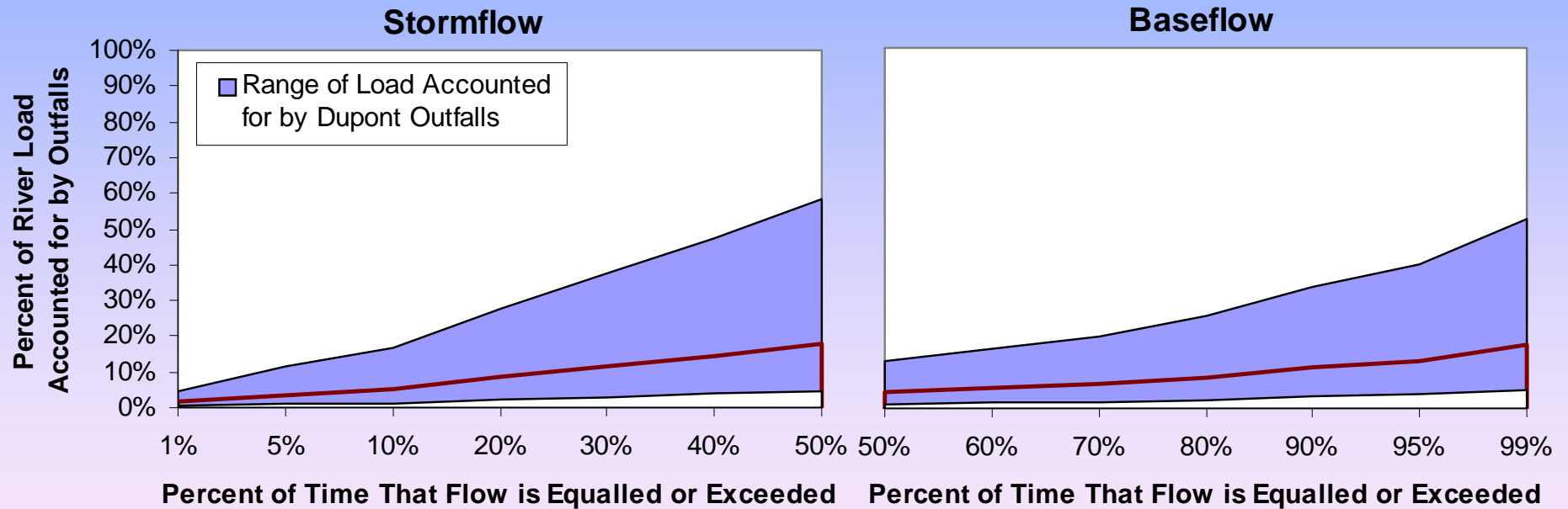
Summary of Loading Analysis Along Plant Reach

- Along the plant reach, plant outfalls can account for the majority of the mercury in the South River under most flow regimes
- Particularly under baseflow conditions, dissolved mercury from the plant outfalls more than accounts for dissolved mercury in the river along the plant reach



How About Further Downstream Where Mercury Levels Peak?

Total Hg at Dooms



Summary of Loading Analysis at Dooms

- During small storm events and low flows, plant outfalls could account for up to half of the total mercury at Dooms
- On average, outfalls probably account for 5-20% of total mercury at Dooms



Don't Misunderstand

- Are mercury loads from the plant outfalls the primary factor in controlling mercury levels throughout the South River?
 - No
- But are mercury loads from the plant outfalls insignificant?
 - No
 - Certainly along the plant reach, the outfalls are the major source under most flow regimes
 - Even compared to loads at Dooms, plant outfalls are not insignificant (5-20%)



Other Evidence that Plant Outfalls are not Insignificant

- While fish tissue levels are highest near Dooms/Crimora, fish tissue levels along the plant reach, where outfalls account for the majority of mercury, still exceed the health advisory level
 - Unlikely that fish tissue will meet the health advisory level without reductions in mercury from existing outfalls
- Using site-specific bioaccumulation factors, a protective instream total mercury concentration may be around 5ng/L
 - At 7Q10 flow, plant outfalls would cause exceedence of a 5ng/L level in stream (12 ng/L)



Other Evidence that Plant Outfalls are not Insignificant

- Clam Study
 - Found a significant increase in clam tissue mercury levels directly downstream of Outfall 001
 - Tissue mercury levels of caged clams within 100 meters of outfall 001 were as high as levels in caged clams at North Park/Basic Park area and about 50% of levels at Dooms



Other Evidence that Plant Outfalls are not Insignificant

- Majority of mercury from plant outfalls is in the dissolved phase (53%)
 - A portion of the dissolved phase is likely readily available for methylation
 - Outfalls may provide mercury in a bioavailable form that kick starts mercury methylation and uptake beginning right at Outfall 001



Other Evidence that Plant Outfalls are not Insignificant

- DEQ bimonthly water column monitoring on occasion has found the highest mercury levels just downstream of the plant (not at Dooms/Crimora)
 - August 2002 and August 2004, Hg levels at Constitution Park were the highest along the river (163 and 214 ng/L, respectively)
 - These were low flow periods (lowest 2% of flows and 23% of flows, respectively)



Other Evidence that Plant Outfalls are not Insignificant

- Plant sources may be one of the easiest sources to remediate or control
 - High concentrations in certain outfalls indicate potential source areas
 - 24,000 ng/L in outfall 011; 15,000 ng/L in 102
 - Majority of mercury in 001 is not coming from WWTP, but must be coming from non-process water flows (like 102)

