Stormwater Monitoring for PCBs in the Delaware Estuary

NJWMC

October 3, 2012

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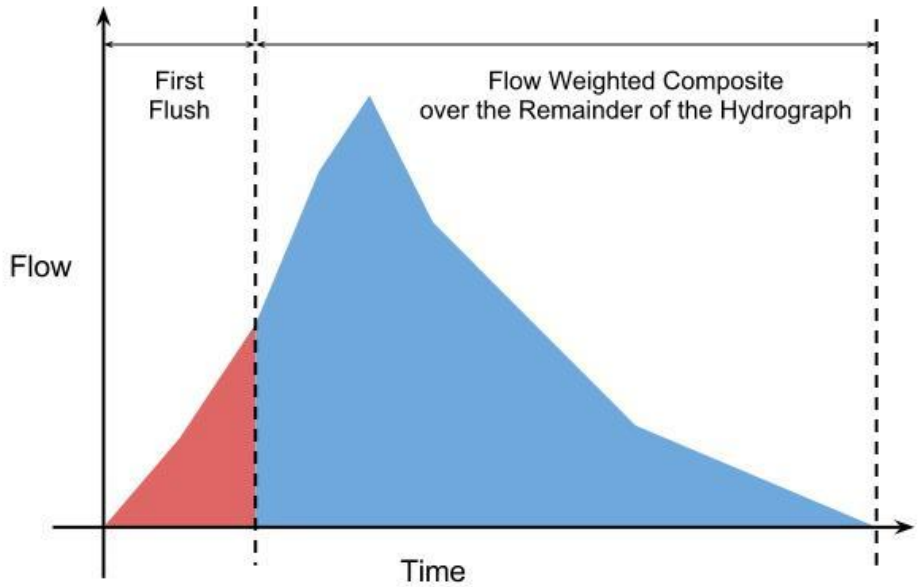
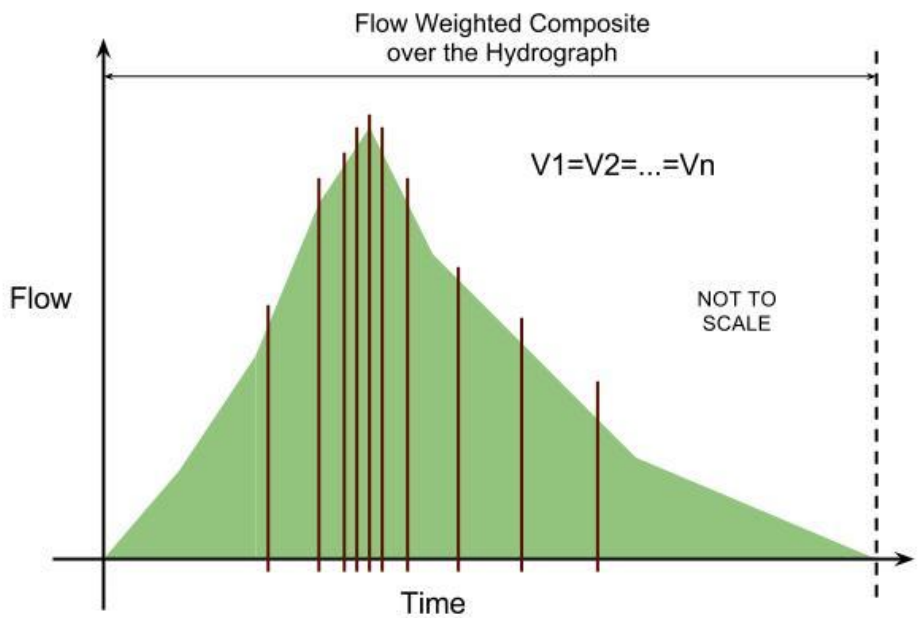
Delaware River Basin Commission

DRBC Stormwater monitoring for PCBs (2004 – 2008)

- EPA grant for Persistant Bioaccumulative Toxics;
- In Stage 1 TMDL, consultant derived stormwater event mean concentration (EMC) from period of record global literature;
- Wanted to determine if current Delaware Basin stormwater concentrations would be very different;
- Wanted to assess importance of first flush on EMC.

2 Sampling Approaches





- Is First Flush very different from remainder of the event?
- Can accurate EMC be derived from flow weighted composite only?

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At each site…

1. Site specific rating curve using Manning's equation;
2. Measure hydrograph(s);
3. Construct a model to approximate measured hydrograph resulting from measured precipitation;
   - TR-55 tabular method, adjust curve numbers to calibrate;
4. Watch quantitative precipitation forecasts;
5. Compute expected hydrograph from forecasted rainfall using model from step 3;
6. Adjust the incremental sample volumes so that total expected volume is within sample container target range;
7. Rapid deployment before start of storm event.

Shellpot Depth - Flow Tables

Stage at Deployment	1.51							
Bubbler Depth at Deployment (inches)	2	4	6	8	10	12	16	
USGS STAGE	Depth Over Bubbler (ft)							CFS
1.51	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.31
1.60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.00
1.72	0.04	N/A	N/A	N/A	N/A	N/A	N/A	3.67
2.00	0.32	0.16	N/A	N/A	N/A	N/A	N/A	18.98
2.51	0.83	0.67	0.50	0.33	0.17	N/A	N/A	105.13
3.01	1.33	1.17	1.00	0.83	0.67	0.50	0.17	279.10
3.52	1.84	1.68	1.51	1.34	1.18	1.01	0.68	530.47
4.07	2.39	2.23	2.06	1.89	1.73	1.56	1.23	840.97
4.50	2.82	2.66	2.49	2.32	2.16	1.99	1.66	1090.23
5.00	3.32	3.16	2.99	2.82	2.66	2.49	2.16	1363.73
6.00	4.32	4.16	3.99	3.82	3.66	3.49	3.16	1930.66
7.00	5.32	5.16	4.99	4.82	4.66	4.49	4.16	2494.27
8.00	6.32	6.16	5.99	5.82	5.66	5.49	5.16	3057.88
9.00	7.32	7.16	6.99	6.82	6.66	6.49	6.16	3621.49
10.00	8.32	8.16	7.99	7.82	7.66	7.49	7.16	4185.10
11.00	9.32	9.16	8.99	8.82	8.66	8.49	8.16	4748.71
12.00	10.32	10.16	9.99	9.82	9.66	9.49	9.16	5312.32
20.00	18.32	18.16	17.99	17.82	17.66	17.49	17.16	9821.20

NJ Deployment Sites

Mt. Holly

Camden
(rejected due to tidal influence)

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Mingo Creek Basin, Philadelphia

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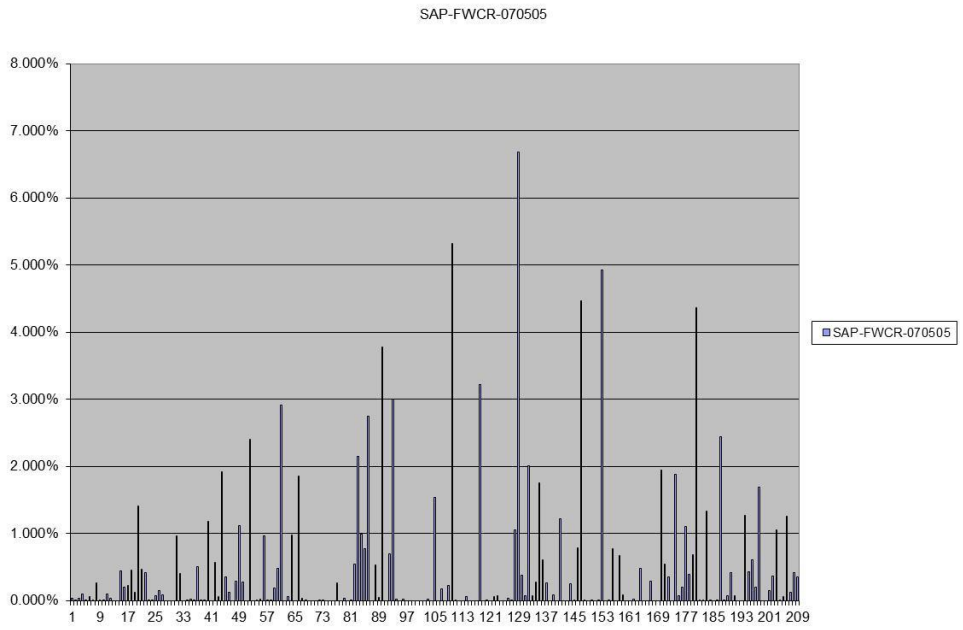
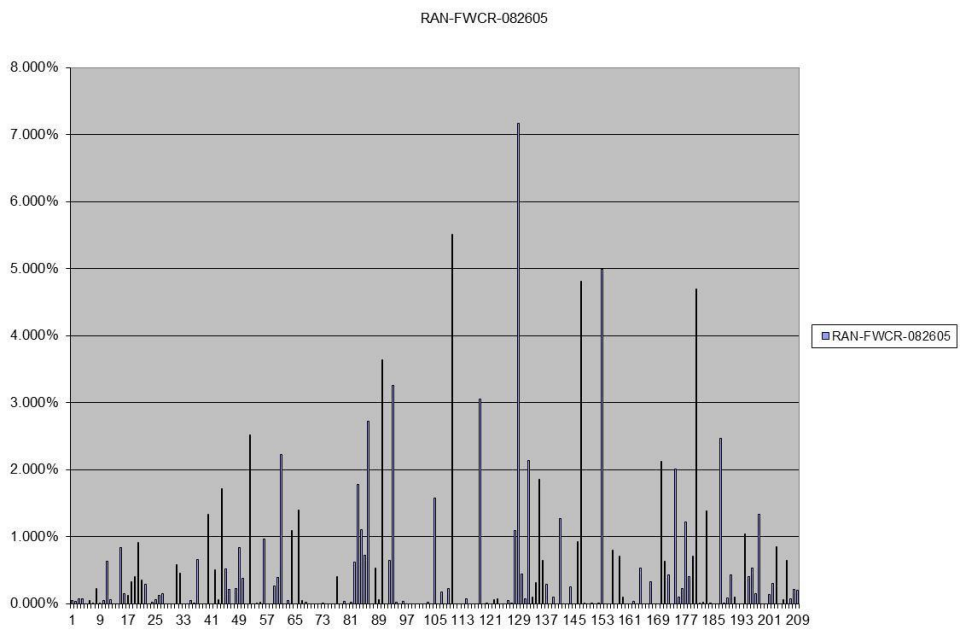
Sample Types and Results

Sample ID	Total PCBs (pg/L)	Date	Location	Type
SPD-FF-060905	512	6/9/2005	Equipment Blank	Blank
SPD-FF-070505	5,873	7/5/2005	State & Ashburner Runoff	First Flush
SAP-FWCR-070505	145,310	7/5/2005	State & Ashburner Runoff	Composite After FF
SPD-FF-071505	16,187	7/15/2005	State & Ashburner Runoff	First Flush
SAP-FWCR-071505	37,559	7/15/2005	State & Ashburner Runoff	Composite After FF
SAP-FWCR-081505	69,581	8/15/2005	State & Ashburner Runoff	Event Composite
MTH-FF-082605	410	8/26/2005	Equipment Blank	Blank
RAN-FF-082605	14,086	8/26/2005	Rancocas Stormwater Runoff	First Flush
RAN-FWCR-082605	4,447	8/26/2005	Rancocas Stormwater Runoff	Composite After FF
RAN-WHC-091505	51,322	9/15/2005	Rancocas Stormwater Runoff	Event Composite
MLP-092105	280	9/21/2005	Millipore Water Blank	Blank
WIL-FF-100605	841	10/6/2005	Equipment Blank	Blank
SPT-FF-100705	25,077	10/7/2005	Shellpot Creek	First Flush
SPT-FWCR-100705	81,248	10/7/2005	Shellpot Creek	Composite After FF
PBL-TWCR-021307	1,028	2/13/2007	Equipment Blank	Blank
MGC-FF-032307	14,136	3/23/2007	Mingo Creek Basin	First Flush
MGC-TWCR-032307	12,686	3/23/2007	Mingo Creek Basin	Composite After FF
PEN-TWCR-041107	1,137	4/11/2007	Equipment Blank	Blank
MGC-TWCR-041107	107,332	4/11/2007	Mingo Creek Basin	Event Composite
FLA-FWCR-062207	771	6/22/2007	Equipment Blank	Blank
SHP-FWCD-071007	30,584	7/10/2007	Shellpot Creek	Event Composite
DRB-FF-072907	3,941	7/29/2007	DRBC Stormwater Retrofit	First Flush
DRB-FWCR-072907	10,455	7/29/2007	DRBC Stormwater Retrofit	Composite After FF
DRB-FWC-101007	11,029	10/10/2007	DRBC Stormwater Retrofit	Event Composite
FRB-FWC-101007	8,013	10/10/2007	Replicate Sample	Replicate





Congener analysis allows comparison of similarity (or dissimilarity) of PCB composition

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Correlation Matrix between samples

			DRB-FF-072907	DRB-FWC-101007	DRB-FWCR-072907	FRB-FWC-101007	MGC-FF-032307	MGC-TWCR-032307	MGC-TWCR-041107	RAN-FF-082605	RAN-FWCR-082605	RAN-WHC-091505	SAP-FWCR-070505	SAP-FWCR-071505	SAP-FWCR-081505	SHP-FWCD-071007	SPD-FF-070505	SPD-FF-071505	SPT-FF-100705	SPT-FWCR-100705
DRBC Stormwater Retrofit	First Flush	DRB-FF-072907	1.00	0.90	0.93	0.89	0.93	0.89	0.87	0.71	0.84	0.79	0.83	0.87	0.83	0.88	0.76	0.82	0.67	0.55
DRBC Stormwater Retrofit	Event Composite	DRB-FWC-101007		1.00	0.99	0.99	0.93	0.82	0.94	0.66	0.84	0.78	0.82	0.86	0.85	0.97	0.70	0.72	0.64	0.47
DRBC Stormwater Retrofit	Composite After FF	DRB-FWCR-072907			1.00	0.99	0.95	0.85	0.94	0.69	0.87	0.80	0.85	0.88	0.88	0.97	0.74	0.76	0.68	0.52
Replicate Sample	Replicate	FRB-FWC-101007				1.00	0.93	0.83	0.93	0.67	0.86	0.79	0.84	0.87	0.87	0.97	0.73	0.73	0.68	0.51
Mingo Creek Basin	First Flush	MGC-FF-032307					1.00	0.97	0.89	0.86	0.95	0.92	0.95	0.97	0.93	0.88	0.86	0.90	0.77	0.65
Mingo Creek Basin	Composite After FF	MGC-TWCR-032307						1.00	0.79	0.93	0.94	0.95	0.96	0.98	0.90	0.76	0.90	0.95	0.79	0.72
Mingo Creek Basin	Event Composite	MGC-TWCR-041107							1.00	0.63	0.78	0.75	0.76	0.81	0.81	0.94	0.64	0.67	0.56	0.39
Rancocas Stormwater Runoff	First Flush	RAN-FF-082605								1.00	0.88	0.96	0.90	0.91	0.82	0.57	0.86	0.92	0.75	0.70
Rancocas Stormwater Runoff	Composite After FF	RAN-FWCR-082605									1.00	0.91	0.98	0.96	0.95	0.79	0.95	0.91	0.89	0.78
Rancocas Stormwater Runoff	Event Composite	RAN-WHC-091505										1.00	0.93	0.95	0.87	0.70	0.84	0.90	0.72	0.63
State & Ashburner Runoff	Composite After FF	SAP-FWCR-070505											1.00	0.98	0.95	0.75	0.95	0.93	0.88	0.79
State & Ashburner Runoff	Composite After FF	SAP-FWCR-071505												1.00	0.93	0.78	0.90	0.94	0.82	0.73
State & Ashburner Runoff	Event Composite	SAP-FWCR-081505													1.00	0.81	0.88	0.86	0.81	0.69
Shellpot Creek	Event Composite	SHP-FWCD-071007														1.00	0.65	0.63	0.58	0.42
State & Ashburner Runoff	First Flush	SPD-FF-070505															1.00	0.91	0.93	0.89
State & Ashburner Runoff	First Flush	SPD-FF-071505																1.00	0.84	0.78
Shellpot Creek	First Flush	SPT-FF-100705																	1.00	0.94
Shellpot Creek	Composite After FF	SPT-FWCR-100705																		1.00

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Correlation matrix to Aroclors

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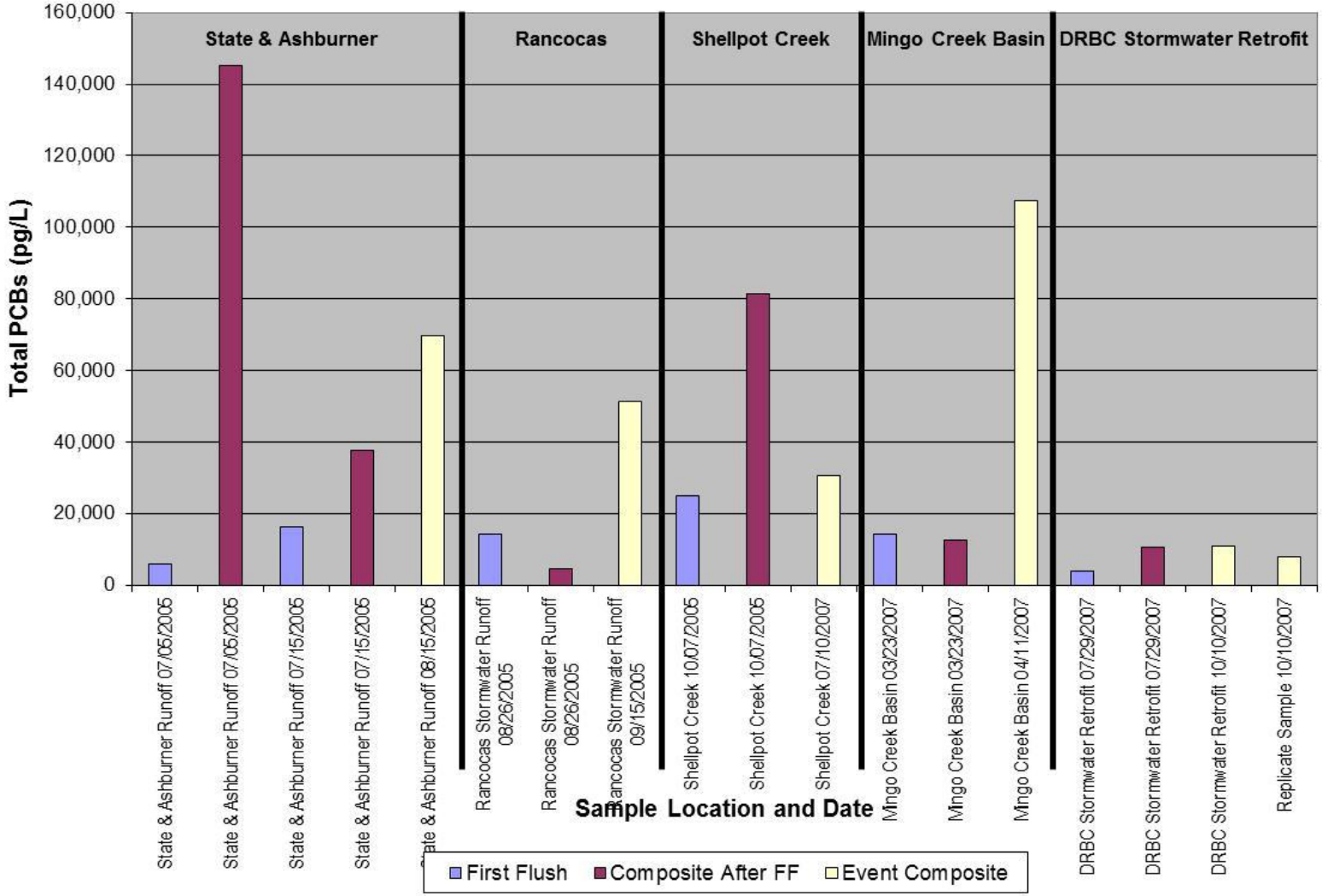
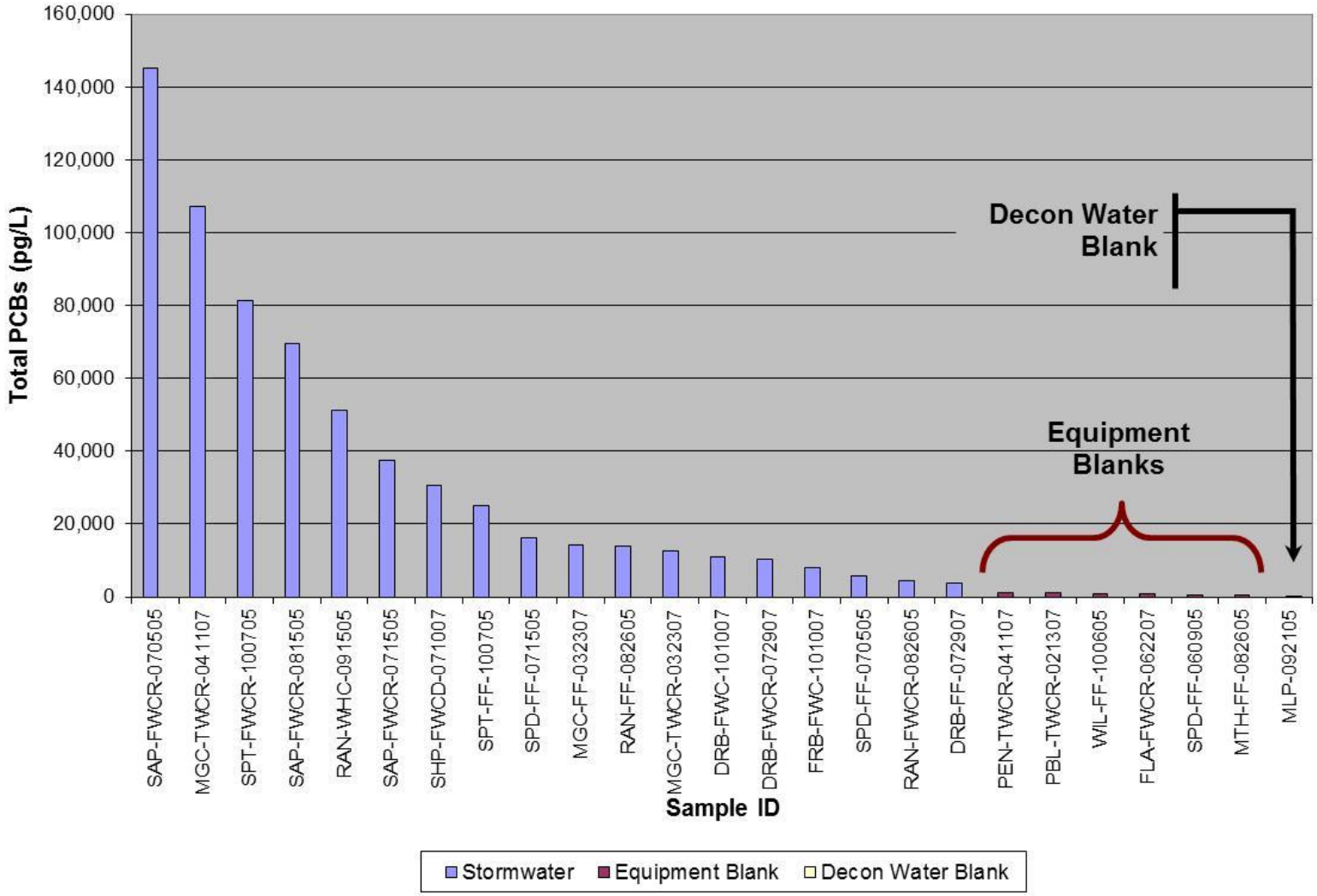
Sample Source	Sample ID	AROCLOR 1221	AROCLOR 1232	AROCLOR 1016	AROCLOR 1242	AROCLOR 1248	AROCLOR 1254	AROCLOR 1260	AROCLOR 1262	AROCLOR 1268
DRBC Stormwater Retrofit	DRB-FF-072907	0.002	0.002	0.015	0.035	0.081	0.426	0.787	0.558	0.000
DRBC Stormwater Retrofit	DRB-FWC-101007	0.000	0.000	0.000	0.001	0.019	0.328	0.917	0.698	0.004
DRBC Stormwater Retrofit	DRB-FWCR-072907	0.002	0.002	0.001	0.001	0.026	0.371	0.904	0.670	0.002
Equipment Blank	FLA-FWCR-062207	0.584	0.876	0.145	0.143	0.028	0.022	0.009	0.002	0.004
Replicate Sample	FRB-FWC-101007	0.002	0.004	0.002	0.000	0.016	0.359	0.912	0.666	0.002
Mingo Creek Basin	MGC-FF-032307	0.003	0.000	0.005	0.028	0.117	0.506	0.760	0.516	0.004
Mingo Creek Basin	MGC-TWCR-032307	0.003	0.004	0.022	0.074	0.220	0.595	0.616	0.379	0.001
Mingo Creek Basin	MGC-TWCR-041107	0.002	0.001	0.000	0.002	0.023	0.256	0.889	0.710	0.005
Millipore Water Blank	MLP-092105	0.796	0.801	0.061	0.062	0.015	0.010	0.000	0.000	0.002
Equipment Blank	MTH-FF-082605	0.430	0.494	0.067	0.065	0.014	0.080	0.328	0.266	0.000
Equipment Blank	PBL-TWCR-021307	0.200	0.816	0.387	0.384	0.094	0.036	0.026	0.014	0.004
Equipment Blank	PEN-TWCR-041107	0.121	0.334	0.106	0.138	0.089	0.319	0.324	0.148	0.005
Rancocas Stormwater Runoff	RAN-FF-082605	0.003	0.007	0.024	0.106	0.345	0.619	0.424	0.234	0.000
Rancocas Stormwater Runoff	RAN-FWCR-082605	0.003	0.001	0.000	0.011	0.113	0.660	0.650	0.376	0.001
Rancocas Stormwater Runoff	RAN-WHC-091505	0.003	0.002	0.013	0.071	0.274	0.523	0.571	0.356	0.000
State & Ashburner Runoff	SAP-FWCR-070505	0.003	0.000	0.002	0.026	0.161	0.673	0.607	0.363	0.007
State & Ashburner Runoff	SAP-FWCR-071505	0.003	0.001	0.011	0.048	0.184	0.597	0.646	0.404	0.001
State & Ashburner Runoff	SAP-FWCR-081505	0.003	0.001	0.000	0.007	0.087	0.560	0.682	0.442	0.019
Shellpot Creek	SHP-FWCD-071007	0.002	0.008	0.008	0.003	0.003	0.287	0.960	0.768	0.006
Equipment Blank	SPD-FF-060905	0.234	0.832	0.337	0.321	0.052	0.026	0.024	0.012	0.005
State & Ashburner Runoff	SPD-FF-070505	0.002	0.000	0.002	0.021	0.155	0.798	0.499	0.243	0.000
State & Ashburner Runoff	SPD-FF-071505	0.003	0.010	0.042	0.107	0.260	0.685	0.477	0.265	0.000
Shellpot Creek	SPT-FF-100705	0.002	0.002	0.002	0.003	0.077	0.834	0.450	0.167	0.001
Shellpot Creek	SPT-FWCR-100705	0.002	0.000	0.000	0.011	0.152	0.962	0.289	0.074	0.004
Equipment Blank	WIL-FF-100605	0.055	0.074	0.012	0.017	0.017	0.231	0.484	0.303	0.000

First Flush compared to Flow Weighted Composite



Blanks compared to Stormwater samples



Comparison of Measurements to Literature Derived EMC

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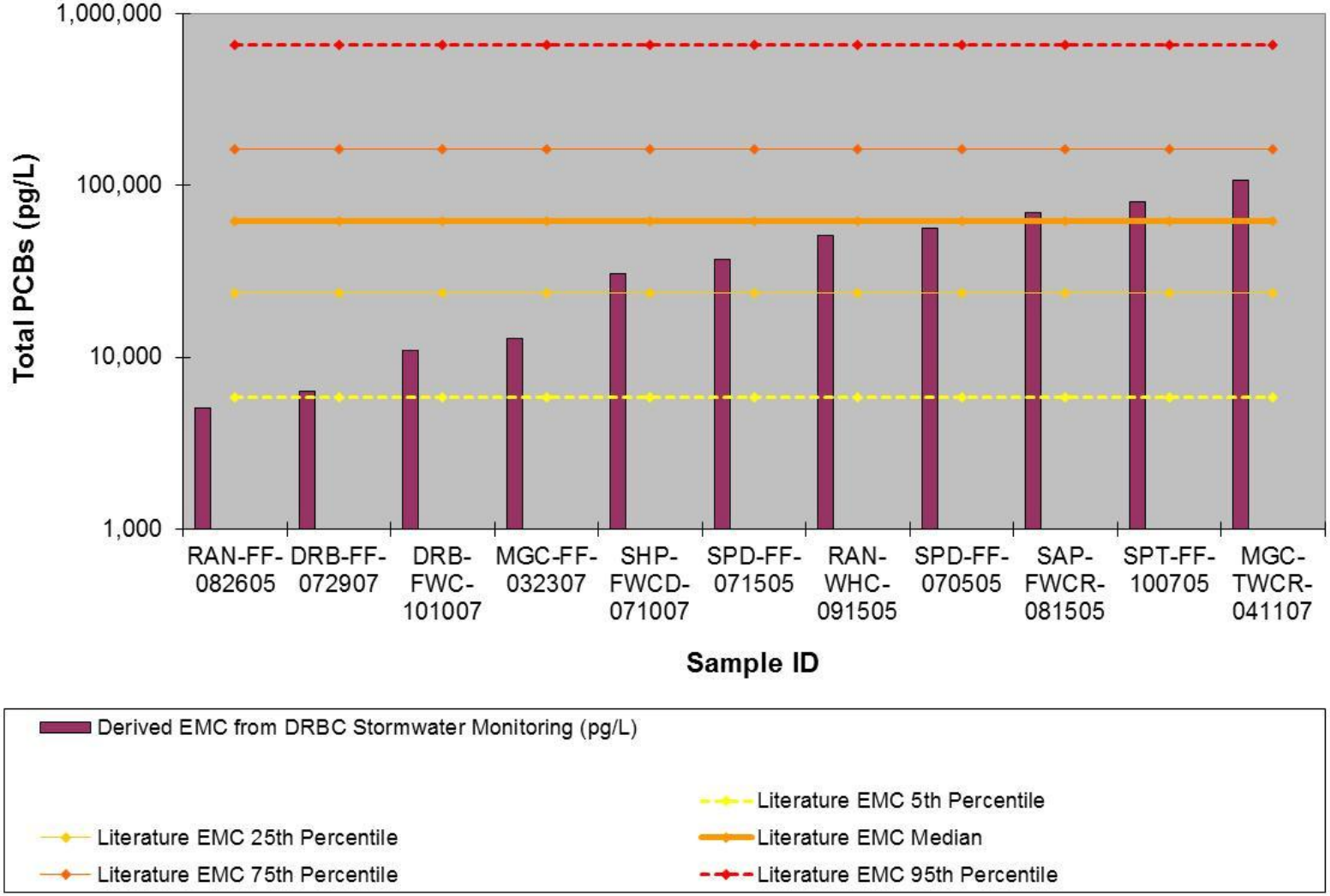

Lessons Learned

- Stormwater sampling is difficult;
  - High failure rate (~50% even at end of project);
  - Weather dependent – drop everything to deploy;
  - Need dedicated staff full time;
- Urban camouflage;
- Deep cycle marine battery, not manufacturer's battery;
- No composite tubing.