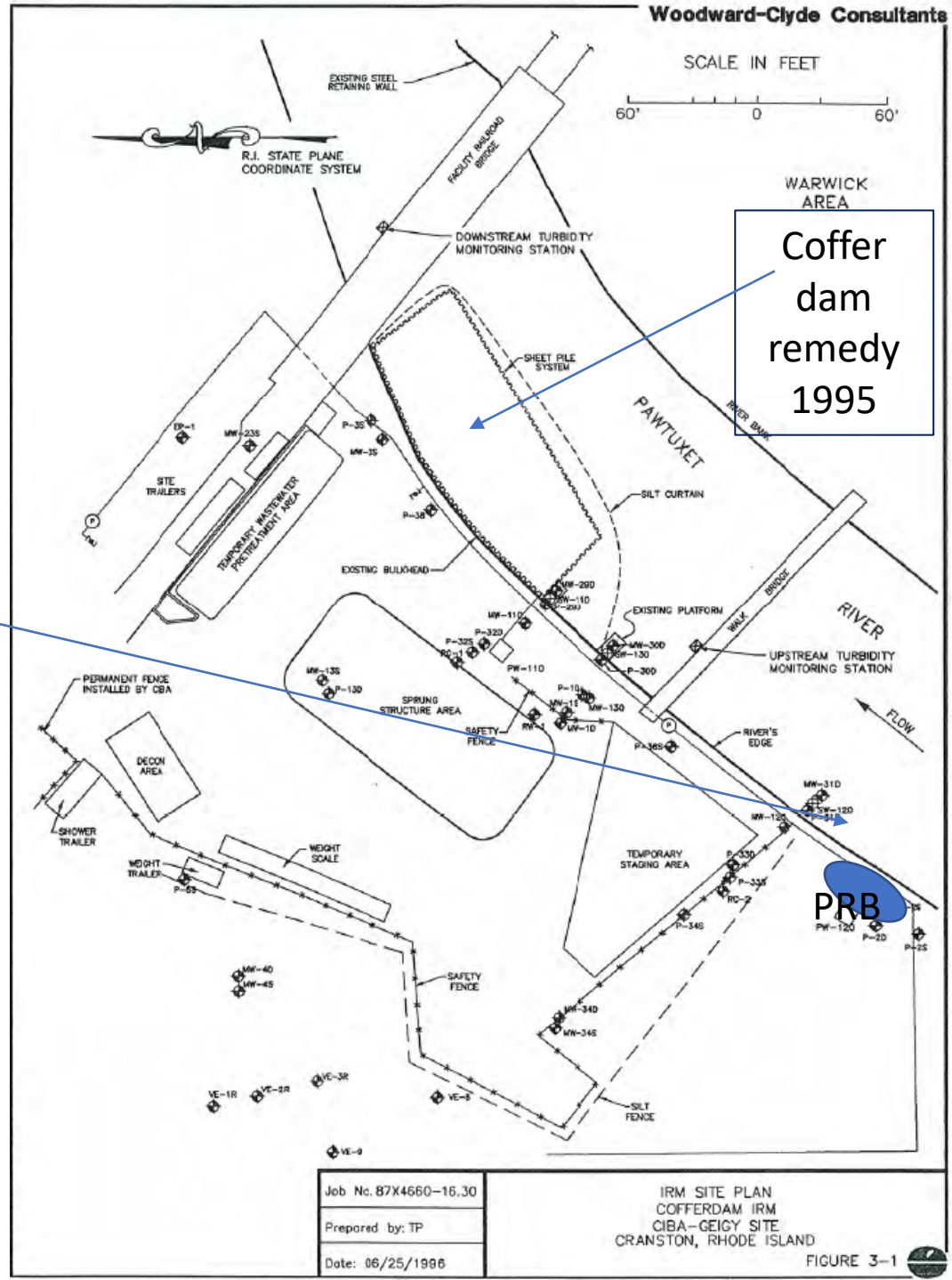
Sediment

- Remedial investigations 1991 to 1995. Slides 2, 3 and 4.
- Sediment IRM: remediate the coffer dam impacts (1995-1996)
  - Excavate sediments and cap with sand (figure to right).
- Post excavation sampling 1996, 2002. Slide 3
  - Detected PCBs upgradient of Walk Bridge (SD-02R).
- 2010: Pawtuxet River floods. EPA requires:
  - Characterize functionality of sand cap
  - Address 2002 data at SD-2R (slide 3)
- 2010 – 2011: Additional sediment characterization and removal. Slides 5 and 6.
- PRB river piezometer data (slide 7)
  - Shallow pore water data indicative of surface discharges consistent with sediment data along facility river reach (chlorobenzene and PCB)
  - Deep pore water indicative of groundwater discharge (1,2-dichlorobenzene, trace PCB)



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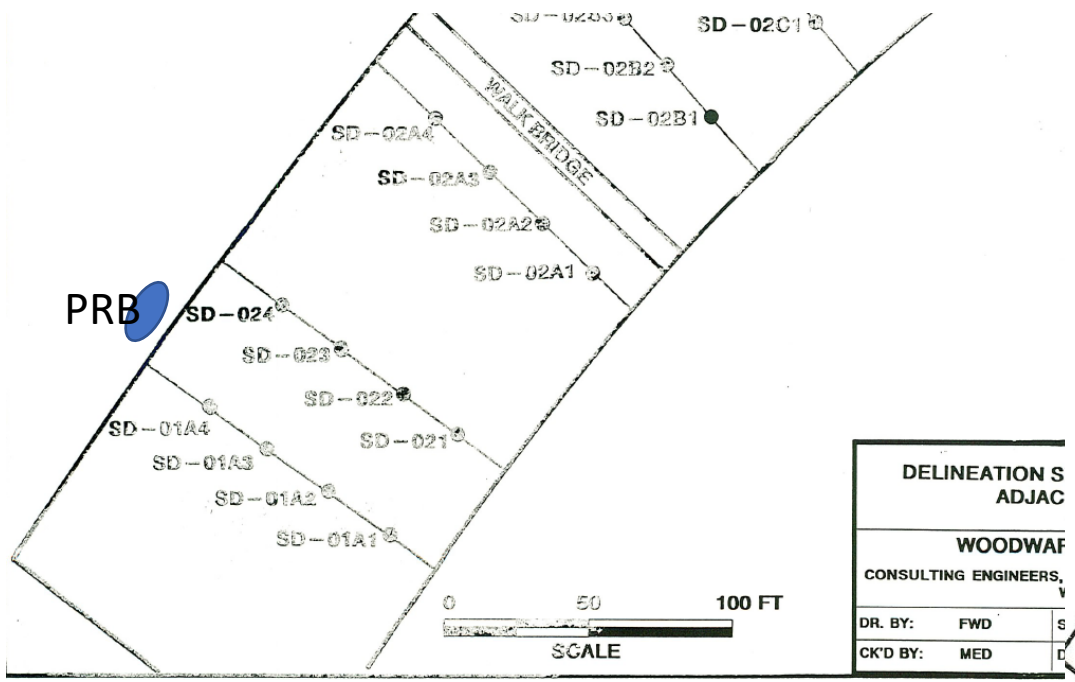
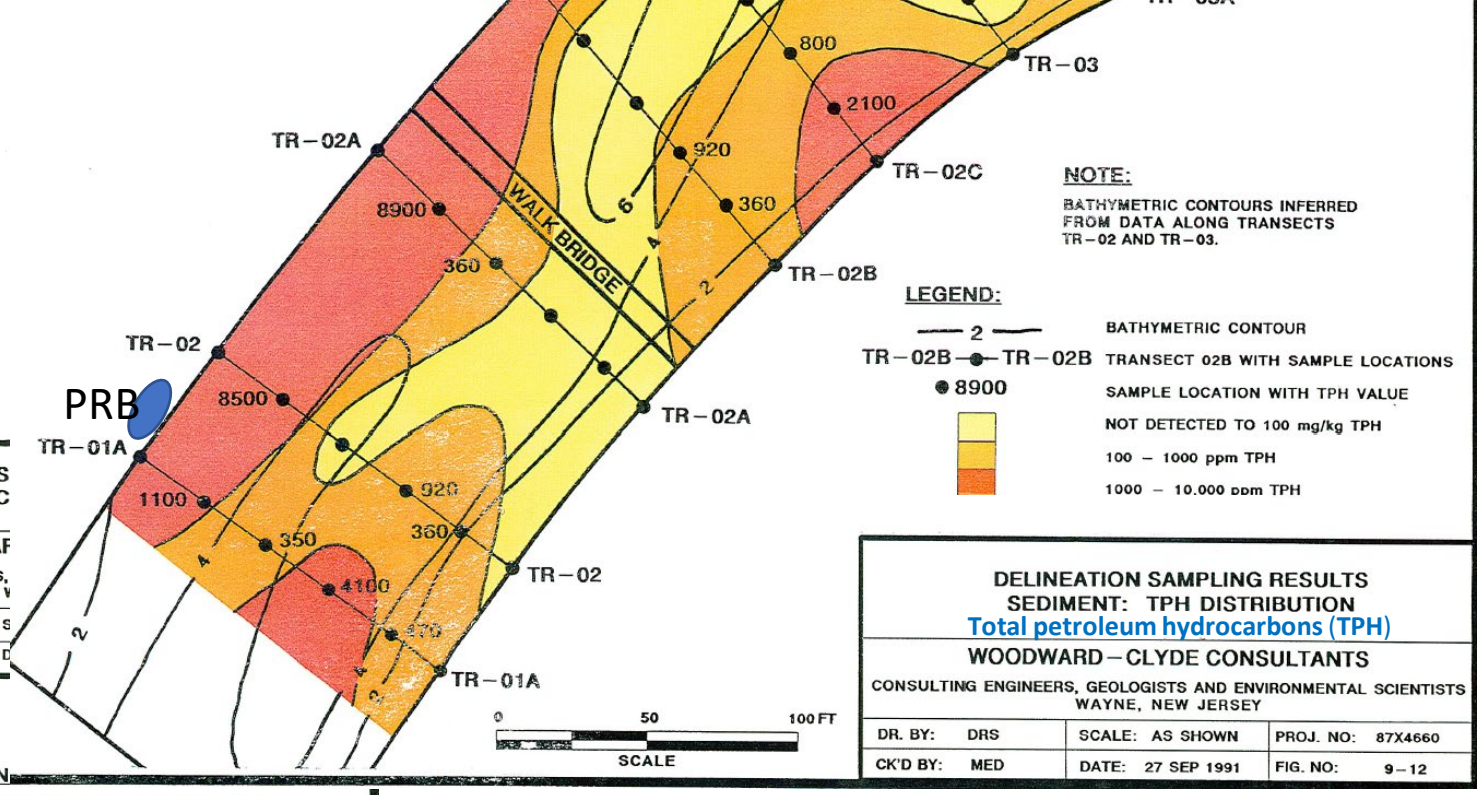
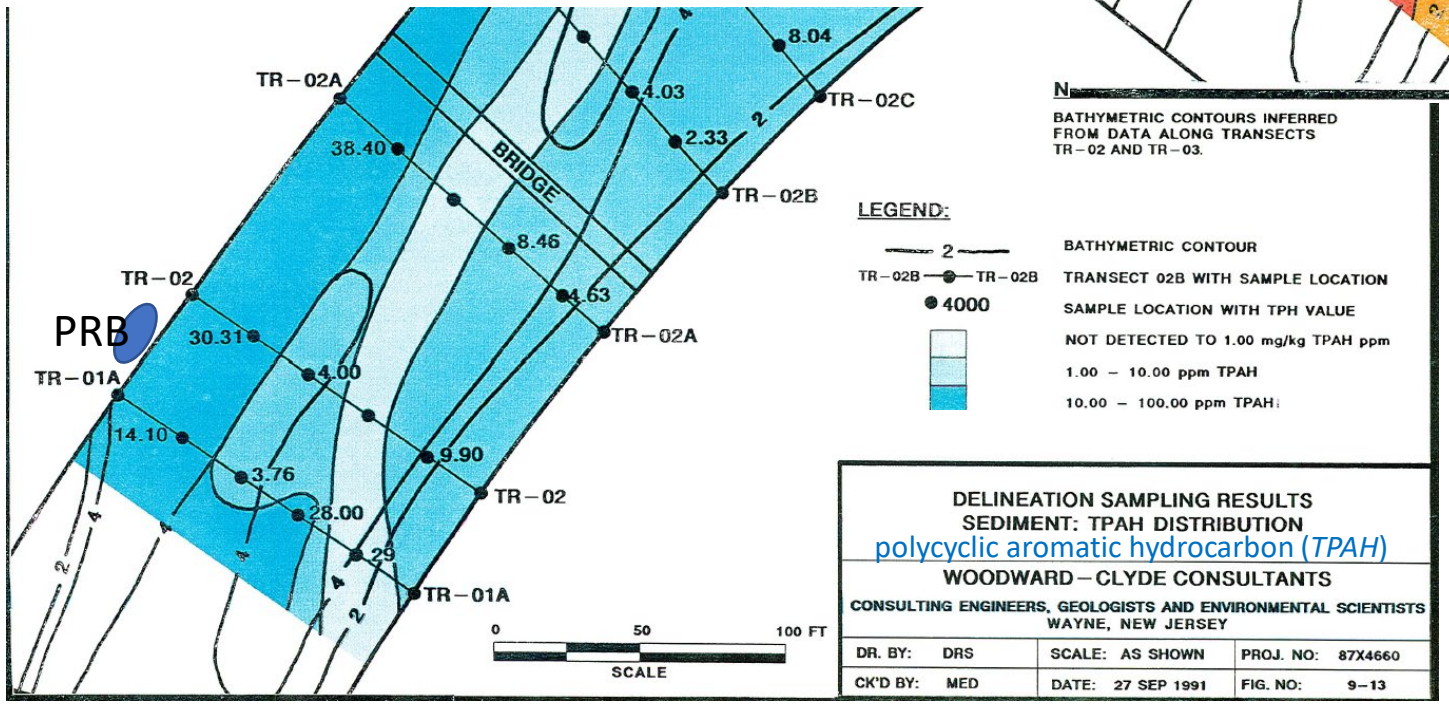
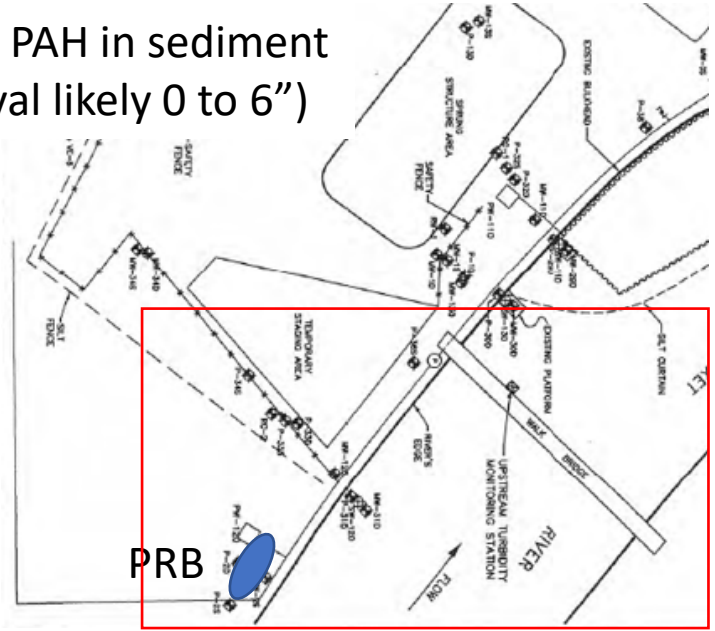
Internal



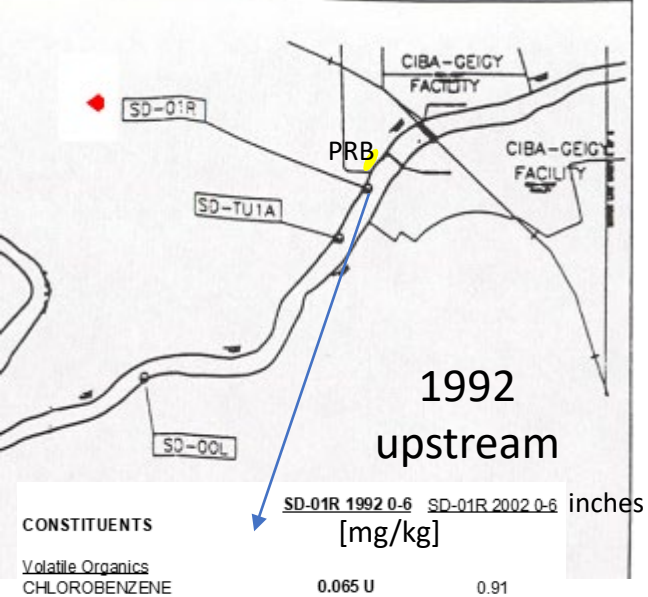




1991 TPH and PAH in sediment
(sample interval likely 0 to 6”)

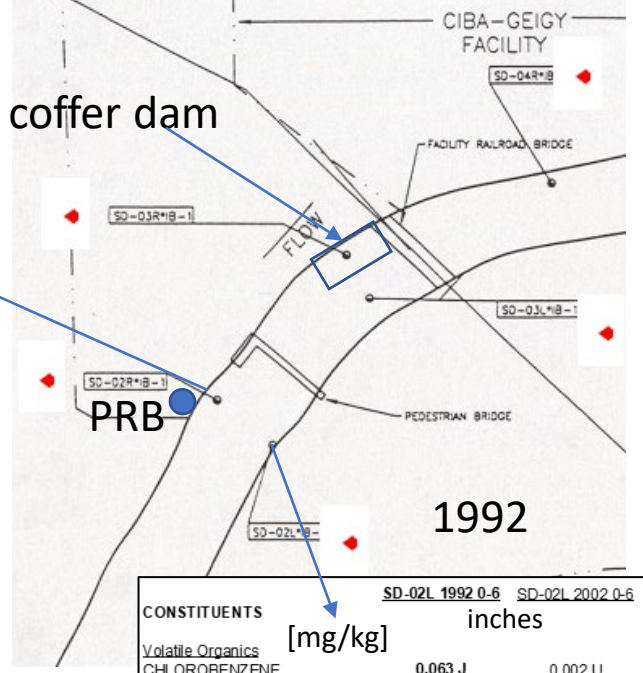


2002 Sediment Monitoring Data [mg/kg].



CONSTITUENTS	SD-01R 1992 0-6 [mg/kg]	SD-01R 2002 0-6 inches
Volatile Organics		
CHLOROBENZENE	0.065 U	0.91
M&P-XYLENE	0.065 U	0.002 U
O-XYLENE	0.065 U	0.027
TOLUENE	0.065 U	0.016
Semi-Volatile Organics		
1,2-DICHLOROBENZENE	0.6 U	0.380 U
4-CHLOROANILINE	0.6 U	0.380 U
TINUVIN 328	NA	0.03035 U
Inorganics		
CADMIUM	0.235 U	5.7
COPPER	27.3 J	187
CYANIDE	0.175 U	0.385 U
LEAD	11 J	313
THALLIUM	0.325	2.2 U
ZINC	28 J	616
PAHs		
2-METHYLNAPHTHALENE	0.6 U	0.380 U
ANTHRACENE	0.14 J	0.79
BENZO(A)ANTHRACENE	0.51 J	3
BENZO(A)PYRENE	0.43 J	3.7
BENZO(B)FLUORANTHENE	0.74 J	5.9
BENZO(G,H,I)PERYLENE	0.39 J	3.3
BENZO(K)FLUORANTHENE	0.83 J	2.1
CHRYSENE	0.61 J	5
DIBENZ(A,H)ANTHRACENE	0.19 J	0.88
FLUORANTHENE	1.7	7.9
INDENO(1,2,3-CD)PYRENE	0.32 J	3.4
PYRENE	0.61 J	7.6
PCBs		
PCB-1221	0.0125 U	0.0075 U
PCB-1232	0.0125 U	0.0075 U
PCB-1242	0.0065 U	0.0075 U
PCB-1248	0.0065 U	0.0075 U
PCB-1254	0.0125 U	0.25
PCB-1260	0.0125 U	0.13

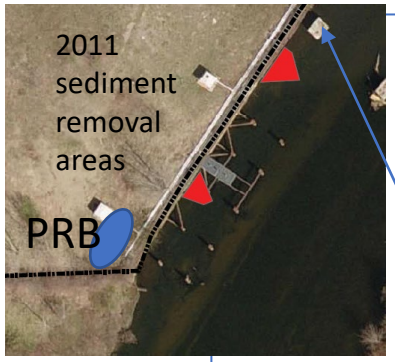
depth in inches CONSTITUENTS	SD-02R 1992 0-6 (1992)	SD-02R 2002 0-2 (2002)	SD-02R 2002 2-4 (2002)	SD-02R 2002 4-6 (2002)	SD-02R 2002 6-12 (2002)
Volatile Organics					
CHLOROBENZENE	26	6.3	6.7	130	360
M&P-XYLENE	1 J	0.033	0.024	1	3.5
O-XYLENE	0.23 J	0.039	0.034	0.51	1.5
TOLUENE	0.87 J	0.042	0.036	1.2	14
Semi-Volatile Organics					
1,2-DICHLOROBENZENE	4.6	0.25	2	5.7	45
4-CHLOROANILINE	1.5 U	0.51	5	7.4	40
TINUVIN 328	NA	4.931	31.1374	30.0525	61.6507
Inorganics					
CADMIUM	22 J	3.2	4.5	6.7	11.2
COPPER	947 J	113	172	279	468
CYANIDE	13.2	0.175 U	0.18 U	0.38	0.99
LEAD	594 J	108	161	204	393
THALLIUM	0.974	1.0 U	1.0 U	0.95	1.1 U
ZINC	1460 J	469	789	1.45 U	5,000
PAHs					
2-METHYLNAPHTHALENE	2.1 J	0.083	0.26	0.57	2.8
ANTHRACENE	0.93 J	0.4	0.53	1.1	0.88
BENZO(A)ANTHRACENE	3.2	1.4	1.6	2.3	2.4
BENZO(A)PYRENE	3.6	1.5	1.7	2	2.6
BENZO(B)FLUORANTHENE	6.5	1.2	2.7	3	4.1
BENZO(G,H,I)PERYLENE	3.3	1.4	1.4	1.5	2.1
BENZO(K)FLUORANTHENE	7.3	1.2	0.97	1.4	1.5
CHRYSENE	5.2	2.2	2.5	2.9	3.5
DIBENZ(A,H)ANTHRACENE	1.5 J	0.42	0.44	0.47	0.385 U
FLUORANTHENE	11	3	3.5	4.8	5.5
INDENO(1,2,3-CD)PYRENE	3	1.4	1.5	1.5	2.2
PYRENE	3.9	2.9	3.3	4.5	4.8
PCBs					
PCB-1221	3.05 U	0.065 U	1.7 U	0.33 U	1.9 U
PCB-1232	3.05 U	0.065 U	1.7 U	0.33 U	1.9 U
PCB-1242	1.55 U	0.065 U	1.7 U	0.33 U	1.9 U
PCB-1248	1.55 U	5.6	96	43	170
PCB-1254	3.05 U	3.3	1.7 U	16	43
PCB-1260	3.05 U	0.065 U	1.7 U	0.33 U	1.9 U

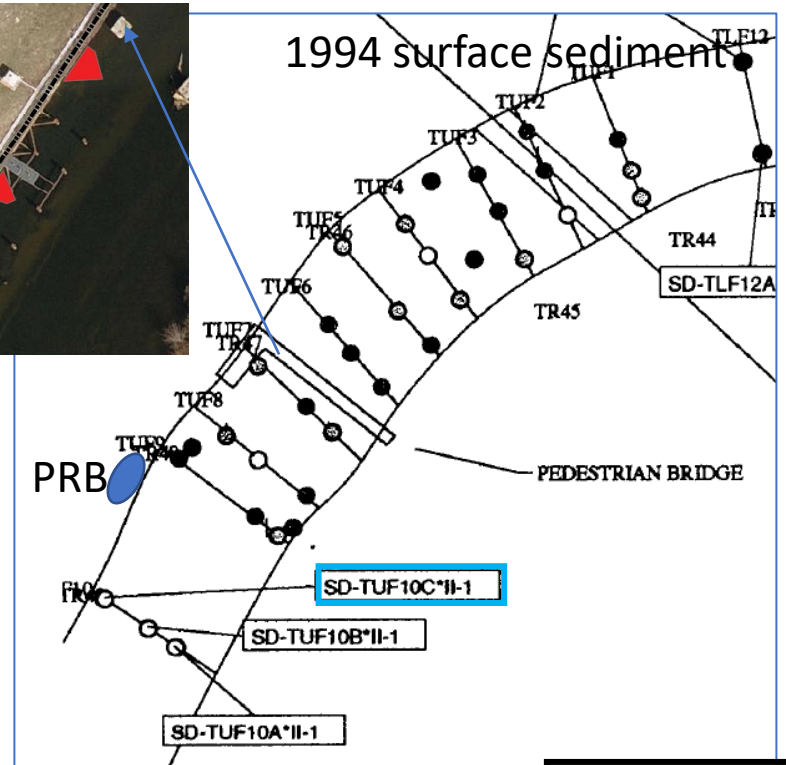


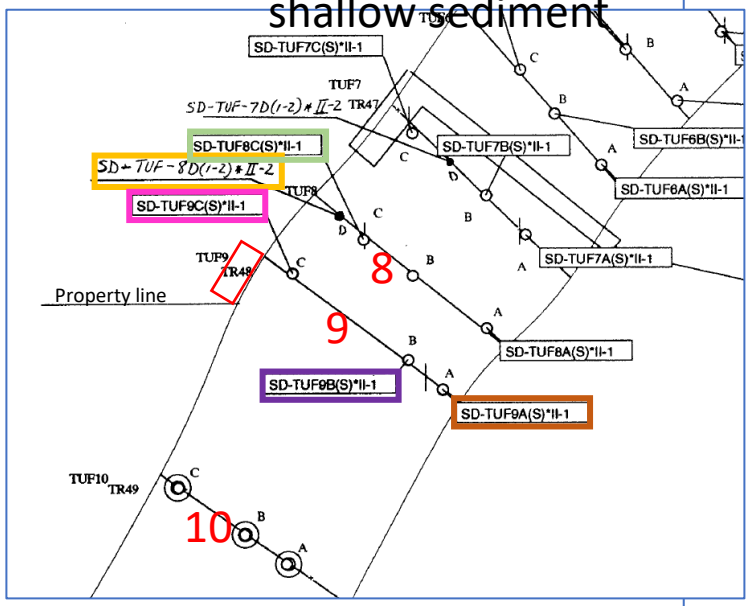
CONSTITUENTS	SD-02L 1992 0-6 [mg/kg]	SD-02L 2002 0-6 inches
Volatile Organics		
CHLOROBENZENE	0.063 J	0.002 U
M&P-XYLENE	0.155 U	0.002 U
O-XYLENE	0.155 U	0.002 U
TOLUENE	0.076 J	0.002 U
Semi-Volatile Organics		
1,2-DICHLOROBENZENE	0.22 J	0.031 U
4-CHLOROANILINE	1.3 U	0.065
TINUVIN 328	NA	0.5119
Inorganics		
CADMIUM	5.3 J	3.4
COPPER	516 J	301
CYANIDE	25.6	0.56
LEAD	375 J	135
THALLIUM	1.16	0.9 U
ZINC	1070 J	705
PAHs		
2-METHYLNAPHTHALENE	0.44 J	0.031 U
ANTHRACENE	0.53 J	0.48
BENZO(A)ANTHRACENE	3.6	1.8
BENZO(A)PYRENE	3.5	2
BENZO(B)FLUORANTHENE	6.9	3
BENZO(G,H,I)PERYLENE	3.2	1.5
BENZO(K)FLUORANTHENE	7.7	1.5
CHRYSENE	6.1	2.2
DIBENZ(A,H)ANTHRACENE	1.3 J	0.46
FLUORANTHENE	14	3.6
INDENO(1,2,3-CD)PYRENE	2.9	1.5
PYRENE	5.3	4.1
PCBs		
PCB-1221	2.65 U	0.031 U
PCB-1232	2.65 U	0.031 U
PCB-1242	1.35 U	0.031 U
PCB-1248	1.35 U	0.031 U
PCB-1254	2.65 U	0.21
PCB-1260	2.65 U	0.031 U

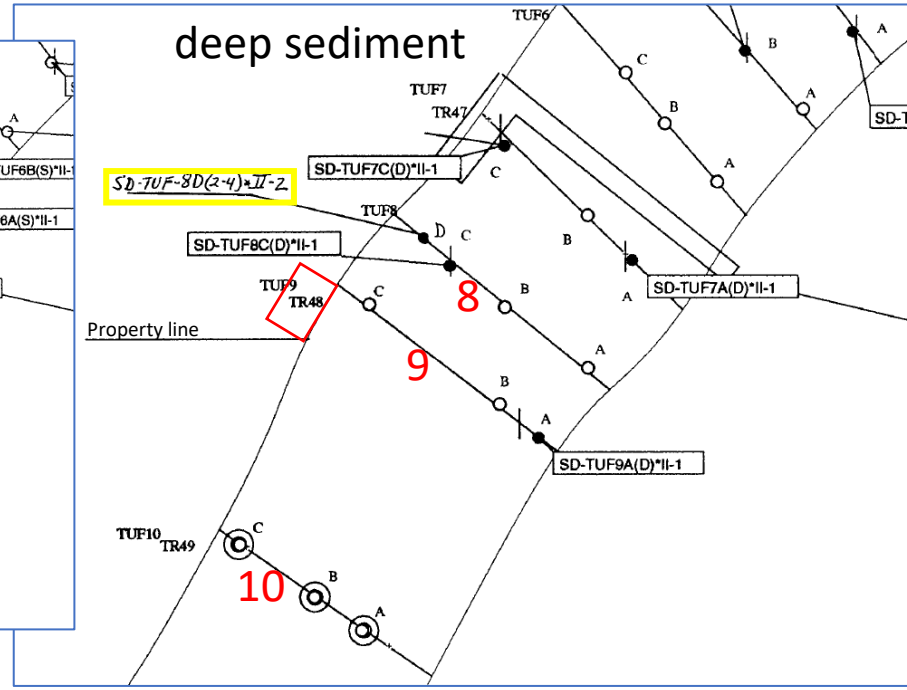
IRM verification monitoring in 2002. Data at SD-02R led to sediment characterization and remediation in 2010 and 2011

Indicator compounds: chlorobenzene, PCB, tinuvin.









	TUF SD-TUF10C*II-1 2/28/94 0 to .5 Result	Q	TUF SD-TUF10A*II-1 2/28/94 0 to .5 Result	Q	TUF SD-TUF10B*II-1 2/28/94 0 to .5 Result	Q	TUF SD-TUF-8D(2-4)*II-2 7/25/94 2 to 4 Result	Q	TUF SD-TUF-8D(1-2)*II-2 7/25/94 1 to 2 Result	Q	TUF SD-TUF8A(S)*II-1 2/26/94 1 to 2 Result	Q	TUF SD-TUF8C(D)*II-1 2/26/94 3 to 4 Result	Q	TUF SD-TUF8C(S)*II-1 2/26/94 1 to 2 Result	Q	TUF SD-TUF9A(D)*II-1 2/28/94 3 to 4 Result	Q	TUF SD-TUF9A(S)*II-1 2/28/94 1 to 2 Result	Q	TUF SD-TUF9B(S)*II-1 2/28/94 1 to 2 Result	Q	TUF SD-TUF9C(S)*II-1 2/28/94 1 to 2 Result	Q
PCB-1016	0.043	U	0.041	U	0.038	U	0.055	U	0.048	U	0.039	U	0.041	U	0.4	U	0.038	U	0.039	U	0.038	U	0.038	U
PCB-1221	0.087	U	0.084	U	0.077	U	0.11	U	0.097	U	0.079	U	0.083	U	0.81	U	0.077	U	0.079	U	0.076	U	0.076	U
PCB-1232	0.043	U	0.041	U	0.038	U	0.055	U	0.048	U	0.039	U	0.041	U	0.4	U	0.038	U	0.039	U	0.038	U	0.038	U
PCB-1242	0.043	U	0.041	U	0.038	U	0.055	U	0.048	U	0.039	U	0.041	U	2		0.038	U	0.039	U	0.038	U	0.15	J
PCB-1248	0.043	U	0.041	U	0.038	U	2.8	J	2.2		0.039	U	0.041	U	0.4	U	0.038	U	0.039	U	0.038	U	0.038	U
PCB-1254	0.043	U	0.041	U	0.038	U	0.055	U	0.048	U	0.039	U	0.041	U	0.4	U	0.038	U	0.039	U	0.038	U	0.038	U
PCB-1260	0.043	U	0.021	J	0.038	U	0.14	J	0.13	J	0.039	U	0.041	U	0.4	U	0.038	U	0.039	U	0.038	U	0.038	U

in mg/kg (ppm).

Transect 10 Transect 8 Transect 9

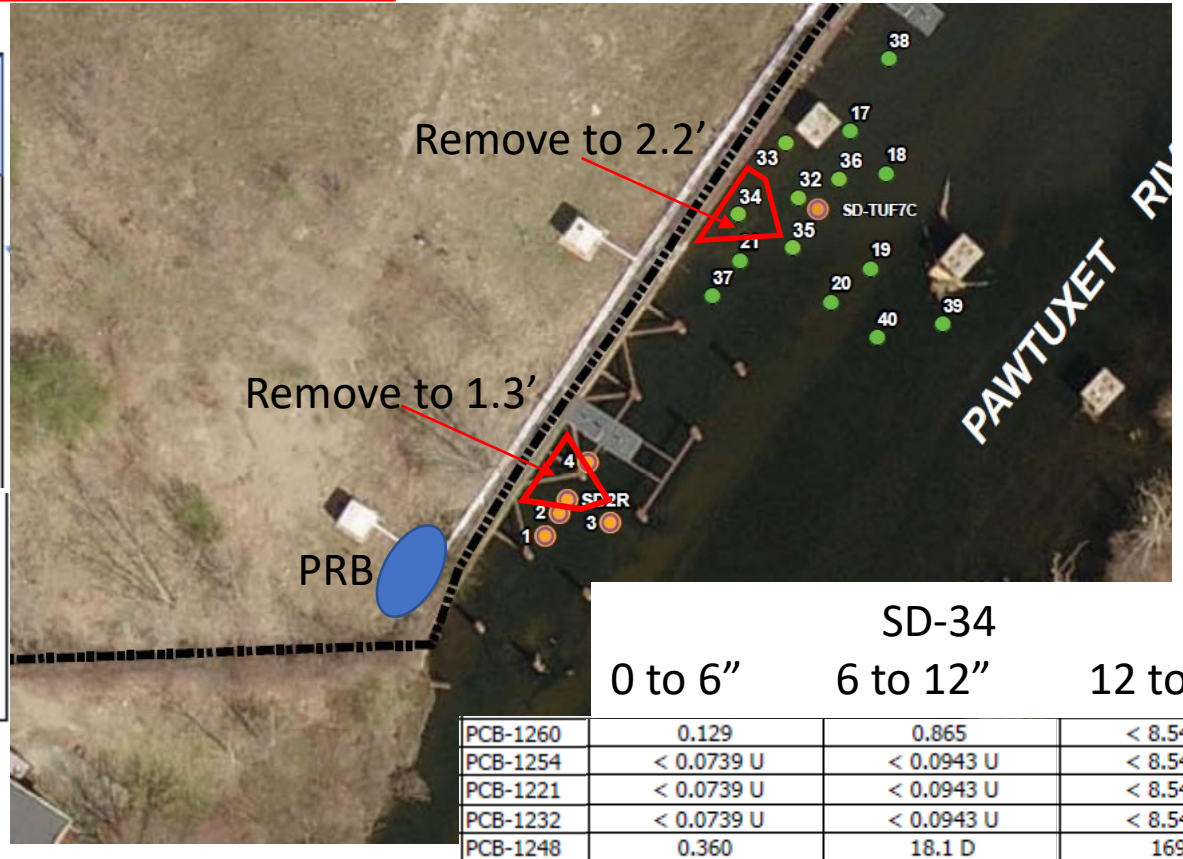
TUF10 is upstream, TUF9 is closest to the PRB.
1994 sediment data: surface (0 to 6”), shallow (1’ to 2’), deep (3’ to 4’)

2010 – 2011 sediment sampling and remediation (AECOM)

Sample Location	1 (Upstream)		2R (Subject Area)					3 (Channel)		4 (Downstream)		
Sample ID	SD-1-A-1	SD-1-B-1	SD-2R-A-1	SD-2R-A-2	SD-2R-B-1	SD-2R-B-2	SD-2R-C-1	SD-3-A-1	SD-3-B-1	SD-4-A-1	SD-4-B-1	SD-4-C-1
Sample Interval (in.)	0-6	6-12	0-6	0-6	6-11	6-11	11-17	0-6	6-9	0-6	6-11	11-17
Sample Date	11.19.10	11.19.10	11.19.10	11.19.10	11.19.10	11.19.10	11.19.10	11.19.10	11.19.10	11.19.10	11.19.10	11.19.10
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte												
PCB-1221	<0.0998 U	<0.0858 U	< 4.90 D U	< 11.1 D U	< 1.43 D U	< 1.53 D U	< 0.0549 U	<0.0588 U	<0.0569 U	<0.0581 U	<3.38 U	<0.0572
PCB-1232	<0.0998 U	<0.0858 U	< 4.90 D U	< 11.1 D U	< 1.43 D U	< 1.53 D U	< 0.0549 U	<0.0588 U	<0.0569 U	<0.0581 U	<3.38 U	<0.0572
PCB-1242	2.95	6.29	< 4.90 D U	< 11.1 D U	< 1.43 D U	< 1.53 D U	< 0.0549 U	<0.0588 U	3.49	0.213	36.6	8.02
PCB-1248	<0.0998 U	<0.0858 U	95.0 D	187 D	17.1 D	16.5 D	0.578	<0.0588 U	<0.0569 U	<0.0581 U	<3.38 U	<0.0572
PCB-1254	<0.0998 U	<0.0858 U	< 4.90 D U	< 11.1 D U	< 1.43 D U	< 1.53 D U	< 0.0549 U	<0.0588 U	<0.0569 U	<0.0581 U	<3.38 U	<0.0572
PCB-1260	<0.0998 U	<0.0858 U	< 4.90 D U	< 11.1 D U	< 1.43 D U	< 1.53 D U	< 0.0549 U	<0.0588 U	<0.0569 U	<0.0581 U	<3.38 U	<0.0572

2002 Sediment Monitoring Data [mg/kg].

depth in inches	SD-02R 1992 0-6	SD-02R 2002 0-2	SD-02R 2002 2-4	SD-02R 2002 4-6	SD-02R 2002 6-12
CONSTITUENTS					
	1996	2002			
Volatile Organics					
CHLOROBENZENE	26	6.3	6.7	130	360
M&P-XYLENE	1 J	0.033	0.024	1	3.5
O-XYLENE	0.23 J	0.039	0.034	0.51	1.5
TOLUENE	0.87 J	0.042	0.036	1.2	14
Semi-Volatile Organics					
1,2-DICHLOROBENZENE	4.6	0.25	2	5.7	45
4-CHLOROANILINE	1.5 U	0.51	5	7.4	40
TINUVIN 328	NA	4.931	31.1374	30.0525	61.6507
PCBs					
PCB-1221	3.05 U	0.065 U	1.7 U	0.33 U	1.9 U
PCB-1232	3.05 U	0.065 U	1.7 U	0.33 U	1.9 U
PCB-1242	1.55 U	0.065 U	1.7 U	0.33 U	1.9 U
PCB-1248	1.55 U	5.6	96	43	170
PCB-1254	3.05 U	3.3	1.7 U	16	43
PCB-1260	3.05 U	0.065 U	1.7 U	0.33 U	1.9 U



SD-34

	0 to 6"	6 to 12"	12 to 24"
PCB-1260	0.129	0.865	< 8.54 D U
PCB-1254	< 0.0739 U	< 0.0943 U	< 8.54 D U
PCB-1221	< 0.0739 U	< 0.0943 U	< 8.54 D U
PCB-1232	< 0.0739 U	< 0.0943 U	< 8.54 D U
PCB-1248	0.360	18.1 D	169 D
PCB-1242	< 0.0739 U	< 0.0943 U	< 8.54 D U

Waste characterization

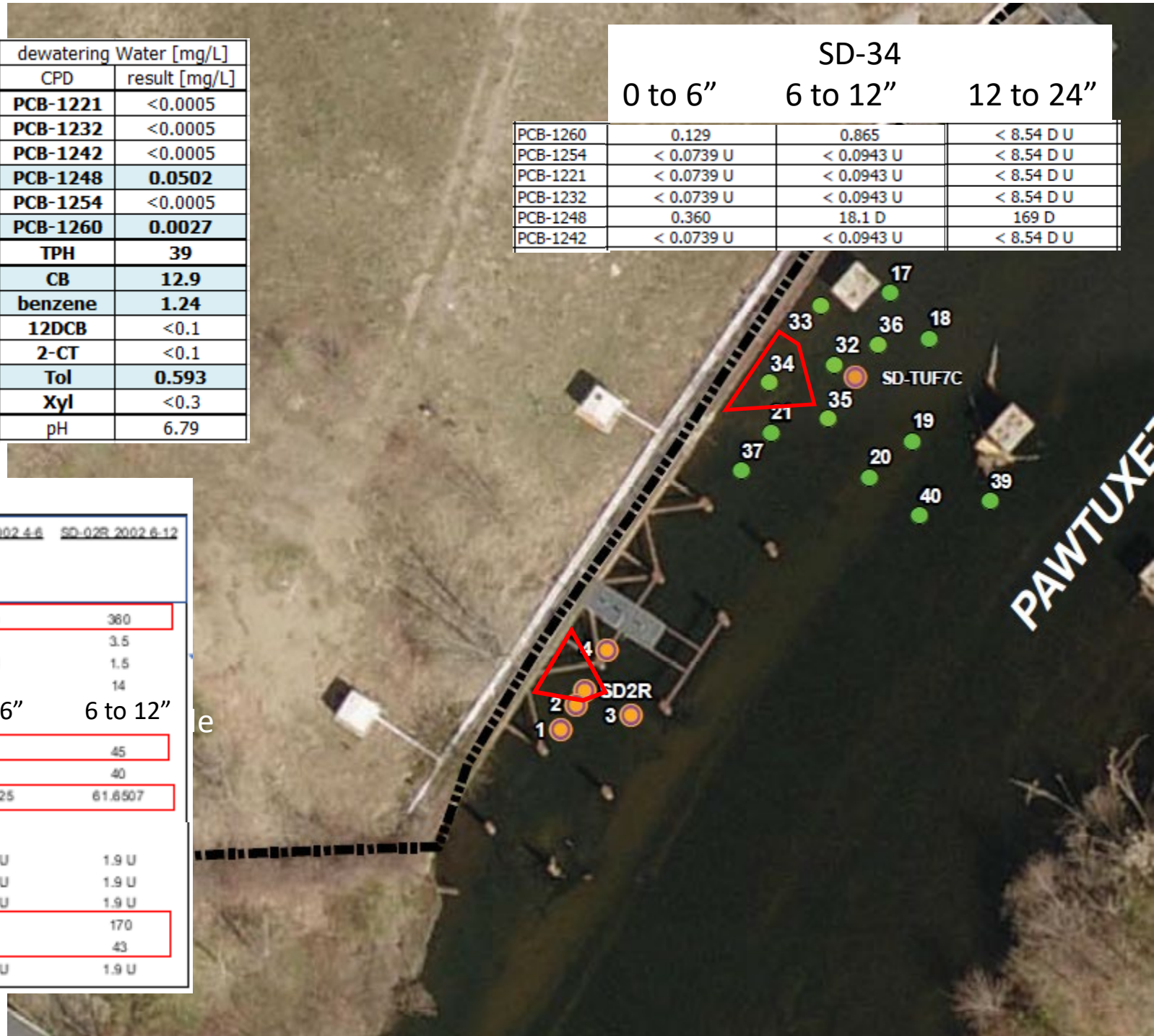
Class	Sediment west [mg/kg]		Sediment middle [mg/kg]		dewatering Water [mg/L]	
	CPD	result [mg/kg]	CPD	result [mg/kg]	CPD	result [mg/L]
PCB	**PCB-1221**	<1.57	**PCB-1221**	<1.84	**PCB-1221**	<0.0005
	PCB-1232	<1.57	**PCB-1232**	<1.84	**PCB-1232**	<0.0005
	PCB-1242	<1.57	**PCB-1242**	<1.84	**PCB-1242**	<0.0005
	PCB-1248	**17.1**	**PCB-1248**	**35.9**	**PCB-1248**	**0.0502**
	PCB-1254	<1.57	**PCB-1254**	<1.84	**PCB-1254**	<0.0005
	PCB-1260	<1.57	**PCB-1260**	<1.84	**PCB-1260**	**0.0027**
TPH	**TPH**	**265**	**TPH**	**1820**	**TPH**	**39**
VOC	**CB**	**26.5**	**CB**	**761**	**CB**	**12.9**
	benzene	**3.36**	**benzene**	**46.3**	**benzene**	**1.24**
	12DCB	**0.0472**	**12DCB**	**0.21**	**12DCB**	<0.1
	2-CT	**0.375**	**2-CT**	<0.144	**2-CT**	<0.1
	Tol	**0.031**	**Tol**	**48.9**	**Tol**	**0.593**
	Xyl	<0.308	**Xyl**	**4.76**	**Xyl**	<0.3
Chemistry	pH	6.93	pH	7.63	pH	6.79

2002 Sediment Monitoring Data [mg/kg].

depth in inches	SD-02R 1992 0-6	SD-02R 2002 0-2	SD-02R 2002 2-4	SD-02R 2002 4-6	SD-02R 2002 6-12
CONSTITUENTS	1996	2002			
Volatile Organics					
CHLOROBENZENE	26	6.3	6.7	130	360
M&P-XYLENE	1 J	0.033	0.024	1	3.5
O-XYLENE	0.23 J	0.039	0.034	0.51	1.5
TOLUENE	0.87 J	0.042	0.036	1.2	14
	0 to 6”	0 to 2”	2 to 4”	4 to 6”	6 to 12”
Semi-Volatile Organics					
1,2-DICHLOROBENZENE	4.6	0.25	2	5.7	45
4-CHLOROANILINE	1.5 U	0.51	5	7.4	40
TINUVIN 328	NA	4.931	31.1374	30.0525	61.6507
PCBs					
PCB-1221	3.05 U	0.065 U	1.7 U	0.33 U	1.9 U
PCB-1232	3.05 U	0.065 U	1.7 U	0.33 U	1.9 U
PCB-1242	1.55 U	0.065 U	1.7 U	0.33 U	1.9 U
PCB-1248	1.55 U	5.6	96	43	170
PCB-1254	3.05 U	3.3	1.7 U	16	43
PCB-1260	3.05 U	0.065 U	1.7 U	0.33 U	1.9 U

SD-34

	0 to 6”	6 to 12”	12 to 24”
PCB-1260	0.129	0.865	< 8.54 D U
PCB-1254	< 0.0739 U	< 0.0943 U	< 8.54 D U
PCB-1221	< 0.0739 U	< 0.0943 U	< 8.54 D U
PCB-1232	< 0.0739 U	< 0.0943 U	< 8.54 D U
PCB-1248	0.360	18.1 D	169 D
PCB-1242	< 0.0739 U	< 0.0943 U	< 8.54 D U



PRB Monitoring Program: River pore water. (2020 PRB Report)

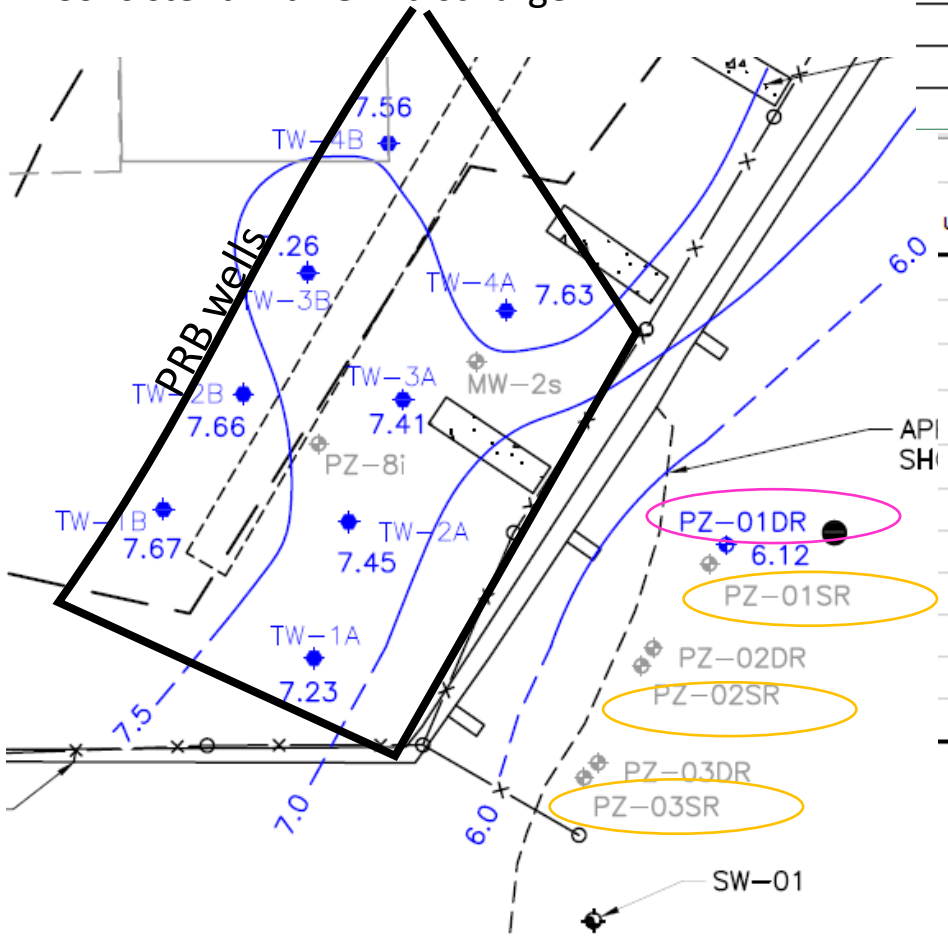
River Piezometer Monitoring

Shallow composition (CB and PCB)

- Consistent with known river sediment impacts

Deep composition (DCB)

- Consistent with GW discharge



	PZ-01SR			7 to 9'	PZ-02SR			7 to 9'	PZ-03SR			7 to 9'
COC [ug/L]	10/16/19 (baseline)	10/28/19	1/9/20	3/30/20	10/16/19 (baseline)	10/28/19	1/9/20	3/30/20	10/16/19 (baseline)	10/28/19	1/9/20	3/30/20
1,2-DCB	**336**	7.4	**428**	**690**	**98**	27.8	83	82	**656**	**322**	**204**	**308**
CB	**9,070**	220	**3,520**	**5,050**	**4,680**	254	**1,900**	**2,160**	**2,380**	673	523	884
2-CT	60.5	2.5	23.7	25.5	34.2	2.3	7.6	2.7	7.7	2.1	< 1	< 1
Tol	37.5	1.4	2.9	1.3	8.6	1.3	1.5	1	1.2	1.3	< 1	1
Xyl	45.7	<3	7.9	7	14.3	<3	<4	2	<3.4	< 3	<3	< 2
PCB	**1.84**	<0.09	0.38	0.5	**1.81**	**8.77**	**4.34**	0.18	**1**	<0.09	**0.97**	<0.09
Persulfate	0	0	0	0	0	0	0	0	0	0	0	0
Sulfate	36.5	25.9	12.9	20.8	37.5	34	17.1	21.1	<5.0	<5.0	<5.0	6.5
pH	6.85	6.78	7.37	6.75	7.14	6.81	6.71	6.46	6.83	6.88	6.57	6.65
DO	0.4	0.24	9.43	2.69	0.33	1.61	10.86	2.90	0.39	0.12	10.55	3.28
ORP	183.4	-306	12.3	-41.4	145.9	-192	33	-40.4	154.7	-388.5	21.3	-101.2

	PZ-01DR			12 to 14'	PZ-02DR			11 to 13'	PZ-03DR			10 to 12'
ug/L	10/16/19 (baseline)	10/28/19	1/9/20	3/30/20	10/16/19 (baseline)	10/28/19	1/9/20	3/30/20	10/16/19 (baseline)	10/28/19	1/9/20	3/30/20
1,2-DCB	**4,480**	**4,510**	**4,580**	**5,240**	<1	2.4	<1	<1	28.2	12.9	26.9	18.2
CB	233	57.9	36.4	50	26.3	38.4	11.3	3.2	559	144	219	250
2-CT	6.4	1.1	<1	< 1	<1	1.3	<1	<1	9.2	3.2	<1	<1
Tol	3.5	2.1	1.4	1.6	<1	1.4	<1	<1	1.5	<1.0	<1	<1
Xyl	9.5	5.1	4.5	4.65	<2	<3	<3	<2	4.6	<3	<3	2
PCB	<0.10	< 0.11	<0.11	<0.11	0.16	0.23	< 0.11	< 0.11	0.41	<0.10	0.18	<0.09
KP	0	0	0	0	0	0	0	0	0	0	0	0
Sulfate	<5.0	5.2	<5.0	<5.0	26.4	26.3	< 5.0	< 5.0	13	15.4	<5.0	<5.0
pH	6.99	6.96	8.52	7.54	6.85	7.35	7.59	9.60	7.14	7.01	6.43	6.55
DO	0.31	0.03	9.67	1.07	1.22	0.02	9.4	1.16	0.37	0.03	10.16	1.93
ORP	135.3	-450.3	-26.9	-196.7	195.8	-503.2	24.1	-97.3	161.9	-472.2	10.9	-69.4