Addendum to Contaminant Monitoring of Deer Island Treatment Plant Effluent 2000 – 2005:

Effluent Data for 2005-2008

Massachusetts Water Resources Authority

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SUMMARY

This report presents contaminant monitoring data collected from the Massachusetts Water Resources Authority's (MWRA's) Deer Island Treatment Plant (DITP) final effluent collected from August 2005 through December 2008. The summary follows on MWRA's Technical Report 2007-02 (Delaney and Rex 2007)[1] which summarized contaminant data collected for the first five years of MWRA's permit (August 2000-July 2005).

Technical details on sample collection and chemical analytical methods are in Delaney and Rex (2007). Mean loadings estimates for this report were based on taking the "best" (lowest detected concentration or most sensitive method) metals or organics results for each day that was sampled and multiplying it by the daily plant flow for that day. For parameters with no (or exceedingly few) non-detects (Zn, Total PCB, Total PAH, Total DDT, and Total Chlordane), a simple arithmetic average was used. For the other parameters, Helsel's robust Regression on Order Statistics (ROS) was used. In this approach, a robust regression is used to fit log transformed data with their normal scores. Then normal scores for the nondetects are fit to this distribution. Then the fitted points are back transformed to the original scale and descriptive statistics are computed (*e.g.* mean). This approach only assumes that the data fit a log-normal distribution and purportedly avoids transformation bias.

The results of the more recent data show substantially reduced levels of most contaminants compared to the first five years, and dramatically lower levels than were predicted in USEPA's original 1988 planning estimates for DITP, reflecting continued improvements in treatment and source reduction. For example, annual loadings of PCBs were only 0.53 kg/year, compared to the SEIS estimate of 50 kg/year. PCBs were never detected in DITP effluent as Aroclor mixtures, which are the only PCBs limited in MWRA's NPDES permit, but a few PCB congeners were frequently detected at low parts per trillion concentrations (nanograms per Liter, ng/L), with a median Total PCB concentration of 0.86 ng/L.

[1] Delaney MF and Rex, AC. 2007. *Contaminant Monitoring of Deer Island Treatment Plant Effluent: 2000-2005.* Boston: Massachusetts Water Resources Authority: Report Enquad 2007

Table 1 Metals Detections and Concentrations in DITP Final Effluent August 2005-December 2008.

Updates Table 4 in Delaney and Rex (2007)

Metal	Method	Samples	Non-Detects	Detects (%)	Range (µg/L)	Median (µg/L)	Upper 95% Percentile (µg/L)	Lowest EPA Water Quality Criterion (µg/L)*
Aluminum	ICP	320	151	169 (53%)	<15 - 208	90	97	None
Antimony	ICP	85	85	0 (0%)	<25	<25	<25	5.6 (HHC)
Arsenic	GFAA	83	81	2 (2%)	<0.8 – 0.89	<0.8	<0.8	0.018 (HHC)
Beryllium	ICP	85	85	0 (0%)	<0.5			None
Boron	ICP	85	51	34 (40%)	<250 – 352	<250	330	None
Cadmium	GFAA	305	123	182 (60%)	<0.03 – 0.34	0.044	0.115	8.8 (CCC)
Chromium	GFAA	306	64	242 (79%)	<0.70 – 3.4	0.91	1.84	50 (CCC) as Cr^{+6}
Copper	GFAA	248	0	248 (100%)	3.1 – 12	6.4	9.3	3.1 (CCC)
	ICP	303	245	58 (19%)	<10 – 71	<10	13.1	3.1 (CCC)
	ICP/MS	41	0	41 (100%)	5.6 – 26	7.9	15.6	3.1 (CCC)
Iron	ICP	85	0	85 (100%)	97 – 630	188	409	None
Lead	GFAA	304	295	9 (3%)	<2.4 – 7.0	<2.4	<2.4	8.1 (CCC)
	ICP/MS	40	0	40 (100%)	0.50 – 7.2	1.0	3.7	8.1 (CCC)
Mercury	CVAA	320	229	91 (28%)	<0.01 – 0.072	<0.01	0.019	0.94 (CCC)
	CVAF	40	0	40 (100%)	0.0055 – 0.025	0.0075	0.020	0.94 (CCC)
Molybdenum	GFAA	219	0	219 (100%)	1.6 – 17	4.8	9.0	None
Nickel	GFAA	304	0	304 (100%)	0.86 – 5.6	2.4	3.5	8.2 (CCC)
Selenium	GFAA	85	85	0 (0%)	<0.9	<0.9	<0.9	71 (CCC)
Silver	GFAA	304	126	178 (58%)	<0.09 – 1.3	0.12	0.31	1.9 (CMC)
Thallium	GFAA	85	85	0 (0%)	<1	<1	<1	0.24 (HHC)
Zinc	ICP	304	0	304 (100%)	7.2 – 85	19.6	36.4	81 (CCC)

* From EPA, 2004. Based on Saltwater or Human Health Criteria.
CCC: Criterion Continuous Concentration is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect.

CMC: Criteria Maximum Concentration is an estimate of the highest concentration of a material in surface water to which an aquatic community can exposed briefly without resulting in an unacceptable effect.

HHC: Human Health Criterion is based on a carcinogenicity of 10^{-6} risk

ICP: Inductively Coupled Plasma Optical Emission Spectrometry
GFAA: Graphite Furnace Atomic Emission Spectrometry
CVAA: Cold Vapor Atomic Emission Spectrometry
CVAA: Cold Vapor Atomic Fluorescence Spectrometry
ICP/MS: Inductively Coupled Plasma Mass Spectrometry

Table 2 Pesticides, PAHs and PCBs Detections and Concentrations in DITP Final Effluent August 2005-December 2008

Updates Table 5 in Delaney and Rex (2007)

Compound	Samples	Non-Detects	Detects (%)	Range (ng/L)	Median (ng/L)	Upper 95% Percentile (ng/L)	Lowest EPA Water Quality Criterion (ng/L)*
Total Chlordane (SIM only)	412	0	412 (100%)	0.16 – 5.7	0.77	2.22	0.80 (HHC) for Chlordane only
Alpha-Chlordane (SIM only)	412	0	412 (100%)	0.14 – 3.7	0.39	1.66	0.80 (HHC) for Chlordane only
Total DDT	412	45	367 (89%)	0.096 – 14.6	0.51	2.41	0.22 (HHC) for 4,4'-DDT only
4,4'-DDE (SIM only)	412	92	320 (78%)	0.096 – 1.58	0.31	1.3	0.22 (HHC)
4,4'-DDT (SIM only)	412	304	108 (26%)	0.176 – 2.93	1.06	1.9	0.22 (HHC)
Gamma-BHC (Lindane) (ECD only)	82	82	0 (0%)	<10 – <28			160 (CMC)
Gamma-BHC (Lindane) (SIM only)[+]	412	298	114 (28%)	0.18 – 21.5	0.67	1.7	160 (CMC)
Hexachlorobenzene (HCB) (ECD only)	82	82	0 (0%)	<10 – <28			0.28 (HHC)
Hexachlorobenzene (HCB) (SIM only) [+]	412	60	352 (85%)	0.025 – <2.4	0.08	0.26	0.28 (HHC)
Total PCB	454	4	450 (99%)	0.10 – 6.12	0.86	2.48	0.064 (HHC)
Chrysene	399	0	399 (100%)	1.16 – 138	6.66	22	3.8 (HHC)
Fluorene	399	15	384 (96%)	1.00 – 113	3.12	10	1,100,000 (HHC)
Total NOAA PAH	204	0	204 (100%)	36 – 2340	105	343	N/A

* From EPA, 2004. Based on Saltwater or Human Health Criteria.
CCC: Criterion Continuous Concentration is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect.

CMC: Criteria Maximum Concentration is an estimate of the highest concentration of a material in surface water to which an aquatic community can exposed briefly without resulting in an unacceptable effect.

HHC: Human Health Criterion is based on a carcinogenicity of 10^{-6} risk

[+] Median and upper 95th percentiles estimated using Regression on Order Statistics for log-transformed results.

ECD: Gas Chromatography with Electronic Capture Detector
SIM: Selected Ion Monitoring Gas Chromatography / Mass Spectrometry

NOTE: Total NOAA PAH is based on the average of duplicate pairs of samples. It is computed as the sum of the detected concentrations for the 24 individual PAH compounds.

Table 3 Annual Effluent Loadings Estimates August 2005-December 2008

Updates Table 8 in Delaney and Rex (2007)

Parameter	Projected for Secondary (Kg/yr) (SEIS)	Mean Loading Kg/yr (August 2005 – December 2008)
Cadmium	697	28
Chromium	3,517	507
Copper	11,945	3,354
Lead	4,961	731
Mercury	216	4.9
Molybdenum		2,437
Nickel	8,926	1,173
Silver	299	73
Zinc		11,409
Total PCB	50	0.53
Total PAH		78.2[+]
Total DDT		0.43
4,4'-DDT (only)	28	0.30
Total Chlordanes		0.55
Heptachlor (only)[#]	10	0.53

[+] Total NOAA PAH, 24 compounds

[#] All Heptachlor results were non-detect, so the median "less than" value (<1.06 ng/L) was used to estimate the mean loading.

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