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

Effluent Data for 2005-2009

Citation:

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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 2009. 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). NOTE: A previous update through December 2008 was released as 2009-05.

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.

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[1] Delaney MF and Rex, AC. 2007. *Contaminant Monitoring of Deer Island Treatment Plant Effluent: 2000-2005.* Boston: Massachusetts Water Resources Authority: Report Enquad 2007-02

Table 1 Metals Detections and Concentrations in DITP Final Effluent August 2005-December 2009.

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	420	200	220 (52%)	<15 - 230	90	99	None
Antimony	ICP	109	109	0 (0%)	<25	<25	<25	5.6 (HHC)
Arsenic	GFAA	108	104	4 (4%)	<0.8 – 1.0	<0.8	<0.8	0.018 (HHC)
Beryllium	ICP	109	109	0 (0%)	<0.5			None
Boron	ICP	109	67	42 (38%)	<250 – 352	<250	328	None
Cadmium	GFAA	393	138	255 (65%)	<0.03 – 0.34	0.049	0.116	8.8 (CCC)
Chromium	GFAA	394	111	283 (72%)	<0.70 – 3.4	0.87	1.69	50 (CCC) as Cr^{+6}
Copper	GFAA	332	0	332 (100%)	2.5 – 12	6.2	9.0	3.1 (CCC)
	ICP	393	328	65 (16%)	<10 – 71	<10	12.6	3.1 (CCC)
	ICP/MS	53	0	53 (100%)	4.5 – 26	7.4	15.6	3.1 (CCC)
Iron	ICP	109	0	109 (100%)	97 – 630	183	459	None
Lead	GFAA	392	381	11 (3%)	<2.4 – 7.0	<2.4	<2.4	8.1 (CCC)
	ICP/MS	52	0	52 (100%)	0.43 – 7.2	0.96	2.5	8.1 (CCC)
Mercury	CVAA	413	315	98 (24%)	<0.01 – 0.072	<0.01	0.017	0.94 (CCC)
	CVAF	52	0	52 (100%)	0.0029 – 0.072	0.0068	0.024	0.94 (CCC)
Molybdenum	GFAA	282	0	282 (100%)	1.5 – 17	4.3	7.7	None
Nickel	GFAA	392	0	392 (100%)	0.80 – 5.6	2.3	3.4	8.2 (CCC)
Selenium	GFAA	109	109	0 (0%)	<0.9	<0.9	<0.9	71 (CCC)
Silver	GFAA	392	192	200 (51%)	<0.09 – 1.3	0.09	0.30	1.9 (CMC)
Thallium	GFAA	109	109	0 (0%)	<1	<1	<1	0.24 (HHC)
Zinc	ICP	392	0	392 (100%)	7.2 – 85	19.2	35.6	81 (CCC)

* From EPA, 2006. 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 2009

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)**	510	0	510 (100%)	0.16 – 5.7	0.78	2.2	0.80 (HHC) for Chlordane only
Alpha-Chlordane (SIM only)	510	0	510 (100%)	0.14 – 3.7	0.55	1.62	0.80 (HHC) for Chlordane only
Total DDT	510	60	450 (88%)	0.084 – 14.6	0.61	2.35	0.22 (HHC) for 4,4'-DDT only
4,4'-DDE (SIM only)	510	131	379 (74%)	0.096 – 1.58	0.31	1.3	0.22 (HHC)
4,4'-DDT (SIM only)	510	344	166 (32%)	0.176 – 2.93	1.05	2.1	0.22 (HHC)
Gamma-BHC (Lindane) (ECD only)	106	106	0 (0%)	<10 – <28			160 (CMC)
Gamma-BHC (Lindane) (SIM only)[+]	510	394	116 (23%)	0.18 – 21.5	0.66	1.45	160 (CMC)
Hexachlorobenzene (HCB) (ECD only)	106	106	0 (0%)	<10 – <28			0.28 (HHC)
Hexachlorobenzene (HCB) (SIM only)[+][#]	503	78	425 (84%)	0.025 – 7.81	0.081	0.24	0.28 (HHC)
Total PCB **(~~SIM only~~)**	564	8	556 (99%)	0.10 – 6.12	0.86	2.48	0.064 (HHC)
Chrysene	488	2	526 (100%)	1.16 – 138	6.77	23	3.8 (HHC)
Fluorene	488	18	470 (96%)	1.00 – 113	3.38	11	1,100,000 (HHC)
Total NOAA PAH	260	0	260 (100%)	29 – 2340	110	349	N/A

* From EPA, 2004. Based on Saltwater or Human Health Criteria.

[#] Seven samples from 2009 were rejected due to elevated HCB concentrations in the associated Laboratory Reagent Blank.

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 2009

Updates Table 8 in Delaney and Rex (2007)

Parameter	Projected for Secondary (Kg/yr) (SEIS)	Mean Loading Kg/yr (August 2005 – December 2009)
Cadmium	697	29
Chromium	3,517	481
Copper	11,945	3,253
Lead	4,961	674
Mercury	216	5.1
Molybdenum		2,223
Nickel	8,926	1,150
Silver	299	67
Zinc		11,182
Total PCB	50	0.52
Total PAH		84.3[+]
Total DDT		0.43
4,4'-DDT (only)	28	0.31
Total Chlordanes		0.54
Heptachlor (only)[#]	10	0.54

[+] Total NOAA PAH, 24 compounds
[#] All Heptachlor results were non-detect, so the median "less than" value (<1.08 ng/L) was used to estimate the mean loading.

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