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Technical Memorandum

To: Project File
From: Jamie Bankston, Sam Reuter and Todd DeJournett
Subject: Site-Specific PAH Toxicity Unit Correlation Factors,
Spirit Lake Sediment Site, U.S. Steel Former Duluth Works, Duluth, Minnesota
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c: Eric Dott

Introduction

This memorandum provides an overview of the development and application of site-specific correlation factors used to evaluate potential polynuclear aromatic hydrocarbon (PAH) toxicity to benthic invertebrates in sediment at the Spirit Lake Sediment Site (Site) in accordance with the USEPA guidance document: *Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures* (USEPA, 2003). By following this guidance, all PAH data collected during the remedial investigation can be used to characterize the Site, including locations where samples were analyzed for the EPA-17 PAH list as well as samples analyzed for the EPA-34 PAH list (Table 1). Following methods in the guidance, a site-specific correlation for ESB toxicity units based on the Final Chronic Value ($ESBTU_{FCV}$) was determined using the EPA-34 PAH and EPA-17 PAH lists (Table 1). As shown in this memorandum, a statistically significant correlation exists between the $ESBTU_{FCV}$ and the EPA-34 PAH list and also between the $ESBTU_{FCV}$ and the EPA-17 PAH list. This correlation allows for the EPA-17 PAH list concentrations and the respective $ESBTU_{FCV,17}$ concentrations to be correlated with statistical confidence to an equivalent $ESBTU_{FCV,34}$. Applying site-specific correlation factors, that are based on site data for the EPA-34 PAH list, to results from samples analyzed for the EPA-17 PAH list generates an $ESBTU_{FCV,34}$ that can then be used to allow screening of all PAH sediment samples for potential toxicity to benthic invertebrates in a manner that approximates a fuller suite of potential PAH impacts at the Site. The procedures followed are presented in the USEPA guidance document (USEPA, 2003).

Methodology

Site-specific correlation equations were developed for $ESBTU_{FCV}$ using the site data results of EPA-34 PAH and EPA-17 PAH list analyses and corresponding calculated $ESBTU_{FCV}$ in accordance with USEPA guidance (USEPA, 2003). Five different site-specific correlation equations were calculated for the following statistical confidence levels (50, 80, 90, 95, and 99 percent) as described below.

1) All Site sediment samples with EPA-34 PAH list data were used to calculate the respective $ESBTU_{FCV,34}$ and $ESBTU_{FCV,17}$ values in accordance with EPA guidance (USEPA, 2003). For non-detect values, ½ the detection limit was used for the respective $ESBTU_{FCV}$ calculations.

2) Data were then sorted by $ESBTU_{FCV,17}$ values; all data points with an $ESBTU_{FCV,17}>1$ were removed from the data set and were not used for development of the correlation equations. By removing this set of data, the correlation equations pertained to data that fit within the screening criterion, $ESBTU_{FCV}<1$. In other words, any data that had an $ESBTU_{FCV,17} >1$ would also have an $ESBTU_{FCV,34} >1$, so there was no need to develop a correlation for data that had $ESBTU_{FCV,17} >1$. (It should be noted that all available data will be used for screening and site assessment, including those data not included in the development of the site-specific correlation factors.)

3) $ESBTU_{FCV,34}$ and $ESBTU_{FCV,17}$ values were plotted on a linear axis.

4) A linear regression correlation equation was fit to the $ESBTU_{FCV}$ data using the software package XLStat for each confidence level (Table 2).

5) A value of 1 for the $ESBTU_{FCV,17}$ was used in each of the linear regression correlation equations and the resulting $ESBTU_{FCV,34}$ was compared to the reported generic factor ratios for EPA-13 PAH and EPA-23 PAH lists (Table 2) as published in the EPA Guidance (USEPA, 2003).

Results

The site-specific correlation factors developed for each confidence level are summarized in Table 2. In addition, the USEPA generic scaling factors for $ESBTU_{FCV,13}$ and $ESBTU_{FCV,23}$ values (USEPA, 2003) are included for comparison to the site-specific results.

The site-specific correlation factor suggests that the $ESBTU_{FCV,17}$ values for this site can be scaled with a high degree of confidence (Figure 1 and Table 2) and an equivalent $ESBTU_{FCV,34}$ can be calculated and used to evaluate potential sediment toxicity. The $ESBTU_{FCV,34}$/$ESBTU_{FCV,17}$ ratios provided in Table 2 show similar values, ranging from 1.72 to 2.04, evidence that a strong site-specific correlation can be used to calculate $ESBTU_{FCV,34}$ from $ESBTU_{FCV,17}$ values. The USEPA generic factors, on the other hand, range from 1.64 to 16.9 and show a greater variability than the Spirit Lake data set, likely because the USEPA data set is a compilation of data from multiple sites. It is, therefore, appropriate to use the developed site-specific correlation factor in the characterization of the Site. Table 3 summarizes the site-specific correlation factor calculation results for scaling from $ESBTU_{FCV,17}$ to $ESBTU_{FCV,34}$.

Conclusion

For the Site, the 95 percent UCL (Upper Confidence Level) correlation equation was used to scale $ESBTU_{FCV,17}$ values to $ESBTU_{FCV,34}$ when the EPA-34 PAH list analyses were not completed for a given sample. The 95 percent UCL is considered representative of the range of uncertainty associated with natural data variability and its use is in accordance with standard practice for analysis of environmental data sets. Having a site-specific correlation between $ESBTU_{FCV,17}$ and $ESBTU_{FCV,34}$ values allows all PAH data collected as part of the remedial investigation to be utilized to further characterize the Site, removing the limitation imposed by using locations that only had the EPA-34 PAH list analyzed. Thus, use of the site-specific correlation factor allows more data to be used for site characterization.

Reference

USEPA, 2003. *Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures*. EPA-600-R-02-013. Office of Research and Development. Washington, DC 20460.

Attachments

Table 1 PAH17 and PAH34 Analyte Lists

Table 2 Site Specific $ESBTU_{FCV}$ PAH Correlation Factors

Table 3 $ESBTU_{FCV,17}$ and $ESBTU_{FCV,34}$

Figure 1 Regression of $ESBTU_{FCV,34}$ @ 0.5DL versus $ESBTU_{FCV,17}$ @ 0.5DL

Table 1
PAH17 and PAH34 Analyte Lists
Spirit Lake Sediment Site
U.S. Steel Former Duluth Works

List Name	EPA-17 PAH[1]	EPA-34 PAH
List Source	**USEPA-2003**	**USEPA-2003**
Acenaphthene	x	x
Acenaphthylene	x	x
Anthracene	x	x
Benzo(a)anthracene	x	x
Benzo(a)pyrene	x	x
Benzo(b)fluoranthene	x	x
Benzo(e)pyrene		x
Benzo(g,h,i)perylene	x	x
Benzo(k)fluoranthene	x	x
Chrysene	x	x
Dibenz(a,h)anthracene	x	x
2,6-dimethylnaphthalene		x
Fluoranthene	x	x
Fluorene	x	x
Indeno(1,2,3-cd)pyrene	x	x
2-Methylnaphthalene	x	x
1-Methylnaphthalene		x
Naphthalene	x	x
Perylene		x
Phenanthrene	x	x
1-methylphenanthrene		x
2,3,5-trimethylnaphthalene		x
Pyrene	x	x
C1-Chrysenes		x
C1-Fluoranthenes/Pyrenes		x
C1-Fluorenes		x
C1-Naphthalenes		x
C1-Phenanthrenes/Anthracenes		x
C2-Chrysenes		x
C2-Fluorenes		x
C2-Naphthalenes		x
C2-Phenanthrenes/Anthracenes		x
C3-Chrysenes		x
C3-Fluorenes		x
C3-Naphthalenes		x
C3-Phenanthrenes/Anthracenes		x
C4-Chrysenes		x
C4-Napthalenes		x
C4-Phenanthrenes/Anthracenes		x
Total Number of PAHs	**17**	**34**

[1]Benzo(b)fluoranthene and benzo(k)fluoranthene are commonly reported as their sum because of insufficient chromatographic separation.

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P:\Duluth\23 MN\69\23691125 St Louis River Duluth Works Sediment\WorkFiles\N_RI Report_2012\REVISED RI Report Package Oct 2012\Appendices\Appendix - PAH site specific scaling\Table 1_PAH17 and PAH34 list.xlsx

Table 2
Site Specific $ESBTU_{FCV}$ PAH Correlation Factors
Spirit Lake Sediment Site
U.S. Steel Former Duluth Works

		Site-Specific Correlation Factors	USEPA Generic Factors*	
Percentile	**Correlation Factor Linear Equations**	**$ESBTU_{FCV,34}$ / $ESBTU_{FCV,17}$****	**$ESBTU_{FCV,34}$ / $ESBTU_{FCV,13}$**	**$ESBTU_{FCV,34}$ / $ESBTU_{FCV,23}$**
50	$ESBTU_{FCV,34}=1.714(ESBTU_{FCV,17})+0.007$	1.72	2.75	1.64
80	$ESBTU_{FCV,34}=1.710(ESBTU_{FCV,17})+0.170$	1.88	6.78	2.8
90	$ESBTU_{FCV,34}=1.709(ESBTU_{FCV,17})+0.216$	1.93	8.45	3.37
95	**$ESBTU_{FCV,34}=1.709(ESBTU_{FCV,17})+0.257$**	**1.97**	11.5	4.14
99	$ESBTU_{FCV,34}=1.707(ESBTU_{FCV,17})+0.337$	2.04	16.9	6.57

Notes:

* USEPA generic factors are from USEPA Table 6-1 (USEPA, 2003)

** Values given for $ESBTU_{FCV,34}/ESBTU_{FCV,17}$ were calculated using the 95% UCL (Upper Confidence Level) factor and an ESBTUFCV,17 value of 1 for comparison.

Table 3
$ESBTU_{FCV,17}$ and $ESBTU_{FCV,34}$
Spirit Lake Sediment Site
U.S. Steel Former Duluth Works

Sample Name	Sample Date	$ESBTU_{FCV,17}$	$ESBTU_{FCV,34}$	Estimated $ESBTU_{FCV,34}$ (calculated from $ESBTU_{FCV,17}$ site-specific correlation factor)
WM-1-1_0.0-0.7_02172011	2/17/2011	0.004	0.0156	0.26
WM-1-2_0.7-1.9_02172011	2/17/2011	0.01	0.022	0.27
WM-1-3_1.9-2.1_02172011	2/17/2011	5	12.7	8.80
WM-1-4_2.5-3.0_02172011	2/17/2011	0.018	0.0271	0.29
WM-2-1_0.0-0.5_02192011	2/19/2011	0.011	0.0182	0.28
WM-2-2_1.2-1.4_02192011	2/19/2011	2.8	--	5.04
WM-2-3_1.4-1.9_02192011	2/19/2011	0.115	--	0.454
WM-3-1_0.0-1.0_02202011	2/20/2011	0.002	0.00523	0.26
WM-3-2_2.0-4.0_02202011	2/20/2011	0.003	0.0081	0.26
WM-3-3_4.2-4.75_02202011	2/20/2011	0.016	0.0337	0.28
WM-3-4_4.75-5.25_02202011	2/20/2011	0.015	0.0295	0.28
WM-4-1_0.0-0.5_02212011	2/21/2011	0.046	0.0949	0.34
WM-4-2_0.5-1.0_02212011	2/21/2011	0.08	0.134	0.39
WM-5-1_0.0-0.5_02222011	2/22/2011	0.018	0.0332	0.29
WM-5-2_1.0-1.5_02222011	2/22/2011	0.014	--	0.281
WM-6-1_0.0-1.0_02222011	2/22/2011	0.088	0.141	0.41
WM-6-1_0.0-1.0_02222011_FD	2/22/2011	0.068	0.12	0.37
WM-6-2_1.4-1.8_02222011	2/22/2011	0.011	0.022	0.28
WM-7-1_0.0-0.5_02222011	2/22/2011	0.021	0.0339	0.29
WM-7-2_1.1-1.6_02222011	2/22/2011	0.023	--	0.296
WM-8-1_0.0-0.5_02242011	2/24/2011	0.048	0.0853	0.34
WM-8-2_0.75-1.25_02242011	2/24/2011	0.381	0.662	0.91
WM-8-3_1.25-1.75_02242011	2/24/2011	0.002	0.006	0.26
WM-9-1_0.0-0.5_03072011	3/7/2011	0.064	0.0886	0.37
WM-9-2_0.5-1.0_03072011	3/7/2011	0.166	--	0.541
WM-9-3_1.5-2.0_03072011	3/7/2011	0.077	--	0.389
WM-9-4_2.0-2.5_03072011	3/7/2011	0.01	--	0.274
WM-10-1_0.0-1.0_02252011	2/25/2011	0.383	1.09	0.91
WM-10-2_1.0-2.0_02252011	2/25/2011	5.6	8.22	9.83
WM-10-3_2.0-2.8_02252011	2/25/2011	0.022	0.0341	0.29
UC-11-1_0.0-1.0_02262011	2/26/2011	3.7	9.81	6.58
UC-11-2_1.0-2.0_02262011	2/26/2011	1.2	1.74	2.31
UC-11-3_2.0-3.0_02262011	2/26/2011	0.524	1.05	1.15
UC-11-4_3.0-3.5_02262011	2/26/2011	0.027	0.0472	0.30
UC-12-1_0.0-0.5_02272011	2/27/2011	0.27	0.35	0.72
UC-12-2_1.5-2.0_02272011	2/27/2011	1.1	--	2.14
UC-12-3_2.5-3.1_02272011	2/27/2011	0.582	--	1.25
UC-12-4_3.1-3.6_02272011	2/27/2011	0.018	--	0.288
WM-13-1_0.0-0.5_03042011	3/4/2011	0.007	0.0114	0.27
WM-13-2_1.5-2.0_03042011	3/4/2011	0.03	--	0.308
WM-13-3_3.25-3.75_03042011	3/4/2011	0.008	--	0.271
WM-13-4_3.75-4.25_03042011	3/4/2011	0.015	--	0.283
WM-14-1_0.0-0.5_02272011	2/27/2011	0.007	0.0166	0.27
WM-14-2_0.5-1.0_02272011	2/27/2011	0.056	--	0.353
WM-14-3_1.0-1.5_02272011	2/27/2011	6.3	--	11
WM-14-4_1.5-2.0_02272011	2/27/2011	0.007	--	0.269
UC-15-1_0.0-1.0_02272011	2/27/2011	0.035	0.0561	0.32
UC-15-2_1.0-2.0_02272011	2/27/2011	0.052	0.0822	0.35
UC-15-3_2.0-3.0_02272011	2/27/2011	0.149	0.344	0.51
UC-15-3_2.0-3.0_02272011_FD	2/27/2011	0.604	1.71	1.29
UC-15-4_3.0-4.0_02272011	2/27/2011	0.188	0.297	0.58
UC-15-4_3.0-4.0_02272011_FD	2/27/2011	0.421	--	0.976
UC-16-1_0.0-0.5_02282011	2/28/2011	0.24	0.317	0.67
UC-16-2_2.0-2.5_02282011	2/28/2011	0.571	--	1.23
UC-16-3_3.0-3.5_02282011	2/28/2011	0.429	--	0.99
UC-16-4_4.0-4.5_02282011	2/28/2011	0.012	--	0.278
UC-17-1_0.0-0.5_03012011	3/1/2011	0.209	0.298	0.61
UC-17-2_1.0-1.5_03012011	3/1/2011	0.602	1.23	1.29
UC-17-3_2.0-2.5_03012011	3/1/2011	0.516	1.06	1.14
UC-17-4_2.5-3.0_03012011	3/1/2011	0.238	0.576	0.66
WM-18-1_0.0-0.7_03012011	3/1/2011	0.029	0.0654	0.31
WM-18-2_0.7-1.7_03012011	3/1/2011	7.4	14.4	12.90
WM-18-3_1.7-2.7_03012011	3/1/2011	0.226	0.36	0.64
WM-19-1_0.0-0.5_03022011	3/2/2011	0.038	0.0427	0.32
WM-19-2_0.75-1.25_03022011	3/2/2011	3.1	--	5.55
WM-19-3_1.25-1.75_03022011	3/2/2011	0.011	--	0.276
UC-20-1_0.0-0.5_03022011	3/2/2011	0.415	0.876	0.97
UC-20-2_1.5-2.0_03022011	3/2/2011	1.6	--	2.99
UC-20-3_2.5-3.0_03022011	3/2/2011	0.157	--	0.525
UC-20-4_3.5-4.0_03022011	3/2/2011	0.434	--	0.999
WM-21-1_0.0-0.5_03042011	3/4/2011	0.014	0.0214	0.28
WM-21-2_2.0-2.5_03042011	3/4/2011	0.043	0.0703	0.33

Table 3
$ESBTU_{FCV,17}$ and $ESBTU_{FCV,34}$
Spirit Lake Sediment Site
U.S. Steel Former Duluth Works

Sample Name	Sample Date	$ESBTU_{FCV,17}$	$ESBTU_{FCV,34}$	Estimated $ESBTU_{FCV,34}$ (calculated from $ESBTU_{FCV,17}$ site-specific correlation factor)
WM-21-3_4.0-4.5_03042011	3/4/2011	12.3	15.7	21.28
WM-21-4_5.0-5.5_03042011	3/4/2011	0.021	0.0316	0.29
WM-22-1_0.0-0.5_03062011	3/6/2011	0.008	0.0142	0.27
WM-22-2_1.5-2.0_03062011	3/6/2011	0.015	0.0335	0.28
WM-22-3_4.0-4.5_03062011	3/6/2011	0.131	0.171	0.48
WM-22-4_5.5-6.0_03062011	3/6/2011	0.016	0.0664	0.28
UC-23-1_0.0-0.5_03022011	3/2/2011	1	2.03	1.97
UC-23-2_1.5-2.0_03022011	3/2/2011	3.7	7.33	6.58
UC-23-3_2.5-3.0_03022011	3/2/2011	0.694	1.43	1.44
UC-23-4_3.75-4.25_03022011	3/2/2011	0.072	0.119	0.38
WM-24-1_0.0-0.5_03072011	3/7/2011	0.223	0.397	0.64
WM-24-2_1.0-1.5_03072011	3/7/2011	7.9	--	13.8
WM-24-2_1.0-1.5_03072011_FD	3/7/2011	6.1	--	10.7
WM-24-3_2.0-2.5_03072011	3/7/2011	0.12	--	0.462
WM-24-4_3.0-3.5_03072011	3/7/2011	0.053	--	0.348
WM-25-1_0.0-0.5_03072011	3/7/2011	0.024	0.0386	0.30
WM-25-2_2.5-3.0_03072011	3/7/2011	0.174	--	0.554
WM-25-3_5.5-6.0_03072011	3/7/2011	5.6	--	9.83
WM-25-4_6.0-6.5_03072011	3/7/2011	0.017	--	0.286
WM-26-1_0.0-0.5_03112011	3/11/2011	0.007	0.0114	0.27
WM-26-2_0.5-1.0_03112011	3/11/2011	0.045	--	0.334
WM-26-3_1.3-1.8_03112011	3/11/2011	3.2	--	5.73
WM-26-4_1.8-2.1_03112011	3/11/2011	0.075	--	0.385
WM-27-1_0.0-0.5_03132011	3/13/2011	0.013	0.0226	0.28
WM-27-2_0.5-1.0_03132011	3/13/2011	0.014	--	0.281
WM-27-3_1.4-1.9_03132011	3/13/2011	0.772	--	1.58
WM-28-1_0.0-0.5_03132011	3/13/2011	0.013	0.0243	0.28
WM-28-2_2.0-2.5_03132011	3/13/2011	0.694	--	1.44
WM-28-2_2.0-2.5_03132011_FD	3/13/2011	0.538	--	1.18
WM-28-3_2.5-3.0_03132011	3/13/2011	3.1	--	5.55
WM-28-4_3.0-3.5_03132011	3/13/2011	0.033	--	0.313
UC-29-1_0.0-0.5_03032011	3/3/2011	0.771	1.17	1.57
UC-29-2_1.0-1.5_03032011	3/3/2011	3.9	5.48	6.92
UC-29-2_1.0-1.5_03032011_FD	3/3/2011	3.3	2.85	5.90
UC-29-3_2.0-2.5_03032011	3/3/2011	0.351	0.499	0.86
UC-29-4_2.5-3.0_03032011	3/3/2011	0.009	0.0155	0.27
WM-30-1_0.0-0.5_03082011	3/8/2011	0.011	0.0245	0.28
WM-30-2_1.0-1.5_03082011	3/8/2011	0.04	0.0518	0.33
WM-30-3_2.0-2.5_03082011	3/8/2011	0.009	0.021	0.27
WM-30-4_3.5-4.0_03082011	3/8/2011	2.9	3.52	5.21
UC-31-1_0.0-0.5_03092011	3/9/2011	3.5	3.71	6.24
UC-31-2_0.5-1.0_03092011	3/9/2011	0.848	--	1.71
UC-31-3_1.0-1.5_03092011	3/9/2011	0.386	--	0.917
UC-31-3_1.0-1.5_03092011_FD	3/9/2011	0.174	--	0.554
UC-31-4_2.0-2.5_03092011	3/9/2011	0.099	0.4059	0.43
UC-31-4_2.0-2.5_03092011_FD	3/9/2011	0.134	--	0.486
WM-32-1_0.0-0.5_03132011	3/13/2011	0.056	0.0641	0.35
WM-32-2_0.5-1.0_03132011	3/13/2011	0.022	0.0362	0.29
WM-32-3_1.0-1.5_03132011	3/13/2011	0.004	0.00647	0.26
WM-32-4_3.5-4.0_03132011	3/13/2011	0.104	0.186	0.43
WM-33-1_0.0-0.5_03082011	3/8/2011	0.196	0.724	0.59
WM-33-2_0.5-1.0_03082011	3/8/2011	0.003	--	0.262
WM-33-3_1.5-2.0_03082011	3/8/2011	0.046	--	0.336
WM-33-4_2.5-3.0_03082011	3/8/2011	0.002	--	0.26
WM-34-1_0.0-0.5_03142011	3/14/2011	0.915	1.29	1.82
WM-34-2_0.5-1.0_03142011	3/14/2011	0.162	--	0.534
WM-34-3_1.0-1.5_03142011	3/14/2011	0.003	--	0.262
UC-35-1_0.0-0.5_03092011	3/9/2011	0.487	0.634	1.09
UC-35-2_0.5-1.0_03092011	3/9/2011	0.068	--	0.373
UC-35-3_2.0-2.5_03092011	3/9/2011	0.024	--	0.298
UC-35-4_4.0-4.5_03092011	3/9/2011	0.045	--	0.334
UC-36-1_0.0-0.5_03092011	3/9/2011	0.554	0.716	1.20
UC-36-2_1.0-1.5_03092011	3/9/2011	0.48	0.55	1.08
UC-36-3_2.0-2.5_03092011	3/9/2011	0.009	0.019	0.27
UC-36-4_2.5-3.0_03092011	3/9/2011	0.004	0.0059	0.26
UC-37-1_0.0-0.5_03102011	3/10/2011	0.3	0.425	0.77
UC-37-2_0.5-1.0_03102011	3/10/2011	0.089	--	0.409
UC-37-3_3.0-3.5_03102011	3/10/2011	0.005	--	0.266
UC-37-4_5.5-6.0_03102011	3/10/2011	0.004	--	0.264
UC-38-1_0.0-0.5_03112011	3/11/2011	0.327	0.393	0.82
UC-38-2_1.5-2.0_03112011	3/11/2011	0.698	--	1.45
UC-38-3_2.0-2.5_03112011	3/11/2011	0.435	--	1

Table 3
$ESBTU_{FCV,17}$ and $ESBTU_{FCV,34}$
Spirit Lake Sediment Site
U.S. Steel Former Duluth Works

Sample Name	Sample Date	$ESBTU_{FCV,17}$	$ESBTU_{FCV,34}$	Estimated $ESBTU_{FCV,34}$ (calculated from $ESBTU_{FCV,17}$ site-specific correlation factor)
UC-38-4_2.9-3.4_03112011	3/11/2011	0.003	--	0.262
UC-39-1_0.0-0.5_03032011	3/3/2011	0.137	0.166	0.49
UC-39-2_2.0-2.5_03032011	3/3/2011	1	--	1.97
UC-39-3_3.0-3.5_03032011	3/3/2011	0.394	--	0.93
UC-39-4_4.0-4.5_03032011	3/3/2011	0.021	--	0.293
UC-40-1_0.0-0.5_03102011	3/10/2011	0.08	0.106	0.39
UC-40-2_1.5-2.0_03102011	3/10/2011	0.627	--	1.33
UC-40-3_3.0-3.5_03102011	3/10/2011	0.553	--	1.2
UC-40-3_3.0-3.5_03102011_FD	3/10/2011	0.373	--	0.894
UC-40-4_4.5-5.0_03102011	3/10/2011	0.011	--	0.276
UC-40-4_4.5-5.0_03102011_FD	3/10/2011	--	--	
WM-41-1_0.0-0.5_03152011	3/15/2011	0.026	0.0484	0.30
WM-41-2_1.0-1.5_03152011	3/15/2011	0.001	--	0.259
WM-41-3_2.0-2.5_03152011	3/15/2011	0.005	--	0.266
WM-41-4_3.0-3.4_03152011	3/15/2011	0.002	--	0.26
WM-42-1_0.0-0.5_03152011	3/15/2011	0.065	0.09623	0.37
WM-42-2_1.0-1.5_03152011	3/15/2011	0.002	--	0.26
WM-42-3_2.0-2.5_03152011	3/15/2011	0.001	--	0.259
WM-42-4_2.5-3.0_03152011	3/15/2011	0.003	--	0.262
WM-43-1_0.0-0.5_03152011	3/15/2011	0.008	0.0126	0.27
WM-43-2_1.7-2.2_03152011	3/15/2011	1.3	--	2.48
WM-43-3_2.2-2.7_03152011	3/15/2011	9.3	--	16.2
WM-43-4_5.0-5.5_03152011	3/15/2011	0.032	--	0.312
WM-44-1_0.0-0.5_03162011	3/16/2011	0.007	0.0112	0.27
WM-44-2_0.5-1.0_03162011	3/16/2011	0.826	--	1.67
WM-44-3_1.0-1.5_03162011	3/16/2011	0.713	--	1.48
WM-44-4_2.0-2.5_03162011	3/16/2011	0.009	--	0.272
WM-45-1_0.0-0.5_03162011	3/16/2011	0.014	0.02601	0.28
WM-45-2_1.5-2.0_03162011	3/16/2011	1.6	--	2.99
WM-45-2_1.5-2.0_03162011_FD	3/16/2011	0.016	--	0.284
WM-45-3_3.0-3.5_03162011	3/16/2011	0.025	--	0.3
WM-45-4_5.0-5.5_03162011	3/16/2011	0.016	--	0.284
WM-46-1_0.0-0.5_03162011	3/16/2011	0.011	0.02	0.28
WM-46-2_2.3-2.8_03162011	3/16/2011	0.168	--	0.544
WM-46-3_2.8-3.3_03162011	3/16/2011	5.9	--	10.3
WM-46-4_4.0-4.5_03162011	3/16/2011	0.019	--	0.289
WM-47-1_0.0-0.5_03162011	3/16/2011	0.017	0.0256	0.29
WM-47-2_2.5-3.0_03162011	3/16/2011	2.3	--	4.19
WM-47-3_3.0-3.5_03162011	3/16/2011	0.762	--	1.56
WM-47-4_3.5-4.0_03162011	3/16/2011	0.027	--	0.303
WM-48-1_0.0-0.5_03172011	3/17/2011	0.012	0.019	0.28
WM-48-2_2.0-2.5_03172011	3/17/2011	0.565	--	1.22
WM-48-3_2.5-3.0_03172011	3/17/2011	1.9	--	3.5
WM-48-4_3.0-3.5_03172011	3/17/2011	0.221	--	0.635
WM-49-1_0.0-0.5_03172011	3/17/2011	0.014	0.0231	0.28
WM-49-2_2.5-3.0_03172011	3/17/2011	0.012	--	0.278
WM-49-2_2.5-3.0_03172011_FD	3/17/2011	0.015	--	0.283
WM-49-3_4.8-5.3_03172011	3/17/2011	0.011	--	0.276
WM-49-4_5.5-6.0_03172011	3/17/2011	0.161	--	0.532
WM-50-1_0.0-0.5_03172011	3/17/2011	0.016	0.0232	0.28
WM-50-2_1.0-1.5_03172011	3/17/2011	0.05	--	0.342
WM-50-3_2.5-3.0_03172011	3/17/2011	0.362	--	0.876
WM-50-4_3.0-3.5_03172011	3/17/2011	0.005	--	0.266
WM-51-1_0.0-0.5_03182011	3/18/2011	0.01	0.0158	0.27
WM-51-2_2.0-2.5_03182011	3/18/2011	0.017	--	0.286
WM-51-3_4.0-4.5_03182011	3/18/2011	0.009	--	0.272
WM-51-4_6.0-6.5_03182011	3/18/2011	0.023	--	0.296
UC-52-1_0.0-0.5_03182011	3/18/2011	0.048	0.0678	0.34
UC-52-2_2.0-2.5_03182011	3/18/2011	0.231	--	0.652
UC-52-3_4.0-4.5_03182011	3/18/2011	0.004	--	0.264
UC-52-4_5.0-5.5_03182011	3/18/2011	0.014	--	0.281
UC-53-1_0.0-0.5_03182011	3/18/2011	0.286	0.349	0.75
UC-53-2_2.0-2.5_03182011	3/18/2011	1.2	--	2.31
UC-53-3_3.0-3.5_03182011	3/18/2011	0.387	--	0.918
UC-53-4_4.5-5.0_03182011	3/18/2011	0.007	--	0.269
UC-54-1_0.0-0.5_03182011	3/18/2011	0.501	0.6	1.11
UC-54-2_0.5-1.0_03182011	3/18/2011	0.017	--	0.286
UC-54-3_1.0-1.5_03182011	3/18/2011	0.063	--	0.365
UC-55-1_0.0-0.5_03182011	3/18/2011	0.962	1.22	1.90
UC-55-2_2.0-2.5_03182011	3/18/2011	0.01	--	0.274
UC-55-2_2.0-2.5_03182011_FD	3/18/2011	0.01	--	0.274
UC-55-3_3.0-3.5_03182011	3/18/2011	0.483	--	1.08

Table 3
$ESBTU_{FCV,17}$ and $ESBTU_{FCV,34}$
Spirit Lake Sediment Site
U.S. Steel Former Duluth Works

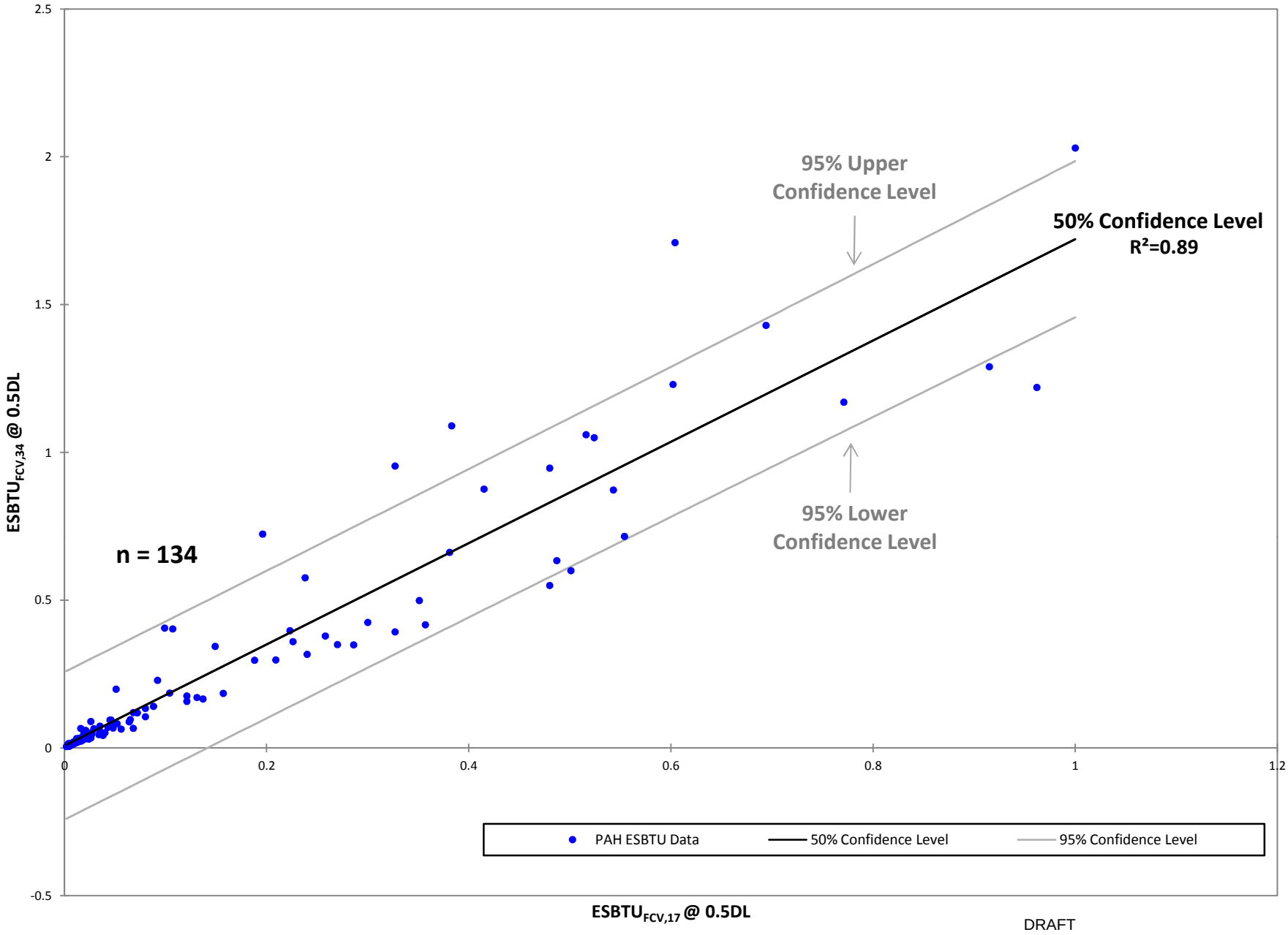
Sample Name	Sample Date	$ESBTU_{FCV,17}$	$ESBTU_{FCV,34}$	Estimated $ESBTU_{FCV,34}$ (calculated from $ESBTU_{FCV,17}$ site-specific correlation factor)
UC-55-4_4.0-4.5_03182011	3/18/2011	0.001	--	0.259
UC-56-1_0.0-0.5_03192011	3/19/2011	0.121	0.158	0.46
UC-56-2_1.0-1.5_03192011	3/19/2011	0.271	--	0.72
UC-56-3_3.0-3.5_03192011	3/19/2011	0.009	--	0.272
UC-56-4_3.9-4.4_03192011	3/19/2011	0.003	--	0.262
UC-57-1_0.0-0.5_03192011	3/19/2011	5	6.1	8.80
UC-57-2_0.5-1.0_03192011	3/19/2011	2.5	--	4.53
UC-57-3_1.5-2.0_03192011	3/19/2011	0.453	--	1.03
UC-57-4_2.0-2.5_03192011	3/19/2011	0.004	--	0.264
WM-58-1_0.0-0.5_03192011	3/19/2011	0.327	0.954	0.82
WM-58-2_0.5-1.0_03192011	3/19/2011	0.29	--	0.753
WM-58-3_1.0-1.5_03192011	3/19/2011	3.3	--	5.9
WM-58-4_2.0-2.5_03192011	3/19/2011	0.001	--	0.259
WM-59-1_0.0-0.5_03212011	3/21/2011	0.068	0.0667	0.37
WM-59-2_0.5-1.0_03212011	3/21/2011	0.94	--	1.86
WM-59-3_1.0-1.5_03212011	3/21/2011	0.009	--	0.272
WM-59-4_1.5-2.0_03212011	3/21/2011	0.002	--	0.26
WM-60-1_0.0-0.5_03212011	3/21/2011	0.012	0.0206	0.28
WM-60-2_0.5-1.0_03212011	3/21/2011	0.007	--	0.269
WM-60-3_1.0-1.4_03212011	3/21/2011	0.004	--	0.264
WM-61-1_0.0-0.5_03212011	3/21/2011	0.019	0.0505	0.29
WM-61-1_0.0-0.5_03212011_FD	3/21/2011	0.012	0.0323	0.28
WM-61-2_1.0-1.5_03212011	3/21/2011	0.006	--	0.267
WM-61-3_1.5-2.0_03212011	3/21/2011	0.014	--	0.281
WM-61-4_2.5-3.0_03212011	3/21/2011	0.011	--	0.276
WM-62-1_0.0-0.5_03212011	3/21/2011	0.015	0.0251	0.28
WM-62-2_0.5-1.0_03212011	3/21/2011	0.015	--	0.283
WM-62-3_1.0-1.5_03212011	3/21/2011	0.012	--	0.278
WM-62-4_1.5-2.0_03212011	3/21/2011	0.04	--	0.325
WM-63-1_0.0-0.5_03212011	3/21/2011	0.48	0.947	1.08
WM-63-2_0.5-1.0_03212011	3/21/2011	0.302	--	0.773
WM-63-3_1.0-1.5_03212011	3/21/2011	9.9	--	17.2
WM-63-4_1.8-2.2_03212011	3/21/2011	0.029	--	0.307
WM-64-1_0.0-0.5_03102011	3/10/2011	0.011	0.0185	0.28
WM-64-2_1.0-1.5_03102011	3/10/2011	0.107	0.403	0.44
WM-64-3_2.0-2.5_03102011	3/10/2011	9	12.1	15.64
WM-64-4_3.0-3.5_03102011	3/10/2011	0.004	0.00664	0.26
WM-65-1_0.0-0.5_03212011	3/21/2011	0.008	0.0163	0.27
WM-65-2_1.0-1.5_03212011	3/21/2011	0.132	--	0.483
WM-65-3_2.0-2.5_03212011	3/21/2011	7.5	--	13.1
WM-65-4_3.0-3.5_03212011	3/21/2011	0.006	--	0.267
WM-66-1_0.0-0.5_03222011	3/22/2011	0.006	0.0127	0.27
WM-66-2_1.0-1.5_03222011	3/22/2011	0.015	--	0.283
WM-66-2_1.0-1.5_03222011_FD	3/22/2011	0.009	--	0.272
WM-66-3_2.0-2.5_03222011	3/22/2011	13.2	--	22.8
WM-66-4_3.0-3.5_03222011	3/22/2011	0.011	--	0.276
WM-67-1_0.0-0.5_03222011	3/22/2011	0.007	0.0118	0.27
WM-67-2_1.0-1.5_03222011	3/22/2011	0.006	--	0.267
WM-67-3_2.5-3.0_03222011	3/22/2011	2.4	--	4.36
WM-67-4_3.1-3.5_03222011	3/22/2011	1.1	--	2.14
WM-68-1_0.0-0.5_03232011	3/23/2011	0.013	0.0215	0.28
WM-68-2_0.5-1.0_03232011	3/23/2011	0.007	--	0.269
WM-68-3_1.0-1.4_03232011	3/23/2011	0.005	--	0.266
WM-69-1_0.0-0.5_03232011	3/23/2011	0.008	0.014	0.27
WM-69-2_0.5-1.0_03232011	3/23/2011	0.02	--	0.291
WM-69-3_1.0-1.5_03232011	3/23/2011	0.759	--	1.55
WM-69-4_1.5-2.0_03232011	3/23/2011	0.374	--	0.896
WM-70-1_0.0-0.5_03232011	3/23/2011	0.01	0.0169	0.27
WM-70-2_2.0-2.5_03232011	3/23/2011	0.179	--	0.563
WM-70-2_2.0-2.5_03232011_FD	3/23/2011	0.121	--	0.464
WM-70-3_2.5-3.0_03232011	3/23/2011	7.4	--	12.9
WM-70-4_3.0-3.5_03232011	3/23/2011	0.041	--	0.327
WM-71-1_0.0-0.5_03232011	3/23/2011	0.045	0.0949	0.33
WM-71-2_1.0-1.5_03232011	3/23/2011	75.5	--	129
WM-71-3_2.0-2.5_03232011	3/23/2011	0.033	--	0.313
WM-71-4_3.0-3.5_03232011	3/23/2011	0.304	--	0.777
WM-72-1_0.0-0.5_03232011	3/23/2011	0.543	0.873	1.18
WM-72-2_1.0-1.5_03232011	3/23/2011	0.007	--	0.269
WM-72-3_2.0-2.5_03232011	3/23/2011	0.061	--	0.361
WM-72-4_3.0-3.5_03232011	3/23/2011	0.048	--	0.339
WM-73-1_0.0-0.5_03242011	3/24/2011	0.092	0.229	0.41
WM-73-2_0.5-1.0_03242011	3/24/2011	1.8	--	3.33

Table 3
$ESBTU_{FCV,17}$ and $ESBTU_{FCV,34}$
Spirit Lake Sediment Site
U.S. Steel Former Duluth Works

Sample Name	Sample Date	$ESBTU_{FCV,17}$	$ESBTU_{FCV,34}$	Estimated $ESBTU_{FCV,34}$ (calculated from $ESBTU_{FCV,17}$ site-specific correlation factor)
WM-73-3_1.0-1.5_03242011	3/24/2011	0.057	--	0.354
WM-73-4_1.5-2.0_03242011	3/24/2011	0.006	--	0.267
WM-74-1_0.0-0.5_03242011	3/24/2011	0.016	0.0259	0.28
WM-74-2_2.5-3.0_03242011	3/24/2011	0.048	--	0.339
WM-74-3_3.0-3.5_03242011	3/24/2011	9.1	--	15.8
WM-74-4_4.0-4.5_03242011	3/24/2011	0.065	--	0.368
UC-75-1_0.0-0.5_06082011	6/8/2011	15	16.9	25.89
UC-75-2_0.5-1.0_06082011	6/8/2011	24.3	27.3	41.79
UC-75-3_1.0-1.5_06082011	6/8/2011	4.1	4.73	7.26
UC-75-4_1.5-2.0_06082011	6/8/2011	1.6	1.82	2.99
UC-76-1_0.0-0.5_06082011	6/8/2011	5.2	6.13	9.14
UC-76-2_0.5-1.0_06082011	6/8/2011	1.5	--	2.82
UC-76-3_1.0-1.5_06082011	6/8/2011	0.494	--	1.1
UC-77-1_0.0-0.5_06092011	6/9/2011	1.3	1.45	2.48
UC-77-2_0.5-1.0_06092011	6/9/2011	0.157	0.185	0.53
UC-77-3_1.0-1.5_06092011	6/9/2011	9.7	10.8	16.83
UC-78-1_0.0-0.5_06092011	6/9/2011	1.6	1.91	2.99
UC-78-2_0.5-1.0_06092011	6/9/2011	2.9	--	5.21
UC-78-3_1.0-1.7_06092011	6/9/2011	3.8	--	6.75
UC-79-1_0.0-0.5_06092011	6/9/2011	7	7.82	12.22
UC-79-2_0.5-1.0_06092011	6/9/2011	1.7	--	3.16
UC-80-1_0.0-0.5_06102011	6/10/2011	7.3	8.37	12.73
UC-80-1_0.0-0.5_06102011_FD	6/10/2011	8.6	--	15
UC-80-2_0.5-1.3_06102011	6/10/2011	2.2	--	4.02
UC-81-1_0.0-0.5_06102011	6/10/2011	5.1	5.91	8.97
UC-81-2_0.5-1.0_06102011	6/10/2011	41.3	44.7	70.84
UC-81-3_1.0-1.5_06102011	6/10/2011	26.5	28.6	45.55
UC-82-1_0.0-0.5_06102011	6/10/2011	43.3	47.1	74.26
UC-82-2_1.0-1.5_06102011	6/10/2011	123	--	210
UC-82-3_2.0-2.5_06102011	6/10/2011	1.6	--	2.99
UC-82-4_2.9-3.4_06102011	6/10/2011	22.7	--	39.1
UC-83-1_0.0-0.5_06132011	6/13/2011	5.8	6.48	10.17
UC-83-2_0.5-1.0_06132011	6/13/2011	4.4	--	7.78
UC-83-3_1.0-1.5_06132011	6/13/2011	1.9	--	3.5
UC-83-4_2.0-2.5_06132011	6/13/2011	4.8	--	8.46
WM-84-1_0.0-0.5_06132011	6/13/2011	1.8	4.07	3.33
WM-84-2_0.5-1.0_06132011	6/13/2011	5.9	7.93	10.34
WM-84-2_0.5-1.0_06132011_FD	6/13/2011	11.8	16.1	20.42
WM-84-3_1.0-1.5_06132011	6/13/2011	30.4	36.3	52.21
WM-85-1_0.0-0.5_06132011	6/13/2011	0.027	0.052	0.30
WM-85-2_1.0-1.5_06132011	6/13/2011	0.002	--	0.26
WM-85-3_2.0-2.5_06132011	6/13/2011	0.004	--	0.264
WM-85-4_2.9-3.4_06132011	6/13/2011	0.013	--	0.279
WM-86-1_0.0-0.5_06152011	6/15/2011	1.3	1.66	2.48
WM-86-2_0.5-1.0_06152011	6/15/2011	0.005	--	0.266
WM-86-3_1.0-1.5_06152011	6/15/2011	0.001	--	0.259
WM-87-1_0.0-0.5_06152011	6/15/2011	0.004	0.00724	0.26
WM-87-2_0.5-1.0_06152011	6/15/2011	0.002	--	0.26
WM-88-1_0.0-0.5_11152011	11/15/2011	0.005	0.00784	0.27
WM-88-2_2.0-2.5_11152011	11/15/2011	0.014	0.0315	0.28
WM-88-2_2.0-2.5_11152011_FD	11/15/2011	0.021	0.0596	0.29
WM-88-3_3.25-3.75_11152011	11/15/2011	0.258	0.379	0.70
WM-88-4_4.0-4.5_11152011	11/15/2011	0.121	0.176	0.46
WM-89-1_0.0-0.5_11152011	11/15/2011	0.004	0.0059	0.26
WM-89-2_2.0-2.5_11152011	11/15/2011	0.016	--	0.284
WM-89-3_3.5-4.0_11152011	11/15/2011	0.637	--	1.35
WM-89-4_5.0-5.5_11152011	11/15/2011	0.002	--	0.26
UC-90-1_0.0-0.5_11162011	11/16/2011	0.024	0.0304	0.30
UC-90-2_0.5-1.0_11162011	11/16/2011	0.026	0.0343	0.30
UC-90-3_2.0-2.5_11162011	11/16/2011	0.005	0.0127	0.27
UC-90-4_3.0-3.5_11162011	11/16/2011	0.003	0.011	0.26
UC-91-1_0.0-0.5_11162011	11/16/2011	0.005	0.00704	0.27
UC-91-2_2.5-3.0_11162011	11/16/2011	0.086	--	0.404
UC-91-3_4.0-4.5_11162011	11/16/2011	0.637	--	1.35
UC-91-4_5.0-5.5_11162011	11/16/2011	0.022	--	0.295
UC-96-1_0.0-0.5_11012011	11/1/2011	2.4	2.76	4.36
UC-96-2_5.0-7.5_11022011	11/2/2011	40.3	--	69.1
UC-96-3_7.5-10.0_11022011	11/2/2011	2.5	--	4.53
UC-96-4_10.0-12.5_11022011	11/2/2011	0.247	--	0.679
UC-97-1_0.0-2.5_11022011	11/2/2011	26.7	29.5	45.89
UC-97-2_5.0-7.5_11022011	11/2/2011	6.8	7.94	11.88
UC-97-3_7.5-10.0_11022011	11/2/2011	0.357	0.417	0.87

Table 3
$ESBTU_{FCV,17}$ and $ESBTU_{FCV,34}$
Spirit Lake Sediment Site
U.S. Steel Former Duluth Works

Sample Name	Sample Date	$ESBTU_{FCV,17}$	$ESBTU_{FCV,34}$	Estimated $ESBTU_{FCV,34}$ (calculated from $ESBTU_{FCV,17}$ site-specific correlation factor)
UC-97-4_15.0-17.5_11022011	11/2/2011	0.035	0.0743	0.32
WM-101-1_0.0-1.0_11162011	11/16/2011	0.051	0.199	0.34
WM-101-2_5.0-7.5_11162011	11/16/2011	0.026	0.0899	0.30
WM-101-3_15.0-17.5_11162011	11/16/2011	0.004	0.00746	0.26
WM-101-4_20.0-22.5_11162011	11/16/2011	0.003	0.00574	0.26
WM-102-1_0.0-2.5_11162011	11/16/2011	0.034	0.0454	0.32
WM-102-2_2.5-5.0_11162011	11/16/2011	0.539	--	1.18
WM-102-2_2.5-5.0_11162011_FD	11/16/2011	0.056	--	0.353
WM-102-3_15.0-17.5_11162011	11/16/2011	0.086	--	0.404
WM-102-3_15.0-17.5_11162011_FD	11/16/2011	0.03	--	0.308
WM-102-4_27.5-30.0_11162011	11/16/2011	0.11	--	0.445



DRAFT

Figure 1
Regression of $ESBTU_{FCV,34}$ @ 0.5DL versus $ESBTU_{FCV,17}$ @ 0.5DL
Spirit Lake Sediment Site
U.S. Steel
Former Duluth Works

P:\Duluth\23 MN\69\23691125 St Louis River Duluth Works Sediment\WorkFiles\D_Computations\ESBPAH17WITHchart.xlsm
Fig 1_95% CL <1

Example calculations used for the Spirit Lake Sediment Site, Former U.S. Steel Duluth Works

** Notes: 1). The calculations were performed on raw database files and therefore use a combination of output fields to perform the calculations. Each worksheet within this workbook provides a summary and example of the data sets for sample UC-23-2_1.5-2.0_03022011.
An excerpt from the final data summary presenting the Toxicity Screening Values is shown below.

Table 13
Sediment Toxicity Screening Calculation Summary
Spirit Lake Sediment Site
U.S. Steel Former Duluth Works Site

				MPCA Guidance				EPA Guidance		Carbon Ratio
				PEC-Q Total PAH13 @0.5DL	Mean PEC-Q Metals	PEC-Q PCBs @ 0DL	Mean PEC-Q Total	ESB Tufcv PAH34 @ 0.5DL	ESB Metals (umol/g oc)	Black Carbon/TOC (%)
Sys Sample Code	Sample Date	Analysis Location	Sample Type Code							
UC-23-1_0.0-0.5_03022011	03/02/2011	LB	N	1.25	0.22	0	0.49	2.03	-247	29.1
UC-23-2_1.5-2.0_03022011	03/02/2011	LB	N	5.18	0.66	0.02	1.95	7.33	-26.7	44.8
UC-23-3_2.5-3.0_03022011	03/02/2011	LB	N	0.953	0.93	0	0.63	1.43	-50.7	42.2
UC-23-4_3.75-4.25_03022011	03/02/2011	LB	N	0.0128	0.11	0	0.04	0.119	-157	29.4

2). With the exception of PCBs and DioxinFurans, all calculations used non-detect (censored values) scaled to 0.5 of the laboratory reporting limit.
In the example below, notice that the detect_flag is "N" and the report result limit is 0.0078; but the report result value field (scaled to 1/2 @ 0.0039) was used.

sys_sample_code	sample_date	sample_type_code	start_depth	end_depth	depth_unit	matrix_code	cas_rn	chemical_name	report_result_text	report_result_value	report_result_unit	report_result_limit	reportable_result	detect_flag
UC-90-1_0.0-0.5_11162011	11/16/2011	N	0	0.5	ft	SD	83-32-9	Acenaphthene	< 0.0039	0.0039	mg/kg	0.0078	Yes	N
UC-90-1_0.0-0.5_11162011	11/16/2011	N	0	0.5	ft	SD	208-96-8	Acenaphthylene	0.015	0.015	mg/kg	0.0078	Yes	Y
UC-90-1_0.0-0.5_11162011	11/16/2011	N	0	0.5	ft	SD	120-12-7	Anthracene	0.018	0.018	mg/kg	0.0078	Yes	Y
UC-90-1_0.0-0.5_11162011	11/16/2011	N	0	0.5	ft	SD	56-55-3	Benzo(a)anthracene	0.06	0.06	mg/kg	0.0078	Yes	Y
UC-90-1_0.0-0.5_11162011	11/16/2011	N	0	0.5	ft	SD	50-32-8	Benzo(a)pyrene	0.072	0.072	mg/kg	0.0078	Yes	Y
UC-90-1_0.0-0.5_11162011	11/16/2011	N	0	0.5	ft	SD	218-01-9	Chrysene	0.062	0.062	mg/kg	0.0078	Yes	Y
UC-90-1_0.0-0.5_11162011	11/16/2011	N	0	0.5	ft	SD	206-44-0	Fluoranthene	0.075	0.075	mg/kg	0.016	Yes	Y
UC-90-1_0.0-0.5_11162011	11/16/2011	N	0	0.5	ft	SD	86-73-7	Fluorene	0.0094	0.0094	mg/kg	0.0078	Yes	Y
UC-90-1_0.0-0.5_11162011	11/16/2011	N	0	0.5	ft	SD	91-20-3	Naphthalene	0.13	0.13	mg/kg	0.0078	Yes	Y
UC-90-1_0.0-0.5_11162011	11/16/2011	N	0	0.5	ft	SD	85-01-8	Phenanthrene	0.028	0.028	mg/kg	0.0078	Yes	Y
UC-90-1_0.0-0.5_11162011	11/16/2011	N	0	0.5	ft	SD	129-00-0	Pyrene	0.076	0.076	mg/kg	0.0078	Yes	Y
UC-90-1_0.0-0.5_11162011	11/16/2011	N	0	0.5	ft	SD	91-57-6	2-Methylnaphthalene	0.0095	0.0095	mg/kg	0.0078	Yes	Y
UC-90-1_0.0-0.5_11162011	11/16/2011	N	0	0.5	ft	SD	53-70-3	Dibenz(a,h)anthracene	0.014	0.014	mg/kg	0.0078	Yes	Y

All concentrations expressed as mg/kg except for the dioxin/furan data. Formulas are shown below and on each individual worksheet.

$$Mean\ PEC-Q\ Metals = \frac{\sum Individual\ Metal\ Concentration / Level\ II\ SQT\ Value}{8(n\ of\ metals\ analyzed\ per\ guidance)}$$

$$Mean\ PEC-Q\ PAHs_{13} = \frac{\sum PAHs_{13}}{Level\ II\ SQT\ Value\ (23)}$$

$$Mean\ PEC-Q\ PCBs = \frac{\sum PCBs}{Level\ II\ SQT\ Value\ (0.68)}$$

$$USEPA\ ESB_{34}\ Tu\ FCV = \sum \frac{Individual\ PAH / TOC}{ESB\ FCV\ Value} * 1{,}000{,}000\ (Unit\ Corr\ Factor)$$

$$USEPA\ ESB\ (AVS)\ Metals = \frac{\sum \left(Each\ Metal\ Concentration / Molecular\ Wt.\right) - \left(Sulfide\ Concentration / Molecular\ Wt.\right)}{TOC\ (as\ decimal)}$$

**TOC For ESB calculations samples with a TOC value >12% were calculated using the substituted 12% equivalent. Samples below 0.2% TOC were removed from the dataset.

$$TEQ_{DF}\ WHO_{XX} = \sum (Individual\ Congener\ * TEF_{DF})$$

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Example Calculations
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action_level_code	action_level	action_level_unit	sys_sample_code	sample_date	sample_type_code	start_depth	end_depth	depth_unit	matrix_code	cas_rn	chemical_name	report_result_text	report_result_value	report_result_unit	report_result_limit	reportable_result	detect_flag	interpreted_qualifiers	validated_yn	Result/SQT	Example:
MN_SED_MPCA_LVL2_SQT	0.089	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	83-32-9	Acenaphthene	1.3	1.3	mg/kg	0.38	Y	Y		Y	14.6067416	
MN_SED_MPCA_LVL2_SQT	0.13	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	208-96-8	Acenaphthylene	1.5	1.5	mg/kg	0.38	Y	Y		Y	11.5384615	
MN_SED_MPCA_LVL2_SQT	0.85	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	120-12-7	Anthracene	8.5	8.5	mg/kg	3.8	Y	Y		Y	10	
MN_SED_MPCA_LVL2_SQT	1.1	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	56-55-3	Benzo(a)anthracene	13	13	mg/kg	3.8	Y	Y		Y	11.8181818	
MN_SED_MPCA_LVL2_SQT	1.5	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	50-32-8	Benzo(a)pyrene	5.5	5.5	mg/kg	0.38	Y	Y		Y	3.66666667	5.18217391
MN_SED_MPCA_LVL2_SQT	1.3	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	218-01-9	Chrysene	12	12	mg/kg	3.8	Y	Y		Y	9.23076923	
MN_SED_MPCA_LVL2_SQT	2.2	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	206-44-0	Fluoranthene	29	29	mg/kg	3.8	Y	Y		Y	13.1818182	
MN_SED_MPCA_LVL2_SQT	0.54	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	86-73-7	Fluorene	3.7	3.7	mg/kg	0.38	Y	Y		Y	6.85185185	
MN_SED_MPCA_LVL2_SQT	0.56	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	91-20-3	Naphthalene	1.2	1.2	mg/kg	0.38	Y	Y		Y	2.14285714	
MN_SED_MPCA_LVL2_SQT	1.2	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	85-01-8	Phenanthrene	21	21	mg/kg	3.8	Y	Y		Y	17.5	
MN_SED_MPCA_LVL2_SQT	1.5	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	129-00-0	Pyrene	20	20	mg/kg	3.8	Y	Y		Y	13.3333333	
MN_SED_MPCA_LVL2_SQT	0.20	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	91-57-6	2-Methylnaphthalene	0.49	0.49	mg/kg	0.38	Y	Y		Y	2.45	
MN_SED_MPCA_LVL2_SQT	0.14	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	53-70-3	Dibenz(a,h)anthracene	2	2	mg/kg	0.38	Y	Y		Y	14.2857143	
		mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	TOC	Carbon, total organic	53800	53800	mg/kg	1000	Yes	Y		Y		
		mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	CBTOCRATIO	Ratio of Carbon Black/TOC		44.795539	%		Yes	Y		Y		
		mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	1333-86-4	Carbon, black	24100	24100	mg/kg	1000	Yes	Y	h	Y		
		mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	SUM1PAH13_	Sum [PEC] PAH13 @ 0.5DL		119.190002	mg/kg		Yes	Y		Y		
MN_SED_MPCA_LVL2_SQT	23	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	PECQPAH13_	PEC-QPAH13 @0.5DL		5.18217373	qu		Yes	Y		Y		

$$Mean\ PEC-Q\,PAHs_{13}=\frac{\sum PAHs_{13}}{Level\ II\,SQT\ Value\,(23)}$$

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action_level_code	action_level	action_level_unit	sys_sample_code	sample_date	sample_type_code	start_depth	end_depth	depth_unit	matrix_code	cas_rn	chemical_name	report_result_text	report_result_value	report_result_unit	report_result_limit	reportable_result	detect_flag	interpreted_qualifiers	reporting_detection_limit	detection_limit_unit	validated_yn	RL > SQT	Result / Level II SQT	Example:
MN_SED_MPCA_LVL2_SQT	33	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	7440-38-2	Arsenic	10	10	mg/kg	1.6	Y	Y		1.6	mg/kg	Y	NO	0.303	
MN_SED_MPCA_LVL2_SQT	110	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	7440-47-3	Chromium	25.6	25.6	mg/kg	1.6	Y	Y		1.6	mg/kg	Y	NO	0.233	
MN_SED_MPCA_LVL2_SQT	1.1	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	7439-97-6	Mercury	0.38	0.38	mg/kg	0.16	Y	Y		0.16	mg/kg	Y	NO	0.345	
MN_SED_MPCA_LVL2_SQT	5	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	7440-43-9	Cadmium	1.8	1.8	mg/kg	0.81	Y	Y		0.81	mg/kg	Y	NO	0.36	0.663625
MN_SED_MPCA_LVL2_SQT	150	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	7440-50-8	Copper	47.6	47.6	mg/kg	4	Y	Y		4	mg/kg	Y	NO	0.317	
MN_SED_MPCA_LVL2_SQT	130	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	7439-92-1	Lead	222	222	mg/kg	1.6	Y	Y		1.6	mg/kg	Y	NO	1.708	
MN_SED_MPCA_LVL2_SQT	49	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	7440-02-0	Nickel	19.6	19.6	mg/kg	6.5	Y	Y		6.5	mg/kg	Y	NO	0.4	
MN_SED_MPCA_LVL2_SQT	460	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	7440-66-6	Zinc	756	756	mg/kg	9.7	Y	Y		9.7	mg/kg	Y	NO	1.643	
MN_SED_MPCA_LVL2_SQT	460	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	PECQMETi	PEC-Qmeti		0.66	mg/kg			Y	Y		mg/kg	Y	NO	0	

$$Mean\ PEC-Q\ Metals = \frac{\sum Individual\ Metal\ Concentration \Big/ Level\ II\ SQT\ Value}{8(n\ of\ metals\ analyzed\ per\ guidance)}$$

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action_level_code	action_level	action_level_unit	sys_sample_code	sample_date	sample_type_code	start_depth	end_depth	depth_unit	matrix_code	cas_rn	chemical_name	report_result_text	report_result_value	report_result_unit	report_result_limit	reportable_result	detect_flag	interpreted_qualifiers	validated_yn	Example:
		mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	12674-11-2	Aroclor 1016	0	0	mg/kg	0.073	Y	N		Y	
		mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	11104-28-2	Aroclor 1221	0	0	mg/kg	0.073	Y	N		Y	
		mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	11141-16-5	Aroclor 1232	0	0	mg/kg	0.073	Y	N		Y	0.014
		mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	53469-21-9	Aroclor 1242	0.014	0.014	mg/kg	0.073	Y	Y	j	Y	0.02058824
		mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	12672-29-6	Aroclor 1248	0	0	mg/kg	0.073	Y	N		Y	
		mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	11097-69-1	Aroclor 1254	0	0	mg/kg	0.073	Y	N		Y	
		mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	11096-82-5	Aroclor 1260	0	0	mg/kg	0.073	Y	N		Y	
		mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	37324-23-5	Aroclor 1262	0	0	mg/kg	0.073	Y	N		Y	
		mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	11100-14-4	Aroclor 1268	0	0	mg/kg	0.073	Y	N		Y	
MN_SED_MPCA_LVL2_	0.68	mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	SUMPCB	Sum of PCBs		0.01	mg/kg		Y	Y		Y	
		mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	PECQPCBi	PEC-Qpcbi		0.02	mg/kg		Y	Y		Y	

$$Mean\ PEC-Q\ PCBs = \frac{\sum PCBs}{Level\ II\ SQT\ Value\ (0.68)}$$

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action_level_code	action_level	action_level_unit	sys_sample_code	sample_date	sample_type_code	start_depth	end_depth	depth_unit	matrix_code	cas_rn	chemical_name	report_result_text	report_result_value	report_result_unit	report_result_limit	reportable_result	detect_flag	interpreted_qualifiers	validated_yn	Any values > ESB_MAX?	Result / TOC / FCV * unit corr.	TOC mg/kg	Example:
EPA_SD_ESB_FCVI	491	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	83-32-9	Acenaphthene	1.3	1.3	mg/kg	0.38	Y	Y		Y	No	0.049212971	53800	
EPA_SD_ESB_FCVI	452	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	208-96-8	Acenaphthylene	1.5	1.5	mg/kg	0.38	Y	Y		Y	No	0.061683719	53800	
EPA_SD_ESB_FCVI	594	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	120-12-7	Anthracene	8.5	8.5	mg/kg	3.8	Y	Y		Y	No	0.265980749	53800	
EPA_SD_ESB_FCVI	841	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	56-55-3	Benzo(a)anthracene	13	13	mg/kg	3.8	Y	Y		Y	No	0.287319486	53800	
EPA_SD_ESB_FCVI	965	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	50-32-8	Benzo(a)pyrene	5.5	5.5	mg/kg	0.38	Y	Y		Y	No	0.105938325	53800	ESB34 TuFCV
EPA_SD_ESB_FCVI	979	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	205-99-2	Benzo(b)fluoranthene	8	8	mg/kg	3.8	Y	Y		Y	No	0.151888544	53800	7.333963869
EPA_SD_ESB_FCVI	981	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	207-08-9	Benzo(k)fluoranthene	5.4	5.4	mg/kg	0.38	Y	Y		Y	No	0.102315746	53800	
EPA_SD_ESB_FCVI	844	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	218-01-9	Chrysene	12	12	mg/kg	3.8	Y	Y		Y	No	0.264275269	53800	
EPA_SD_ESB_FCVI	707	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	206-44-0	Fluoranthene	29	29	mg/kg	3.8	Y	Y		Y	No	0.76242356	53800	
EPA_SD_ESB_FCVI	538	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	86-73-7	Fluorene	3.7	3.7	mg/kg	0.38	Y	Y		Y	No	0.12783129	53800	Sum ESB34
EPA_SD_ESB_FCVI	385	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	91-20-3	Naphthalene	1.2	1.2	mg/kg	0.38	Y	Y		Y	No	0.05793463	53800	317.688
EPA_SD_ESB_FCVI	596	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	85-01-8	Phenanthrene	21	21	mg/kg	3.8	Y	Y		Y	No	0.654923779	53800	
EPA_SD_ESB_FCVI	697	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	129-00-0	Pyrene	20	20	mg/kg	3.8	Y	Y		Y	No	0.533353245	53800	
		mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	TOC	Carbon, total organic	53800	53800	mg/kg	1000	Yes	Y		Y	No		53800	Sum ESB13
		mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	1333-86-4	Carbon, black	24100	24100	mg/kg	1000	Yes	Y	h	Y	No		53800	130.1
		mg/kg	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	CBTOCRATIO	Ratio of Carbon Black/TOC		45	%		Yes	Y		Y	No		53800	
EPA_SD_ESB_FCVI	1095	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	191-24-2	Benzo(g,h,i)perylene	5.5	5.5	mg/kg	0.38	Y	Y		Y	No	0.093361172	53800	
EPA_SD_ESB_FCVI	1123	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	53-70-3	Dibenz(a,h)anthracene	2	2	mg/kg	0.38	Y	Y		Y	No	0.033103046	53800	Ratio 13 to 34
EPA_SD_ESB_FCVI	1115	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	193-39-5	Indeno(1,2,3-cd)pyrene	5.6	5.6	mg/kg	0.38	Y	Y		Y	No	0.09335356	53800	40.95213256
EPA_SD_ESB_FCVI	967	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	192-97-2	Benzo(e)pyrene	56	56	mg/kg	15	Y	Y		Y	No	1.07641385	53800	
EPA_SD_ESB_FCVI	967	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	198-55-0	Perylene	41	41	mg/kg	15	Y	Y		Y	No	0.788088712	53800	
EPA_SD_ESB_FCVI	447	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	91-57-6	2-Methylnaphthalene	0.49	0.49	mg/kg	0.38	Y	Y		Y	No	0.020375406	53800	Ratio BC/TOC
EPA_SD_ESB_FCVI	446	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	90-12-0	1-Methylnaphthalene	0.57	0.57	mg/kg	0.15	Y	Y		Y	No	0.023755147	53800	44.79553903
EPA_SD_ESB_FCVI	929	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	C1CHRYS	C1-Chrysenes	12	12	mg/kg	0.0073	Y	Y	X	Y	No	0.240095078	53800	
EPA_SD_ESB_FCVI	770	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	C1FLPY	C1-Fluoranthenes/Pyrenes	34	34	mg/kg	0.0073	Y	Y	X	Y	No	0.820740598	53800	
EPA_SD_ESB_FCVI	611	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	C1FLUOR	C1-Fluorenes	1.3	1.3	mg/kg	0.0073	Y	Y	X	Y	No	0.039547576	53800	
EPA_SD_ESB_FCVI	444	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	C1NAPH	C1-Naphthalenes	0.96	0.96	mg/kg	0.0073	Y	Y	X	Y	No	0.040188888	53800	
EPA_SD_ESB_FCVI	670	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	C1PHAN	C1-Phenanthrenes/Anthracenes	8.5	8.5	mg/kg	0.0073	Y	Y	X	Y	No	0.235809799	53800	
EPA_SD_ESB_FCVI	1008	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	C2CHRYS	C2-Chrysenes	7.4	7.4	mg/kg	0.0073	Y	Y	X	Y	No	0.13645483	53800	
EPA_SD_ESB_FCVI	686	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	C2FLUOR	C2-Fluorenes	0.21	0.21	mg/kg	0.0073	Y	Y	X	Y	No	0.005690008	53800	
EPA_SD_ESB_FCVI	510	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	C2NAPH	C2-Naphthalenes	1.4	1.4	mg/kg	0.0073	Y	Y	X	Y	No	0.051024127	53800	
EPA_SD_ESB_FCVI	746	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	C2PHAN	C2-Phenanthrenes/Anthracenes	3.7	3.7	mg/kg	0.0073	Y	Y	X	Y	No	0.092189322	53800	
EPA_SD_ESB_FCVI	1112	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	C3CHRYS	C3-Chrysenes	3.6	3.6	mg/kg	0.0073	Y	Y	X	Y	No	0.060174908	53800	
EPA_SD_ESB_FCVI	581	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	C3NAPH	C3-Naphthalenes	1.1	1.1	mg/kg	0.0073	Y	Y	X	Y	No	0.035191216	53800	
EPA_SD_ESB_FCVI	829	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	C3PHAN	C3-Phenanthrenes/Anthracenes	2.1	2.1	mg/kg	0.0073	Y	Y	X	Y	No	0.047084991	53800	
EPA_SD_ESB_FCVI	1214	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	C4CHRYS	C4-Chrysenes	1	1	mg/kg	0.0073	Y	Y	X	Y	No	0.015310841	53800	
EPA_SD_ESB_FCVI	657	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	C4NAPH	C4-Napthalenes	0.051	0.051	mg/kg	0.0073	Y	Y	X	Y	No	0.001442854	53800	
EPA_SD_ESB_FCVI	913	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	C4PHAN	C4-Phenanthrenes/Anthracenes	0.11	0.11	mg/kg	0.0073	Y	Y	X	Y	No	0.002239441	53800	
EPA_SD_ESB_FCVI	913	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	RATIOESB13	Ratio of 13 to 34 ESBPAHs		40.9521332	%		Y	Y		Y	No	0.002239441	53800	
EPA_SD_ESB_FCVI	913	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	ESBTUFCV34	Sum EPA-ESBTUfcv34		7.33396387	qu		Y	Y	a	Y	No	0.002239441	53800	
EPA_SD_ESB_FCVI	913	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	SUMESBPAH	Sum of ESBPAH13		130.100006	mg/kg		Y	Y		Y	No	0.002239441	53800	
EPA_SD_ESB_FCVI	913	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	SUMESBPAH	Sum of ESBPAH34		317.687988	mg/kg		Y	Y		Y	No	0.002239441	53800	
EPA_SD_ESB_MAXI	33400	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	83-32-9	Acenaphthene	1.3	1.3	mg/kg	0.38	Y	Y		Y			53800	
EPA_SD_ESB_MAXI	24000	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	208-96-8	Acenaphthylene	1.5	1.5	mg/kg	0.38	Y	Y		Y			53800	
EPA_SD_ESB_MAXI	1300	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	120-12-7	Anthracene	8.5	8.5	mg/kg	3.8	Y	Y		Y			53800	
EPA_SD_ESB_MAXI	4153	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	56-55-3	Benzo(a)anthracene	13	13	mg/kg	3.8	Y	Y		Y			53800	
EPA_SD_ESB_MAXI	3840	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	50-32-8	Benzo(a)pyrene	5.5	5.5	mg/kg	0.38	Y	Y		Y			53800	
EPA_SD_ESB_MAXI	2169	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	205-99-2	Benzo(b)fluoranthene	8	8	mg/kg	3.8	Y	Y		Y			53800	
EPA_SD_ESB_MAXI	1220	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	207-08-9	Benzo(k)fluoranthene	5.4	5.4	mg/kg	0.38	Y	Y		Y			53800	
EPA_SD_ESB_MAXI	826	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	218-01-9	Chrysene	12	12	mg/kg	3.8	Y	Y		Y			53800	
EPA_SD_ESB_MAXI	23870	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	206-44-0	Fluoranthene	29	29	mg/kg	3.8	Y	Y		Y			53800	
EPA_SD_ESB_MAXI	26000	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	86-73-7	Fluorene	3.7	3.7	mg/kg	0.38	Y	Y		Y			53800	
EPA_SD_ESB_MAXI	61700	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	91-20-3	Naphthalene	1.2	1.2	mg/kg	0.38	Y	Y		Y			53800	
EPA_SD_ESB_MAXI	34300	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	85-01-8	Phenanthrene	21	21	mg/kg	3.8	Y	Y		Y			53800	
EPA_SD_ESB_MAXI	9090	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	129-00-0	Pyrene	20	20	mg/kg	3.8	Y	Y		Y			53800	
EPA_SD_ESB_MAXI	648	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	191-24-2	Benzo(g,h,i)perylene	5.5	5.5	mg/kg	0.38	Y	Y		Y			53800	
EPA_SD_ESB_MAXI	2389	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	53-70-3	Dibenz(a,h)anthracene	2	2	mg/kg	0.38	Y	Y		Y			53800	
EPA_SD_ESB_MAXI	4300	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	192-97-2	Benzo(e)pyrene	56	56	mg/kg	15	Y	Y		Y			53800	
EPA_SD_ESB_MAXI	431	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	198-55-0	Perylene	41	41	mg/kg	15	Y	Y		Y			53800	
EPA_SD_ESB_MAXI	154800	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	91-57-6	2-Methylnaphthalene	0.49	0.49	mg/kg	0.38	Y	Y		Y			53800	
EPA_SD_ESB_MAXI	165700	ug/g oc	UC-23-2_1.5-2.0_03022011	3/2/2011	N	1.5	2	ft	SD	90-12-0	1-Methylnaphthalene	0.57	0.57	mg/kg	0.15	Y	Y		Y			53800	

**** These methylnapthalenes are excluded from the calculation due to the presence of the C1,C2,C3 and C4 naphthalene homologue groups.

** This green shading highlights data that were used to evaluate whether the site data exceeds the MAXi value prior to calculations using the FCVi and are informational only.

Note: In cases where the TOC >12% a substituted value equivalent to 12% TOC (120000 mg/kg) was used for this calculation.

$$USEPA\ ESB_{34}\ Tu\ FCV = \sum \frac{Individual\ \ PAH \Big/ TOC}{ESB\ FCV\ Value} * 1{,}000{,}000\ (Unit\ \ Corr\ \ Factor)$$

U.S. Steel -
RI Report Appendix B
Example Calculations
Barr Engineering Company

sys_sample_code	cas_rn	chemical_name	report_result_text	report_result_value	report_result_unit	report_result_limit	reportable_result	detect_flag	interpreted_qualifiers	validated_yn	TOC %	Result / Molecular Wt.	Example:	Molecular Wt.
UC-23-2_1.5-2.0_03022011	SAV	Sulfide, Acid-Volatile	187	187	mg/kg	35.1	Yes	Y		Y	0.0538	5.82554545	5.82554517	32.1
UC-23-2_1.5-2.0_03022011	7440-43-9	Cadmium	0.65	0.65	mg/kg	0.31	Yes	Y		Y	0.0538	0.00578292		112.4
UC-23-2_1.5-2.0_03022011	7440-50-8	Copper	8.7	8.7	mg/kg	13.6	Yes	Y	j	Y	0.0538	0.13700787	4.38737038	63.5
UC-23-2_1.5-2.0_03022011	7439-92-1	Lead	111	111	mg/kg	5.5	Yes	Y		Y	0.0538	0.53571429	-1.4381748	207.2
UC-23-2_1.5-2.0_03022011	7440-02-0	Nickel	1.4	1.4	mg/kg	21.9	Yes	Y	j	Y	0.0538	0.02385008	-26.7318727	58.7
UC-23-2_1.5-2.0_03022011	7440-66-6	Zinc	241	241	mg/kg	11.0	Yes	Y		Y	0.0538	3.6850152		65.4
UC-23-2_1.5-2.0_03022011	TOC	Carbon, total organic	53800	53800	mg/kg	1000	Yes	Y		Y	0.0538			
UC-23-2_1.5-2.0_03022011	ESBAVSSEM	Sum [ESB] AVS-SEM/foc		-26.7318783	mg/kg		Yes	Y		Y	0.0538	0		

$$USEPA\ ESB(AVS)\ Metals = \frac{\sum\left(Each\ Metal\ Concentration \Big/ Molecular\ Wt.\right) - \left(Sulfide\ Concentration \Big/ Molecular\ Wt.\right)}{TOC\ (as\ decimal)}$$

U.S. Steel -
RI Report Appendix B
Example Calculations
Barr Engineering Company

NG/KG	UC-23-2_1.5-2.0_03022011	Toxicity Equivalency Factors WHO05$_q$ [HH]	UC-23-2_1.5-2.0_03022011 ND = 1/2 EDL	UC-23-2_1.5-2.0_03022011 ND = 0
TCDD EQUIV CALCS				
2,3,7,8-TCDD	6.41 j ng/kg		**6.41**	**6.41**
1,2,3,7,8-Dioxin penta	< 10.50 ng/kg		**5.25**	**0**
1,2,3,4,7,8-Dioxin, hexa	< 6.41 ng/kg		**3.205**	**0**
1,2,3,6,7,8-Dioxin, hexa	33.8 j ng/kg		**33.8**	**33.8**
1,2,3,7,8,9-Dioxin, hexa	14.1 j ng/kg		**14.1**	**14.1**
1,2,3,4,6,7,8-Dioxin, hepta	715 ng/kg		**715**	**715**
Dioxin octa	7210 ng/kg		**7210**	**7210**
2,3,7,8-TCDF	< 16.40 j ng/kg		**8.2**	**0**
1,2,3,7,8-Dibenzofuran, penta	< 3.74 ng/kg		**1.87**	**0**
2,3,4,7,8-Dibenzofuran, penta	< 6.12 j ng/kg		**3.06**	**0**
1,2,3,4,7,8-Dibenzofuran, hexa	5.54 j ng/kg		**5.54**	**5.54**
1,2,3,6,7,8-Dibenzofuran, hexa	6.87 j ng/kg		**6.87**	**6.87**
1,2,3,7,8,9-Dibenzofuran, hexa	< 7.11 ng/kg		**3.555**	**0**
2,3,4,6,7,8-Dibenzofuran, hexa	6.87 j ng/kg		**6.87**	**6.87**
1,2,3,4,6,7,8-Dibenzofuran, hepta	163 ng/kg		**163**	**163**
1,2,3,4,7,8,9-Dibenzofuran, hepta	8.19 j ng/kg		**8.19**	**8.19**
Dibenzofuran octa	269 ng/kg		**269**	**269**
2,3,7,8-TCDD		**1**	6.41	6.41
1,2,3,7,8-Dioxin penta		**1**	5.25	0
1,2,3,4,7,8-Dioxin, hexa		**0.1**	0.3205	0
1,2,3,6,7,8-Dioxin, hexa		**0.1**	3.38	3.38
1,2,3,7,8,9-Dioxin, hexa		**0.1**	1.41	1.41
1,2,3,4,6,7,8-Dioxin, hepta		**0.01**	7.15	7.15
Dioxin octa		**0.0003**	2.163	2.163
2,3,7,8-TCDF		**0.1**	0.82	0
1,2,3,7,8-Dibenzofuran, penta		**0.03**	0.0561	0
2,3,4,7,8-Dibenzofuran, penta		**0.3**	0.918	0
1,2,3,4,7,8-Dibenzofuran, hexa		**0.1**	0.554	0.554
1,2,3,6,7,8-Dibenzofuran, hexa		**0.1**	0.687	0.687
1,2,3,7,8,9-Dibenzofuran, hexa		**0.1**	0.3555	0
2,3,4,6,7,8-Dibenzofuran, hexa		**0.1**	0.687	0.687
1,2,3,4,6,7,8-Dibenzofuran, hepta		**0.01**	1.63	1.63
1,2,3,4,7,8,9-Dibenzofuran, hepta		**0.01**	0.0819	0.0819
Dibenzofuran octa		**0.0003**	0.0807	0.0807
		TEQ	31.9537	24.2336

NG/KG	Toxicity Equivalency Factors WHO 98 [HH]	UC-23-2_1.5-2.0_03022011 ND = 1/2 EDL	UC-23-2_1.5-2.0_03022011 ND = 0
TCDD EQUIV CALCS			
2,3,7,8-TCDD		**6.41**	**6.41**
1,2,3,7,8-Dioxin penta		**5.25**	**0**
1,2,3,4,7,8-Dioxin, hexa		**3.205**	**0**
1,2,3,6,7,8-Dioxin, hexa		**33.8**	**33.8**
1,2,3,7,8,9-Dioxin, hexa		**14.1**	**14.1**
1,2,3,4,6,7,8-Dioxin, hepta		**715**	**715**
Dioxin octa		**7210**	**7210**
2,3,7,8-TCDF		**8.2**	**0**
1,2,3,7,8-Dibenzofuran, penta		**1.87**	**0**
2,3,4,7,8-Dibenzofuran, penta		**3.06**	**0**
1,2,3,4,7,8-Dibenzofuran, hexa		**5.54**	**5.54**
1,2,3,6,7,8-Dibenzofuran, hexa		**6.87**	**6.87**
1,2,3,7,8,9-Dibenzofuran, hexa		**3.555**	**0**
2,3,4,6,7,8-Dibenzofuran, hexa		**6.87**	**6.87**
1,2,3,4,6,7,8-Dibenzofuran, hepta		**163**	**163**
1,2,3,4,7,8,9-Dibenzofuran, hepta		**8.19**	**8.19**
Dibenzofuran octa		**269**	**269**
2,3,7,8-TCDD	**1**	6.41	6.41
1,2,3,7,8-Dioxin penta	**1**	5.25	0
1,2,3,4,7,8-Dioxin, hexa	**0.1**	0.3205	0
1,2,3,6,7,8-Dioxin, hexa	**0.1**	3.38	3.38
1,2,3,7,8,9-Dioxin, hexa	**0.1**	1.41	1.41
1,2,3,4,6,7,8-Dioxin, hepta	**0.01**	7.15	7.15
Dioxin octa	**0.0001**	0.721	2.163
2,3,7,8-TCDF	**0.1**	0.82	0
1,2,3,7,8-Dibenzofuran, penta	**0.05**	0.0935	0
2,3,4,7,8-Dibenzofuran, penta	**0.5**	1.53	0
1,2,3,4,7,8-Dibenzofuran, hexa	**0.1**	0.554	0.554
1,2,3,6,7,8-Dibenzofuran, hexa	**0.1**	0.687	0.687
1,2,3,7,8,9-Dibenzofuran, hexa	**0.1**	0.3555	0
2,3,4,6,7,8-Dibenzofuran, hexa	**0.1**	0.687	0.687
1,2,3,4,6,7,8-Dibenzofuran, hepta	**0.01**	1.63	1.63
1,2,3,4,7,8,9-Dibenzofuran, hepta	**0.01**	0.0819	0.0819
Dibenzofuran octa	**0.0001**	0.0269	0.0807
	TEQ	31.1073	24.2336

NG/KG	Toxicity Equivalency Factors WHO 98 [FISH]	UC-23-2_1.5-2.0_03022011 ND = 1/2 EDL	UC-23-2_1.5-2.0_03022011 ND = 0
TCDD EQUIV CALCS			
2,3,7,8-TCDD		**6.41**	**6.41**
1,2,3,7,8-Dioxin penta		**5.25**	**0**
1,2,3,4,7,8-Dioxin, hexa		**3.205**	**0**
1,2,3,6,7,8-Dioxin, hexa		**33.8**	**33.8**
1,2,3,7,8,9-Dioxin, hexa		**14.1**	**14.1**
1,2,3,4,6,7,8-Dioxin, hepta		**715**	**715**
Dioxin octa		**7210**	**7210**
2,3,7,8-TCDF		**8.2**	**0**
1,2,3,7,8-Dibenzofuran, penta		**1.87**	**0**
2,3,4,7,8-Dibenzofuran, penta		**3.06**	**0**
1,2,3,4,7,8-Dibenzofuran, hexa		**5.54**	**5.54**
1,2,3,6,7,8-Dibenzofuran, hexa		**6.87**	**6.87**
1,2,3,7,8,9-Dibenzofuran, hexa		**3.555**	**0**
2,3,4,6,7,8-Dibenzofuran, hexa		**6.87**	**6.87**
1,2,3,4,6,7,8-Dibenzofuran, hepta		**163**	**163**
1,2,3,4,7,8,9-Dibenzofuran, hepta		**8.19**	**8.19**
Dibenzofuran octa		**269**	**269**
2,3,7,8-TCDD	**1**	6.41	6.41
1,2,3,7,8-Dioxin penta	**1**	5.25	0
1,2,3,4,7,8-Dioxin, hexa	**0.5**	1.6025	0
1,2,3,6,7,8-Dioxin, hexa	**0.01**	0.338	3.38
1,2,3,7,8,9-Dioxin, hexa	**0.01**	0.141	1.41
1,2,3,4,6,7,8-Dioxin, hepta	**0.001**	0.715	7.15
Dioxin octa	**0.0001**	0.721	2.163
2,3,7,8-TCDF	**0.05**	0.41	0
1,2,3,7,8-Dibenzofuran, penta	**0.05**	0.0935	0
2,3,4,7,8-Dibenzofuran, penta	**0.5**	1.53	0
1,2,3,4,7,8-Dibenzofuran, hexa	**0.1**	0.554	0.554
1,2,3,6,7,8-Dibenzofuran, hexa	**0.1**	0.687	0.687
1,2,3,7,8,9-Dibenzofuran, hexa	**0.1**	0.3555	0
2,3,4,6,7,8-Dibenzofuran, hexa	**0.1**	0.687	0.687
1,2,3,4,6,7,8-Dibenzofuran, hepta	**0.01**	1.63	1.63
1,2,3,4,7,8,9-Dibenzofuran, hepta	**0.01**	0.0819	0.0819
Dibenzofuran octa	**0.0001**	0.0269	0.0807
	TEQ	21.2333	24.2336

q Van den Berg, et al., The 2005 (or 1998) World Health Organization Re-evaluation of Human and Mammalian (or 1998 Fish) Toxic Equivalency Factors for Dioxins and Dioxin-like Compounds. ToxSci Advance Access published July 7, 2006.

RED values indicate a scaled value (non-detect) either at 1/2 of the EDL or ND = 0.

$$TEQ_{DF}\ WHO_{XX} = \sum (Individual\ \ Congener\ * TEF_{DF})$$