Appendix A1
PRG Summary Memorandum

Ecology Technical Subgroup

March 16, 2009

MEMORANDUM

To: Ecology Technical Subgroup

From: Ecology Technical Subgroup

Re: Summary of Preliminary Remedial Goals for Protection of Wildlife at the Buffalo River Area of Concern

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The Ecology Subgroup (Eco-Group) of the Great Lakes Legacy Act Buffalo River Project Coordination Team has collaborated to identify Preliminary Remedial Goals (PRGs) for use in the Buffalo River Feasibility Study (FS). PRGs were established for polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), mercury, and lead concentrations in sediments. From these PRGs, Remedial Goals (RGs) were identified by each of the stakeholder representatives. Table 1 provides the PRGs and RGs identified by the Eco-Group as being protective of environmental resources. The derivation of these values are documented in a series of PRG Memoranda developed via a collaborative Eco-Group effort, reports, and guidance (ENVIRON 2009a,b,c; USACE 2009a,b; NYSDEC 2007; CSC 2009). This summary memorandum and the associated series of PRG Memoranda that document the PRG development process will be provided as an appendix to the Feasibility Study.

The PRG development process involved a transparent effort among stakeholders; wherein, electronic calculation files were widely distributed and reviewed. Throughout this process, input from the various stakeholders was incorporated both quantitatively and qualitatively. New York State Department of Environmental Conservation (NYSDEC) criteria for wildlife and fish tissue were incorporated into the developed criteria when applicable. Alternative criteria and data where used to develop additional lines of evidence to support PRG decisions. The following general statements can be made regarding the PRGs for each of the four primary chemicals:

- Total PAHs: The PRG developed for Total PAHs (with 17 non-alkylated PAHs) is based on the United States Environmental Protection Agency (USEPA) Equilibrium Partitioning Approach. Supporting evidence was provided by multiple sediment toxicity tests both with and without toxic responses. It also includes evaluation of USEPA's target lipid model approach using bioaccumulation data developed by the United States Army Corps of Engineers (USACE). The PAH PRG identified by the Eco-Group is 16 mg/kg.
- Total PCBs: The total PCB PRG considered a risk-based evaluation using limited site-specific fish tissue data and NYSDEC fish tissue criteria

considered protective of piscivorous wildlife. The total PCB PRGs range from 0.18 to 0. 44 mg/kg.

- Lead: Recently sampled fish tissue from the river have contaminant concentrations that are below the NYSDEC fish tissue criteria for lead. A risk-based assessment was done to demonstrate an average sediment lead concentration that would likely be below levels that would result in adverse impacts to wildlife, including those that incidentally ingest sediment (e.g., ducks). Recent surface-weighted average lead sediment concentrations and corresponding current fish tissue data were evaluated as well as results from multiple toxicity tests. A member of the Eco-Group identified the NYSDEC screening value of 36 mg/kg as a selected RG. The site-specific RGs range from 85 to 103 mg/kg.
- Mercury: Recently sampled fish tissues from the river have chemical concentrations that are below the NYSDEC and USEPA fish tissue criteria for mercury. Risk-based assessments were done to demonstrate that current average sediment mercury concentrations in surface sediment throughout most of the Buffalo River are likely to be below levels that would result in adverse impacts to wildlife. Sediment toxicity testing results from 2005 and 2007 were included in this analysis (USACE 2009 and CSC 2009). Toxicity testing in 2005 did not show any toxic effects due to mercury (or any other chemical). Although, toxicity testing conducted in 2007 indicated benthic impairment due to sediment mercury concentrations is possible, it was noted that the highest concentrations of mercury from this analysis were based on samples collected deep in the sediment column, below the average current exposures expected for wildlife. Therefore, recent surface-weighted average mercury sediment concentrations and corresponding current fish tissue data were evaluated were used to help with mercury PRG development. A member of the Eco-Group identified the NYSDEC screening value of 0.18 mg/kg as a selected RG. The site-specific RGs range from 0.43 to 0.54 mg/kg.

It is acknowledged that the noted PRGs have inherent uncertainty; however, the derived values represent a best educated estimation given current available data and technical approaches.

References

CSC. 2009. Concentration Response Report. Submitted to USEPA Great Lakes National Program Office. Revised March 6.

ENVIRON. 2009a. Memorandum: Polycyclic Aromatic Hydrocarbon (PAH) Remedial Target Concentrations (RTC) Analysis for Buffalo River. 29 January 2009.

ENVIRON. 2009b. Preliminary Remedial Goals (PRG) for PCB-Exposed Wildlife at the Buffalo River AOC: Evaluation of Toxicity Studies That Form the Basis of the PRGs. 3 February 2009.

ENVIRON. 2009c. Memorandum: Preliminary Remedial Goal (PRG) for PCBs and Streamlined Risk Evaluation for PCB-Exposed Wildlife at the Buffalo River AOC. 14 February 2009.

ENVIRON. 2009d. Memorandum: Preliminary Remedial Goal (PRG) for Mercury and Lead for Wildlife at the Buffalo River AOC.

NYSDEC. 2007. Numerical Guidance Values for Assessing Risk to Aquatic Life from Contaminants in Sediment. Division of Fish, Wildlife, & Marine Resources. June 19.

USACE. 2009a. Use of 2005 Toxicity Test on Upper Buffalo River for PRG Development for Protection of Benthic Macroinvertebrates. Power Point presentation to the Ecology Subgroup, January 16, 2009, Buffalo, NY.

USACE. 2009b. Development of a Preliminary Remedial Goal for total Polychlorinated Biphenyls (PCBs): Theoretical Bioaccumulation Potential. February 25.
Pickard/SWP/4404.

Table 1: Preliminary Remedial Goal Summary Table

Chemical	PRGs develpment (a) (mg/kg)	PRG Identified in Concensus Process (a)	Stakeholder Group	Basis (a)	Source (b)
Total PAHs (17)	16			USEPA EqP Approach Estimates Based on Site Specific Risk Based Mean PRG	FS Appendix A2
	16.4			EcoTox NOEC	USACE 2009
	1.61			Sediment Screening Values	NYSDEC 2007
Total PAHs (17)	0.43 - 17			Correlation Analysis	CSC 2009
Fluorene	0.28 - 1.1			Correlation Analysis	CSC 2009
Anthracene	0.31 - 1.2			Correlation Analysis	CSC 2009
	11			Geostatistical 95% UCL after hot spot removal (c)	FS Data (calculation by NYSDEC)
Total PAHs (17)		**16**	**Concurrance among stakeholders**	**PAH developed for benthic protection because these organisms are highly sensitive to PAHs. PAH PRG not developed specifically for the protection of fish and wildlife but remedial action for benthics presumed protective for other wildlife.**	
Total PCBs	0.048 - 0.054			Estimated Range Site-Specific Risk-Based PRG for Piscivorous Wildlife (HQ=0.3)	FS Appendix A3a
	0.44 - 0.45			Estimated Mean Site-Specific Risk-Based PRG for Piscivorous Wildlife (HQ=1)	FS Appendix A3a
	0.1 - 1.3			Estimated Range Site-Specific Risk-Based PRG for Piscivorous Wildlife	FS Appendix A3a
	0.36			EcoTox NOEC (benthic)	USACE 2009
	0.18 - 0.2			Theoretical Bioacculation Potential (pumpkinseed extrapolation)	FS Appendix A3b
	0.005-0.06			Sediment Screening Values	NYSDEC 2007
	0.24 - 0.25			Dataset UCL (d)	FS Data (calculation by NYSDEC)
	0.15			Geostatistical 95% UCL after hot spot removal (c)	FS
Total PCBs		**0.44**	**GLNPO**	**Mean Site-Specific Risk-Based PRG**	
Total PCBs		**0.44**	**Honeywell**	**Mean Site-Specific Risk-Based PRG**	
Total PCBs		**0.20**	**Riverkeeper**	**USACE TBP**	
Total PCBs		**0.18**	**NYSDEC**	**USACE TBP**	
Total PCBs		**0.20**	**USACE**	**USACE TBP**	
Mercury (e)	0.54			Dataset UCL (d)	FS
	0.46 - 1.2			Dataset UCL (d)	FS
	0.41			Geostatistical 95% UCL after hot spot removal (c)	FS Data (calculation by NYSDEC)
	0.43			EcoTox NOEC (benthic)	USACE 2009
	0.01 - 0.18			Sediment Screening Values	NYSDEC 2007
	0.33 - 0.85			Correlation Analysis (f)	CSC 2009
Mercury		**0.46**	**GLNPO**	**Estimated based on SWAC in the Buffalo River (excludes averages in Ship Canal)**	
Mercury		**0.54**	**Honeywell**	**Estimated based on SWAC in the Buffalo River and Ship Canal**	
Mercury		**0.18**	**Riverkeeper**	**NYSDEC Screening Value**	
Mercury		**0.43**	**NYSDEC**	**Maximum value accepted for protection of all biota**	
Mercury		**0.46**	**USACE**	**Estimated based on SWAC in the Buffalo River (excludes averages in Ship Canal)**	
Lead (e)	323			Estimated Mean of Site-Specific Risk-Based PRG for Sediment-Worm Ingesting Wildlife	FS Appendix A4
	185 - 495			Estimated Range Site-Specific Risk-Based PRG for Sediment-Worm Ingesting Wildlife	FS Appendix A4
	103			Dataset UCL (d)	FS
	92 - 205			Dataset UCL (d)	FS
	73			Geostatistical 95% UCL after hot spot removal (c)	FS Data (calculation by NYSDEC)
	85			EcoTox NOEC	USACE 2009
	36			Sediment Screening Values	NYSDEC 2007
	31 - 53			Correlation Analysis (f)	CSC 2009
Lead		**92**	**GLNPO**	**Estimated based on SWAC in the Buffalo River (excludes averages in Ship Canal)**	
Lead		**103**	**Honeywell**	**Estimated based on SWAC in the Buffalo River and Ship Canal**	
Lead		**36**	**Riverkeeper**	**NYSDEC Screening Value**	
Lead		**85**	**NYSDEC**	**Maximum value accepted for protection of all biota**	
Lead		**92**	**USACE**	**Estimated based on SWAC in the Buffalo River (excludes averages in Ship Canal)**	

Notes

(a) A variety of approaches were considered that address risk directly via the calculation of values above which risks may occur or conservatively address risks indirectly (e.g., evaluation of current conditions using an upper confidence limit for consideration that remedial actions do not result in significantly increased concentrations and unbounded no effects concentrations).

(b) Souce identified; FS Appendix shows the compiled appendix in which PRG memoranda will be provided.

(c) UCLs derived using Statistix 7.0 software on 1/8th mile surface-weighted averages of the dataset and excluding hot spots by removing concentrations and corresponding surface areas that exceeding the 95% UCL.

(d) UCL derived using ProUCL software from SWACs from the complete data set.

(e) Risk based estimates show that mercury and lead do not pose unacceptable risks at current conditions in fish and sediment. Upper confidence limits represent the average concentrations in surface sediment that currently exist so that such conditions do not significantly increase following a remedial action that may exposure higher concentrations at depth.

(f) Unbounded NOEC and correlation analyses show correlation not causation.

EqP	Equilibrium Partitioning Approach	NE	Not Estimated
FS	Feasibility Study	PRG	Preliminary Remedial Goal
NE	Not Estimated	PCBs	Polychlorinated biphenyls
NOEC	No Effects Concentration	PAHs	Polycyclic Aromatic Hydrocarbons
TBP	Theoretical Bioaccumulation Potential	USEPA	United States Environmental Protection Agency
UCL	95 Percent Upper Confidence Limit	HQ	Hazard Quotient
USACE	United States Army Corps of Engineer	SWAC	Surface Weighted Average Concentration
NYSDEC	New York State Department of Env Cons		

Appendix A2
PAH PRG Memorandum

ENVIRON

February 11, 2009

MEMORANDUM

To: Ecology Technical Subgroup

From: Mary Sorensen, Darrel Lauren, and Jen Lyndall

Re: Polycyclic Aromatic Hydrocarbon (PAH) Preliminary Remedial Goal (PRG) for Buffalo River

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The Ecology Subgroup (Eco-Group) of the Great Lakes Legacy Act Buffalo River Project Coordination Team has collaborated on efforts to identify PRGs for use in the Buffalo River Feasibility Study (FS). The US Army Corps of Engineers (USACE) recommended a PRG of 16 mg ΣPAH[1]/kg dry weight sediment January 16, 2009 during a meeting in Buffalo, NY and this was discussed again during the January 26 weekly Eco-Group call. This memorandum summarizes the information discussed during the Eco-Group call, and provides a detailed summary of data that support this discussion so that Eco-Group members can make a final recommendation of the PAH Remedial Goal. Specifically, four lines of evidence demonstrate that the recommended PRG of 16 mg/kg is a protective, chronic concentration appropriate for consideration as part of the FS of the Buffalo River, as described below and illustrated on Figure 1:

1. ASci (2005) conducted bioassays of Buffalo River sediments using *Hyalella azteca* and *Chironomus tentans* exposed to sediments collected at eleven stations in the upper reaches of the Buffalo River. Results show no biologically significant toxicity at 16.4 mg Σ17 PAH/kg dry weight sediment, and therefore, this was considered a no effect concentration (NOEC) by the USACE and member of the Ecology Subgroup. Because these were 10-day bioassays, additional lines of evidence were evaluated to determine whether this value was protective of chronic exposures. The following analysis demonstrates that this NOEC is appropriate for considering chronic exposures.
2. The United States Environmental Protection Agency's *Equilibrium Partitioning (EqP) Approach for the Derivation of Sediment Quality Benchmarks for PAH Mixtures* (2003) was applied, using available sediment data from the ASci (2005) toxicity testing study.
    a. Results showed that the toxicity units (TUs[2]) for these samples were ≤1 for the Σ17 PAH/kg and for Σ34 PAH/kg (estimated based on the 2008 Buffalo

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[1] This document refers to the ΣPAH as the 17 unsubstituted (i.e., non-alkylated) PAHs that comprise the total PAH value, unless otherwise noted as .Σ34 PAHs. Reference to the Σ34 PAHs refers to both the alkylated and non-alkylated PAHs.
[2] Toxicity units are similar to the hazard quotient and hazard index because they represent the ratio of potential exposures and effects that are summed to a single value for evaluating whether adverse effects could occur. According to USEPA (2003) a TU≤1 indicate that PAHs in sediment are not biologically

River alkylated and non-alkylated PAH average conversion factor and average percent organic carbon content (Table 1)).

b. The basis of the USEPA EqP approach, the Target Lipid Model, starts with a no effect tissue residue, and therefore, is inherently a chronic (i.e., long term) exposure model for sediment dwelling organisms (USEPA 2003). Therefore, the TU for sediments from the ASci (2003) toxicity study samples demonstrate that 16 mg/kg dry weight sediment is a protective chronic value.

3. The USACE's (2003) bioaccumulation tests with *Lumbriculus variegatus* (an aquatic worm) were also considered using the USEPA's EqP approach. The sediment data and worm data provided opportunity for additional analysis using the EqP for a data set where both predictions in sediments could be compared to actual tissue residues.
   a. TUs were calculated using sediment data from the bioaccumulation study (Table 2). Some of the locations had TUs≤1 but other results showed that in the area of River Mile (RM) 3.7 to 4.6 TUs >2 (ranging from 2 to 3 where sediment concentrations were approximately 43 mg/kg to 68.5 mg/kg dry [Σ17 PAH]).
   b. Setting the TU=1 showed that the average Σ17 PAH remedial target would be 26 mg/kg (Table 2).
   c. TUs were evaluated for worm body burdens of PAHs and compared to the no effect body residue benchmark value (Table 3). These results were generally consistent with those seen in Table 2 because where the PAH TUs predicted toxicity (TU>2), the body burdens of PAHs in worm tissues were the highest and exceeded the no effect body residue yielding TUs of 8 and 11 (RM 3.7, referred to as Concrete Central in the USACE 2003 report) and TUs of 4 and 7 at RM 4.6 (referred to as the CSX Railbridge location in the USACE report). There was one location with predicted toxicity using sediment data (Table 2; TU=2; with 65 mgΣ17 PAHs/kg) at the Hamburg Street Drain (RM 0.7); however, as seen on Table 3, the body residues for PAHs in worms were low and did not exceed the no effects body residue. This finding is consistent with elevated organic carbon at this location.
4. The USEPA's *EqP* approach was also applied to the ASci (2007a) toxicity testing study conducted in the lower reaches of the Buffalo River, where such sample results were used as the technical basis of the Concentration-Response Analysis (USEPA 2008).
   a. Results showed that the toxicity units (TUs[3]) for these samples were ≤1 for Σ34 PAH/kg for some of the locations but other locations had TUs>2 showing that PAHs could have likely contributed to the toxicity seen (Table 4)).
   b. Setting the TU=1 showed that the average Σ17 PAH remedial target would be approximately 17 mg/kg is consistent with the 16 mg/kg value proposed by the USACE (Table 4).

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available and do not pose an unacceptable risk to wildlife. TUs set =1 can be used to derive protective, chronic sediment remedial targets.

[3] Toxicity units are similar to the hazard quotient and hazard index because they represent the ratio of potential exposures and effects that are summed to a single value for evaluating whether adverse effects could occur. According to USEPA (2003) a TU≤1 indicate that PAHs in sediment are not biologically available and do not pose an unacceptable risk to wildlife. TUs set =1 can be used to derive protective, chronic sediment remedial targets.

5. The USEPA's *EqP* approach was also applied to the ASci (2007b) toxicity testing study conducted in the navigational channel as part of the USACE evaluation of dredged sediment disposal. These data were considered in two ways because the total organic carbon content (TOC) of the samples was drastically different than that seen in the Buffalo River AOC and many of the locations tested were outside the AOC. Specifically, the EqP approach was applied using TOC from the actual study (Table 5a) and using average TOC from the Buffalo River (Table 5b).
    a. Results showed that the toxicity units (TUs[4]) for these samples were ≤1 for Σ34 PAH/kg at all locations except 1 (Table 5a)).
    b. Setting the TU=1 using TOC measures relevant to the Buffalo River showed that the average Σ17 PAH remedial target would be 14.6 mg/kg which is only slightly lower than the 16 mg/kg value proposed by the USACE (Table 5b). It is noted that Table 5a using the extremely low TOC values shows a lower Σ17 PAH remedial target than the 16 mg/kg value being discussed, it is important to recognize that the TOC values in these samples had only 15% of samples > 2% TOC (and only 2% >2.6% TOC) as compared to the Buffalo River sample characteristics with 77% of samples having >2% TOC (and an average of 2.6% TOC).
6. Finally, while not necessarily a separate line of evidence from that described above, it is also important to recognize that the approach used to estimate Σ17 PAH remedial targets in the tables attached is very conservative because it does not account for other sources of carbon in the river that also mitigate PAH toxicity, such as soot and black carbon.

Conclusions

Multiple lines-of-evidence demonstrate that the USACE 2009 proposed value of 16 mg ΣPAH/kg dry weight sediment is a protective, chronic remedial target concentration. Upon review of this data, the Eco-Group will make a formal recommendation regarding the use of the 16 mg/kg NOEC. The lines of evidence that that were identified herein that support this conclusion are:

- The toxicity testing study on Buffalo River sediments that identified a NOEC for PAHs (ASci 2005; USACE 2009).
- The USEPA's EqP target-lipid model, based on the assumption of chronic exposures, showed that the sediment data from the ASci 2005 toxicity study have a PAH TU ≤1 (i.e., the USEPA threshold considered for potential concern are TUs>1).
- USACE's bioaccumulation data sets were also evaluated to evaluate the USEPA's approach and this indicated the USEPA approach was consistent and conservative.
- Setting a TU =1 (a protective benchmark) and using a calculational approach that assumes that all of the toxicity of 34 PAHs is related to the 17 PAHs, average remedial targets that represent chronic NOEC values protective of benthic dwelling

[4] Toxicity units are similar to the hazard quotient and hazard index because they represent the ratio of potential exposures and effects that are summed to a single value for evaluating whether adverse effects could occur. According to USEPA (2003) a TU≤1 indicate that PAHs in sediment are not biologically available and do not pose an unacceptable risk to wildlife. TUs set =1 can be used to derive protective, chronic sediment remedial targets.

wildlife in sediments consistent with average organic carbon conditions such as those in the Buffalo River were seen as approximately 16 mg/kg (Table 1), 26 mg/kg (Table 2), 15 mg/kg (Table 5b), and 17 mg/kg (Table 4). These are very consistent values and justify the use of 16 mg/kg as the PRG for Buffalo River.

References

ASci Corporation. 2005. Results of Ten-Day Hyalella azteca and Chironomus tentans Toxicity Tests with Whole Sediments from Buffalo River. ASci Corporation, Duluth.

ASci Corporation. 2007a. Results of Ten-Day Hyalella azteca and Chironomus tentans Toxicity Tests with Whole Sediments from Buffalo River. ASci Corporation, Duluth. Samples collected in June 2007.

ASci Corporation. 2007b. Results of Ten-Day Hyalella azteca and Chironomus tentans Toxicity Tests with Whole Sediments from Buffalo River. ASci Corporation, Duluth. Samples collected in October 2007.

USACE. 2003. Sediment sampling, biological analyses, and chemical analyses for Buffalo River area of concern, Buffalo, New York. Vol.s 1 and 2. USACE, Vicksburg, MS.

USACE. 2009. Use of 2005 toxicity test on upper Buffalo River for PRG development. Protection of benthic macroinvertebrates. Power Point presentation to the Ecology Subgroup, January 16, 2009, Buffalo, NY.

USEPA. 2003. Procedures for the derivation of equilibrium partitioning sediment benchmarks (ESBs) for the protection of benthic organism: PAH mixtures. EPA-600-R-02-013. Office of Research and Development. Washington, DC 20460.

USEPA. 2008. Draft Concentration-Response Report prepared for GLNPO.

Table 1: Sediment PAH Analysis Using USACE's 2005 *Hyalella azteca* and *Chironomid tentans* Toxicity Data

Compound	Final Chronic Value (mg/kg OC)	11 surface samples (full data set recommended by USACE)		
		CF=	1.36	(a)
		2.6	% Organic Carbon	
Unsubstituted PAHs		µg/kg	µg/gOC	TU (b)
Acenaphthene	491	200	7.7	0.016
Acenaphthylene	452	26	1.0	0.002
Anthracene	594	650	25	0.042
Benzo (a) anthracene	841	1200	46	0.055
Benzo (a) pyrene	965	950	37	0.038
Benzo (b) fluoranthene	979	1200	46	0.047
Benzo (e) pyrene	967			
Benzo (g,h,i) perylene	1,095	460	17.7	0.016
Benzo (k) fluoranthene	981	930	36	0.036
Chrysene	844	1200	46	0.055
Dibenz (a,h) anthracene	1,123	150	6	0.005
Fluoranthene	707	3300	127	0.180
Fluorene	538	350	13	0.025
Indeno (1,2,3-cd) pyrene	1,115	430	17	0.015
Naphthalene	385	320	12	0.032
Phenanthrene	596	2100	81	0.136
Pyrene	697	2700	104	0.149
Alkylated PAHs				
2-Methylnaphthalene	447	200	7.7	0.017
	Sum 17 PAHs	16366	TU 17=	0.9
	Sum 34 PAHs	22258	TU 34=	1

PAH TU≤ 1	Toxicity from PAHs unlikely
PAH TU >1	Toxicity from PAH possible, additional evaluation warranted
CF	conversion factor
µg/gOC	microgram per gram of organic carbon
µg/kg	microgram per kilogram
PAH	polycyclic aromatic hydrocarbon
RM	river mile
TPAH	total polycyclic aromatic hydrocarbon
TU	toxicity unit (i.e., hazard quotient); rounded to one significant figure
USACE	US Army Corps of Engineers
(a)	The conversion factor between the full 34 PAH list and the 17 PAH list is 1.38 with the full data set and 1.36 based on this data set that includes 2-methylnapthylene.

Table 2: Sediment PAH Analysis Using USACE's 2003 *Lumbriculus variegatus* Data

Compound	Final Chronic Value (µg/goc)	Katherine St Peninsula (RM 3.3)			Concrete Central (RM 3.7)			CSX Railbridge (RM 4.6)			Upstream From Park Street Bridge (RM 5.5)			Hamburg Street Drain (RM 0.7)			Ship Canal		
		CF=	1.36		CF=	1.36		CF=	1.58		CF=	1.68		CF=	1.36		CF=	1.36	
			OC=	25		OC=	34		OC=	28		OC=	24		OC=	64		OC=	96
Unsubstituted PAHs		**µg/kg**	**µg/gOC**	**TU (a)**	**µg/kg**	**µg/gOC**	**TU (a)**	**µg/kg**	**µg/gOC**	**TU (a)**	**µg/kg**	**µg/gOC**	**TU (a)**	**µg/kg**	**µg/gOC**	**TU (a)**	**µg/kg**	**µg/gOC**	**TU (a)**
Acenaphthene	491	14	0.57	0.001	428	13	0.026	246	8.8	0.018	0	0	0	0	0	0	0	0	0
Acenaphthylene	452	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anthracene	594	668	27	0.045	2010	59	0.100	809	29	0.049	149	6.2	0.010	1970	30.8	0.05	1490	16	0.03
Benzo (a) anthracene	841	745	30	0.035	4320	127	0.15	1740	62	0.074	374	15.6	0.019	4840	75.6	0.09	4390	46	0.05
Benzo (a) pyrene	965	324	13	0.013	3410	100	0.10	1180	42	0.044	363	15.1	0.016	4120	64.4	0.07	3390	35	0.04
Benzo (b) fluoranthene	979	516	21	0.021	3210	94	0.096	1240	44	0.045	372	15.5	0.016	4190	65.5	0.07	3210	33	0.03
Benzo (e) pyrene	967		0			0			0		0	0	0	0	0	0	0	0	0
Benzo (g,h,i) perylene	1,095	373	15	0.014	2040	60	0.055	754	27	0.025	255	10.6	0.010	1930	30	0.03	3450	36	0.033
Benzo (k) fluoranthene	981	514	21	0.021	3140	92	0.094	980	35	0.036	293	12.2	0.012	3930	61	0.06	2970	31	0.032
Chrysene	844	859	34	0.041	4640	136	0.16	1820	65	0.077	572	23.8	0.028	6350	99	0.12	4350	45	0.054
Dibenz (a,h) anthracene	1,123	98	3.9	0.003	550	16	0.014	217	8	0.007	0	0	0	0	0	0	0	0	0
Fluoranthene	707	1560	62	0.088	6860	202	0.29	3720	133	0.19	943	39.3	0.056	14600	228	0.32	8700	91	0.128
Fluorene	538	337	13	0.025	380	11	0.021	457	16	0.030	237	9.9	0.018	1260	20	0.04	0	0	0.000
Indeno (1,2,3-cd) pyrene	1,115	406	16	0.015	2380	70	0.063	205	7	0.007	261	10.9	0.010	3440	54	0.05	2150	22	0.020
Naphthalene	385	221	8.8	0.023	220	6	0.017	43	2	0.004	0	0	0	0	0	0	0	0	0
Phenanthrene	596	1060	42	0.071	2750	81	0.14	2400	86	0.144	407	17.0	0.028	8900	139	0.23	4850	51	0.085
Pyrene	697	1650	66	0.095	6900	203	0.29	3150	112.5	0.16	1000	41.7	0.060	13000	203	0.29	9190	96	0.137
	Sum 17 PAHs	9345	TU 17=	0.5	43238	TU 17=	2	18961	TU 17=	0.9	5226	TU 17=	0.3	68530	TU 17=	1	48140	TU 17=	0.6
	Sum 34 PAHs	12709	TU 34=	0.7	58804	TU 34=	2	25787	TU 34=	1	7107	TU 34=	0.4	93201	TU 34=	2	65470	TU 34=	1

Average 17 PAH Concentration (mg/kg) w/TU=1 (b) **26**
Average 17 PAH Concentration (mg/kg) w/TU=1 (c) **26**
Average 34 PAH Concentration (mg/kg) w/TU=1 (d) **35**

PAH TU≤ 1	Toxicity unit from PAHs unlikely
PAH TU >1	Toxicity from PAH predicted but no toxicity observed
Value	Average protective Σ17PAH concentration calculated as described below.
CF	conversion factor based on site-specific Buffalo River sediment data provided in the attached worksheet
µg/gOC	microgram per gram of organic carbon
µg/kg	microgram per kilogram
(a)	TUs were calculated by dividing the dry weight sediment concentrations normalized to organic carbon (OC) by the Final Chronic Value toxicity benchmarks (USEPA 2003).
(b)	The average protective Σ17PAH concentration is calculated by setting the TU=1. Specifically, it is based on the average of (Σ34PAH dry weight sediment concentrations divided by the actual TU of 34PAHs) divided by (1.68*1000) to adjust 34 PAHs to 17PAHs and to convert units of microgram to milligram. Therefore, the formula =Average(Sum 34 PAHs per location/TU34 per location)/(1.68*1000) = 1 For this worksheet, the following cells are included in the above stated formula. '=AVERAGE(D43/F43,H43/J43,L43/N43,P43/R43,T43/V43,X43/Z43)/(1.68*1000)
(c)	Alternative approach =Sum17 PAHs divided by the TU34 (converted to mg/kg). For TU=1, value =Sum 17 PAHs For this worksheet, the following cells are included in the above stated formula. '=AVERAGE(D43/F43,H43/J43,L43/N43,P43/R43,T43/V43,X43/Z43)/(1.68*1000)
(d)	Average protective Σ34PAH concentration calculated by dividing the Sum 34 PAHs by TU34.

PAH	polycyclic aromatic hydrocarbon
TPAH	total polycyclic aromatic hydrocarbon
TU	toxicity unit (i.e., hazard quotient); rounded to one significant figure
RM	river mile

Table 3: Worm Body Residue Analysis using the Target Lipid Model

	28-day *Lumbriculus variegatus* µg/g-lipid																
	Naphtalene	Acenaphthene	Fluorene	Phenanthrene	Fluoranhrene	Anthracene	Pyrene	Chrysene	BBA	BBF	BKF	BaP	IP	DBAA	BghiP	∑PAHs per replicate µg/g-lipid	Mean ∑PAHs per location µg/g-lipid
Molecular weight	128.19	154.21	166.2	178.2	202.26	178.2	202.26	228.29	228.29	252.32	252.32	252.32	276.34	278.35	276.34		
Upstream From Park Street Bridge (BR2; RM 5.5)	0.0	0.0	2.1	10.0	24.3	2.1	21.2	14.3	6.9	5.9	4.0	0.0	0.0	0.0	1.2	92	
2	0.0	0.0	3.8	19.9	44.8	3.8	42.0	27.6	8.8	16.0	8.8	0.0	2.7	0.0	3.8	182	
3	0.0	0.0	7.8	9.7	22.3	4.9	39.4	21.3	6.8	7.8	0.0	0.0	0.0	0.0		120	
4	0.0	0.0	2.6	16.0	37.5	2.6	41.0	23.1	8.7	14.1	10.3	5.1	3.2	0.0	3.8	168	
5	0.0	0.0	6.0	6.5	14.9	3.6	27.3	16.2	6.0	8.4	0.0	0.0	6.0	0.0	3.0	98	127
Ship Canal (BR5)	0.0	0.0	0.0	12.6	133.9	77.4	119.4	54.8	48.4	32.3	37.1	27.4	12.6	0.0	12.6	568	
2	0.0	0.0	0.0	0.0	30.1	0.0	28.1	13.7	9.8	10.5	9.8	7.8	3.8	0.0	3.8	117	
3	0.0	0.0	0.0	5.3	11.9	0.0	17.6	8.5	4.8	6.8	5.7	0.0	1.9	0.0	2.4	65	
4	0.0	0.0	0.0	3.7	11.1	0.0	15.3	8.9	3.7	6.8	6.3	0.0	0.0	0.0	2.6	58	
5	0.0	0.0	0.0	4.2	19.8	0.0	21.6	11.2	6.9	10.3	10.3	0.0	4.3	0.0	4.3	93	119
Katherine St Pen (BR4; RM3.3)	0.0	0.0	7.3	22.7	40.7	13.3	46.7	25.3	15.3	16.0	11.3	12.0	5.2	0.0	6.5	222	
2	0.0	0.0	2.4	6.7	10.3	3.3	13.2	6.5	3.1	3.3	2.2	2.2	0.0	0.0	1.3	54	
3	0.0	0.0	1.7	5.3	9.0	2.9	12.7	5.5	2.9	2.9	2.5	2.0	0.7	0.0	1.1	49	
4	0.0	0.9	3.3	9.7	15.6	4.9	23.0	10.0	6.1	5.6	5.4	4.6	1.4	0.0	1.9	92	
5	3.3	3.7	9.3	34.2	58.7	17.3	58.7	33.8	24.9	22.7	17.8	19.1	8.0	1.6	8.9	322	112
Hamburg Street Drain (BR6; RM 0.7)	0.0	0.0	6.0	37.7	82.6	5.7	71.9	44.9	17.4	31.1	17.4	6.6	4.6	0.0	6.6	332	
2	0.0	0.0	6.8	41.0	93.2	6.0	79.5	53.4	20.5	35.4	26.7	11.2	6.0	0.0	8.1	388	
3	0.0	0.0	8.0	47.7	124.8	7.2	97.2	69.7	24.8	45.9	30.3	12.8	7.2	0.0	11.0	487	
4	0.0	0.0	6.5	36.4	82.1	5.3	69.0	45.1	16.3	28.8	19.0	8.2	3.9	0.0	6.0	327	
5	0.0	0.0	8.4	50.4	112.6	8.2	92.4	62.2	24.4	40.3	23.5	10.1	5.6	0.0	8.2	446	391
Concrete Central (BR7; RM 3.7)	0.0	0.0	0.0	3.5	11.0	0.0	13.7	14.6	5.9	10.0	8.7	5.9	3.5	0.0	4.0	81	
2	0.0	0.0	0.0	5.3	23.9	4.8	28.2	79.1	22.1	28.8	28.2	23.3	11.0	2.4	12.3	270	
3	0.0	0.0	0.0	5.1	18.6	0.0	20.3	18.0	6.4	11.6	10.5	7.6	4.1	0.0	4.6	107	
4	36.9	34.8	46.1	242.6	957.4	446.1	829.8	730.5	688.7	692.9	603.5	704.3	427.7	57.4	305.0	6804	
5	15.7	20.7	23.1	143.8	1305.8	266.9	1181.8	1132.2	1115.7	1132.2	1000.0	1281.0	750.4	102.5	513.2	9985	692
CSX Railway Bridge (BR9; RM 4.6)	0.0	0.0	6.5	31.5	116.3	7.6	95.7	71.7	35.9	39.1	31.5	16.3	7.6		9.8	470	
2 Not available																	
3	11.1	40.0	42.9	202.9	1120.0	62.9	965.7	697.1	588.6	688.6	545.7	562.9	337.1	42.9	260.0	6168	
4	0.0	0.0	6.1	31.0	74.7	6.1	97.7	49.4	20.7	29.9	17.2	10.1	5.1	0.0	8.0	356	
5	5.5	83.5	76.9	446.2	511.0	116.5	439.6	252.7	233.0	161.5	149.5	141.8	85.7	14.3	75.8	2793	1303

Acenaphthene ND in all samples

	28-day *Lumbriculus variegatus* µmol/g-lipid															**Sum PAH**	**TLM**	**HQ**
River Mile 5.5	0.000	0.000	0.012	0.056	0.120	0.012	0.105	0.063	0.030	0.023	0.016	0.000	0.000	0.000	0.004	0.44	3.79	0.1
2	0.000	0.000	0.023	0.112	0.221	0.021	0.208	0.121	0.039	0.063	0.035	0.000	0.010	0.000	0.014	0.87	3.79	0.2
3	0.000	0.000	0.047	0.054	0.110	0.027	0.195	0.093	0.030	0.031	0.000	0.000	0.000	0.000	0.000	0.59	3.79	0.2
4	0.000	0.000	0.015	0.090	0.185	0.014	0.203	0.101	0.038	0.056	0.041	0.020	0.012	0.000	0.014	0.79	3.79	0.2
5	0.000	0.000	0.036	0.036	0.074	0.020	0.135	0.071	0.026	0.033	0.000	0.000	0.022	0.000	0.011	0.46	3.79	0.1
Ship Canal	0.000	0.000	0.000	0.071	0.662	0.434	0.590	0.240	0.212	0.128	0.147	0.109	0.046	0.000	0.046	2.7	3.79	0.7
2	0.000	0.000	0.000	0.000	0.149	0.000	0.139	0.060	0.043	0.041	0.039	0.031	0.014	0.000	0.014	0.53	3.79	0.1
3	0.000	0.000	0.000	0.030	0.059	0.000	0.087	0.037	0.021	0.027	0.023	0.000	0.007	0.000	0.009	0.30	3.79	0.1
4	0.000	0.000	0.000	0.021	0.055	0.000	0.075	0.039	0.016	0.027	0.025	0.000	0.000	0.000	0.010	0.27	3.79	0.1
5	0.000	0.000	0.000	0.024	0.098	0.000	0.107	0.049	0.030	0.041	0.041	0.000	0.016	0.000	0.016	0.42	3.79	0.1
Katherine St Penninsula (RM 3.3)	0.000	0.000	0.044	0.127	0.201	0.075	0.231	0.111	0.067	0.063	0.045	0.048	0.019	0.000	0.024	1.1	3.79	0.3
2	0.000	0.000	0.014	0.038	0.051	0.019	0.065	0.028	0.014	0.013	0.009	0.009	0.000	0.000	0.005	0.26	3.79	0.1
3	0.000	0.000	0.010	0.030	0.044	0.016	0.063	0.024	0.013	0.011	0.010	0.008	0.003	0.000	0.004	0.24	3.79	0.1
4	0.000	0.006	0.020	0.055	0.077	0.027	0.114	0.044	0.027	0.022	0.021	0.018	0.005	0.000	0.007	0.44	3.79	0.1
5	0.026	0.024	0.056	0.192	0.290	0.097	0.290	0.148	0.109	0.090	0.070	0.076	0.029	0.006	0.032	1.5	3.79	0.4
Hamburg Street Drain (RM 0.7)	0.000	0.000	0.036	0.212	0.409	0.032	0.355	0.197	0.076	0.123	0.069	0.026	0.016	0.000	0.024	1.6	3.79	0.4
2	0.000	0.000	0.041	0.230	0.461	0.033	0.393	0.234	0.090	0.140	0.106	0.044	0.022	0.000	0.029	1.8	3.79	0.5
3	0.000	0.000	0.048	0.268	0.617	0.040	0.481	0.305	0.109	0.182	0.120	0.051	0.026	0.000	0.040	2.3	3.79	0.6
4	0.000	0.000	0.039	0.204	0.406	0.030	0.341	0.198	0.071	0.114	0.075	0.032	0.014	0.000	0.022	1.5	3.79	0.4
5	0.000	0.000	0.051	0.283	0.557	0.046	0.457	0.272	0.107	0.160	0.093	0.040	0.020	0.000	0.029	2.1	3.79	0.6
Concrete Central (RM 3.7)	0.000	0.000	0.000	0.020	0.054	0.000	0.068	0.064	0.026	0.040	0.034	0.024	0.013	0.000	0.014	0.36	3.79	0.1
2	0.000	0.000	0.000	0.030	0.118	0.027	0.140	0.347	0.097	0.114	0.112	0.092	0.040	0.009	0.044	1.2	3.79	0.3
3	0.000	0.000	0.000	0.029	0.092	0.000	0.101	0.079	0.028	0.046	0.041	0.030	0.015	0.000	0.017	0.48	3.79	0.1
4	0.288	0.225	0.277	1.361	4.734	2.503	4.103	3.200	3.017	2.746	2.392	2.791	1.548	0.206	1.104	30	3.79	8
5	0.122	0.134	0.139	0.807	6.456	1.498	5.843	4.960	4.887	4.487	3.963	5.077	2.716	0.368	1.857	43	3.79	11
CSX Railway Bridge (RM4.6)	0.000	0.000	0.039	0.177	0.575	0.043	0.473	0.314	0.157	0.155	0.125	0.065	0.028	0.000	0.035	2.2	3.79	0.6
2 Not available																		
3	0.087	0.259	0.258	1.138	5.537	0.353	4.775	3.054	2.578	2.729	2.163	2.231	1.220	0.154	0.941	27	3.79	7
4	0.000	0.000	0.037	0.174	0.369	0.034	0.483	0.217	0.091	0.118	0.068	0.040	0.018	0.000	0.029	1.7	3.79	0.4
5	0.043	0.542	0.463	2.504	2.526	0.654	2.173	1.107	1.020	0.640	0.592	0.562	0.310	0.051	0.274	13	3.79	4

TU ≤ 1	Toxic units (i.e., hazard quotients) less than one indicates toxicity from PAHs unlikely
TU >1	Toxic unit (i.e., hazard quotients) greater than 1 indicates toxicity from PAH is predicted, but no toxicity was observed in this chronic study
(a)	conversion factor from 17 to 34 PAHs = 1.68 based on site-specific studies of Buffalo River sediment (2008)
µmol/g-lipid	microgram per gram of lipid

PAH	polycyclic aromatic hydrocarbon
TLM	target lipid model weight weight value
TU	toxic unit; rounded to one significant figure
RM	river mile

Table 4a: PAH Toxicity Units and Preliminary Remedial Goals Calculated Using the 2007 Toxicity Testing Study Conducted by ASci based on Data Used in the Concentration-Response Analysis

Sample ID #		2-9-480-L58				14-9-495-L510				19-9-500-R03			
Depth (ft)		5.0 - 8.2				5.4 - 9.7				0 - 3			
Buffalo River Conversion Factor (a)	1.35	3.7 % Organic Carbon				3.0 % Organic Carbon				3.2 % Organic Carbon			
Compound	Final Chronic Value (µg/goc)	PAH Concentration (ug/kg)	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (ug/kg)	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (ug/kg)	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs													
Acenaphthene	491	1200	1.2E+00	3.2E+01	6.5E-02	670	6.7E-01	2.2E+01	4.6E-02	160	1.6E-01	5.0E+00	1.0E-02
Acenaphthylene	452	480	4.8E-01	1.3E+01	2.8E-02	380	3.8E-01	1.3E+01	2.8E-02	320	3.2E-01	9.9E+00	2.2E-02
Anthracene	594	2600	2.6E+00	7.0E+01	1.2E-01	3000	3.0E+00	1.0E+02	1.7E-01	360	3.6E-01	1.1E+01	1.9E-02
Benzo (a) anthracene	841	1500	1.5E+00	4.0E+01	4.8E-02	1400	1.4E+00	4.7E+01	5.6E-02	930	9.3E-01	2.9E+01	3.4E-02
Benzo (a) pyrene	965	1300	1.3E+00	3.5E+01	3.6E-02	1100	1.1E+00	3.7E+01	3.8E-02	940	9.4E-01	2.9E+01	3.0E-02
Benzo (b) fluoranthene	979	1400	1.4E+00	3.7E+01	3.8E-02	1300	1.3E+00	4.3E+01	4.4E-02	1200	1.2E+00	3.7E+01	3.8E-02
Benzo (e) pyrene	967		0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00
Benzo (g,h,i) perylene	1,095	230	2.3E-01	6.1E+00	5.6E-03	240	2.4E-01	8.0E+00	7.3E-03	260	2.6E-01	8.1E+00	7.4E-03
Benzo (k) fluoranthene	981	1400	1.4E+00	3.7E+01	3.8E-02	1500	1.5E+00	5.0E+01	5.1E-02	1400	1.4E+00	4.3E+01	4.4E-02
Chrysene	844	1600	1.6E+00	4.3E+01	5.1E-02	1500	1.5E+00	5.0E+01	5.9E-02	1300	1.3E+00	4.0E+01	4.8E-02
Dibenz (a,h) anthracene	1,123	84	8.4E-02	2.2E+00	2.0E-03	85	8.5E-02	2.8E+00	2.5E-03	73	7.3E-02	2.3E+00	2.0E-03
Fluoranthene	707	4000	4.0E+00	1.1E+02	1.5E-01	4200	4.2E+00	1.4E+02	2.0E-01	2600	2.6E+00	8.1E+01	1.1E-01
Fluorene	538	3400	3.4E+00	9.1E+01	1.7E-01	4100	4.1E+00	1.4E+02	2.5E-01	230	2.3E-01	7.1E+00	1.3E-02
Indeno (1,2,3-cd) pyrene	1,115	220	2.2E-01	5.9E+00	5.3E-03	240	2.4E-01	8.0E+00	7.2E-03	250	2.5E-01	7.8E+00	7.0E-03
Naphthalene	385	330	3.3E-01	8.8E+00	2.3E-02	330	3.3E-01	1.1E+01	2.9E-02	160	1.6E-01	5.0E+00	1.3E-02
Phenanthrene	596	4600	4.6E+00	1.2E+02	2.1E-01	3900	3.9E+00	1.3E+02	2.2E-01	1600	1.6E+00	5.0E+01	8.3E-02
Pyrene	697	3000	3.0E+00	8.0E+01	1.2E-01	3800	3.8E+00	1.3E+02	1.8E-01	1700	1.7E+00	5.3E+01	7.6E-02
Alkylated PAHs													
2-Methylnaphthalene	447	620	6.2E-01	1.7E+01	3.7E-02	1200	1.2E+00	4.0E+01	9.0E-02	110	1.1E-01	3.4E+00	7.6E-03
			Σ17PAH mg/kg		Σ17PAH TU		Σ17PAH mg/kg		Σ17PAH TU		Σ17PAH mg/kg		Σ17PAH TU
			28.0		1		28.9		1		13.6		0.6
			Σ34PAH mg/kg				Σ34PAH mg/kg				Σ34PAH mg/kg		
			37.7		2		39.0		2		18.3		0.8
Σ17PAH mg/kg, TU=1(b)					18.3				14.5				17.7
Σ34PAH mg/kg, TU=1(c)					24.6				19.5				23.9
*Average TOCs for the AOC													

Average Sum of 17 PAHs mg/kg T	17.2
Average Sum of 34 PAHs mg/kg T	23.2

TU ≤ 1 Toxic units (i.e., hazard quotients) less than one indicates toxicity from PAHs unlikely

TU >1 Toxic unit (i.e., hazard quotients) greater than 1 indicates toxicity from PAH is predicted, but no toxicity was observed in this chronic study

(a) The conversion factor between the full 34 PAH list and the 17 PAH list is 1.36 with the full data set and 1.35 based on this data set that includes 2-methylnapthylene as indicated in the worksheet within this workbook.

(b) The average protective Σ17PAH concentration is calculated by setting the TU34=1. Specifically, it is based on the average of (Σ17PAH dry weight sediment concentrations divided by the actual TU of 34PAHs) divided by (1000) to convert units of microgram to milligram.

(c) The average protective Σ34PAH concentration is calculated by setting the TU34=1. Specifically, it is based on the average of (Σ34PAH dry weight sediment concentrations divided by the TU of 34PAHs) divided by (1000) to convert units of microgram to milligram.

CF	conversion factor	RM	river mile
µg/gOC	microgram per gram of organic carbon	TOC	total organic carbon
µg/kg	microgram per kilogram	TPAH	total polycyclic aromatic hydrocarbon
PAH	polycyclic aromatic hydrocarbon	TU	toxicity unit (i.e., hazard quotient); rounded to one significant figure
		USACE	US Army Corps of Engineers

Table 4a: PAH Toxicity Units and Preliminary Remedial Goals Calculated Using the 2007 Toxicity Testing Study Conducted by ASci based on Data Used in the Concentration-Response Analysis

Sample ID #	**9-9-487-R46**				**26-9-515-L49**				**29-9-520-L79**			
Depth (ft)	**4.0 - 5.9**				**4.0 - 9.0**				**7.0 - 8.8**			
Buffalo River Conversion Factor (a)	3.6 % Organic Carbon				2.9 % Organic Carbon				2.5 % Organic Carbon			
Compound	PAH Concentration (ug/kg)	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (ug/kg)	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (ug/kg)	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs												
Acenaphthene	640	6.4E-01	1.8E+01	3.6E-02	3500	3.5E+00	1.2E+02	2.4E-01	140	1.4E-01	5.7E+00	1.2E-02
Acenaphthylene	245	2.5E-01	6.7E+00	1.5E-02	1250	1.3E+00	4.3E+01	9.4E-02	63	6.3E-02	2.6E+00	5.6E-03
Anthracene	1300	1.3E+00	3.6E+01	6.0E-02	7600	7.6E+00	2.6E+02	4.4E-01	440	4.4E-01	1.8E+01	3.0E-02
Benzo (a) anthracene	1200	1.2E+00	3.3E+01	3.9E-02	3200	3.2E+00	1.1E+02	1.3E-01	890	8.9E-01	3.6E+01	4.3E-02
Benzo (a) pyrene	1100	1.1E+00	3.0E+01	3.1E-02	2000	2.0E+00	6.8E+01	7.1E-02	770	7.7E-01	3.1E+01	3.2E-02
Benzo (b) fluoranthene	1300	1.3E+00	3.6E+01	3.6E-02	1800	1.8E+00	6.1E+01	6.3E-02	930	9.3E-01	3.8E+01	3.8E-02
Benzo (e) pyrene		0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00
Benzo (g,h,i) perylene	240	2.4E-01	6.6E+00	6.0E-03	380	3.8E-01	1.3E+01	1.2E-02	220	2.2E-01	8.9E+00	8.1E-03
Benzo (k) fluoranthene	1300	1.3E+00	3.6E+01	3.6E-02	2700	2.7E+00	9.2E+01	9.4E-02	1300	1.3E+00	5.3E+01	5.4E-02
Chrysene	1300	1.3E+00	3.6E+01	4.2E-02	3300	3.3E+00	1.1E+02	1.3E-01	1200	1.2E+00	4.9E+01	5.8E-02
Dibenz (a,h) anthracene	78	7.8E-02	2.1E+00	1.9E-03	140	1.4E-01	4.8E+00	4.3E-03	57	5.7E-02	2.3E+00	2.1E-03
Fluoranthene	3200	3.2E+00	8.8E+01	1.2E-01	13000	1.3E+01	4.4E+02	6.3E-01	2100	2.1E+00	8.5E+01	1.2E-01
Fluorene	2000	2.0E+00	5.5E+01	1.0E-01	7500	7.5E+00	2.6E+02	4.8E-01	370	3.7E-01	1.5E+01	2.8E-02
Indeno (1,2,3-cd) pyrene	230	2.3E-01	6.3E+00	5.7E-03	340	3.4E-01	1.2E+01	1.0E-02	190	1.9E-01	7.7E+00	6.9E-03
Naphthalene	190	1.9E-01	5.2E+00	1.4E-02	1100	1.1E+00	3.8E+01	9.8E-02	71	7.1E-02	2.9E+00	7.5E-03
Phenanthrene	2800	2.8E+00	7.7E+01	1.3E-01	16000	1.6E+01	5.5E+02	9.2E-01	960	9.6E-01	3.9E+01	6.5E-02
Pyrene	2700	2.7E+00	7.4E+01	1.1E-01	8900	8.9E+00	3.0E+02	4.4E-01	1900	1.9E+00	7.7E+01	1.1E-01
Alkylated PAHs												
2-Methylnaphthalene	245	2.5E-01	6.7E+00	1.5E-02	3000	3.0E+00	1.0E+02	2.3E-01	61	6.1E-02	2.5E+00	5.5E-03
		Σ17PAH mg/kg		**Σ17PAH TU**		**Σ17PAH mg/kg**		**Σ17PAH TU**		**Σ17PAH mg/kg**		**Σ17PAH TU**
		20.1		**1**		**75.7**		**4**		**11.7**		**0.6**
		Σ34PAH mg/kg				**Σ34PAH mg/kg**				**Σ34PAH mg/kg**		
		27.0		**1**		**102**		**5**		**15.7**		**0.8**
Σ17PAH mg/kg, TU=1(b)				**18.6**				**13.8**				**13.8**
Σ34PAH mg/kg, TU=1(c)				**25.1**				**18.6**				**18.6**
***Average TOCs for the AOC**												

Table 4a: PAH Toxicity Units and Preliminary Remedial Goals Calculated Using the 2007 Toxicity Testing Study Conducted by ASci based on Data Used in the Concentration-Response Analysis

Sample ID #	**35-9-530-L510**				**50-9-551-L25**				**61-9-570-L810**			
Depth (ft)	**5.0 - 9.6**				**2.2 - 5.2**				**8.0 - 9.7**			
Buffalo River Conversion Factor (a)	3.2 % Organic Carbon				3.6 % Organic Carbon				2.7 % Organic Carbon			
Compound	PAH Concentration (ug/kg)	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (ug/kg)	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (ug/kg)	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs												
Acenaphthene	3400	3.4E+00	1.1E+02	2.1E-01	2600	2.6E+00	7.1E+01	1.5E-01	780	7.8E-01	2.9E+01	6.0E-02
Acenaphthylene	850	8.5E-01	2.6E+01	5.8E-02	1.1E+03	1.1E+00	3.0E+01	6.7E-02	600	6.0E-01	2.3E+01	5.0E-02
Anthracene	6600	6.6E+00	2.0E+02	3.4E-01	6500	6.5E+00	1.8E+02	3.0E-01	2400	2.4E+00	9.0E+01	1.5E-01
Benzo (a) anthracene	2400	2.4E+00	7.4E+01	8.8E-02	2500	2.5E+00	6.9E+01	8.2E-02	2500	2.5E+00	9.4E+01	1.1E-01
Benzo (a) pyrene	1600	1.6E+00	5.0E+01	5.1E-02	1400	1.4E+00	3.8E+01	4.0E-02	2300	2.3E+00	8.6E+01	9.0E-02
Benzo (b) fluoranthene	1500	1.5E+00	4.6E+01	4.7E-02	1600	1.6E+00	4.4E+01	4.5E-02	2700	2.7E+00	1.0E+02	1.0E-01
Benzo (e) pyrene		0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00
Benzo (g,h,i) perylene	300	3.0E-01	9.3E+00	8.5E-03	310	3.1E-01	8.5E+00	7.8E-03	470	4.7E-01	1.8E+01	1.6E-02
Benzo (k) fluoranthene	2300	2.3E+00	7.1E+01	7.3E-02	1400	1.4E+00	3.8E+01	3.9E-02	2400	2.4E+00	9.0E+01	9.2E-02
Chrysene	2600	2.6E+00	8.0E+01	9.5E-02	2600	2.6E+00	7.1E+01	8.5E-02	2600	2.6E+00	9.8E+01	1.2E-01
Dibenz (a,h) anthracene	120	1.2E-01	3.7E+00	3.3E-03	100	1.0E-01	2.7E+00	2.4E-03	200	2.0E-01	7.5E+00	6.7E-03
Fluoranthene	7700	7.7E+00	2.4E+02	3.4E-01	9800	9.8E+00	2.7E+02	3.8E-01	7500	7.5E+00	2.8E+02	4.0E-01
Fluorene	8500	8.5E+00	2.6E+02	4.9E-01	7700	7.7E+00	2.1E+02	3.9E-01	1600	1.6E+00	6.0E+01	1.1E-01
Indeno (1,2,3-cd) pyrene	290	2.9E-01	9.0E+00	8.1E-03	300	3.0E-01	8.2E+00	7.4E-03	450	4.5E-01	1.7E+01	1.5E-02
Naphthalene	740	7.4E-01	2.3E+01	6.0E-02	620	6.2E-01	1.7E+01	4.4E-02	280	2.8E-01	1.1E+01	2.7E-02
Phenanthrene	10000	1.0E+01	3.1E+02	5.2E-01	11000	1.1E+01	3.0E+02	5.1E-01	5100	5.1E+00	1.9E+02	3.2E-01
Pyrene	5600	5.6E+00	1.7E+02	2.5E-01	7100	7.1E+00	2.0E+02	2.8E-01	5600	5.6E+00	2.1E+02	3.0E-01
Alkylated PAHs												
2-Methylnaphthalene	1100	1.1E+00	3.4E+01	7.6E-02	950	9.5E-01	2.6E+01	5.8E-02	580	5.8E-01	2.2E+01	4.9E-02
		Σ17PAH mg/kg		**Σ17PAH TU**		**Σ17PAH mg/kg**		**Σ17PAH TU**		**Σ17PAH mg/kg**		**Σ17PAH TU**
		55.6		**3**		**57.6**		**2**		**38.06**		**2**
		Σ34PAH mg/kg				**Σ34PAH mg/kg**				**Σ34PAH mg/kg**		
		74.9		**4**		**77.6**		**3**		**51.29**		**3**
Σ17PAH mg/kg, TU=1(b)				**15.2**				**17.2**				**14.0**
Σ34PAH mg/kg, TU=1(c)				**20.4**				**23.2**				**18.8**
***Average TOCs for the AOC**												

Table 4a: PAH Toxicity Units and Preliminary Remedial Goals Calculated Using the 2007 Toxicity Testing Study Conducted by ASci based on Data Used in the Concentration-Response Analysis

Sample ID #	79-9-801-L46			
Depth (ft)	4.5 - 6.0			
Buffalo River Conversion Factor (a)	4.0 % Organic Carbon			
Compound	PAH Concentration (ug/kg)	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs				
Acenaphthene	690	6.9E-01	1.7E+01	3.5E-02
Acenaphthylene	485	4.9E-01	1.2E+01	2.7E-02
Anthracene	3700	3.7E+00	9.3E+01	1.6E-01
Benzo (a) anthracene	1400	1.4E+00	3.5E+01	4.2E-02
Benzo (a) pyrene	1200	1.2E+00	3.0E+01	3.1E-02
Benzo (b) fluoranthene	1400	1.4E+00	3.5E+01	3.6E-02
Benzo (e) pyrene		0.0E+00	0.0E+00	0.0E+00
Benzo (g,h,i) perylene	220	2.2E-01	5.5E+00	5.1E-03
Benzo (k) fluoranthene	1300	1.3E+00	3.3E+01	3.3E-02
Chrysene	1700	1.7E+00	4.3E+01	5.1E-02
Dibenz (a,h) anthracene	68	6.8E-02	1.7E+00	1.5E-03
Fluoranthene	3600	3.6E+00	9.1E+01	1.3E-01
Fluorene	3100	3.1E+00	7.8E+01	1.5E-01
Indeno (1,2,3-cd) pyrene	200	2.0E-01	5.0E+00	4.5E-03
Naphthalene	320	3.2E-01	8.1E+00	2.1E-02
Phenanthrene	3800	3.8E+00	9.6E+01	1.6E-01
Pyrene	3200	3.2E+00	8.1E+01	1.2E-01
Alkylated PAHs				
2-Methylnaphthalene	1800	1.8E+00	4.5E+01	1.0E-01
		Σ17PAH mg/kg		Σ17PAH TU
		28.18		1
		Σ34PAH mg/kg		
		37.98		1
Σ17PAH mg/kg, TU=1(b)				**19.1**
Σ34PAH mg/kg, TU=1(c)				**25.7**
***Average TOCs for the AOC**				

Sample ID #	90-9-816+50-R34			
Depth (ft)	2.8 - 4.7			
Buffalo River Conversion Factor (a)	3.6 % Organic Carbon			
Compound	PAH Concentration (ug/kg)	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs				
Acenaphthene	940	9.4E-01	2.6E+01	5.4E-02
Acenaphthylene	600	6.0E-01	1.7E+01	3.7E-02
Anthracene	1900	1.9E+00	5.4E+01	9.0E-02
Benzo (a) anthracene	2500	2.5E+00	7.0E+01	8.4E-02
Benzo (a) pyrene	2200	2.2E+00	6.2E+01	6.4E-02
Benzo (b) fluoranthene	2800	2.8E+00	7.9E+01	8.1E-02
Benzo (e) pyrene		0.0E+00	0.0E+00	0.0E+00
Benzo (g,h,i) perylene	470	4.7E-01	1.3E+01	1.2E-02
Benzo (k) fluoranthene	3400	3.4E+00	9.6E+01	9.8E-02
Chrysene	2700	2.7E+00	7.6E+01	9.0E-02
Dibenz (a,h) anthracene	180	1.8E-01	5.1E+00	4.5E-03
Fluoranthene	7500	7.5E+00	2.1E+02	3.0E-01
Fluorene	1700	1.7E+00	4.8E+01	8.9E-02
Indeno (1,2,3-cd) pyrene	520	5.2E-01	1.5E+01	1.3E-02
Naphthalene	190	1.9E-01	5.4E+00	1.4E-02
Phenanthrene	4500	4.5E+00	1.3E+02	2.1E-01
Pyrene	4700	4.7E+00	1.3E+02	1.9E-01
Alkylated PAHs				
2-Methylnaphthalene	600	6.0E-01	1.7E+01	3.8E-02
		Σ17PAH mg/kg		Σ17PAH TU
		37.40		1
		Σ34PAH mg/kg		
		50.40		2
Σ17PAH mg/kg, TU=1(b)				**18.9**
Σ34PAH mg/kg, TU=1(c)				**25.4**

Sample ID #	103-9-841-L23			
Depth (ft)	1.7 - 3.2			
Buffalo River Conversion Factor (a)	3.1 % Organic Carbon			
Compound	PAH Concentration (ug/kg)	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs				
Acenaphthene	500	5.0E-01	1.6E+01	3.3E-02
Acenaphthylene	550	5.5E-01	1.8E+01	3.9E-02
Anthracene	2400	2.4E+00	7.8E+01	1.3E-01
Benzo (a) anthracene	1800	1.8E+00	5.8E+01	6.9E-02
Benzo (a) pyrene	1300	1.3E+00	4.2E+01	4.4E-02
Benzo (b) fluoranthene	2300	2.3E+00	7.4E+01	7.6E-02
Benzo (e) pyrene		0.0E+00	0.0E+00	0.0E+00
Benzo (g,h,i) perylene	270	2.7E-01	8.7E+00	8.0E-03
Benzo (k) fluoranthene	1900	1.9E+00	6.1E+01	6.3E-02
Chrysene	2300	2.3E+00	7.4E+01	8.8E-02
Dibenz (a,h) anthracene	97	9.7E-02	3.1E+00	2.8E-03
Fluoranthene	6000	6.0E+00	1.9E+02	2.7E-01
Fluorene	1100	1.1E+00	3.6E+01	6.6E-02
Indeno (1,2,3-cd) pyrene	260	2.6E-01	8.4E+00	7.5E-03
Naphthalene	230	2.3E-01	7.4E+00	1.9E-02
Phenanthrene	2600	2.6E+00	8.4E+01	1.4E-01
Pyrene	4000	4.0E+00	1.3E+02	1.9E-01
Alkylated PAHs				
2-Methylnaphthalene	450	4.5E-01	1.5E+01	3.3E-02
		Σ17PAH mg/kg		Σ17PAH TU
		28.06		1
		Σ34PAH mg/kg		
		37.81		2
Σ17PAH mg/kg, TU=1(b)				**16.3**
Σ34PAH mg/kg, TU=1(c)				**21.9**

Sample ID #	123-9-872+88-C01			
Depth (ft)	ponar			
Buffalo River Conversion Factor (a)	7.1 % Organic Carbon			
Compound	PAH Concentration (ug/kg)	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs				
Acenaphthene	980	9.8E-01	1.4E+01	2.8E-02
Acenaphthylene	4600	4.6E+00	6.5E+01	1.4E-01
Anthracene	1400	1.4E+00	2.0E+01	3.3E-02
Benzo (a) anthracene	2200	2.2E+00	3.1E+01	3.7E-02
Benzo (a) pyrene	2300	2.3E+00	3.3E+01	3.4E-02
Benzo (b) fluoranthene	2300	2.3E+00	3.3E+01	3.3E-02
Benzo (e) pyrene		0.0E+00	0.0E+00	0.0E+00
Benzo (g,h,i) perylene	810	8.1E-01	1.1E+01	1.0E-02
Benzo (k) fluoranthene	2800	2.8E+00	4.0E+01	4.0E-02
Chrysene	2400	2.4E+00	3.4E+01	4.0E-02
Dibenz (a,h) anthracene	240	2.4E-01	3.4E+00	3.0E-03
Fluoranthene	5900	5.9E+00	8.3E+01	1.2E-01
Fluorene	4900	4.9E+00	6.9E+01	1.3E-01
Indeno (1,2,3-cd) pyrene	810	8.1E-01	1.1E+01	1.0E-02
Naphthalene	33000	3.3E+01	4.7E+02	1.2E+00
Phenanthrene	12000	1.2E+01	1.7E+02	2.8E-01
Pyrene	4700	4.7E+00	6.6E+01	9.5E-02
Alkylated PAHs				
2-Methylnaphthalene	5100	5.1E+00	7.2E+01	1.6E-01
		Σ17PAH mg/kg		Σ17PAH TU
		86.4		2
		Σ34PAH mg/kg		
		116		3
Σ17PAH mg/kg, TU=1(b)				**26.6**
Σ34PAH mg/kg, TU=1(c)				**35.8**

Table 5a: Sediment PAH Analysis Using USACE's 2007 Toxicity Testing Data (with TOC from the Study)

USACE 2007		BL-1	Outside AOC		BL-2	Outside AOC		BL-3	Outside AOC	
Buffalo River Conversion Factor (a)	1.34	0.6 % Organic Carbon			1.0 % Organic Carbon			0.8 % Organic Carbon		
Compound	Final Chronic Value (µg/goc)	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs										
Acenaphthene	491	3.0E-04	4.9E-02	1.0E-04	1.7E-03	1.8E-01	3.6E-04	3.4E-03	4.4E-01	9.0E-04
Acenaphthylene	452	9.9E-04	1.6E-01	3.5E-04	2.9E-03	3.0E-01	6.7E-04	9.2E-03	1.2E+00	2.7E-03
Anthracene	594	2.0E-03	3.3E-01	5.5E-04	6.0E-03	6.2E-01	1.0E-03	1.2E-02	1.5E+00	2.6E-03
Benzo (a) anthracene	841	7.8E-03	1.3E+00	1.5E-03	2.1E-02	2.1E+00	2.6E-03	3.8E-02	4.9E+00	5.8E-03
Benzo (a) pyrene	965	5.9E-03	9.6E-01	9.9E-04	1.6E-02	1.6E+00	1.7E-03	3.3E-02	4.3E+00	4.5E-03
Benzo (b) fluoranthene	979	8.2E-03	1.3E+00	1.4E-03	1.9E-02	2.0E+00	2.0E-03	5.1E-02	6.7E+00	6.9E-03
Benzo (e) pyrene	967		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
Benzo (g,h,i) perylene	1,095	4.2E-03	6.8E-01	6.2E-04	9.2E-03	9.5E-01	8.7E-04	2.4E-02	3.1E+00	2.8E-03
Benzo (k) fluoranthene	981	4.2E-03	6.8E-01	6.9E-04	1.1E-02	1.1E+00	1.2E-03	1.9E-02	2.5E+00	2.6E-03
Chrysene	844	4.5E-04	7.3E-02	8.6E-05	9.1E-03	9.5E-01	1.1E-03	5.5E-02	7.2E+00	8.5E-03
Dibenz (a,h) anthracene	1,123	7.2E-04	1.2E-01	1.0E-04	1.8E-03	1.9E-01	1.7E-04	5.6E-03	7.4E-01	6.6E-04
Fluoranthene	707	1.7E-02	2.8E+00	3.9E-03	4.4E-02	4.6E+00	6.4E-03	8.7E-02	1.1E+01	1.6E-02
Fluorene	538	1.0E-03	1.7E-01	3.1E-04	4.0E-03	4.2E-01	7.8E-04	7.1E-03	9.3E-01	1.7E-03
Indeno (1,2,3-cd) pyrene	1,115	3.5E-03	5.7E-01	5.1E-04	8.2E-03	8.5E-01	7.7E-04	2.0E-02	2.6E+00	2.4E-03
Naphthalene	385	6.8E-04	1.1E-01	2.8E-04	1.9E-03	1.9E-01	5.0E-04	5.0E-03	6.5E-01	1.7E-03
Phenanthrene	596	8.1E-03	1.3E+00	2.2E-03	2.9E-02	3.0E+00	5.0E-03	3.7E-02	4.8E+00	8.1E-03
Pyrene	697	8.4E-04	1.4E-01	1.9E-04	2.8E-02	2.9E+00	4.1E-03	7.8E-02	1.0E+01	1.5E-02
Alkylated PAHs										
1-Methylnaphthalene	446	8.0E-04	1.3E-01	2.9E-04	1.6E-03	1.6E-01	3.6E-04	4.0E-03	5.2E-01	1.2E-03
2-Methylnaphthalene	447	7.2E-04	1.2E-01	2.6E-04	1.4E-03	1.4E-01	3.2E-04	4.1E-03	5.4E-01	1.2E-03
C1-Anthracenes/ Phenanthrenes	670		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Chrysenes	929		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluoranthenes/ Pyrenes	770		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluorenes	611		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Anthracenes/ Phenanthrenes	746		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Chrysenes	1,008		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Fluorenes	686		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Napthalenes	510		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Anthracenes/ Phenanthrenes	829		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Chrysenes	1,112		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Fluorenes	769		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Napthalenes	581		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Anthracenes/ Phenanthrenes	913		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Chrysenes	1,214		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Napthalenes	657		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
		Σ17PAH mg/kg		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**
		0.07		**0.01**	**0.21**		**0.03**	**0.49**		**0.09**
		Σ34PAH mg/kg			**Σ34PAH mg/kg**			**Σ34PAH mg/kg**		
		0.09		**0.02**	**0.29**		**0.04**	**0.66**		**0.11**
Σ17PAH mg/kg, TU=1(b,c)				**3.5**			**5.4**			**4.3**
Σ34PAH mg/kg, TU=1(b,d)				**4.7**			**7.2**			**5.8**

USACE 2007		BL-4	Outside AOC		BH-16	RM 0.8		BH-17	RM 0.5	
Buffalo River Conversion Factor (a)	1.34	0.8 % Organic Carbon			1.4 % Organic Carbon			1.9 % Organic Carbon		
Compound	Final Chronic Value (µg/goc)	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs										
Acenaphthene	491	8.9E-03	1.1E+00	2.3E-03	3.8E-02	2.7E+00	5.4E-03	1.7E-02	8.8E-01	1.8E-03
Acenaphthylene	452	7.6E-03	9.6E-01	2.1E-03	5.2E-02	3.6E+00	8.0E-03	2.5E-02	1.3E+00	2.9E-03
Anthracene	594	2.3E-02	2.9E+00	4.9E-03	2.2E-01	1.5E+01	2.6E-02	5.0E-02	2.6E+00	4.4E-03
Benzo (a) anthracene	841	7.6E-02	9.5E+00	1.1E-02	5.0E-01	3.5E+01	4.2E-02	2.1E-01	1.1E+01	1.3E-02
Benzo (a) pyrene	965	6.3E-02	8.0E+00	8.3E-03	4.0E-01	2.8E+01	2.9E-02	2.0E-01	1.1E+01	1.1E-02
Benzo (b) fluoranthene	979	9.4E-02	1.2E+01	1.2E-02	6.6E-01	4.6E+01	4.7E-02	3.8E-01	2.0E+01	2.0E-02
Benzo (e) pyrene	967		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
Benzo (g,h,i) perylene	1,095	4.2E-02	5.3E+00	4.8E-03	2.5E-01	1.8E+01	1.6E-02	1.5E-01	7.6E+00	7.0E-03
Benzo (k) fluoranthene	981	3.8E-02	4.8E+00	4.9E-03	2.2E-01	1.5E+01	1.5E-02	1.0E-01	5.3E+00	5.4E-03
Chrysene	844	9.4E-02	1.2E+01	1.4E-02	5.7E-02	3.9E+00	4.6E-03	4.0E-01	2.1E+01	2.4E-02
Dibenz (a,h) anthracene	1,123	5.0E-03	6.3E-01	5.6E-04	9.1E-02	6.3E+00	5.6E-03	1.1E-02	5.4E-01	4.8E-04
Fluoranthene	707	1.6E-01	2.0E+01	2.8E-02	9.1E-01	6.3E+01	8.9E-02	4.6E-01	2.4E+01	3.4E-02
Fluorene	538	1.7E-02	2.2E+00	4.0E-03	1.4E-01	9.7E+00	1.8E-02	3.1E-02	1.6E+00	3.0E-03
Indeno (1,2,3-cd) pyrene	1,115	3.4E-02	4.3E+00	3.9E-03	1.9E-01	1.3E+01	1.2E-02	1.3E-01	6.7E+00	6.0E-03
Naphthalene	385	6.9E-03	8.6E-01	2.2E-03	3.6E-02	2.5E+00	6.4E-03	1.6E-02	8.2E-01	2.1E-03
Phenanthrene	596	8.1E-02	1.0E+01	1.7E-02	2.8E-01	1.9E+01	3.3E-02	1.9E-01	9.9E+00	1.7E-02
Pyrene	697	1.5E-01	1.8E+01	2.6E-02	3.2E-02	2.2E+00	3.2E-03	5.3E-01	2.7E+01	3.9E-02
Alkylated PAHs										
1-Methylnaphthalene	446	5.1E-03	6.4E-01	1.4E-03	3.6E-02	2.5E+00	5.7E-03	1.1E-02	5.8E-01	1.3E-03
2-Methylnaphthalene	447	5.6E-03	7.0E-01	1.6E-03	3.2E-02	2.2E+00	5.0E-03	1.3E-02	6.9E-01	1.6E-03
C1-Anthracenes/ Phenanthrenes	670		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Chrysenes	929		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluoranthenes/ Pyrenes	770		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluorenes	611		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Anthracenes/ Phenanthrenes	746		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Chrysenes	1,008		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Fluorenes	686		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Napthalenes	510		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Anthracenes/ Phenanthrenes	829		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Chrysenes	1,112		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Fluorenes	769		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Napthalenes	581		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Anthracenes/ Phenanthrenes	913		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Chrysenes	1,214		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Napthalenes	657		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
		Σ17PAH mg/kg		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**
		0.90		**0.1**	**4.15**		**0.4**	**2.92**		**0.2**
		Σ34PAH mg/kg			**Σ34PAH mg/kg**			**Σ34PAH mg/kg**		
		1.20		**0.2**	**5.55**		**0.5**	**3.90**		**0.3**
Σ17PAH mg/kg, TU=1(b,c)				**4.5**			**8.4**			**11.3**
Σ34PAH mg/kg, TU=1(b,d)				**6.0**			**11.2**			**15.1**

***TOCs are NOT representative of the overall TOC of the AOC**

Average Sum of 17 PAHs mg/kg TU=1 AOC Data	**9.6**
Average Sum of 17 PAHs mg/kg TU=1 All Data	**8.6**
Average Sum of 34 PAHs mg/kg TU=1 All Data	**11.5**

Average TC 1.53

Geomean T 1.46

(a) The conversion factor between the full 34 PAH list and the 17 PAH list is 1.36 with the full data set and 1.35 based on this data set that includes 1 and 2-methylnapthylene, as indicated in the excel worksheet provided in the workbook associated with this table.

(b) This data set reflects samples collected within the navigational channel with only approximately 15% of samples with ≥ 2% TOC, which is significantly different than the overall AOC data set with > 75% of samples having ≥ 2% TOC.

(c) The average protective Σ17PAH concentration is calculated by setting the TU34=1. Specifically, it is based on the average of (Σ17PAH dry weight sediment concentrations divided by the actual TU of 34PAHs) divided by (1000) to convert units of microgram to milligram.

(d) The average protective Σ34PAH concentration is calculated by setting the TU34=1. Specifically, it is based on the average of (Σ34PAH dry weight sediment concentrations divided by the TU of 34PAHs) divided by (1000) to convert units of microgram to milligram.

Table 5a: Sediment PAH Analysis Using USACE's 2007 Toxicity Testing Data (with TOC from the Study)

USACE 2007	BH-18	RM 0.4			BH-18		BH-22	Outside AOC		BH-23	Outside AOC		BH-24	Outside AOC		BH-25	Outside AOC		BH-26	Outside AOC	
Buffalo River Conversion Factor (a)	1.6	% Organic Carbon			ΣPAH TU = 1		0.9	% Organic Carbon		1.2	% Organic Carbon		1.6	% Organic Carbon		1.3	% Organic Carbon		1.3	% Organic Carbon	
Compound	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	Concentrations where ΣPAH TU = 1	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs																					
Acenaphthene	2.4E-02	1.5E+00	3.0E-03	9.6E-02	5.9E+00	1.2E-02	3.0E-02	3.2E+00	6.6E-03	2.0E-02	1.6E+00	3.4E-03	3.9E-02	2.5E+00	5.0E-03	2.1E-01	1.6E+01	3.3E-02	3.2E-02	2.4E+00	4.8E-03
Acenaphthylene	2.3E-02	1.4E+00	3.2E-03	9.3E-02	5.7E+00	1.3E-02	1.0E-01	1.1E+01	2.4E-02	5.9E-02	4.8E+00	1.1E-02	1.2E-01	7.4E+00	1.6E-02	4.7E-01	3.8E+01	8.3E-02	7.6E-02	5.7E+00	1.3E-02
Anthracene	6.7E-02	4.1E+00	7.0E-03	2.7E-01	1.6E+01	2.8E-02	1.6E-01	1.7E+01	2.8E-02	9.3E-02	7.5E+00	1.3E-02	1.9E-01	1.2E+01	2.0E-02	8.7E-01	7.0E+01	1.2E-01	1.5E-01	1.1E+01	1.9E-02
Benzo (a) anthracene	2.5E-01	1.5E+01	1.8E-02	9.9E-01	6.1E+01	7.3E-02	5.0E-01	5.3E+01	6.4E-02	2.7E-01	2.2E+01	2.6E-02	5.6E-01	3.5E+01	4.2E-02	2.3E+00	1.8E+02	2.1E-01	4.4E-01	3.3E+01	4.0E-02
Benzo (a) pyrene	2.0E-01	1.2E+01	1.3E-02	8.0E-01	4.9E+01	5.1E-02	4.5E-01	4.8E+01	4.9E-02	2.6E-01	2.1E+01	2.2E-02	4.9E-01	3.1E+01	3.2E-02	2.1E+00	1.7E+02	1.7E-01	3.5E-01	2.6E+01	2.7E-02
Benzo (b) fluoranthene	2.7E-01	1.7E+01	1.7E-02	1.1E+00	6.5E+01	6.7E-02	5.8E-01	6.2E+01	6.4E-02	3.4E-01	2.7E+01	2.8E-02	6.9E-01	4.3E+01	4.4E-02	2.6E+00	2.0E+02	2.1E-01	5.1E-01	3.8E+01	3.9E-02
Benzo (e) pyrene		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
Benzo (g,h,i) perylene	1.4E-01	8.6E+00	7.8E-03	5.5E-01	3.4E+01	3.1E-02	2.2E-01	2.3E+01	2.1E-02	5.8E-03	4.7E-01	4.3E-04	1.2E-02	7.5E-01	6.8E-04	1.0E+00	8.2E+01	7.5E-02	2.1E-01	1.5E+01	1.4E-02
Benzo (k) fluoranthene	2.0E-01	1.2E+01	1.2E-02	7.8E-01	4.8E+01	4.9E-02	2.1E-01	2.3E+01	2.3E-02	1.2E-01	9.9E+00	1.0E-02	2.0E-01	1.3E+01	1.3E-02	9.5E-01	7.6E+01	7.8E-02	1.5E-01	1.1E+01	1.2E-02
Chrysene	3.9E-01	2.4E+01	2.8E-02	1.5E+00	9.4E+01	1.1E-01	5.7E-01	6.1E+01	7.2E-02	3.6E-01	2.9E+01	3.4E-02	7.3E-01	4.6E+01	5.5E-02	2.7E+00	2.2E+02	2.6E-01	5.7E-01	4.3E+01	5.1E-02
Dibenz (a,h) anthracene	2.6E-02	1.6E+00	1.4E-03	1.0E-01	6.3E+00	5.6E-03	5.9E-02	6.3E+00	5.6E-03	1.5E-02	1.2E+00	1.1E-03	3.0E-02	1.9E+00	1.7E-03	2.6E-01	2.1E+01	1.8E-02	2.2E-02	1.7E+00	1.5E-03
Fluoranthene	5.2E-01	3.2E+01	4.5E-02	2.0E+00	1.3E+02	1.8E-01	6.4E-01	6.9E+01	9.7E-02	4.1E-01	3.3E+01	4.7E-02	7.5E-01	4.7E+01	6.6E-02	3.3E+00	2.6E+02	3.7E-01	6.0E-01	4.5E+01	6.4E-02
Fluorene	4.2E-02	2.6E+00	4.8E-03	1.7E-01	1.0E+01	1.9E-02	7.4E-02	7.9E+00	1.5E-02	4.6E-02	3.7E+00	6.8E-03	7.7E-02	4.9E+00	9.0E-03	5.2E-01	4.1E+01	7.7E-02	6.6E-02	4.9E+00	9.2E-03
Indeno (1,2,3-cd) pyrene	1.3E-01	8.0E+00	7.2E-03	5.1E-01	3.2E+01	2.8E-02	2.0E-01	2.1E+01	1.9E-02	1.5E-01	1.2E+01	1.1E-02	2.5E-01	1.6E+01	1.4E-02	9.6E-01	7.7E+01	6.9E-02	1.9E-01	1.5E+01	1.3E-02
Naphthalene	3.8E-02	2.4E+00	6.2E-03	1.5E-01	9.4E+00	2.4E-02	2.4E-01	2.6E+01	6.8E-02	1.5E-01	1.2E+01	3.1E-02	3.4E-01	2.1E+01	5.5E-02	1.2E+00	9.5E+01	2.5E-01	2.2E-01	1.6E+01	4.3E-02
Phenanthrene	2.4E-01	1.5E+01	2.5E-02	9.4E-01	5.8E+01	9.8E-02	2.9E-01	3.1E+01	5.1E-02	2.0E-01	1.6E+01	2.7E-02	3.8E-01	2.4E+01	4.0E-02	2.1E+00	1.7E+02	2.8E-01	3.1E-01	2.3E+01	3.9E-02
Pyrene	5.6E-01	3.4E+01	4.9E-02	2.2E+00	1.4E+02	2.0E-01	7.2E-01	7.6E+01	1.1E-01	4.7E-01	3.8E+01	5.4E-02	8.3E-01	5.2E+01	7.5E-02	3.5E+00	2.8E+02	4.0E-01	6.6E-01	4.9E+01	7.1E-02
Alkylated PAHs																					
1-Methylnaphthalene	1.3E-02	8.2E-01	1.8E-03	5.3E-02	3.2E+00	7.3E-03	2.6E-02	2.8E+00	6.2E-03	1.8E-02	1.4E+00	3.2E-03	3.0E-02	1.9E+00	4.3E-03	1.3E-01	1.0E+01	2.3E-02	2.5E-02	1.8E+00	4.1E-03
2-Methylnaphthalene	1.8E-02	1.1E+00	2.4E-03	7.0E-02	4.3E+00	9.6E-03	2.4E-02	2.5E+00	5.6E-03	3.1E-02	2.5E+00	5.5E-03	6.3E-02	4.0E+00	8.9E-03	1.2E-01	9.9E+00	2.2E-02	4.7E-02	3.5E+00	7.9E-03
C1-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Chrysenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluoranthenes/ Pyrenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluorenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Chrysenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Fluorenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Napthalenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Chrysenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Fluorenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Napthalenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Chrysenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Napthalenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
	Σ17PAH mg/kg		**Σ17PAH TU**			**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**
	3.13		**0.3**			**1**	**5.08**		**0.7**	**3.01**		**0.3**	**5.77**		**0.5**	**25.15**		**3**	**4.63**		**0.5**
	Σ34PAH mg/kg						**Σ34PAH mg/kg**		**1**	**Σ34PAH mg/kg**			**Σ34PAH mg/kg**			**Σ34PAH mg/kg**			**Σ34PAH mg/kg**		
	4.19		**0.3**				**6.80**		**0.97**	**4.02**		**0.4**	**7.73**		**0.7**	**33.64**		**4**	**6.19**		**0.6**
Σ17PAH mg/kg, TU=1(b,c)			**9.3**						**5.2**			**6.8**			**8.6**			**6.8**			**7.3**
Σ34PAH mg/kg, TU=1(b,d)			**12.4**						**7.0**			**9.0**			**11.5**			**9.2**			**9.8**

***TOCs are NOT representative of th**

TU ≤ 1	Toxic units (i.e., hazard quotients) less than one indicates toxicity from PAHs unlikely
TU >1	Toxic unit (i.e., hazard quotients) greater than 1 indicates toxicity from PAH is predicted, but no toxicity was observed in this chronic study
	TOC<2%
	TOC >2%
CF	conversion factor

µg/gOC	microgram per gram of organic carbon
µg/kg	microgram per kilogram
PAH	polycyclic aromatic hydrocarbon
RM	river mile
TOC	total organic carbon
TPAH	total polycyclic aromatic hydrocarbon
TU	toxicity unit (i.e., hazard quotient); rounded to one significant figure
USACE	US Army Corps of Engineers

Table 5a: Sediment PAH Analysis Using USACE's 2007 Toxicity Testing Data (with TOC from the Study)

USACE 2007	BH-27	Outside AOC		BH-28	Outside AOC		BH-19	Outside AOC		BH-20	Outside AOC	
Buffalo River Conversion Factor (a)	2.1	% Organic Carbon		2.0	% Organic Carbon		1.8	% Organic Carbon		1.6	% Organic Carbon	
Compound	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs												
Acenaphthene	2.8E-02	1.3E+00	2.7E-03	3.4E-02	1.7E+00	3.4E-03	1.4E-02	7.7E-01	1.6E-03	1.9E-02	1.2E+00	2.4E-03
Acenaphthylene	6.5E-02	3.1E+00	6.8E-03	6.5E-02	3.2E+00	7.1E-03	1.7E-02	9.5E-01	2.1E-03	2.9E-02	1.9E+00	4.1E-03
Anthracene	1.2E-01	5.7E+00	9.5E-03	1.4E-01	6.7E+00	1.1E-02	3.8E-02	2.1E+00	3.6E-03	6.5E-02	4.2E+00	7.0E-03
Benzo (a) anthracene	3.9E-01	1.8E+01	2.2E-02	3.8E-01	1.9E+01	2.2E-02	1.3E-01	7.2E+00	8.5E-03	2.5E-01	1.6E+01	1.9E-02
Benzo (a) pyrene	3.3E-01	1.6E+01	1.6E-02	3.0E-01	1.5E+01	1.5E-02	1.2E-01	6.5E+00	6.8E-03	2.4E-01	1.5E+01	1.6E-02
Benzo (b) fluoranthene	4.7E-01	2.2E+01	2.3E-02	4.3E-01	2.1E+01	2.1E-02	1.9E-01	1.1E+01	1.1E-02	4.1E-01	2.6E+01	2.7E-02
Benzo (e) pyrene		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
Benzo (g,h,i) perylene	2.1E-01	1.0E+01	9.2E-03	1.9E-01	9.2E+00	8.4E-03	8.1E-02	4.6E+00	4.2E-03	1.8E-01	1.2E+01	1.1E-02
Benzo (k) fluoranthene	1.3E-01	6.3E+00	6.4E-03	1.3E-01	6.5E+00	6.6E-03	6.9E-02	3.9E+00	4.0E-03	1.2E-01	7.6E+00	7.7E-03
Chrysene	4.9E-01	2.3E+01	2.8E-02	4.9E-01	2.4E+01	2.9E-02	2.1E-01	1.2E+01	1.4E-02	4.2E-01	2.7E+01	3.1E-02
Dibenz (a,h) anthracene	2.2E-02	1.0E+00	9.2E-04	1.8E-02	8.7E-01	7.8E-04	6.6E-03	3.7E-01	3.3E-04	1.4E-02	9.2E-01	8.2E-04
Fluoranthene	5.3E-01	2.5E+01	3.5E-02	5.8E-01	2.8E+01	4.0E-02	2.6E-01	1.5E+01	2.1E-02	4.8E-01	3.0E+01	4.3E-02
Fluorene	5.8E-02	2.8E+00	5.1E-03	6.8E-02	3.4E+00	6.3E-03	2.9E-02	1.7E+00	3.1E-03	3.7E-02	2.3E+00	4.3E-03
Indeno (1,2,3-cd) pyrene	2.0E-01	9.3E+00	8.4E-03	1.8E-01	8.6E+00	7.7E-03	7.3E-02	4.1E+00	3.7E-03	1.6E-01	1.0E+01	9.3E-03
Naphthalene	1.7E-01	8.1E+00	2.1E-02	2.2E-01	1.1E+01	2.8E-02	1.4E-02	7.7E-01	2.0E-03	3.9E-02	2.5E+00	6.5E-03
Phenanthrene	2.7E-01	1.3E+01	2.1E-02	3.3E-01	1.6E+01	2.7E-02	1.3E-01	7.6E+00	1.3E-02	1.9E-01	1.2E+01	2.0E-02
Pyrene	6.1E-01	2.9E+01	4.1E-02	6.5E-01	3.2E+01	4.6E-02	2.9E-01	1.7E+01	2.4E-02	5.7E-01	3.6E+01	5.2E-02
Alkylated PAHs												
1-Methylnaphthalene	2.2E-02	1.1E+00	2.4E-03	2.3E-02	1.1E+00	2.5E-03	8.7E-03	4.9E-01	1.1E-03	1.2E-02	7.3E-01	1.6E-03
2-Methylnaphthalene	3.9E-02	1.9E+00	4.2E-03	4.3E-02	2.1E+00	4.7E-03	1.1E-02	6.0E-01	1.3E-03	1.7E-02	1.1E+00	2.4E-03
C1-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluoranthenes/ Pyrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
	Σ17PAH mg/kg		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**
	4.14		**0.3**	**4.24**		**0.3**	**1.68**		**0.1**	**3.25**		**0.3**
	Σ34PAH mg/kg		**0.4**	**Σ34PAH mg/kg**			**Σ34PAH mg/kg**			**Σ34PAH mg/kg**		
	5.53		**0.35**	**5.67**		**0.4**	**2.25**		**0.2**	**4.35**		**0.4**
Σ17PAH mg/kg, TU=1(b,c)			**11.7**			**11.1**			**10.1**			**9.2**
Σ34PAH mg/kg, TU=1(b,d)			**15.7**			**14.8**			**13.5**			**12.3**

USACE 2007	BH-21	Outside AOC		BH-21			BH-13	SC		BH-14	SC	
Buffalo River Conversion Factor (a)	1.2	% Organic Carbon		ΣPAH TU = 1			1.8	% Organic Carbon		1.6	% Organic Carbon	
Compound	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	Concentrations where ΣPAH TU = 1	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs												
Acenaphthene	8.4E-03	6.9E-01	1.4E-03	3.5E-02	2.9E+00	5.8E-03	9.5E-03	5.3E-01	1.1E-03	8.1E-03	4.9E-01	1.0E-03
Acenaphthylene	3.7E-02	3.0E+00	6.7E-03	1.5E-01	1.3E+01	2.8E-02	1.6E-02	9.2E-01	2.0E-03	1.2E-02	7.6E-01	1.7E-03
Anthracene	6.4E-02	5.3E+00	8.9E-03	2.6E-01	2.2E+01	3.7E-02	2.8E-02	1.6E+00	2.7E-03	2.8E-02	1.7E+00	2.9E-03
Benzo (a) anthracene	2.4E-01	2.0E+01	2.4E-02	1.0E+00	8.3E+01	9.9E-02	1.0E-01	5.6E+00	6.7E-03	1.3E-01	7.9E+00	9.4E-03
Benzo (a) pyrene	2.5E-01	2.1E+01	2.1E-02	1.0E+00	8.6E+01	8.9E-02	7.8E-02	4.4E+00	4.5E-03	1.1E-01	6.6E+00	6.9E-03
Benzo (b) fluoranthene	4.1E-01	3.4E+01	3.5E-02	1.7E+00	1.4E+02	1.5E-01	1.2E-01	6.5E+00	6.6E-03	1.8E-01	1.1E+01	1.1E-02
Benzo (e) pyrene		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
Benzo (g,h,i) perylene	1.7E-01	1.4E+01	1.3E-02	6.9E-01	5.7E+01	5.2E-02	4.2E-02	2.4E+00	2.2E-03	6.8E-02	4.2E+00	3.8E-03
Benzo (k) fluoranthene	1.4E-01	1.1E+01	1.1E-02	5.6E-01	4.6E+01	4.7E-02	4.7E-02	2.6E+00	2.7E-03	7.1E-02	4.3E+00	4.4E-03
Chrysene	1.2E-02	1.0E+00	1.2E-03	5.1E-02	4.2E+00	5.0E-03	1.2E-01	7.0E+00	8.3E-03	1.8E-01	1.1E+01	1.3E-02
Dibenz (a,h) anthracene	4.4E-02	3.6E+00	3.2E-03	1.8E-01	1.5E+01	1.3E-02	1.4E-02	7.8E-01	7.0E-04	3.1E-02	1.9E+00	1.7E-03
Fluoranthene	4.4E-01	3.7E+01	5.2E-02	1.8E+00	1.5E+02	2.1E-01	1.5E-01	8.3E+00	1.2E-02	2.5E-01	1.5E+01	2.1E-02
Fluorene	2.8E-02	2.3E+00	4.3E-03	1.2E-01	9.5E+00	1.8E-02	1.4E-02	7.6E-01	1.4E-03	1.2E-02	7.3E-01	1.4E-03
Indeno (1,2,3-cd) pyrene	1.5E-01	1.2E+01	1.1E-02	6.0E-01	5.0E+01	4.5E-02	4.3E-02	2.4E+00	2.2E-03	6.9E-02	4.2E+00	3.8E-03
Naphthalene	4.5E-02	3.7E+00	9.6E-03	1.9E-01	1.5E+01	4.0E-02	1.6E-02	8.8E-01	2.3E-03	8.0E-03	4.8E-01	1.3E-03
Phenanthrene	1.3E-01	1.1E+01	1.8E-02	5.4E-01	4.5E+01	7.5E-02	5.1E-02	2.8E+00	4.8E-03	8.7E-02	5.3E+00	8.9E-03
Pyrene	1.5E-01	1.3E+01	1.8E-02	6.4E-01	5.3E+01	7.6E-02	1.4E-01	8.0E+00	1.1E-02	2.2E-01	1.4E+01	2.0E-02
Alkylated PAHs												
1-Methylnaphthalene	8.0E-03	6.6E-01	1.5E-03	3.3E-02	2.7E+00	6.1E-03	7.6E-03	4.3E-01	9.5E-04	4.5E-03	2.8E-01	6.2E-04
2-Methylnaphthalene	7.0E-03	5.8E-01	1.3E-03	2.9E-02	2.4E+00	5.4E-03	9.9E-03	5.6E-01	1.2E-03	5.4E-03	3.3E-01	7.4E-04
C1-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Chrysenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluoranthenes/ Pyrenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluorenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Chrysenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Fluorenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Napthalenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Chrysenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Fluorenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Napthalenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Chrysenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Napthalenes		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
	Σ17PAH mg/kg		**Σ17PAH TU**			**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**
	2.33		**0.2**			**1**	**1.00**		**0.07**	**1.47**		**0.1**
	Σ34PAH mg/kg						**Σ34PAH mg/kg**			**Σ34PAH mg/kg**		
	3.12		**0.3**				**1.34**		**0.1**	**1.96**		**0.2**
Σ17PAH mg/kg, TU=1(b,c)			**7.2**						**10.2**			**9.7**
Σ34PAH mg/kg, TU=1(b,d)			**9.7**						**13.7**			**13.0**

***TOCs are NOT representative of th**

Table 5a: Sediment PAH Analysis Using USACE's 2007 Toxicity Testing Data (with TOC from the Study)

USACE 2007	BH-15	SC		BH-10	RM 2.0		BH-11	RM 1.6		BH-11		
Buffalo River Conversion Factor (a)	1.7 % Organic Carbon			2.4 % Organic Carbon			1.2 % Organic Carbon			ΣPAH TU = 1		
Compound	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	Concentrations where ΣPAH TU = 1	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs												
Acenaphthene	2.9E-03	1.7E-01	3.5E-04	5.9E-03	2.5E-01	5.1E-04	1.3E-02	1.1E+00	2.3E-03	7.1E-02	6.1E+00	1.2E-02
Acenaphthylene	3.6E-03	2.1E-01	4.7E-04	7.2E-03	3.0E-01	6.7E-04	1.3E-02	1.1E+00	2.4E-03	7.1E-02	6.0E+00	1.3E-02
Anthracene	8.0E-03	4.7E-01	7.8E-04	1.9E-02	7.8E-01	1.3E-03	3.8E-02	3.2E+00	5.4E-03	2.1E-01	1.7E+01	2.9E-02
Benzo (a) anthracene	3.1E-02	1.8E+00	2.1E-03	8.1E-02	3.4E+00	4.0E-03	1.4E-01	1.2E+01	1.4E-02	7.7E-01	6.5E+01	7.8E-02
Benzo (a) pyrene	2.9E-02	1.7E+00	1.7E-03	7.6E-02	3.2E+00	3.3E-03	1.2E-01	9.9E+00	1.0E-02	6.4E-01	5.4E+01	5.6E-02
Benzo (b) fluoranthene	4.9E-02	2.8E+00	2.9E-03	1.1E-01	4.4E+00	4.5E-03	2.0E-01	1.7E+01	1.7E-02	1.1E+00	9.1E+01	9.3E-02
Benzo (e) pyrene		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Benzo (g,h,i) perylene	1.8E-02	1.1E+00	9.7E-04	4.3E-02	1.8E+00	1.7E-03	7.5E-02	6.3E+00	5.8E-03	4.1E-01	3.4E+01	3.1E-02
Benzo (k) fluoranthene	1.8E-02	1.1E+00	1.1E-03	4.8E-02	2.0E+00	2.1E-03	6.7E-02	5.7E+00	5.8E-03	3.6E-01	3.1E+01	3.1E-02
Chrysene	2.7E-02	1.6E+00	1.9E-03	1.1E-01	4.5E+00	5.3E-03	1.9E-01	1.6E+01	1.9E-02	1.0E+00	8.8E+01	1.0E-01
Dibenz (a,h) anthracene	4.0E-03	2.3E-01	2.1E-04	1.3E-02	5.7E-01	5.0E-04	3.3E-02	2.8E+00	2.5E-03	1.8E-01	1.5E+01	1.4E-02
Fluoranthene	6.5E-02	3.8E+00	5.3E-03	1.5E-01	6.2E+00	8.8E-03	2.8E-01	2.3E+01	3.3E-02	1.5E+00	1.3E+02	1.8E-01
Fluorene	6.3E-03	3.7E-01	6.8E-04	9.6E-03	4.0E-01	7.5E-04	2.0E-02	1.7E+00	3.1E-03	1.1E-01	9.2E+00	1.7E-02
Indeno (1,2,3-cd) pyrene	1.5E-02	8.5E-01	7.7E-04	3.9E-02	1.6E+00	1.5E-03	7.5E-02	6.4E+00	5.7E-03	4.1E-01	3.5E+01	3.1E-02
Naphthalene	2.9E-03	1.7E-01	4.4E-04	4.3E-03	1.8E-01	4.7E-04	1.1E-02	8.9E-01	2.3E-03	5.7E-02	4.9E+00	1.3E-02
Phenanthrene	3.1E-02	1.8E+00	3.1E-03	6.4E-02	2.7E+00	4.5E-03	1.4E-01	1.2E+01	2.0E-02	7.9E-01	6.7E+01	1.1E-01
Pyrene	5.9E-02	3.5E+00	5.0E-03	1.5E-01	6.2E+00	8.9E-03	2.6E-01	2.2E+01	3.2E-02	1.4E+00	1.2E+02	1.7E-01
Alkylated PAHs												
1-Methylnaphthalene	2.3E-03	1.3E-01	3.0E-04	2.8E-03	1.2E-01	2.6E-04	4.7E-03	4.0E-01	8.9E-04	2.6E-02	2.2E+00	4.9E-03
2-Methylnaphthalene	1.6E-03	9.2E-02	2.1E-04	3.1E-03	1.3E-01	3.0E-04	5.8E-03	4.9E-01	1.1E-03	3.2E-02	2.7E+00	6.0E-03
C1-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C1-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C1-Fluoranthenes/ Pyrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C1-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C2-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C2-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C2-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C2-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C3-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C3-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C3-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C3-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C4-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C4-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
C4-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Σ17PAH mg/kg		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**			**Σ17PAH TU**
	0.37		**0.03**	**0.92**		**0.05**	**1.68**		**0.2**			**1**
	Σ34PAH mg/kg			**Σ34PAH mg/kg**			**Σ34PAH mg/kg**					
	0.50		**0.04**	**1.23**		**0.07**	**2.25**		**0.25**			
Σ17PAH mg/kg, TU=1(b,c)			**9.8**			**13.9**			**6.9**			
Σ34PAH mg/kg, TU=1(b,d)			**13.2**			**18.6**			**9.2**			

USACE 2007	BH-12	RM 1.0		BH-5	RM 4.2		BH-6	RM 3.8		BH-7	RM 3.5	
Buffalo River Conversion Factor (a)	1.4 % Organic Carbon			2.2 % Organic Carbon			1.9 % Organic Carbon			1.5 % Organic Carbon		
Compound	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs												
Acenaphthene	3.5E-02	2.5E+00	5.0E-03	2.2E-02	1.0E+00	2.1E-03	1.0E-03	5.6E-02	1.1E-04	2.2E-03	1.5E-01	3.0E-04
Acenaphthylene	1.2E-02	8.5E-01	1.9E-03	2.0E-02	9.3E-01	2.1E-03	2.4E-03	1.3E-01	2.9E-04	3.6E-03	2.4E-01	5.3E-04
Anthracene	8.8E-02	6.1E+00	1.0E-02	5.3E-02	2.4E+00	4.1E-03	3.6E-03	1.9E-01	3.2E-04	6.3E-03	4.2E-01	7.0E-04
Benzo (a) anthracene	1.2E-01	8.5E+00	1.0E-02	2.1E-01	9.6E+00	1.1E-02	1.3E-02	6.7E-01	8.0E-04	3.0E-02	2.0E+00	2.4E-03
Benzo (a) pyrene	5.8E-02	4.0E+00	4.2E-03	1.8E-01	8.2E+00	8.5E-03	1.1E-02	5.7E-01	5.9E-04	2.9E-02	1.9E+00	2.0E-03
Benzo (b) fluoranthene	1.0E-01	7.2E+00	7.3E-03	2.8E-01	1.3E+01	1.3E-02	1.6E-02	8.8E-01	9.0E-04	4.7E-02	3.1E+00	3.2E-03
Benzo (e) pyrene		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
Benzo (g,h,i) perylene	2.8E-02	1.9E+00	1.8E-03	1.0E-01	4.7E+00	4.3E-03	6.0E-03	3.2E-01	3.0E-04	1.7E-02	1.1E+00	1.0E-03
Benzo (k) fluoranthene	2.8E-02	1.9E+00	2.0E-03	1.1E-01	5.0E+00	5.1E-03	5.9E-03	3.2E-01	3.2E-04	1.7E-02	1.2E+00	1.2E-03
Chrysene	2.2E-01	1.5E+01	1.8E-02	3.2E-01	1.5E+01	1.8E-02	5.5E-04	3.0E-02	3.5E-05	3.4E-02	2.2E+00	2.7E-03
Dibenz (a,h) anthracene	9.1E-03	6.3E-01	5.6E-04	2.9E-02	1.3E+00	1.2E-03	8.8E-04	4.7E-02	4.2E-05	3.8E-03	2.5E-01	2.2E-04
Fluoranthene	2.3E-01	1.6E+01	2.2E-02	4.1E-01	1.9E+01	2.7E-02	2.5E-02	1.3E+00	1.9E-03	6.4E-02	4.2E+00	6.0E-03
Fluorene	8.9E-02	6.2E+00	1.1E-02	3.6E-02	1.6E+00	3.1E-03	2.1E-03	1.2E-01	2.1E-04	4.4E-03	2.9E-01	5.4E-04
Indeno (1,2,3-cd) pyrene	2.4E-02	1.6E+00	1.5E-03	1.6E-02	7.3E-01	6.6E-04	5.0E-03	2.7E-01	2.4E-04	1.4E-02	9.3E-01	8.4E-04
Naphthalene	9.3E-03	6.4E-01	1.7E-03	5.9E-02	2.7E+00	7.1E-03	1.8E-03	9.5E-02	2.5E-04	2.0E-03	1.3E-01	3.4E-04
Phenanthrene	1.5E-01	1.0E+01	1.7E-02	2.0E-01	9.1E+00	1.5E-02	1.3E-02	7.1E-01	1.2E-03	2.7E-02	1.8E+00	3.0E-03
Pyrene	3.2E-01	2.2E+01	3.2E-02	4.1E-01	1.9E+01	2.7E-02	1.3E-02	7.1E-01	1.0E-03	6.4E-02	4.3E+00	6.1E-03
Alkylated PAHs												
1-Methylnaphthalene	1.2E-02	8.5E-01	1.9E-03	9.7E-03	4.5E-01	1.0E-03	1.2E-03	6.4E-02	1.4E-04	1.5E-03	9.7E-02	2.2E-04
2-Methylnaphthalene	1.2E-02	8.6E-01	1.9E-03	1.7E-02	7.6E-01	1.7E-03	9.7E-04	5.2E-02	1.2E-04	1.1E-03	7.2E-02	1.6E-04
C1-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluoranthenes/ Pyrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
	Σ17PAH mg/kg		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**
	1.54		**0.2**	**2.48**		**0.2**	**0.12**		**0.009**	**0.37**		**0.03**
	Σ34PAH mg/kg			**Σ34PAH mg/kg**			**Σ34PAH mg/kg**			**Σ34PAH mg/kg**		
	2.06		**0.2**	**3.32**		**0.2**	**0.16**		**0.01**	**0.49**		**0.04**
Σ17PAH mg/kg, TU=1(b,c)			**7.6**			**12.2**			**10.4**			**8.8**
Σ34PAH mg/kg, TU=1(b,d)			**10.2**			**16.4**			**13.9**			**11.8**

***TOCs are NOT representative of th**

Table 5a: Sediment PAH Analysis Using USACE's 2007 Toxicity Testing Data (with TOC from the Study)

USACE 2007	BH-8	RM 2.7		BH-9	RM 2.1		BH-1	RM 5.4	
Buffalo River Conversion Factor (a)	1.5	% Organic Carbon		1.7	% Organic Carbon		1.6	% Organic Carbon	
Compound	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs									
Acenaphthene	3.9E-02	2.6E+00	5.2E-03	1.5E-03	8.8E-02	1.8E-04	9.4E-03	6.1E-01	1.2E-03
Acenaphthylene	2.4E-01	1.6E+01	3.6E-02	2.8E-03	1.7E-01	3.7E-04	1.4E-02	9.1E-01	2.0E-03
Anthracene	1.5E-01	9.7E+00	1.6E-02	4.9E-03	2.9E-01	4.9E-04	2.5E-02	1.6E+00	2.7E-03
Benzo (a) anthracene	1.2E+00	8.1E+01	9.6E-02	2.2E-02	1.3E+00	1.6E-03	1.2E-01	7.9E+00	9.4E-03
Benzo (a) pyrene	1.1E+00	7.5E+01	7.8E-02	1.4E-02	8.4E-01	8.7E-04	1.1E-01	7.4E+00	7.6E-03
Benzo (b) fluoranthene	1.5E+00	9.7E+01	9.9E-02	2.5E-02	1.5E+00	1.5E-03	1.9E-01	1.2E+01	1.3E-02
Benzo (e) pyrene		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
Benzo (g,h,i) perylene	5.6E-01	3.7E+01	3.4E-02	1.0E-02	6.1E-01	5.6E-04	8.5E-02	5.5E+00	5.0E-03
Benzo (k) fluoranthene	4.7E-01	3.1E+01	3.2E-02	8.3E-03	5.0E-01	5.1E-04	6.5E-02	4.2E+00	4.3E-03
Chrysene	1.3E+00	8.3E+01	9.9E-02	5.8E-04	3.5E-02	4.1E-05	2.0E-01	1.3E+01	1.5E-02
Dibenz (a,h) anthracene	1.6E-01	1.1E+01	9.4E-03	2.5E-03	1.5E-01	1.3E-04	3.0E-02	1.9E+00	1.7E-03
Fluoranthene	9.7E-01	6.4E+01	9.1E-02	3.5E-02	2.1E+00	2.9E-03	2.8E-01	1.8E+01	2.6E-02
Fluorene	6.5E-02	4.3E+00	8.0E-03	3.5E-03	2.1E-01	3.9E-04	1.3E-02	8.3E-01	1.5E-03
Indeno (1,2,3-cd) pyrene	5.5E-01	3.6E+01	3.2E-02	9.8E-03	5.9E-01	5.3E-04	7.8E-02	5.0E+00	4.5E-03
Naphthalene	6.3E-02	4.2E+00	1.1E-02	1.9E-03	1.1E-01	2.9E-04	7.6E-03	4.9E-01	1.3E-03
Phenanthrene	3.9E-01	2.6E+01	4.4E-02	1.5E-02	9.3E-01	1.6E-03	1.1E-01	7.0E+00	1.2E-02
Pyrene	9.3E-01	6.2E+01	8.8E-02	1.3E-02	7.5E-01	1.1E-03	2.6E-01	1.6E+01	2.4E-02
Alkylated PAHs									
1-Methylnaphthalene	2.1E-02	1.4E+00	3.1E-03	1.0E-03	6.1E-02	1.4E-04	4.9E-03	3.1E-01	7.1E-04
2-Methylnaphthalene	1.9E-02	1.3E+00	2.8E-03	1.2E-03	7.0E-02	1.6E-04	5.2E-03	3.3E-01	7.4E-04
C1-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluoranthenes/ Pyrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
	Σ17PAH mg/kg		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**
	9.70		**0.8**	**0.17**		**0.01**	**1.61**		**0.1**
	Σ34PAH mg/kg			**Σ34PAH mg/kg**			**Σ34PAH mg/kg**		
	12.97		**1**	**0.23**		**0.02**	**2.15**		**0.2**
Σ17PAH mg/kg, TU=1(b,c)			**9.3**			**9.6**			**9.1**
Σ34PAH mg/kg, TU=1(b,d)			**12.4**			**12.8**			**12.2**

USACE 2007	BH-2	RM 5.3		BH-3	RM 4.8		BH-4	RM 4.6	
Buffalo River Conversion Factor (a)	1.8	% Organic Carbon		1.5	% Organic Carbon		2.2	% Organic Carbon	
Compound	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs									
Acenaphthene	8.6E-02	4.7E+00	9.6E-03	3.5E-03	2.4E-01	4.8E-04	6.0E-03	2.8E-01	5.6E-04
Acenaphthylene	1.2E-02	6.4E-01	1.4E-03	6.2E-03	4.2E-01	9.2E-04	4.8E-03	2.2E-01	4.9E-04
Anthracene	1.7E-01	9.6E+00	1.6E-02	1.1E-02	7.3E-01	1.2E-03	1.2E-02	5.3E-01	8.8E-04
Benzo (a) anthracene	1.1E-01	6.1E+00	7.3E-03	5.5E-02	3.7E+00	4.4E-03	2.3E-02	1.1E+00	1.3E-03
Benzo (a) pyrene	8.5E-02	4.7E+00	4.9E-03	5.2E-02	3.5E+00	3.6E-03	2.1E-02	9.7E-01	1.0E-03
Benzo (b) fluoranthene	1.2E-01	6.6E+00	6.7E-03	8.8E-02	5.9E+00	6.0E-03	3.3E-02	1.5E+00	1.5E-03
Benzo (e) pyrene		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
Benzo (g,h,i) perylene	5.9E-02	3.3E+00	3.0E-03	4.1E-02	2.8E+00	2.5E-03	1.4E-02	6.3E-01	5.8E-04
Benzo (k) fluoranthene	4.9E-02	2.7E+00	2.8E-03	3.3E-02	2.2E+00	2.3E-03	1.4E-02	6.6E-01	6.7E-04
Chrysene	1.3E-02	7.0E-01	8.3E-04	8.4E-02	5.7E+00	6.7E-03	7.4E-03	3.4E-01	4.0E-04
Dibenz (a,h) anthracene	2.0E-02	1.1E+00	1.0E-03	1.4E-02	9.5E-01	8.5E-04	3.5E-03	1.6E-01	1.4E-04
Fluoranthene	2.2E-01	1.2E+01	1.7E-02	1.3E-01	8.6E+00	1.2E-02	5.2E-02	2.4E+00	3.3E-03
Fluorene	1.0E-01	5.5E+00	1.0E-02	6.2E-03	4.2E-01	7.8E-04	7.5E-03	3.4E-01	6.3E-04
Indeno (1,2,3-cd) pyrene	4.9E-02	2.7E+00	2.4E-03	3.7E-02	2.5E+00	2.2E-03	1.1E-02	4.8E-01	4.3E-04
Naphthalene	9.7E-01	5.4E+01	1.4E-01	3.5E-03	2.4E-01	6.2E-04	5.2E-02	2.4E+00	6.1E-03
Phenanthrene	2.1E-01	1.2E+01	2.0E-02	5.2E-02	3.5E+00	5.9E-03	3.0E-02	1.4E+00	2.3E-03
Pyrene	7.2E-03	4.0E-01	5.7E-04	1.2E-01	8.1E+00	1.2E-02	4.2E-02	1.9E+00	2.7E-03
Alkylated PAHs									
1-Methylnaphthalene	6.3E-02	3.5E+00	7.8E-03	2.6E-03	1.7E-01	3.9E-04	4.7E-03	2.1E-01	4.8E-04
2-Methylnaphthalene	5.8E-02	3.2E+00	7.1E-03	2.6E-03	1.8E-01	4.0E-04	4.9E-03	2.2E-01	5.0E-04
C1-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluoranthenes/ Pyrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
	Σ17PAH mg/kg		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**
	2.41		**0.3**	**0.74**		**0.06**	**0.34**		**0.02**
	Σ34PAH mg/kg			**Σ34PAH mg/kg**			**Σ34PAH mg/kg**		
	3.22		**0.3**	**0.99**		**0.08**	**0.46**		**0.03**
Σ17PAH mg/kg, TU=1(b,c)			**7.0**			**8.7**			**10.6**
Σ34PAH mg/kg, TU=1(b,d)			**9.3**			**11.7**			**14.2**

***TOCs are NOT representative of th**

Table 5b: Sediment PAH Analysis Using USACE's 2007 Toxicity Testing Data and Average Buffalo River TOC

USACE 2007		BL-1	Outside AOC		BL-2	Outside AOC	
Buffalo River Conversion Factor (a)	1.34	2.6	% Organic Carbon		2.6	% Organic Carbon	
Compound	Final Chronic Value (µg/goc)	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs							
Acenaphthene	491	3.0E-04	1.2E-02	2.4E-05	1.7E-03	6.5E-02	1.3E-04
Acenaphthylene	452	9.9E-04	3.8E-02	8.4E-05	2.9E-03	1.1E-01	2.5E-04
Anthracene	594	2.0E-03	7.7E-02	1.3E-04	6.0E-03	2.3E-01	3.9E-04
Benzo (a) anthracene	841	7.8E-03	3.0E-01	3.5E-04	2.1E-02	8.0E-01	9.5E-04
Benzo (a) pyrene	965	5.9E-03	2.3E-01	2.4E-04	1.6E-02	6.1E-01	6.3E-04
Benzo (b) fluoranthene	979	8.2E-03	3.1E-01	3.2E-04	1.9E-02	7.2E-01	7.4E-04
Benzo (e) pyrene	967		0.0E+00	0.0E+00		0.0E+00	0.0E+00
Benzo (g,h,i) perylene	1,095	4.2E-03	1.6E-01	1.5E-04	9.2E-03	3.5E-01	3.2E-04
Benzo (k) fluoranthene	981	4.2E-03	1.6E-01	1.6E-04	1.1E-02	4.2E-01	4.3E-04
Chrysene	844	4.5E-04	1.7E-02	2.0E-05	9.1E-03	3.5E-01	4.2E-04
Dibenz (a,h) anthracene	1,123	7.2E-04	2.8E-02	2.5E-05	1.8E-03	7.0E-02	6.3E-05
Fluoranthene	707	1.7E-02	6.5E-01	9.2E-04	4.4E-02	1.7E+00	2.4E-03
Fluorene	538	1.0E-03	4.0E-02	7.4E-05	4.0E-03	1.5E-01	2.9E-04
Indeno (1,2,3-cd) pyrene	1,115	3.5E-03	1.4E-01	1.2E-04	8.2E-03	3.2E-01	2.8E-04
Naphthalene	385	6.8E-04	2.6E-02	6.7E-05	1.9E-03	7.2E-02	1.9E-04
Phenanthrene	596	8.1E-03	3.1E-01	5.2E-04	2.9E-02	1.1E+00	1.8E-03
Pyrene	697	8.4E-04	3.2E-02	4.6E-05	2.8E-02	1.1E+00	1.5E-03
Alkylated PAHs							
1-Methylnaphthalene	446	8.0E-04	3.1E-02	6.9E-05	1.6E-03	6.0E-02	1.3E-04
2-Methylnaphthalene	447	7.2E-04	2.8E-02	6.2E-05	1.4E-03	5.3E-02	1.2E-04
C1-Anthracenes/ Phenanthrenes	670		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Chrysenes	929		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluoranthenes/ Pyrenes	770		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluorenes	611		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Anthracenes/ Phenanthrenes	746		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Chrysenes	1,008		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Fluorenes	686		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Napthalenes	510		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Anthracenes/ Phenanthrenes	829		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Chrysenes	1,112		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Fluorenes	769		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Napthalenes	581		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Anthracenes/ Phenanthrenes	913		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Chrysenes	1,214		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Napthalenes	657		0.0E+00	0.0E+00		0.0E+00	0.0E+00
		Σ17PAH mg/kg		Σ17PAH TU	Σ17PAH mg/kg		Σ17PAH TU
		0.07		0.003	0.21		0.01
		Σ34PAH mg/kg			Σ34PAH mg/kg		
		0.09		0.005	0.29		0.01
Σ17PAH mg/kg, TU=1(b,c)				14.8			14.4
Σ34PAH mg/kg, TU=1(b,d)				19.8			19.3

Compound	BL-3	Outside AOC		BL-4	Outside AOC	
	2.6	% Organic Carbon		2.6	% Organic Carbon	
	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs						
Acenaphthene	3.4E-03	1.3E-01	2.7E-04	8.9E-03	3.4E-01	7.0E-04
Acenaphthylene	9.2E-03	3.5E-01	7.8E-04	7.6E-03	2.9E-01	6.5E-04
Anthracene	1.2E-02	4.5E-01	7.5E-04	2.3E-02	8.9E-01	1.5E-03
Benzo (a) anthracene	3.8E-02	1.4E+00	1.7E-03	7.6E-02	2.9E+00	3.5E-03
Benzo (a) pyrene	3.3E-02	1.3E+00	1.3E-03	6.3E-02	2.4E+00	2.5E-03
Benzo (b) fluoranthene	5.1E-02	2.0E+00	2.0E-03	9.4E-02	3.6E+00	3.7E-03
Benzo (e) pyrene		0.0E+00	0.0E+00		0.0E+00	0.0E+00
Benzo (g,h,i) perylene	2.4E-02	9.2E-01	8.4E-04	4.2E-02	1.6E+00	1.5E-03
Benzo (k) fluoranthene	1.9E-02	7.5E-01	7.6E-04	3.8E-02	1.5E+00	1.5E-03
Chrysene	5.5E-02	2.1E+00	2.5E-03	9.4E-02	3.6E+00	4.3E-03
Dibenz (a,h) anthracene	5.6E-03	2.2E-01	1.9E-04	5.0E-03	1.9E-01	1.7E-04
Fluoranthene	8.7E-02	3.4E+00	4.7E-03	1.6E-01	6.0E+00	8.4E-03
Fluorene	7.1E-03	2.7E-01	5.1E-04	1.7E-02	6.6E-01	1.2E-03
Indeno (1,2,3-cd) pyrene	2.0E-02	7.8E-01	7.0E-04	3.4E-02	1.3E+00	1.2E-03
Naphthalene	5.0E-03	1.9E-01	5.0E-04	6.9E-03	2.6E-01	6.8E-04
Phenanthrene	3.7E-02	1.4E+00	2.4E-03	8.1E-02	3.1E+00	5.2E-03
Pyrene	7.8E-02	3.0E+00	4.3E-03	1.5E-01	5.6E+00	8.0E-03
Alkylated PAHs						
1-Methylnaphthalene	4.0E-03	1.5E-01	3.4E-04	5.1E-03	2.0E-01	4.4E-04
2-Methylnaphthalene	4.1E-03	1.6E-01	3.5E-04	5.6E-03	2.1E-01	4.8E-04
C1-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluoranthenes/ Pyrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
	Σ17PAH mg/kg		Σ17PAH TU	Σ17PAH mg/kg		Σ17PAH TU
	0.49		0.02	0.90		0.0
	Σ34PAH mg/kg			Σ34PAH mg/kg		
	0.66		0.03	1.20		0.1
Σ17PAH mg/kg, TU=1(b,c)			14.7			14.8
Σ34PAH mg/kg, TU=1(b,d)			19.7			19.8

Compound	BH-16	RM 0.8		BH-17	RM 0.5	
	2.6	% Organic Carbon		2.6	% Organic Carbon	
	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs						
Acenaphthene	3.8E-02	1.5E+00	3.0E-03	1.7E-02	6.5E-01	1.3E-03
Acenaphthylene	5.2E-02	2.0E+00	4.4E-03	2.5E-02	9.7E-01	2.1E-03
Anthracene	2.2E-01	8.6E+00	1.4E-02	5.0E-02	1.9E+00	3.2E-03
Benzo (a) anthracene	5.0E-01	1.9E+01	2.3E-02	2.1E-01	7.9E+00	9.4E-03
Benzo (a) pyrene	4.0E-01	1.5E+01	1.6E-02	2.0E-01	7.8E+00	8.1E-03
Benzo (b) fluoranthene	6.6E-01	2.5E+01	2.6E-02	3.8E-01	1.5E+01	1.5E-02
Benzo (e) pyrene		0.0E+00	0.0E+00		0.0E+00	0.0E+00
Benzo (g,h,i) perylene	2.5E-01	9.7E+00	8.9E-03	1.5E-01	5.7E+00	5.2E-03
Benzo (k) fluoranthene	2.2E-01	8.3E+00	8.5E-03	1.0E-01	4.0E+00	4.0E-03
Chrysene	5.7E-02	2.2E+00	2.6E-03	4.0E-01	1.5E+01	1.8E-02
Dibenz (a,h) anthracene	9.1E-02	3.5E+00	3.1E-03	1.1E-02	4.0E-01	3.6E-04
Fluoranthene	9.1E-01	3.5E+01	5.0E-02	4.6E-01	1.8E+01	2.5E-02
Fluorene	1.4E-01	5.3E+00	9.9E-03	3.1E-02	1.2E+00	2.2E-03
Indeno (1,2,3-cd) pyrene	1.9E-01	7.4E+00	6.7E-03	1.3E-01	5.0E+00	4.4E-03
Naphthalene	3.6E-02	1.4E+00	3.6E-03	1.6E-02	6.1E-01	1.6E-03
Phenanthrene	2.8E-01	1.1E+01	1.8E-02	1.9E-01	7.4E+00	1.2E-02
Pyrene	3.2E-02	1.2E+00	1.8E-03	5.3E-01	2.0E+01	2.9E-02
Alkylated PAHs						
1-Methylnaphthalene	3.6E-02	1.4E+00	3.1E-03	1.1E-02	4.3E-01	9.7E-04
2-Methylnaphthalene	3.2E-02	1.2E+00	2.8E-03	1.3E-02	5.2E-01	1.2E-03
C1-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluoranthenes/ Pyrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00
	Σ17PAH mg/kg		Σ17PAH TU	Σ17PAH mg/kg		Σ17PAH TU
	4.15		0.2	2.92		0.1
	Σ34PAH mg/kg			Σ34PAH mg/kg		
	5.55		0.3	3.90		0.2
Σ17PAH mg/kg, TU=1(b,c)			15.1			15.2
Σ34PAH mg/kg, TU=1(b,d)			20.2			20.3

*Average TOCs for the AOC

Average Sum of 17 PAHs mg/kg TU=1 AOC Data	**14.6**
Average Sum of 17 PAHs mg/kg TU=1 All Data	**14.6**
Average Sum of 34 PAHs mg/kg TU=1 All Data	**19.5**

Average TOC	1.53
Geomean TOC	1.46

(a) The conversion factor between the full 34 PAH list and the 17 PAH list is 1.36 with the full data set and 1.34 based on this data set that includes 1 and 2-methylnapthylene as indicated in the excel worksheet provided in the workbook associated with this table.

(b) This data set reflects samples collected within the navigational channel with only approximately 2% of samples with ≥ 2% TOC, which is significantly different than the overall AOC data set with 77% of samples having ≥ 2% TOC (see associated TOC excel worksheet provided in the workbook).

(c) The average protective Σ17PAH concentration is calculated by setting the TU34=1. Specifically, it is based on the average of (Σ17PAH dry weight sediment concentrations divided by the actual TU of 34PAHs) divided by (1000) to convert units of microgram to milligram.

(d) The average protective Σ34PAH concentration is calculated by setting the TU34=1. Specifically, it is based on the average of (Σ34PAH dry weight sediment concentrations divided by the TU of 34PAHs) divided by (1000) to convert units of microgram to milligram.

Table 5b: Sediment PAH Analysis Using USACE's 2007 Toxicity Testing Data and Average Buffalo River TOC

USACE 2007		BH-18	RM 0.4		BH-22	Outside AOC		BH-23	Outside AOC		BH-24	Outside AOC		BH-25	Outside AOC		BH-26	Outside AOC	
Buffalo River Conversion Factor (a)	1.34	2.6 % Organic Carbon			2.6 % Organic Carbon			2.6 % Organic Carbon			2.6 % Organic Carbon			2.6 % Organic Carbon			2.6 % Organic Carbon		
Compound	Final Chronic Value (µg/goc)	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs																			
Acenaphthene	491	2.4E-02	9.3E-01	1.9E-03	3.0E-02	1.2E+00	2.4E-03	2.0E-02	7.8E-01	1.6E-03	3.9E-02	1.5E+00	3.1E-03	2.1E-01	7.9E+00	1.6E-02	3.2E-02	1.2E+00	2.5E-03
Acenaphthylene	452	2.3E-02	9.0E-01	2.0E-03	1.0E-01	4.0E+00	8.8E-03	5.9E-02	2.3E+00	5.0E-03	1.2E-01	4.5E+00	1.0E-02	4.7E-01	1.8E+01	4.0E-02	7.6E-02	2.9E+00	6.4E-03
Anthracene	594	6.7E-02	2.6E+00	4.3E-03	1.6E-01	6.0E+00	1.0E-02	9.3E-02	3.6E+00	6.0E-03	1.9E-01	7.2E+00	1.2E-02	8.7E-01	3.4E+01	5.6E-02	1.5E-01	5.8E+00	9.7E-03
Benzo (a) anthracene	841	2.5E-01	9.6E+00	1.1E-02	5.0E-01	1.9E+01	2.3E-02	2.7E-01	1.0E+01	1.2E-02	5.6E-01	2.1E+01	2.6E-02	2.3E+00	8.7E+01	1.0E-01	4.4E-01	1.7E+01	2.0E-02
Benzo (a) pyrene	965	2.0E-01	7.8E+00	8.1E-03	4.5E-01	1.7E+01	1.8E-02	2.6E-01	1.0E+01	1.0E-02	4.9E-01	1.9E+01	2.0E-02	2.1E+00	8.0E+01	8.3E-02	3.5E-01	1.3E+01	1.4E-02
Benzo (b) fluoranthene	979	2.7E-01	1.0E+01	1.1E-02	5.8E-01	2.2E+01	2.3E-02	3.4E-01	1.3E+01	1.3E-02	6.9E-01	2.6E+01	2.7E-02	2.6E+00	9.8E+01	1.0E-01	5.1E-01	2.0E+01	2.0E-02
Benzo (e) pyrene	967		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
Benzo (g,h,i) perylene	1,095	1.4E-01	5.3E+00	4.9E-03	2.2E-01	8.3E+00	7.6E-03	5.8E-03	2.2E-01	2.1E-04	1.2E-02	4.6E-01	4.2E-04	1.0E+00	3.9E+01	3.6E-02	2.1E-01	7.9E+00	7.2E-03
Benzo (k) fluoranthene	981	2.0E-01	7.6E+00	7.7E-03	2.1E-01	8.2E+00	8.3E-03	1.2E-01	4.7E+00	4.8E-03	2.0E-01	7.7E+00	7.8E-03	9.5E-01	3.7E+01	3.7E-02	1.5E-01	5.8E+00	5.9E-03
Chrysene	844	3.9E-01	1.5E+01	1.8E-02	5.7E-01	2.2E+01	2.6E-02	3.6E-01	1.4E+01	1.6E-02	7.3E-01	2.8E+01	3.3E-02	2.7E+00	1.1E+02	1.2E-01	5.7E-01	2.2E+01	2.6E-02
Dibenz (a,h) anthracene	1,123	2.6E-02	9.9E-01	8.8E-04	5.9E-02	2.3E+00	2.0E-03	1.5E-02	5.9E-01	5.3E-04	3.0E-02	1.2E+00	1.0E-03	2.6E-01	9.9E+00	8.8E-03	2.2E-02	8.5E-01	7.5E-04
Fluoranthene	707	5.2E-01	2.0E+01	2.8E-02	6.4E-01	2.5E+01	3.5E-02	4.1E-01	1.6E+01	2.2E-02	7.5E-01	2.9E+01	4.1E-02	3.3E+00	1.3E+02	1.8E-01	6.0E-01	2.3E+01	3.3E-02
Fluorene	538	4.2E-02	1.6E+00	3.0E-03	7.4E-02	2.8E+00	5.3E-03	4.6E-02	1.8E+00	3.3E-03	7.7E-02	3.0E+00	5.5E-03	5.2E-01	2.0E+01	3.7E-02	6.6E-02	2.5E+00	4.7E-03
Indeno (1,2,3-cd) pyrene	1,115	1.3E-01	5.0E+00	4.5E-03	2.0E-01	7.5E+00	6.7E-03	1.5E-01	5.6E+00	5.0E-03	2.5E-01	9.8E+00	8.8E-03	9.6E-01	3.7E+01	3.3E-02	1.9E-01	7.5E+00	6.7E-03
Naphthalene	385	3.8E-02	1.5E+00	3.8E-03	2.4E-01	9.4E+00	2.4E-02	1.5E-01	5.7E+00	1.5E-02	3.4E-01	1.3E+01	3.4E-02	1.2E+00	4.6E+01	1.2E-01	2.2E-01	8.4E+00	2.2E-02
Phenanthrene	596	2.4E-01	9.2E+00	1.5E-02	2.9E-01	1.1E+01	1.9E-02	2.0E-01	7.6E+00	1.3E-02	3.8E-01	1.5E+01	2.5E-02	2.1E+00	8.0E+01	1.3E-01	3.1E-01	1.2E+01	2.0E-02
Pyrene	697	5.6E-01	2.1E+01	3.1E-02	7.2E-01	2.8E+01	4.0E-02	4.7E-01	1.8E+01	2.6E-02	8.3E-01	3.2E+01	4.6E-02	3.5E+00	1.3E+02	1.9E-01	6.6E-01	2.5E+01	3.6E-02
Alkylated PAHs																			
1-Methylnaphthalene	446	1.3E-02	5.1E-01	1.1E-03	2.6E-02	1.0E+00	2.2E-03	1.8E-02	6.8E-01	1.5E-03	3.0E-02	1.2E+00	2.6E-03	1.3E-01	5.0E+00	1.1E-02	2.5E-02	9.4E-01	2.1E-03
2-Methylnaphthalene	447	1.8E-02	6.8E-01	1.5E-03	2.4E-02	9.1E-01	2.0E-03	3.1E-02	1.2E+00	2.6E-03	6.3E-02	2.4E+00	5.4E-03	1.2E-01	4.8E+00	1.1E-02	4.7E-02	1.8E+00	4.1E-03
C1-Anthracenes/ Phenanthrenes	670		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Chrysenes	929		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluoranthenes/ Pyrenes	770		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluorenes	611		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Anthracenes/ Phenanthrenes	746		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Chrysenes	1,008		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Fluorenes	686		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Napthalenes	510		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Anthracenes/ Phenanthrenes	829		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Chrysenes	1,112		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Fluorenes	769		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Napthalenes	581		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Anthracenes/ Phenanthrenes	913		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Chrysenes	1,214		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Napthalenes	657		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
		Σ17PAH mg/kg		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**
		3.13		**0.2**	**5.08**		**0.3**	**3.01**		**0.2**	**5.77**		**0.3**	**25.15**		**1**	**4.63**		**0.2**
		Σ34PAH mg/kg			**Σ34PAH mg/kg**			**Σ34PAH mg/kg**			**Σ34PAH mg/kg**			**Σ34PAH mg/kg**			**Σ34PAH mg/kg**		
		4.19		**0.2**	**6.80**		**0.4**	**4.02**		**0.2**	**7.73**		**0.4**	**33.64**		**2**	**6.19**		**0.3**
Σ17PAH mg/kg, TU=1(b,c)				**14.9**			**14.5**			**14.2**			**14.1**			**14.2**			**14.3**
Σ34PAH mg/kg, TU=1(b,d)				**19.9**			**19.4**			**19.0**			**18.8**			**19.0**			**19.2**
***Average TOCs for the AOC**																			

TU ≤ 1	Toxic units (i.e., hazard quotients) less than one indicates toxicity from PAHs unlikely
TU >1	Toxic unit (i.e., hazard quotients) greater than 1 indicates toxicity from PAH is predicted, but no toxicity was observed in this chronic study
	TOC<2%
	TOC >2%

Table 5b: Sediment PAH Analysis Using USACE's 2007 Toxicity Testing Data and Average Buffalo River TOC

USACE 2007		BH-27	Outside AOC		BH-28	Outside AOC		BH-19	Outside AOC	
Buffalo River Conversion Factor (a)	1.34	2.6	% Organic Carbon		2.6	% Organic Carbon		2.6	% Organic Carbon	
Compound	Final Chronic Value (µg/goc)	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs										
Acenaphthene	491	2.8E-02	1.1E+00	2.2E-03	3.4E-02	1.3E+00	2.7E-03	1.4E-02	5.2E-01	1.1E-03
Acenaphthylene	452	6.5E-02	2.5E+00	5.5E-03	6.5E-02	2.5E+00	5.5E-03	1.7E-02	6.5E-01	1.4E-03
Anthracene	594	1.2E-01	4.6E+00	7.7E-03	1.4E-01	5.3E+00	8.9E-03	3.8E-02	1.4E+00	2.4E-03
Benzo (a) anthracene	841	3.9E-01	1.5E+01	1.8E-02	3.8E-01	1.4E+01	1.7E-02	1.3E-01	4.8E+00	5.8E-03
Benzo (a) pyrene	965	3.3E-01	1.3E+01	1.3E-02	3.0E-01	1.2E+01	1.2E-02	1.2E-01	4.4E+00	4.6E-03
Benzo (b) fluoranthene	979	4.7E-01	1.8E+01	1.8E-02	4.3E-01	1.6E+01	1.7E-02	1.9E-01	7.3E+00	7.5E-03
Benzo (e) pyrene	967		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
Benzo (g,h,i) perylene	1,095	2.1E-01	8.2E+00	7.4E-03	1.9E-01	7.2E+00	6.5E-03	8.1E-02	3.1E+00	2.8E-03
Benzo (k) fluoranthene	981	1.3E-01	5.1E+00	5.2E-03	1.3E-01	5.1E+00	5.2E-03	6.9E-02	2.7E+00	2.7E-03
Chrysene	844	4.9E-01	1.9E+01	2.2E-02	4.9E-01	1.9E+01	2.2E-02	2.1E-01	7.9E+00	9.4E-03
Dibenz (a,h) anthracene	1,123	2.2E-02	8.3E-01	7.4E-04	1.8E-02	6.8E-01	6.1E-04	6.6E-03	2.5E-01	2.3E-04
Fluoranthene	707	5.3E-01	2.0E+01	2.9E-02	5.8E-01	2.2E+01	3.1E-02	2.6E-01	1.0E+01	1.4E-02
Fluorene	538	5.8E-02	2.2E+00	4.1E-03	6.8E-02	2.6E+00	4.9E-03	2.9E-02	1.1E+00	2.1E-03
Indeno (1,2,3-cd) pyrene	1,115	2.0E-01	7.5E+00	6.8E-03	1.8E-01	6.7E+00	6.0E-03	7.3E-02	2.8E+00	2.5E-03
Naphthalene	385	1.7E-01	6.6E+00	1.7E-02	2.2E-01	8.3E+00	2.1E-02	1.4E-02	5.2E-01	1.4E-03
Phenanthrene	596	2.7E-01	1.0E+01	1.7E-02	3.3E-01	1.3E+01	2.1E-02	1.3E-01	5.2E+00	8.6E-03
Pyrene	697	6.1E-01	2.3E+01	3.3E-02	6.5E-01	2.5E+01	3.6E-02	2.9E-01	1.1E+01	1.6E-02
Alkylated PAHs										
1-Methylnaphthalene	446	2.2E-02	8.5E-01	1.9E-03	2.3E-02	8.7E-01	1.9E-03	8.7E-03	3.3E-01	7.5E-04
2-Methylnaphthalene	447	3.9E-02	1.5E+00	3.4E-03	4.3E-02	1.7E+00	3.7E-03	1.1E-02	4.0E-01	9.0E-04
C1-Anthracenes/ Phenanthrenes	670		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Chrysenes	929		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluoranthenes/ Pyrenes	770		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluorenes	611		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Anthracenes/ Phenanthrenes	746		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Chrysenes	1,008		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Fluorenes	686		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Napthalenes	510		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Anthracenes/ Phenanthrenes	829		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Chrysenes	1,112		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Fluorenes	769		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Napthalenes	581		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Anthracenes/ Phenanthrenes	913		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Chrysenes	1,214		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Napthalenes	657		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
		Σ17PAH mg/kg		Σ17PAH TU	Σ17PAH mg/kg		Σ17PAH TU	Σ17PAH mg/kg		Σ17PAH TU
		4.14		0.2	4.24		0.2	1.68		0.1
		Σ34PAH mg/kg		0.3	Σ34PAH mg/kg			Σ34PAH mg/kg		
		5.53		0.28	5.67		0.3	2.25		0.1
Σ17PAH mg/kg, TU=1(b,c)				**14.5**			**14.2**			**14.9**
Σ34PAH mg/kg, TU=1(b,d)				**19.4**			**18.9**			**19.9**
***Average TOCs for the AOC**										

USACE 2007		BH-20	Outside AOC		BH-21	Outside AOC		BH-13	SC	
Buffalo River Conversion Factor (a)	1.34	2.6	% Organic Carbon		2.6	% Organic Carbon		2.6	% Organic Carbon	
Compound	Final Chronic Value (µg/goc)	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs										
Acenaphthene	491	1.9E-02	7.1E-01	1.4E-03	8.4E-03	3.2E-01	6.5E-04	9.5E-03	3.6E-01	7.4E-04
Acenaphthylene	452	2.9E-02	1.1E+00	2.5E-03	3.7E-02	1.4E+00	3.1E-03	1.6E-02	6.3E-01	1.4E-03
Anthracene	594	6.5E-02	2.5E+00	4.2E-03	6.4E-02	2.5E+00	4.1E-03	2.8E-02	1.1E+00	1.8E-03
Benzo (a) anthracene	841	2.5E-01	9.5E+00	1.1E-02	2.4E-01	9.3E+00	1.1E-02	1.0E-01	3.8E+00	4.6E-03
Benzo (a) pyrene	965	2.4E-01	9.3E+00	9.7E-03	2.5E-01	9.6E+00	1.0E-02	7.8E-02	3.0E+00	3.1E-03
Benzo (b) fluoranthene	979	4.1E-01	1.6E+01	1.6E-02	4.1E-01	1.6E+01	1.6E-02	1.2E-01	4.4E+00	4.5E-03
Benzo (e) pyrene	967		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
Benzo (g,h,i) perylene	1,095	1.8E-01	7.0E+00	6.4E-03	1.7E-01	6.4E+00	5.8E-03	4.2E-02	1.6E+00	1.5E-03
Benzo (k) fluoranthene	981	1.2E-01	4.6E+00	4.7E-03	1.4E-01	5.2E+00	5.3E-03	4.7E-02	1.8E+00	1.8E-03
Chrysene	844	4.2E-01	1.6E+01	1.9E-02	1.2E-02	4.8E-01	5.6E-04	1.2E-01	4.8E+00	5.7E-03
Dibenz (a,h) anthracene	1,123	1.4E-02	5.5E-01	4.9E-04	4.4E-02	1.7E+00	1.5E-03	1.4E-02	5.3E-01	4.8E-04
Fluoranthene	707	4.8E-01	1.8E+01	2.6E-02	4.4E-01	1.7E+01	2.4E-02	1.5E-01	5.7E+00	8.0E-03
Fluorene	538	3.7E-02	1.4E+00	2.6E-03	2.8E-02	1.1E+00	2.0E-03	1.4E-02	5.2E-01	9.7E-04
Indeno (1,2,3-cd) pyrene	1,115	1.6E-01	6.3E+00	5.6E-03	1.5E-01	5.6E+00	5.0E-03	4.3E-02	1.6E+00	1.5E-03
Naphthalene	385	3.9E-02	1.5E+00	3.9E-03	4.5E-02	1.7E+00	4.5E-03	1.6E-02	6.0E-01	1.6E-03
Phenanthrene	596	1.9E-01	7.3E+00	1.2E-02	1.3E-01	5.0E+00	8.4E-03	5.1E-02	1.9E+00	3.3E-03
Pyrene	697	5.7E-01	2.2E+01	3.1E-02	1.5E-01	5.9E+00	8.5E-03	1.4E-01	5.5E+00	7.8E-03
Alkylated PAHs										
1-Methylnaphthalene	446	1.2E-02	4.4E-01	9.9E-04	8.0E-03	3.1E-01	6.9E-04	7.6E-03	2.9E-01	6.5E-04
2-Methylnaphthalene	447	1.7E-02	6.4E-01	1.4E-03	7.0E-03	2.7E-01	6.0E-04	9.9E-03	3.8E-01	8.5E-04
C1-Anthracenes/ Phenanthrenes	670		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Chrysenes	929		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluoranthenes/ Pyrenes	770		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluorenes	611		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Anthracenes/ Phenanthrenes	746		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Chrysenes	1,008		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Fluorenes	686		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Napthalenes	510		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Anthracenes/ Phenanthrenes	829		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Chrysenes	1,112		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Fluorenes	769		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Napthalenes	581		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Anthracenes/ Phenanthrenes	913		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Chrysenes	1,214		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Napthalenes	657		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
		Σ17PAH mg/kg		Σ17PAH TU	Σ17PAH mg/kg		Σ17PAH TU	Σ17PAH mg/kg		Σ17PAH TU
		3.25		0.2	2.33		0.1	1.00		0.05
		Σ34PAH mg/kg			Σ34PAH mg/kg			Σ34PAH mg/kg		
		4.35		0.2	3.12		0.1	1.34		0.1
Σ17PAH mg/kg, TU=1(b,c)				**15.2**			**15.5**			**14.9**
Σ34PAH mg/kg, TU=1(b,d)				**20.3**			**20.8**			**20.0**
***Average TOCs for the AOC**										

CF	conversion factor
µg/gOC	microgram per gram of organic carbon
µg/kg	microgram per kilogram
PAH	polycyclic aromatic hydrocarbon
RM	river mile
TOC	total organic carbon
TPAH	total polycyclic aromatic hydrocarbon
TU	toxicity unit (i.e., hazard quotient); rounded to one significant figure
USACE	US Army Corps of Engineers

Table 5b: Sediment PAH Analysis Using USACE's 2007 Toxicity Testing Data and Average Buffalo River TOC

USACE 2007		BH-14	SC		BH-15	SC		BH-10	RM 2.0	
Buffalo River Conversion Factor (a)	1.34	2.6 % Organic Carbon			2.6 % Organic Carbon			2.6 % Organic Carbon		
Compound	Final Chronic Value (µg/goc)	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs										
Acenaphthene	491	8.1E-03	3.1E-01	6.3E-04	2.9E-03	1.1E-01	2.3E-04	5.9E-03	2.3E-01	4.6E-04
Acenaphthylene	452	1.2E-02	4.8E-01	1.1E-03	3.6E-03	1.4E-01	3.1E-04	7.2E-03	2.8E-01	6.1E-04
Anthracene	594	2.8E-02	1.1E+00	1.8E-03	8.0E-03	3.1E-01	5.2E-04	1.9E-02	7.2E-01	1.2E-03
Benzo (a) anthracene	841	1.3E-01	5.0E+00	5.9E-03	3.1E-02	1.2E+00	1.4E-03	8.1E-02	3.1E+00	3.7E-03
Benzo (a) pyrene	965	1.1E-01	4.2E+00	4.3E-03	2.9E-02	1.1E+00	1.1E-03	7.6E-02	2.9E+00	3.0E-03
Benzo (b) fluoranthene	979	1.8E-01	6.8E+00	7.0E-03	4.9E-02	1.9E+00	1.9E-03	1.1E-01	4.0E+00	4.1E-03
Benzo (e) pyrene	967		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
Benzo (g,h,i) perylene	1,095	6.8E-02	2.6E+00	2.4E-03	1.8E-02	7.0E-01	6.4E-04	4.3E-02	1.7E+00	1.5E-03
Benzo (k) fluoranthene	981	7.1E-02	2.7E+00	2.8E-03	1.8E-02	7.0E-01	7.1E-04	4.8E-02	1.9E+00	1.9E-03
Chrysene	844	1.8E-01	6.7E+00	8.0E-03	2.7E-02	1.0E+00	1.2E-03	1.1E-01	4.1E+00	4.8E-03
Dibenz (a,h) anthracene	1,123	3.1E-02	1.2E+00	1.1E-03	4.0E-03	1.5E-01	1.4E-04	1.3E-02	5.2E-01	4.6E-04
Fluoranthene	707	2.5E-01	9.5E+00	1.3E-02	6.5E-02	2.5E+00	3.5E-03	1.5E-01	5.7E+00	8.0E-03
Fluorene	538	1.2E-02	4.6E-01	8.6E-04	6.3E-03	2.4E-01	4.5E-04	9.6E-03	3.7E-01	6.9E-04
Indeno (1,2,3-cd) pyrene	1,115	6.9E-02	2.6E+00	2.4E-03	1.5E-02	5.6E-01	5.0E-04	3.9E-02	1.5E+00	1.3E-03
Naphthalene	385	8.0E-03	3.1E-01	7.9E-04	2.9E-03	1.1E-01	2.9E-04	4.3E-03	1.7E-01	4.3E-04
Phenanthrene	596	8.7E-02	3.3E+00	5.6E-03	3.1E-02	1.2E+00	2.0E-03	6.4E-02	2.5E+00	4.1E-03
Pyrene	697	2.2E-01	8.6E+00	1.2E-02	5.9E-02	2.3E+00	3.3E-03	1.5E-01	5.7E+00	8.1E-03
Alkylated PAHs										
1-Methylnaphthalene	446	4.5E-03	1.7E-01	3.9E-04	2.3E-03	8.7E-02	1.9E-04	2.8E-03	1.1E-01	2.4E-04
2-Methylnaphthalene	447	5.4E-03	2.1E-01	4.6E-04	1.6E-03	6.1E-02	1.4E-04	3.1E-03	1.2E-01	2.7E-04
C1-Anthracenes/ Phenanthrenes	670		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Chrysenes	929		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluoranthenes/ Pyrenes	770		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluorenes	611		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Anthracenes/ Phenanthrenes	746		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Chrysenes	1,008		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Fluorenes	686		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Napthalenes	510		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Anthracenes/ Phenanthrenes	829		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Chrysenes	1,112		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Fluorenes	769		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Napthalenes	581		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Anthracenes/ Phenanthrenes	913		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Chrysenes	1,214		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Napthalenes	657		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
		Σ17PAH mg/kg		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**
		1.47		**0.1**	**0.37**		**0.02**	**0.92**		**0.05**
		Σ34PAH mg/kg			**Σ34PAH mg/kg**			**Σ34PAH mg/kg**		
		1.96		**0.1**	**0.50**		**0.02**	**1.23**		**0.06**
Σ17PAH mg/kg, TU=1(b,c)				**15.4**			**15.0**			**15.3**
Σ34PAH mg/kg, TU=1(b,d)				**20.6**			**20.0**			**20.4**
***Average TOCs for the AOC**										

USACE 2007	BH-11	RM 1.6		BH-12	RM 1.0		BH-5	RM 4.2	
Buffalo River Conversion Factor (a)	2.6 % Organic Carbon			2.6 % Organic Carbon			2.6 % Organic Carbon		
Compound	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs									
Acenaphthene	1.3E-02	5.0E-01	1.0E-03	3.5E-02	1.4E+00	2.8E-03	2.2E-02	8.5E-01	1.7E-03
Acenaphthylene	1.3E-02	5.0E-01	1.1E-03	1.2E-02	4.7E-01	1.0E-03	2.0E-02	7.8E-01	1.7E-03
Anthracene	3.8E-02	1.4E+00	2.4E-03	8.8E-02	3.4E+00	5.7E-03	5.3E-02	2.0E+00	3.4E-03
Benzo (a) anthracene	1.4E-01	5.4E+00	6.4E-03	1.2E-01	4.7E+00	5.6E-03	2.1E-01	8.1E+00	9.6E-03
Benzo (a) pyrene	1.2E-01	4.5E+00	4.7E-03	5.8E-02	2.2E+00	2.3E-03	1.8E-01	6.9E+00	7.1E-03
Benzo (b) fluoranthene	2.0E-01	7.5E+00	7.7E-03	1.0E-01	4.0E+00	4.0E-03	2.8E-01	1.1E+01	1.1E-02
Benzo (e) pyrene		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
Benzo (g,h,i) perylene	7.5E-02	2.9E+00	2.6E-03	2.8E-02	1.1E+00	9.7E-04	1.0E-01	4.0E+00	3.6E-03
Benzo (k) fluoranthene	6.7E-02	2.6E+00	2.6E-03	2.8E-02	1.1E+00	1.1E-03	1.1E-01	4.2E+00	4.3E-03
Chrysene	1.9E-01	7.3E+00	8.7E-03	2.2E-01	8.4E+00	9.9E-03	3.2E-01	1.2E+01	1.5E-02
Dibenz (a,h) anthracene	3.3E-02	1.3E+00	1.1E-03	9.1E-03	3.5E-01	3.1E-04	2.9E-02	1.1E+00	1.0E-03
Fluoranthene	2.8E-01	1.1E+01	1.5E-02	2.3E-01	8.7E+00	1.2E-02	4.1E-01	1.6E+01	2.2E-02
Fluorene	2.0E-02	7.6E-01	1.4E-03	8.9E-02	3.4E+00	6.3E-03	3.6E-02	1.4E+00	2.6E-03
Indeno (1,2,3-cd) pyrene	7.5E-02	2.9E+00	2.6E-03	2.4E-02	9.0E-01	8.1E-04	1.6E-02	6.2E-01	5.5E-04
Naphthalene	1.1E-02	4.0E-01	1.0E-03	9.3E-03	3.6E-01	9.3E-04	5.9E-02	2.3E+00	5.9E-03
Phenanthrene	1.4E-01	5.5E+00	9.3E-03	1.5E-01	5.7E+00	9.6E-03	2.0E-01	7.6E+00	1.3E-02
Pyrene	2.6E-01	1.0E+01	1.4E-02	3.2E-01	1.2E+01	1.8E-02	4.1E-01	1.6E+01	2.2E-02
Alkylated PAHs									
1-Methylnaphthalene	4.7E-03	1.8E-01	4.0E-04	1.2E-02	4.7E-01	1.1E-03	9.7E-03	3.7E-01	8.4E-04
2-Methylnaphthalene	5.8E-03	2.2E-01	5.0E-04	1.2E-02	4.8E-01	1.1E-03	1.7E-02	6.3E-01	1.4E-03
C1-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluoranthenes/ Pyrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
	Σ17PAH mg/kg		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**
	1.68		**0.1**	**1.54**		**0.1**	**2.48**		**0.1**
	Σ34PAH mg/kg			**Σ34PAH mg/kg**			**Σ34PAH mg/kg**		
	2.25		**0.11**	**2.06**		**0.1**	**3.32**		**0.2**
Σ17PAH mg/kg, TU=1(b,c)			**15.1**			**13.8**			**14.6**
Σ34PAH mg/kg, TU=1(b,d)			**20.2**			**18.5**			**19.5**
***Average TOCs for the AOC**									

Table 5b: Sediment PAH Analysis Using USACE's 2007 Toxicity Testing Data and Average Buffalo River TOC

USACE 2007

Buffalo River Conversion Factor (a) 1.34

Compound	Final Chronic Value (µg/goc)	BH-6 RM 3.8 (2.6 % Organic Carbon) PAH Concentration (mg/kg)	BH-6 PAH Concentration (µg/goc)	BH-6 Toxic Units	BH-7 RM 3.5 (2.6 % Organic Carbon) PAH Concentration (mg/kg)	BH-7 PAH Concentration (µg/goc)	BH-7 Toxic Units	BH-8 RM 2.7 (2.6 % Organic Carbon) PAH Concentration (mg/kg)	BH-8 PAH Concentration (µg/goc)	BH-8 Toxic Units
Unsubstituted PAHs										
Acenaphthene	491	1.0E-03	4.0E-02	8.1E-05	2.2E-03	8.6E-02	1.7E-04	3.9E-02	1.5E+00	3.0E-03
Acenaphthylene	452	2.4E-03	9.4E-02	2.1E-04	3.6E-03	1.4E-01	3.1E-04	2.4E-01	9.4E+00	2.1E-02
Anthracene	594	3.6E-03	1.4E-01	2.3E-04	6.3E-03	2.4E-01	4.1E-04	1.5E-01	5.6E+00	9.5E-03
Benzo (a) anthracene	841	1.3E-02	4.8E-01	5.7E-04	3.0E-02	1.2E+00	1.4E-03	1.2E+00	4.7E+01	5.6E-02
Benzo (a) pyrene	965	1.1E-02	4.1E-01	4.2E-04	2.9E-02	1.1E+00	1.1E-03	1.1E+00	4.3E+01	4.5E-02
Benzo (b) fluoranthene	979	1.6E-02	6.3E-01	6.4E-04	4.7E-02	1.8E+00	1.8E-03	1.5E+00	5.6E+01	5.7E-02
Benzo (e) pyrene	967		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
Benzo (g,h,i) perylene	1,095	6.0E-03	2.3E-01	2.1E-04	1.7E-02	6.6E-01	6.0E-04	5.6E-01	2.2E+01	2.0E-02
Benzo (k) fluoranthene	981	5.9E-03	2.3E-01	2.3E-04	1.7E-02	6.7E-01	6.8E-04	4.7E-01	1.8E+01	1.9E-02
Chrysene	844	5.5E-04	2.1E-02	2.5E-05	3.4E-02	1.3E+00	1.5E-03	1.3E+00	4.8E+01	5.7E-02
Dibenz (a,h) anthracene	1,123	8.8E-04	3.4E-02	3.0E-05	3.8E-03	1.4E-01	1.3E-04	1.6E-01	6.1E+00	5.4E-03
Fluoranthene	707	2.5E-02	9.5E-01	1.3E-03	6.4E-02	2.5E+00	3.5E-03	9.7E-01	3.7E+01	5.3E-02
Fluorene	538	2.1E-03	8.2E-02	1.5E-04	4.4E-03	1.7E-01	3.1E-04	6.5E-02	2.5E+00	4.6E-03
Indeno (1,2,3-cd) pyrene	1,115	5.0E-03	1.9E-01	1.7E-04	1.4E-02	5.4E-01	4.9E-04	5.5E-01	2.1E+01	1.9E-02
Naphthalene	385	1.8E-03	6.8E-02	1.8E-04	2.0E-03	7.5E-02	2.0E-04	6.3E-02	2.4E+00	6.3E-03
Phenanthrene	596	1.3E-02	5.1E-01	8.5E-04	2.7E-02	1.0E+00	1.7E-03	3.9E-01	1.5E+01	2.5E-02
Pyrene	697	1.3E-02	5.1E-01	7.3E-04	6.4E-02	2.5E+00	3.5E-03	9.3E-01	3.6E+01	5.1E-02
Alkylated PAHs										
1-Methylnaphthalene	446	1.2E-03	4.6E-02	1.0E-04	1.5E-03	5.7E-02	1.3E-04	2.1E-02	7.9E-01	1.8E-03
2-Methylnaphthalene	447	9.7E-04	3.7E-02	8.3E-05	1.1E-03	4.2E-02	9.4E-05	1.9E-02	7.4E-01	1.7E-03
C1-Anthracenes/ Phenanthrenes	670		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Chrysenes	929		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluoranthenes/ Pyrenes	770		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluorenes	611		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Anthracenes/ Phenanthrenes	746		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Chrysenes	1,008		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Fluorenes	686		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Napthalenes	510		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Anthracenes/ Phenanthrenes	829		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Chrysenes	1,112		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Fluorenes	769		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Napthalenes	581		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Anthracenes/ Phenanthrenes	913		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Chrysenes	1,214		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Napthalenes	657		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00

Compound	BH-9 RM 2.1 (2.6 % Organic Carbon) PAH Concentration (mg/kg)	BH-9 PAH Concentration (µg/goc)	BH-9 Toxic Units	BH-1 RM 5.4 (2.6 % Organic Carbon) PAH Concentration (mg/kg)	BH-1 PAH Concentration (µg/goc)	BH-1 Toxic Units	BH-2 RM 5.3 (2.6 % Organic Carbon) PAH Concentration (mg/kg)	BH-2 PAH Concentration (µg/goc)	BH-2 Toxic Units
Unsubstituted PAHs									
Acenaphthene	1.5E-03	5.6E-02	1.1E-04	9.4E-03	3.6E-01	7.4E-04	8.6E-02	3.3E+00	6.7E-03
Acenaphthylene	2.8E-03	1.1E-01	2.4E-04	1.4E-02	5.4E-01	1.2E-03	1.2E-02	4.5E-01	9.9E-04
Anthracene	4.9E-03	1.9E-01	3.2E-04	2.5E-02	9.5E-01	1.6E-03	1.7E-01	6.7E+00	1.1E-02
Benzo (a) anthracene	2.2E-02	8.4E-01	1.0E-03	1.2E-01	4.7E+00	5.6E-03	1.1E-01	4.3E+00	5.1E-03
Benzo (a) pyrene	1.4E-02	5.3E-01	5.5E-04	1.1E-01	4.4E+00	4.5E-03	8.5E-02	3.3E+00	3.4E-03
Benzo (b) fluoranthene	2.5E-02	9.7E-01	9.9E-04	1.9E-01	7.3E+00	7.5E-03	1.2E-01	4.6E+00	4.7E-03
Benzo (e) pyrene		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
Benzo (g,h,i) perylene	1.0E-02	3.9E-01	3.6E-04	8.5E-02	3.3E+00	3.0E-03	5.9E-02	2.3E+00	2.1E-03
Benzo (k) fluoranthene	8.3E-03	3.2E-01	3.3E-04	6.5E-02	2.5E+00	2.5E-03	4.9E-02	1.9E+00	1.9E-03
Chrysene	5.8E-04	2.2E-02	2.6E-05	2.0E-01	7.6E+00	9.0E-03	1.3E-02	4.9E-01	5.8E-04
Dibenz (a,h) anthracene	2.5E-03	9.6E-02	8.5E-05	3.0E-02	1.1E+00	1.0E-03	2.0E-02	7.8E-01	7.0E-04
Fluoranthene	3.5E-02	1.3E+00	1.9E-03	2.8E-01	1.1E+01	1.5E-02	2.2E-01	8.3E+00	1.2E-02
Fluorene	3.5E-03	1.3E-01	2.5E-04	1.3E-02	5.0E-01	9.2E-04	1.0E-01	3.8E+00	7.1E-03
Indeno (1,2,3-cd) pyrene	9.8E-03	3.8E-01	3.4E-04	7.8E-02	3.0E+00	2.7E-03	4.9E-02	1.9E+00	1.7E-03
Naphthalene	1.9E-03	7.2E-02	1.9E-04	7.6E-03	2.9E-01	7.6E-04	9.7E-01	3.7E+01	9.7E-02
Phenanthrene	1.5E-02	5.9E-01	9.9E-04	1.1E-01	4.2E+00	7.0E-03	2.1E-01	8.2E+00	1.4E-02
Pyrene	1.3E-02	4.8E-01	6.9E-04	2.6E-01	9.8E+00	1.4E-02	7.2E-03	2.8E-01	4.0E-04
Alkylated PAHs									
1-Methylnaphthalene	1.0E-03	3.9E-02	8.7E-05	4.9E-03	1.9E-01	4.2E-04	6.3E-02	2.4E+00	5.4E-03
2-Methylnaphthalene	1.2E-03	4.5E-02	1.0E-04	5.2E-03	2.0E-01	4.4E-04	5.8E-02	2.2E+00	5.0E-03
C1-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluoranthenes/ Pyrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Fluorenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Anthracenes/ Phenanthrenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Chrysenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Napthalenes		0.0E+00	0.0E+00		0.0E+00	0.0E+00		0.0E+00	0.0E+00

Station	Σ17PAH mg/kg	Σ17PAH TU	Σ34PAH mg/kg	Σ34PAH TU	Σ17PAH mg/kg, TU=1(b,c)	Σ34PAH mg/kg, TU=1(b,d)
BH-6	0.12	0.006	0.16	0.01	14.6	19.5
BH-7	0.37	0.02	0.49	0.02	15.1	20.2
BH-8	9.70	0.5	12.97	0.6	15.9	21.3
BH-9	0.17	0.01	0.23	0.01	15.0	20.1
BH-1	1.61	0.1	2.15	0.1	15.3	20.5
BH-2	2.41	0.2	3.22	0.2	10.0	13.4

*Average TOCs for the AOC

Table 5b: Sediment PAH Analysis Using USACE's 2007 Toxicity Testing Data and Average Buffalo River TOC

USACE 2007		BH-3	RM 4.8		BH-4	RM 4.6	
Buffalo River Conversion Factor (a)	1.34	2.6	% Organic Carbon		2.6	% Organic Carbon	
Compound	Final Chronic Value (µg/goc)	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units	PAH Concentration (mg/kg)	PAH Concentration (µg/goc)	Toxic Units
Unsubstituted PAHs							
Acenaphthene	491	3.5E-03	1.3E-01	2.7E-04	6.0E-03	2.3E-01	4.7E-04
Acenaphthylene	452	6.2E-03	2.4E-01	5.3E-04	4.8E-03	1.9E-01	4.1E-04
Anthracene	594	1.1E-02	4.2E-01	7.0E-04	1.2E-02	4.4E-01	7.4E-04
Benzo (a) anthracene	841	5.5E-02	2.1E+00	2.5E-03	2.3E-02	8.9E-01	1.1E-03
Benzo (a) pyrene	965	5.2E-02	2.0E+00	2.1E-03	2.1E-02	8.2E-01	8.4E-04
Benzo (b) fluoranthene	979	8.8E-02	3.4E+00	3.4E-03	3.3E-02	1.3E+00	1.3E-03
Benzo (e) pyrene	967		0.0E+00	0.0E+00		0.0E+00	0.0E+00
Benzo (g,h,i) perylene	1,095	4.1E-02	1.6E+00	1.4E-03	1.4E-02	5.3E-01	4.8E-04
Benzo (k) fluoranthene	981	3.3E-02	1.3E+00	1.3E-03	1.4E-02	5.5E-01	5.6E-04
Chrysene	844	8.4E-02	3.2E+00	3.8E-03	7.4E-03	2.8E-01	3.4E-04
Dibenz (a,h) anthracene	1,123	1.4E-02	5.4E-01	4.8E-04	3.5E-03	1.3E-01	1.2E-04
Fluoranthene	707	1.3E-01	4.9E+00	7.0E-03	5.2E-02	2.0E+00	2.8E-03
Fluorene	538	6.2E-03	2.4E-01	4.4E-04	7.5E-03	2.9E-01	5.3E-04
Indeno (1,2,3-cd) pyrene	1,115	3.7E-02	1.4E+00	1.3E-03	1.1E-02	4.1E-01	3.7E-04
Naphthalene	385	3.5E-03	1.4E-01	3.5E-04	5.2E-02	2.0E+00	5.2E-03
Phenanthrene	596	5.2E-02	2.0E+00	3.4E-03	3.0E-02	1.1E+00	1.9E-03
Pyrene	697	1.2E-01	4.6E+00	6.6E-03	4.2E-02	1.6E+00	2.3E-03
Alkylated PAHs							
1-Methylnaphthalene	446	2.6E-03	9.8E-02	2.2E-04	4.7E-03	1.8E-01	4.1E-04
2-Methylnaphthalene	447	2.6E-03	1.0E-01	2.3E-04	4.9E-03	1.9E-01	4.2E-04
C1-Anthracenes/ Phenanthrenes	670		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Chrysenes	929		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluoranthenes/ Pyrenes	770		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C1-Fluorenes	611		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Anthracenes/ Phenanthrenes	746		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Chrysenes	1,008		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Fluorenes	686		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C2-Napthalenes	510		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Anthracenes/ Phenanthrenes	829		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Chrysenes	1,112		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Fluorenes	769		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C3-Napthalenes	581		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Anthracenes/ Phenanthrenes	913		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Chrysenes	1,214		0.0E+00	0.0E+00		0.0E+00	0.0E+00
C4-Napthalenes	657		0.0E+00	0.0E+00		0.0E+00	0.0E+00
		Σ17PAH mg/kg		**Σ17PAH TU**	**Σ17PAH mg/kg**		**Σ17PAH TU**
		0.74		**0.04**	**0.34**		**0.02**
		Σ34PAH mg/kg			**Σ34PAH mg/kg**		
		0.99		**0.05**	**0.46**		**0.03**
Σ17PAH mg/kg, TU=1(b,c)				**15.3**			**12.6**
Σ34PAH mg/kg, TU=1(b,d)				**20.5**			**16.9**
***Average TOCs for the AOC**							

Appendix A3
PCB PRG Information

A3a: PCB PRG Memorandum and Attachments
A3b: PCB USACE Theoretical Bioaccumulation Potential

Appendix A3a
PCB PRG Memorandum
PCB Attachment 1

ENVIRON

March 13, 2009

MEMORANDUM

To: Ecology Technical Subgroup

From: Mary Sorensen, Darrel Lauren, and Jen Lyndall

Re: Preliminary Remedial Goal (PRG) for PCBs and Streamlined Risk Evaluation for PCB-Exposed Wildlife at the Buffalo River AOC

Executive Summary

The Ecology Subgroup (Eco-Group) of the Great Lakes Legacy Act Buffalo River Project Coordination Team has collaborated on efforts to identify preliminary remedial goals (PRGs)[1] of contaminants in sediments for use in the Buffalo River Feasibility Study (FS). This memorandum (memo) is focused on polychlorinated biphenyls (PCBs) and the fish tissue concentrations considered relevant as a basis of PRGs for Buffalo River.

This memo briefly describes the approach used for the development of sediment PRGs estimated based on target fish tissue concentrations that are protective of fish eating wildlife. The approach described herein is consistent with approaches discussed during weekly Eco-Group calls, including modifications made based on improvements identified during the February 2nd Eco-Group call. Several tables are provided to support this memo and Attachment 1 provides the electronic excel workbook of these tables in a calculational format. All supporting data used in the calculations are provided as linked worksheets to facilitate review by the Eco-Group. Upon final agreement of PRGs, a final version of this memo will be submitted from the Eco-Group as an appendix to the Buffalo River FS report.

A range of sediment PCB PRGs is identified herein for consideration in the Buffalo River FS. This approach is similar to that provided for the PAH PRG (memorandum dated February 11) where multiple lines of evidence were used to support the final proposed PRG. It was decided by the Eco-Group during the February 2nd conference call that a range of PCB PRGs was appropriate because it allowed consideration of multiple risk-based criteria valued by the Eco-Group. Four biological exposure "scenarios" based on the natural history of the most sensitive wildlife receptor, the mink, were developed. These were used to evaluate the influence of biologically important variables on the PRGs. These variables are briefly listed below (discussed in greater detail in the *PRG Development* and *Streamlined Risk Evaluation* sections of this memo).

- Fish tissue PCB concentration
- Area use factors (AUF)
- Percent of fish in mink diet

[1] The acronym PRG may be used interchangeably with remedial target concentration (RTC) indicating the targets being evaluated for use in the FS. Actual remedial goals will be identified in the FS.

- Biota-sediment accumulation factor (BSAFs)
- Toxicity reference values (TRVs)

Table 1 shows the sediment PCB PRGs proposed for the Buffalo River FS range from 0.048 mg/kg to 1.3 mg/kg, with average values ranging from 0.44 mg/kg for all scenarios to 0.45 mg/kg for biologically relevant scenarios.

The remainder of this memo describes the:

- PRG development approach, including tabular summary of PRG calculations, and
- Streamlined risk evaluation, including formulae used to derive the PRGs where HQs were set equal to 1

PRG Development Approach

The PRGs presented in Table 1 are based on the calculations provided in Table 2. As identified in Table 2, four "scenarios" were developed to evaluate the PRGs for mink that varied based on consideration of the following elements:

- The basis of fish tissue concentrations used in the analysis: The basis of fish tissue concentrations were set equal to the fish tissue criterion identified by NYSDEC for the Niagara River mink or estimated values where the hazard quotient (HQ) was set equal to the value of 1 (i.e., an HQ ≤ 1 indicates that chemical concentrations do not pose an unacceptable risk to wildlife). Note that separately from PRG development, sediment, worm, and fish tissues for Buffalo River were evaluated to demonstrate the risks posed by current conditions in the river, so that as part of the FS, risk reduction can be evaluated.
- AUFs, based on either 100% or 60% AUF: Habitat characteristics of the Buffalo River which will govern the use of the river by mink were estimated based on the US Fish and Wildlife Service Habitat Suitability Index (USFWS 1989) and consideration of mink exposure to fish tissue as described by NYSDEC in the wildlife narratives provided in the Niagara River report (1987). An estimate of 60% AUF is the maximum AUF that could reasonably be expected for individual mink in the Buffalo River given habitat requirements and conditions present in the Buffalo River, even considering high quality habitat restoration options that are being considered in the FS.
- Mink exposure based on 90%, 50%, or 60% fish in the diet: The 90% estimate was based on NYSDEC request. This is a highly conservative estimate because the NYSDEC (1987) wildlife narrative for mink indicates that "*While other authors also suggest the diet is almost 100% aquatic food depending on season and feeding location, normal fish content in the diet is deemed closer to 30% than 50% (Aulerich 1973; Linscombe et al. 1982). Aulerich et al. (1973) used 30% fish in their mink feeding studies because it is the percentage used in mink ranching to yield optimal development.*" The 50% to 60% estimates used for the PRG development were considered a reasonable compromise between the NYSDEC request for 90% and the NYSDEC (1987) statements of 30% being appropriate.
- BSAFs reflective of sediment to fish uptake calculated by the US Army Corps of Engineers (USACE) were used (Attachment 1). The scenarios varied between values

identified for the AOC as a whole (including the Ship Canal) or the BSAF for the Buffalo River.

- HQs were set equal to 1 with the exception of when the NYSDEC fish tissue criterion was used. The HQ generated using the NYSDEC criterion was 0.3 to 0.5 (unitless), which are values typically below those used to establish remedial goals. However, this information is included in the range of PRGs because it provides necessary consideration of fish tissue criteria valued by NYSDEC.
- TRVs were based on the no adverse effects level (NOAEL) fish tissue criteria toxicity reference values (TRVs) described in Attachment 2 which consider both the criteria identified by New York State Department of Environmental Conservation (NYSDEC 1987), and the US Environmental Protection Agency (USEPA) Great Lakes Initiative (GLI) (1995). For the PRG development, TRVs were consistently set to the USEPA GLI, with only one scenario with the exception where the TRV used by USEPA for the remediation of PCBs in Housatonic River sediments was considered (Bursian et al. 2003; USEPA 2004). These Michigan State University researchers (Bursian et al. 2003) performed studies on mink ingestion of PCBs that provide an updated insight of the base studies described in Attachment 2. An important consideration in the Bursian et al. 2003 study is that fish like carp are high in thiaminase, which metabolizes thiamine. Thiamine deficiency has many of the characteristics of PCB poisoning. More recent studies, such as Bursian et al. (2003) recognized this and added thiamine to the diet of mink fed fish with elevated thiaminase. Previous studies did not report the influence of thiaminase on the toxicity observed. It is also important to note that the study selected by USEPA GLI was Aulerich and Ringer (1977); and, Dr. Aulerich is Dr. Bursian's coauthor on the 2003 study.

Four scenarios for mink were developed, with an overview of these scenarios provided in Table 1. Generally, the four scenarios fell into three categories, as follows:

- Scenarios 1 and 2: Sediment PRGs Estimated Based on Mink Consumption of Fish Tissue Concentrations That Yield an HQ = 1
    - Scenarios 1 and 2 were essentially identical with the difference being consideration of the USACE BSAFs. Scenario 1 used the AOC wide BSAFs (i.e., those including the Ship Canal) and Scenario 2 used the Buffalo River (BR) BSAFs. As seen on Tables 1 and 2, there was little difference between these approaches.
- Scenario 3: Sediment PRGs Estimated Based on Mink Consumption of Fish Tissue Concentrations Equal to NYSDEC Criteria (HQs <1)
- Scenario 4: Sediment PRGs Estimated Based on Mink Consumption of Fish Tissue Concentrations That Yield an HQ = 1; Bursian et al. 2003 TRV (USEPA Housatonic 2004, 2006)

As seen in Tables 1 and 2, there are several iterations of each scenario (notated as Scenario 1a, 1b, 1c; 2a, 2b, 2c; 3a, 3b, 3c; and 4a, 4b, 4c). The differences between each are focused so that key elements of consideration could be quantified. Specifically, the following iterations were provided:

- Scenarios 1 and 2 a, b, c iterations vary based on AUF (100%, 60%, and 60%) and the percent of fish in diet (50%, 50%, and 90%). The AUF variation allowed fish tissue estimates (and thus back-calculated PRGs) to be based on consideration of both worst case HQ=1 and most biologically relevant HQ=1.

- Scenario 3 focused on iterations focused on the most biologically relevant AUF (60%) and included variations in percent of fish in diet (50%, 50%, and 90%), and variations in BSAF (AOC, BR, and BR).
- Scenario 4 is the only case where the USEPA GLI TRV was substituted with another study used by USEPA, the Bursian et al. 2003 study used as the basis of the remedial goals selected for the Housatonic River (USEPA 2004, 2006). The iterations within the scenario were kept at 100% AUF in efforts to keep the evaluation conservative for the benefit of the stakeholder group, the fish in diet was consistent with that from Scenarios 1, 2, and 3. The BSAFs were consistent with that from Scenario 3 (i.e., both AOC and BR were considered).

The estimated (Scenarios 1, 2, and 4) and designated (Scenario 3) fish tissue concentrations were used to back calculate a sediment PCB PRG (in mg/kg) as follows:

- Dry weight fish tissue concentrations (i.e., those needed to calculate HQs) were converted to wet weight by assuming fish are comprised of 75% water (i.e., dry weight values were divided by four).
- Wet weight fish tissues were lipid normalized so that they could be used with BSAFs that were organic carbon normalized. An average of 3% lipids and 2.6% total organic carbon (TOC) were used based on fish tissue data (Table 1 and linked data sources in Attachment 1).

Streamlined Risk Evaluation

A streamlined risk evaluation was also provided as part of this PRG effort because:

- Identification of baseline risks to mammalian and avian fish-eating receptors provides a basis to evaluate risk reduction in the FS
- concerns were raised during the January 16th Eco-Group meeting in Buffalo, NY about the potential risks for not only fish eating wildlife but also those avian receptors that may incidentally ingest sediment during foraging.

This streamlined risk evaluation was conducted in a manner consistent with the USEPA *Ecological Risk Assessment Guidance for Superfund* (1997) and the NYSDEC *Fish and Wildlife Impact Assessment* (1994). The wildlife species selected for this purpose were the mink, the belted kingfisher, and the semipalmated sandpiper. Mink and kingfisher were selected because they obtain a large percentage of their caloric requirements for fish consumption. The sandpiper was selected as a representative of a feeding guild that obtains its caloric requirements from benthic invertebrates and also incidentally ingests a large amount of sediment. The remainder of this memo briefly describes the formulae and data sources.

Formulae

The following general formula was used to estimate exposures for mink and kingfisher:

$$\text{Total Dose (mg/kg - BW - day)} = \left(\frac{\{(P_{FISH} \times C_{FISH}) + (P_{INV} \times C_{INV})\} \times (IR_F) \times (AUF)}{BW} \right)$$

Where:

P_{FISH} = Proportion of the diet comprised of fish (unitless)
C_{FISH} = Concentration of the constituent in fish (mg/kg)
P_{INV} = Proportion of the diet comprised of invertebrates (unitless)
C_{INV} = Concentration of the constituent in invertebrates (mg/kg)
IR_F = Ingestion rate of food (kg/day)
AUF = Area use factor (unitless)
BW = Body weight of the organism (kg)

A similar formula was used to evaluate a hypothetical avian receptor that would have maximum ingestion of sediment and worms during foraging:

$$\text{Total Dose (mg/kg - BW - day)} = \left(\frac{\{(P_{SED} \times C_{SED}) + (P_{INV} \times C_{INV})\} \times (IR_F) \times (AUF)}{BW} \right)$$

Where the parameters are similar to those already described and the following newly introduced parameters are:

P_{SED} = Proportion of the diet comprised of sediment (unitless)
C_{SED} = Concentration of the constituent in sediment (mg/kg)

Hazard quotients were calculated as follows:

$$\text{HQ (unitless)} = \left(\frac{(\text{Total Dose})}{\text{TRV}} \right)$$

Where:

HQ = Hazard quotient (unitless)
TRV = Toxicity Reference Value (mg/kg-BW-day)
Total Dose = Dose (mg/kg-BW-day)

Data Sources

The majority of the data sources have already been described (i.e., TOC, BSAFs, TRVs) as these are the same as those described for PRG development.

The only additional parameter that is unique to the streamlined risk evaluation are the fish and worm tissue data because those were not used directly in the PRG development. Fish tissue data were those from the NYSDEC (2007) study (Figure 1 provides a graphical illustration of the PCBs collected in fish tissues from the AOC; Attachment 1 provides the complete fish PCB data set). Forty-eight whole body fish concentrations of PCBs were evaluated. Fish size ranged from 8 to 1543 g wet weight. The intake formulae above require consideration of fish tissue in dry weight, therefore, wet weight fish tissues were converted to dry weight (Attachment 1).

The fish were evaluated by size for the kingfisher because PCBs increase with age and trophic level and kingfisher are physically limited in the size of the fish they can capture and carry in flight (USEPA 2003). As a further confirmation of the small fish PCB concentrations used for kingfisher, the 2007 data for fish < 50g was compared to the data reported by Preddice et al. (2006) for young-of-year bluntnose minnows collected from the Buffalo River at river mile (RM) 3.7. The PCB concentrations derived from smallest size class of fish collected in 2007 was identical (0.19 ug PCB/kg wet weight) to that reported by Preddice et al. (2006). The kingfisher exposures were considered using average fish tissue concentrations and the maximum fish tissue concentration from any location sampled.

Worm tissue concentrations used to evaluate the avian receptors that may incidentally ingest sediment during foraging were estimated using the USACE BSAFs for worms (data used is provided in Attachment 1). The wet weight worm concentrations were converted to dry weight units by assuming 80% body water and multiplying by 5.
Food ingestion rates were calculated according to allometric equations provided for mammalian and avian carnivores, as noted in USEPA's *Wildlife Exposure Factors Handbook* (2003), and average body weights were also obtained from this handbook. Incidental sediment ingestion rate (30%) was taken from USEPA (1996) and is the highest seen in Beyer et al. (2008) evaluation of sediment ingestion for waterfowl (where they identify 22% as the highest average in diet.

Results

The results are provided in Table 3. The HQs are less than or equal to a value of 1 for kingfisher, mink, and the sandpiper regardless of the particular criteria used (NYSDEC or USEPA GLI) or the AUF (100% or 60%) with one exception. A mink HQ of 2 is seen for mink that are assumed to ingest 90% fish and feed in the Buffalo River AOC 100% of the time. While these particular parameters are not considered biologically relevant for reasons already described for PRGs, they do show a basis upon which theoretical risk reduction can be quantitatively compared in the FS. It is noted that the fish tissue data for carp are in question between NYSDEC and USEPA and while the NYSDEC values for carp lipids are reflected in the data set used to calculate BSAFs, the updated carp tissue concentrations were not used in the risk estimates for mink (i.e., kingfisher eat smaller fish). As such, the risk results for mink are potentially underestimated. This uncertainty has no bearing on the PRG calculations presented earlier in this memorandum because the fish tissue concentrations are not used in those calculations.

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Table 1: PCB PRG Summary Matrix (a)

Scenario	Fish Basis (b)	AUF (c)	Fish in Diet % (d)	BSAF Basis (e)	HQ (f)	USEPA TRV Basis (g)	[Fish] mg/kg, wwt (h)	SD PRG mg/kg (i)
1a†	Buffalo River	100	50	AOC	1	GLI	0.28	0.10
1b*†	Estimated	60	50	AOC	1	GLI	0.46	0.17
1c†	Estimated	60	90	AOC	1	GLI	0.28	0.10
2a†	Estimated	100	50	BR	1	GLI	0.28	0.11
2b	Estimated	60	50	BR	1	GLI	0.46	0.19
2c†	Estimated	60	90	BR	1	GLI	0.28	0.11
3a*	NYSDEC	60	50	AOC	0.3	GLI	0.13	0.048
3b	NYSDEC	60	50	BR	0.3	GLI	0.13	0.054
3c	NYSDEC	60	90	BR	0.5	GLI	0.13	0.054
4a*†	Estimated	100	50	AOC	1	HR	3.13	1.1
4b†	Estimated	100	50	BR	1	HR	3.13	1.3
4c†	Estimated	100	90	BR	1	HR	2.13	0.78
Average of those scenarios with biologically relevant mink use of the river (as denoted with the symbol *):							1.24	0.45
Average of HQ=1 (as denoted with the symbol †):							1.16	0.44

Notes:

(a) The scenarios and detailed formulate and calculated values are provided in Table 2.

(b) Estimated values are those based on HQs equal to 1, unless noted as NYSDEC.

(c) AUF is based on Buffalo River habitat suitability characteristics for mink, as defined by the US Fish and Wildlife Service (1989). 60% use of the Buffalo River is considered the reasonably maximum that could be expected after anticipated (albeit yet undefined) restoration is implemented. 100% AUF is provided as a conservative estimate, but is not considered biologically relevant.

(d) Diet is based on NYSDEC request (90%) or those average estimates based on NYSDEC (1987) wildlife narrative. 50% fish in diet is considered a conservatively high level that is biologically relevant (NYSDEC 1987).

(e) US Army Corps of Engineers BSAF for sediment to fish used, with values representing the AOC as a whole or focused on the Buffalo River.

(f) HQ was set equal to 1, unless calculated for NYSDEC criteria.

(g) The USEPA GLI TRV was used for the majority of scenario evaluations. The USEPA Housatonic River TRV was also considered due to the value of this study (Bursian et al. 2003) provided as an attachment to this memo.

(h) Fish tissue and PRG values linked to Table 2 as denoted by color coding.

%	Percent
AOC	Area of Concern
AUF	Area Use Factor
BR	Buffalo River
BSAF	Biota-Sediment Accumulation Factor
HQ	Hazard Quotient
mg/kg	Milligram per Kilogram
NYSDEC	New York State Department of Environmental Conservation
PRG	Preliminary Remediation Goal
SD	Sediment
wwt	Wet Weight
(purple)	Wet Weight Fish Tissue Concentrations
(pink)	Sediment PRG

Table 2: Sediment PRGs Linked to Fish Tissue Residues

Sediment PRGs Estimated Based on Mink Consumption of Fish Tissue Concentrations That Yield an HQ = 1

Scenario 1a. HQ=1; 100% AUF; BSAF = USACE total AOC average; diet of 50% fish							**100% AUF (a)**	60% AUF (b)
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg	[Invertebrate] mg/kg	Total Dose (mg/kg/d)	TRV (mg/kg-BW-d)	**HQ**	HQ
(50% fish, 100% AUF, AOC BSAF)	1000	0.049	1.14	0.192	0.03	0.03	**1**	0.6
			(Estimate based on HQ=1)			(USEPA GLI Criterion)		
all fish are 75% water			0.284	mg wwt fish				
all fish are 3.6% lipid	3.6		8.0	g-lipid fish				
All AOC BSAF	2.0		4.0	ug/g-OC				
sediment OC	2.6		104	ug/kg				
PRG			0.104	mg/kg				

Scenario 1b. HQ=1; 60% AUF; BSAF = USACE total AOC average; diet of 50% fish							100% AUF (a)	**60% AUF (b)**
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg	[Invertebrate] mg/kg	Total Dose (mg/kg/d)	TRV (mg/kg-BW-d)	HQ	**HQ**
(50% fish, 60% AUF, AOC BSAF)	1000	0.049	1.85	0.192	0.05	0.03	2	**1**
			(Estimate based on HQ=1)			(USEPA GLI Criterion)		
all fish are 75% water			0.463	mg wwt fish				
all fish are 3.6% lipid	3.6		13.0	g-lipid fish				
All AOC BSAF	2.0		6.5	ug/g-OC				
sediment OC	2.6		169	ug/kg				
PRG			0.169	mg/kg				

Scenario 1c. HQ=1; 60% AUF; BSAF = USACE total AOC average; diet of 90% fish (NYSDEC Request)							100% AUF (a)	**60% AUF (b)**
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg	[Invertebrate] mg/kg	Total Dose (mg/kg/d)	TRV (mg/kg-BW-d)	HQ	**HQ**
(90% fish, 60% AUF, AOC BSAF)	1000	0.049	1.10	0.192	0.05	0.03	2	**1**
			(Estimate based on HQ=1)			(USEPA GLI Criterion)		
all fish are 75% water			0.275	mg wwt fish				
all fish are 3.6% lipid	3.6		7.7	g-lipid fish				
All AOC BSAF	2.0		3.9	ug/g-OC				
sediment OC	2.6		101	ug/kg				
PRG			0.101	mg/kg				

Scenario 2a. HQ=1 assuming 100% AUF; BSAF = USACE BR average, diet 50% fish							**100% AUF (a)**	60% AUF (b)
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg	[Invertebrate] mg/kg	Total Dose (mg/kg/d)	TRV (mg/kg-BW-d)	**HQ**	HQ
(50% fish, 60% AUF, BR BSAF)	1000	0.049	1.10	0.192	0.03	0.03	**1**	0.6
			(Estimate based on HQ=1)			(USEPA GLI Criterion)		
all fish are 75% water			0.275	mg wwt fish				
all fish are 3.6% lipid	3.6		7.7	g-lipid fish				
BR BSAF	1.8		4.4	ug/g-OC				
sediment OC	2.6		113	ug/kg				
PRG			0.113	mg/kg				

Scenario 2b. HQ=1 assuming 60% AUF; BSAF = USACE BR average, diet 50% fish							100% AUF (a)	**60% AUF (b)**
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg	[Invertebrate] mg/kg	Total Dose (mg/kg/d)	TRV (mg/kg-BW-d)	HQ	**HQ**
(50% fish, 60% AUF, BR BSAF)	1000	0.049	1.85	0.192	0.05	0.03	2	**1**
			(Estimate based on HQ=1)			(USEPA GLI Criterion)		
all fish are 75% water			0.463	mg wwt fish				
all fish are 3.6% lipid	3.6		13.0	g-lipid fish				
BR BSAF	1.8		7.3	ug/g-OC				
sediment OC	2.6		191	ug/kg				
PRG			0.191	mg/kg				

Scenario 2c. HQ=1 assuming 60% AUF; BSAF = USACE BR average, diet 90% fish (NYSDEC request)							100% AUF (a)	**60% AUF (b)**
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg	[Invertebrate] mg/kg	Total Dose (mg/kg/d)	TRV (mg/kg-BW-d)	HQ	**HQ**
(90% fish, 60% AUF, BR BSAF)	1000	0.049	1.10	0.192	0.05	0.03	2	**1**
			(Estimate based on HQ=1)			(USEPA GLI Criterion)		
all fish are 75% water			0.275	mg wwt fish				
all fish are 3.6% lipid	3.6		7.7	g-lipid fish				
BR BSAF	1.8		4.4	ug/g-OC				
sediment OC	2.6		113	ug/kg				
PRG			0.113	mg/kg				

Table 2: Sediment PRGs Linked to Fish Tissue Residues

Sediment PRGs Estimated Based on Mink Consumption of Fish Tissue Concentrations Equal to NYSDEC Criteria (HQs <1)

Scenario 3a. PRG based on NYSDEC mink criterion; BSAF = USACE AOC average, diet 50% fish

Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg	[Invertebrate] mg/kg	Total Dose (mg/kg/d)	TRV (mg/kg-BW-d)	100% AUF (a) HQ	60% AUF (b) HQ
(NYSDEC, 50% fish, 60% AUF, BR BSAF)	1000	0.049	0.52	0.192	0.02	0.03	0.5	0.3
			(NYSDEC Criterion)			(USEPA GLI Criterion)		
all fish are 75% water			0.13	mg wwt fish				
all fish are 3.6% lipid	3.6		3.7	g-lipid fish				
BR BSAF	2.0		1.8	ug/g-OC				
sediment OC	2.6		48	ug/kg				
PRG			0.048	mg/kg				

Scenario 3b. PRG based on NYSDEC mink criterion; BSAF = USACE BR average, diet 50% fish

Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg	[Invertebrate] mg/kg	Total Dose (mg/kg/d)	TRV (mg/kg-BW-d)	100% AUF (a) HQ	60% AUF (b) HQ
(NYSDEC, 50% fish, 60% AUF, BR BSAF)	1000	0.049	0.52	0.192	0.02	0.03	0.5	0.3
			(NYSDEC Criterion)			(USEPA GLI Criterion)		
all fish are 75% water			0.13	mg wwt fish				
all fish are 3.6% lipid	3.6		3.7	g-lipid fish				
BR BSAF	1.8		2.1	ug/g-OC				
sediment OC	2.6		54	ug/kg				
PRG			0.054	mg/kg				

Scenario 3c. PRG based on NYSDEC mink criterion; BSAF = USACE BR average, diet 90% fish

Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg	[Invertebrate] mg/kg	Total Dose (mg/kg/d)	TRV (mg/kg-BW-d)	100% AUF (a) HQ	60% AUF (b) HQ
(NYSDEC, 90% fish, 60% AUF, BR BSAF)	1000	0.049	0.52	0.192	0.02	0.03	0.8	0.5
			(NYSDEC Criterion)			(USEPA GLI Criterion)		
all fish are 75% water			0.13	mg wwt fish				
all fish are 3.6% lipid	3.6		3.7	g-lipid fish				
BR BSAF	1.8		2.1	ug/g-OC				
sediment OC	2.6		54	ug/kg				
PRG			0.054	mg/kg				

Sediment PRGs Estimated Based on Mink Consumption of Fish Tissue Concentrations That Yield an HQ = 1; Bursian et al. 2003 TRV (U

Scenario 4a. HQ=1; 100% AUF; BSAF = USACE total AOC average; diet of 50% fish

Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg	[Invertebrate] mg/kg	Total Dose (mg/kg/d)	TRV (mg/kg-BW-d)	**100% AUF (a) HQ**	60% AUF (b) HQ
(50% fish, 100% AUF, AOC BSAF)	1000	0.049	12.50	0.192	0.31	0.414	**1**	0.4
			(Estimate based on HQ=1)			(USEPA Housatonic)		
all fish are 75% water			3.13	mg wwt fish				
all fish are 3.6% lipid	3.6		88	g-lipid fish				
All AOC BSAF	2.0		44	ug/g-OC				
sediment OC	2.6		1145	ug/kg				
PRG			1.14	mg/kg				

Scenario 4b. HQ=1; 100% AUF; BSAF = USACE BR average; diet of 50% fish

Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg	[Invertebrate] mg/kg	Total Dose (mg/kg/d)	TRV (mg/kg-BW-d)	**100% AUF (a) HQ**	**60% AUF (b) HQ**
(50% fish, 100% AUF, AOC BSAF)	1000	0.049	12.50	0.192	0.31	0.414	**1**	**0.4**
			(Estimate based on HQ=1)			(USEPA Housatonic)		
all fish are 75% water			3.13	mg wwt fish				
all fish are 3.6% lipid	3.6		88.0	g-lipid fish				
All AOC BSAF	1.8		49.6	ug/g-OC				
sediment OC	2.6		1289	ug/kg				
PRG			1.29	mg/kg				

Scenario 4c. HQ=1; 100% AUF; BSAF = USACE total AOC average; diet of 90% fish (NYSDEC Request)

Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg	[Invertebrate] mg/kg	Total Dose (mg/kg/d)	TRV (mg/kg-BW-d)	**100% AUF (a) HQ**	**60% AUF (b) HQ**
(50% fish, 100% AUF, AOC BSAF)	1000	0.049	8.50	0.192	0.37	0.414	**1**	**0.5**
			(Estimate based on HQ=1)			(USEPA Housatonic)		
all fish are 75% water			2.13	mg wwt fish				
all fish are 3.6% lipid	3.6		59.8	g-lipid fish				
All AOC BSAF	2.0		29.9	ug/g-OC				
sediment OC	2.6		778	ug/kg				
PRG			0.778	mg/kg				

Notes:

AOC	Area of Concern	mg	Milligram
AUF	Area Use Factor	mg/kg	Milligram per Kilogram
BSAF	Biota-Sediment Accumulation Factor	mg/kg-BW-d	Milligram per Kilogram of Body Weight per Day
BW	Body Weight	OC	Organic Carbon
dwt	Dry Weight	PRG	Preliminary Remediation Goal
g	Gram	TRV	Toxicity Reference Value
GLI	Great Lakes Initiative	ug/g-OC	Microgram per Gram Organic Carbon
HQ	Hazard Quotient (rounded to one sig. figure)	USACE	United States Army Corp of Engineers
IR	Ingestion Rate	USEPA	United States Environmental Protection Division
kg/kg/d	Kilogram per Kilogram per Day	wwt	Wet Weight
NYSDEC	NY State Department of Environmental Conservation	%	Percent
(blue)	Exposure Notes	(pink)	Sediment
(yellow)	HQ > 1	(purple)	Wet Weight Fish Tissue Concentrations
(green)	HQ ≤ 1		

Table 3: Wildlife Streamlined Risk Calculations

Kingfisher Risk Calculations for Buffalo River using Site-Specific Information							
Buffalo River Site-Specific Exposure			Average Fish Tissue Concentration from AOC				100% AUF
Belted Kingfisher	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	Dose- Fish	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ
(Average Exposure)	150	0.157	0.81	0.127	0.13	0.6	0.2
			Maximum Fish Tissue Concentration from AOC				
Belted Kingfisher	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	Dose- Fish	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ
(Maximum Exposure)	150	0.157	0.81	0.127	0.13	0.6	0.2

Kingfisher Risk Calculations using NYSDEC and USEPA Criteria (a)							
NYSDEC Niagra Fish Tissue Criterion Exposure Concentration							
Belted Kingfisher	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	Dose- Fish	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ
(NYSDEC Criterion)	150	0.157	0.44	0.069	0.07	0.6	0.1
			(0.11 mg/kg wwt = 0.44 mg/kg dwt assuming fish = 75% water)				
USEPA GLI Fish Tissue Criterion Exposure Concentration							
Belted Kingfisher	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	Dose- Fish	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ
(USEPA GLI Criterion)	150	0.157	3.84	0.602	0.60	0.6	1
			(0.96 mg/kg wwt = 3.84 mg/kg dwt assuming fish = 75% water)				

Mink Risk Calculations for Buffalo River using Site-Specific Information								
Buffalo River Site-Specific Exposure			90% fish; NYSDEC Request, not realistic biologically (a)				100% AUF (a)	60% AUF (b)
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	[Invertebrate] mg/kg	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ	HQ
(90% fish ingestion)	1000	0.049	1.14	0.192	0.05	0.03	2	1
			50% fish; 30% invertebrates; remainder terrestrial (c)					
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	[Invertebrate] mg/kg	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ	HQ
(50% fish ingestion)	1000	0.049	1.14	0.192	0.03	0.03	1	0.6
			60% fish; 20% invertebrates; remainder terrestrial (d)					
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	[Invertebrate] mg/kg	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ	HQ
(60% fish ingestion)	1000	0.049	1.14	0.192	0.04	0.03	1	0.7

Table 3: Wildlife Streamlined Risk Calculations

Mink Risk Calculations using NYSDEC and USEPA Criteria (a)								
NYSDEC Niagra Fish Tissue Criterion Exposure Concentration					90% fish; NYSDEC Request		100% AUF (a)	60% AUF (b)
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	[Invertebrate] mg/kg	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ	HQ
(NYSDEC Criterion)	1000	0.049	0.52	0.192	0.02	0.03	0.8	0.5
			(0.13 mg/kg wwt = 0.52 mg/kg dwt assuming fish = 75% water)					
			50% fish; 30% invertebrates, remainder terrestrial (c)					
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	[Invertebrate] mg/kg	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ	HQ
(NYSDEC Criterion)	1000	0.049	0.52	0.192	0.02	0.03	0.5	0.3
			(0.13 mg/kg wwt = 0.52 mg/kg dwt assuming fish = 75% water)					
			60% fish; 20% invertebrates, remainder terrestrial (d)					
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	[Invertebrate] mg/kg	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ	HQ
(NYSDEC Criterion)	1000	0.049	0.52	0.192	0.02	0.03	0.6	0.3
			(0.13 mg/kg wwt = 0.52 mg/kg dwt assuming fish = 75% water)					
USEPA GLI Fish Tissue Criterion Exposure Concentration					90% fish; NYSDEC Request		100% AUF (a)	60% AUF (b)
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	[Invertebrate] mg/kg	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ	
(USEPA GLI Criterion)	1000	0.049	0.60	0.192	0.03	0.03	0.9	0.5
			(0.15 mg/kg wwt = 0.6 mg/kg dwt assuming fish = 75% water)					
			50% fish; 30% invertebrates, remainder terrestrial (c)					
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	[Invertebrate] mg/kg	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ	
(USEPA GLI Criterion)	1000	0.049	0.60	0.192	0.02	0.03	0.6	0.3
			(0.15 mg/kg wwt = 0.6 mg/kg dwt assuming fish = 75% water)					
			60% fish; 20% invertebrates, remainder terrestrial (d)					
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	[Invertebrate] mg/kg	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ	
(USEPA GLI Criterion)	1000	0.049	0.60	0.192	0.02	0.03	0.6	0.4
			(0.15 mg/kg wwt = 0.6 mg/kg dwt assuming fish = 75% water)					

Table 3: Wildlife Streamlined Risk Calculations

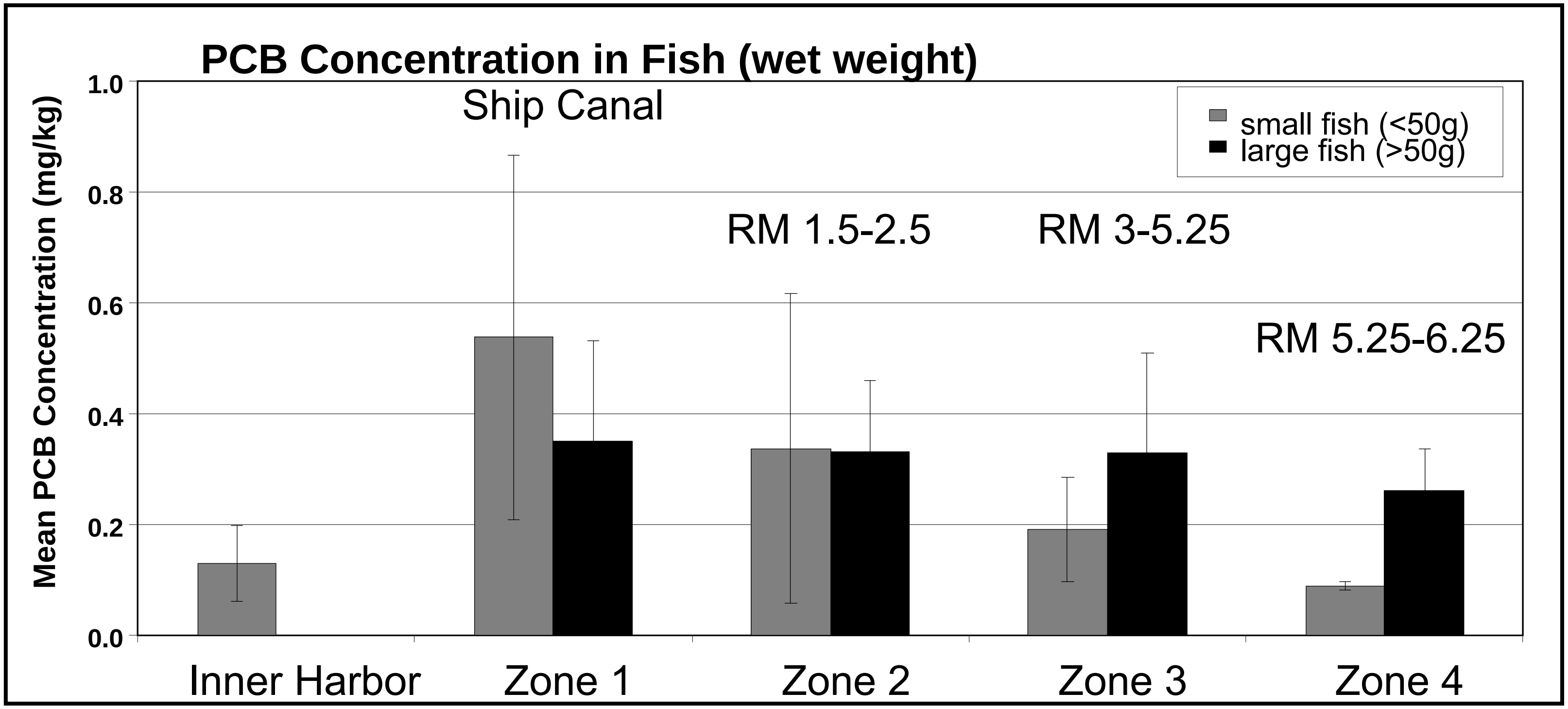
Mink Risk Calculations for Buffalo River using Site-Specific Information and Bursian et al. 2003 TRV								
Buffalo River Site-Specific Exposure			90% fish; NYSDEC Request, not realistic biologically (a)				100% AUF (a)	60% AUF (b)
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	[Invertebrate] mg/kg	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ	HQ
(90% fish ingestion)	1000	0.049	1.14	0.192	0.05	0.414	0.1	0.07
			50% fish; 30% invertebrates; remainder terrestrial (c)					
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	[Invertebrate] mg/kg	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ	HQ
(50% fish ingestion)	1000	0.049	1.14	0.192	0.03	0.414	0.07	0.04
			60% fish; 20% invertebrates; remainder terrestrial (d)					
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	[Invertebrate] mg/kg	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ	HQ
(60% fish ingestion)	1000	0.049	1.14	0.192	0.04	0.414	0.08	0.05

Worm and Sediment Ingesting Bird: Risk Calculations for Buffalo River using Site-Specific Information									100% AUF
Semipalmated sandpiper	BW (g)	IR (kg/kg/d)	[Sediment] mg/kg	[Invertebrate] mg/kg	Dose - Invertebrates	Dose - Sediment	Total Dose (mg/kg/d), dwt	TRV (mg/kg/d)1	HQ
	55	0.220	0.071	0.19	0.0423	0.005	0.047	0.6	0.08

Notes:

%	percent	kg/kg/d	Kilogram per Kilogram per Day
AOC	Area of Concern	mg/kg	Milligram per Kilogram
AUF	Area Use Factor	IR (kg/kg/d)	IR (kg/kg/d)
BW	Body Weight	NYSDEC	New York State Department of Environmental Conservation
dwt	Dry Weight	PRG	Preliminary Remediation Goal
g	Gram	TRV	Toxicity Reference Value
GLI	Great Lakes Initiative	USEPA	United States Environmental Protection Division
IR	Ingestion Rate	wwt	Wet Weight
HQ	Hazard Quotient (rounded to one sig. figure)		
(blue)	Exposure Notes		
(yellow)	HQ > 1		
(green)	HQ ≤ 1		

- Measured Fish Tissue Concentrations in Buffalo River
  - Measured maximum residues= 0.87 mg/kg small fish to 0.69 (large fish) whole body (wet weight)



RM River Mile

ENVIRON

PCB Concentration in Fish

Figure 1

Appendix A3a
PCB PRG Memorandum
Attachment 2

ENVIRON

February 3, 2009

MEMORANDUM

To: Ecology Technical Subgroup

From: Mary Sorensen, Darrel Lauren, and Jen Lyndall

Re: Preliminary Remedial Goals (PRG) for PCB-Exposed Wildlife at the Buffalo River AOC: Evaluation of Toxicity Studies That Form the Basis of the PRGs

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The Ecology Subgroup (Eco-Group) of the Great Lakes Legacy Act Buffalo River Project Coordination Team has collaborated on efforts to identify preliminary remedial goals (PRGs)[1] of contaminants in sediments for use in the Buffalo River Feasibility Study (FS). This memorandum is focused on polychlorinated biphenyls (PCBs) and the fish tissue concentrations considered relevant as a basis of PRGs for Buffalo River.

New York State Department of Environmental Conservation (NYSDEC) identified a PCB fish tissue concentration considered protective of fish-eating wildlife in the Niagara River (0.11 mg/kg wet weight; Table 26 of NYSDEC 1987) for use in establishing PRGs for sediment PCBs in the Buffalo River. The basis of the fish tissue concentration used for the Niagara River was evaluated in light of two decades of scientific developments since the Niagara report was published. This memorandum provides a summary of the review, and shows that while the value used for the Niagara River was appropriate for use by NYSDEC in 1987, a more current United States Environmental Protection Agency (USEPA) Great Lakes Initiative (GLI) tissue concentration protective of fish-eating wildlife should be considered for the Buffalo River because it better reflects current scientific understanding of PCB toxicity to wildlife, and is consistent with the current consideration of more than 50 studies of PCBs in wildlife (USEPA 2006; Fuchsman et al. 2008). The specific rationales that support this recommendation are:

1. The USEPA GLI criterion being identified for use in the development of Buffalo River PRGs is a no observable adverse effects level (NOAEL) that is not substantially different than that identified for use by NYSDEC when comparable units are considered. Specifically, the fish tissue criterion identified by NYSDEC (1987) 0.11 mg PCB/kg, wet weight is protective of fish eating birds and is the lowest of the estimated fish tissue benchmarks considered for the Niagara River. The NYSDEC (1987) fish criterion for mink is only slightly greater (0.13 mg PCB/kg, wet weight) than that identified for birds. The USEPA GLI fish tissue criterion for mink is very similar (15 mg PCB/kg wet weight[2]) to the NYSDEC value for mink, when units are

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[1] The acronym PRG may be used interchangeably with remedial target concentration (RTC) indicating the targets being evaluated for use in the FS. Actual remedial goals will be identified in the FS.
[2] The mink criterion identified in the GLI is provided on Page 4-7 of USEPA 1995.

converted from an ingestion dose value into a wet weight fish tissue criterion[3]. The USEPA (1995) fish tissue criterion for fish eating birds (i.e., 0.96 mg PCB/kg wet weight fish tissue[4]) is higher than that identified by NYSDEC (1987) and thus, the lower mink value from USEPA (1995) would be the more stringent value for consideration in the PRG development.

2. The NYSDEC (1987) fish tissue criterion protective of fish eating mammals, 0.13 mg PCB/kg wet weight, is based on a study by Platonow and Karstad (1973) in which mink were fed beef from Aroclor-fed cattle. The lowest concentrations tested, 0.64 mg PCB/kg, resulted in adverse effects. NYSDEC (1987) assumed that the no effect concentration would be obtained by multiplying this concentration by an uncertainty factor of 0.2.

   The USEPA (1995) reviewed the Platonow and Karstad (1973) paper and reported that that "reproductive impairment occurs in mink at even lower concentrations when PCBs fed to mink have been metabolized by [mammalian] species". Fish do not metabolize PCBs like mammals, so mink eating fish are exposed to less toxic congener profiles than mink that are fed PCBs in cattle. Therefore, USEPA (1995) also reviewed nine other studies and selected a study by Aulerich and Ringer (1977) as the best study upon which to base water quality concentrations that are protective of mammalian wildlife in the Great Lakes. These authors exposed mink to Aroclor 1254 at 0, 5, and 10 mg/kg for nine-months. They also exposed mink to Aroclor 1016, 1221, 1242, and 1254 for 297-days. Only Aroclor 1254 had an adverse effect on mink reproduction. USEPA (1995) estimated a lowest effect concentration of 2 mg PCB/kg and calculated a lowest observable adverse effects level (LOAEL) of 0.3 mg PCB/kg body weight per day. They then applied an uncertainty factor of 10 to estimate the no observable adverse effects level (NOAEL). This value, 0.03 mg PCB/ kg body weight per day was nearly identical to that obtained by Hornshaw et al. (1983) by feeding Great Lakes fish to mink for 290-days during the reproductive cycle. Therefore, since USEPA (1995) provides a full description of the tests and recognized the importance of metabolism, and the value presented herein for mink is consistent with that identified in other studies and that identified for use by NYSDEC for mink in the Niagara River, 0.03 mg PCB/ kg body weight per day (i.e., 0.15 mg/kg wet weight fish tissue) is the appropriate NOAEL for the mink for the Buffalo River.

3. As mentioned previously, the NYSDEC (1987) fish tissue criterion is based on protection of fish eating birds, 0.11 mg PCB/kg wet weight. This concentration is based on a study by Britton and Huston (1973) in laying hens exposed to Aroclor

[3] USEPA 1995 reports the criterion in units of milligram per kilogram of body weight per day (mg/kg-BW-day), which converts to mg/kg wet weight fish tissue by considering that (1) mink have a body weight of 1 kilogram; (2) mink consume 0.049 kg/kg-BW-day; and (3) that fish are comprised of 75% water (i.e., ([0.03 mg/kg-BW-day/0.049 kg/kg-BW-day]/4 = 0.15mg/kg wet weight fish tissue).

[4] The dose based benchmark of 0.6mg/kg-BW-day identified in USEPA (1995) page 4-14 equates to 0.96 mg/kg wet weight fish using a similar equation as that described for mink except substituting a belted kingfisher ingestion rate of 0.157 kg/kg-BW-day (i.e., [0.6 mg/kg-BW-day/0.157 kg/kg-BW-day]/4 = 0.96mg/kg wet weight fish tissue).

1242. NYSDEC (1987) report a NOAEL of 0.224 mg PCB/kg body weight per day and then divided this value by ten to account for the possibility that the kingfisher might be more sensitive than the chicken. This equates to an estimated fish tissue concentration of 0.11 mg PCB/kg wet weight.

USEPA (1995) reviewed chronic studies with birds but selected the study by Dahlgren et al. (1972) as the best study upon which to base water quality concentrations that are protective of avian wildlife in the Great Lakes. Dahlgren et al. (1972) administered Aroclor 1254 at 12.5 of 50 mg once a week by gelatin capsule to ring-necked pheasant for sixteen-weeks during the reproductive cycle. USEPA (1995) reported that no effects were found on egg fertility or chick growth at 12.5 mg/week. This study was selected in part because preference was given to studies with wildlife species, rather than chickens. USEPA (1995) calculated a LOAEL of 1.8 mg Aroclor 1254/kg body weight per day and used a 3-fold application factor because they considered that kingfisher may be more sensitive than pheasant, and an additional uncertainty factor of 3 to convert the LOAEL to a NOAEL of 0.2 mg Aroclor 1254/kg body weight per day. USEPA (1995) provides a description of these studies and calculated a NOAEL of 3.4 mg PCB/kg body weight per day.

In 1987 and 1995, it was not known that Gallinaceous birds such as the chicken are the most sensitive species of birds tested (Karchner et al. 2006; Head 2008) and current practice does not add an additional application factor when applying these NOAELs to other avian species. For example, Head et al. (2008) reported that common tern are 260-fold less sensitive than chicken and American kestrel are 122 to 163-fold less sensitive chicken. Wood duck are >46-fold less sensitive than chicken. Therefore, no additional uncertainty factors should be applied to the avian NOAELs discussed above. This means that the NYSDEC (1987) LOAEL should have been 0.22 mg Aroclor 1254/kg body weight per day and the USEPA (1995) NOAEL should be 0.6 mg Aroclor 1254/kg body weight per day. Since USEPA (1995) provides a full description of these experiments, ENVIRON believes that 0.6 mg Aroclor 1254/kg body weight per day is the appropriate NOAEL for avian receptors. This value equates to 0.96 mg PCB/kg wet weight. It is worthy of note that the NYSDEC value of 0.22 mg Aroclor 1254/kg body weight per day equates to 0.35 mg/kg wet weight fish tissue (refer to previous footnotes for conversion factors and approaches), and thus is higher than the mink fish tissue criterion discussed earlier in this memo.

Conclusions

Appropriate PRGs for the Buffalo River should be based on scientifically valid approaches, with consideration of regulatory precedent to the extent that such approaches used in the past reflect our current understanding of physical, chemical, and biological environment. This memorandum provides a detailed description of the rationales that support the use of mammalian and avian fish tissue criteria of 0.15 mg/kg and 0.96 mg/kg wet weight fish, respectively, for consideration of PRG development. The mink value in particular is very similar to that identified by NYSDEC for use in the Niagara River.

These values are based on studies cited for use in the Great Lakes (USEPA 1995) and reflect concentrations consistent with those being used as remedial targets in the Hudson and Housatonic Rivers (USEPA 2004; 2006). In addition, because the mixture of PCBs in the Buffalo River small fish most resembles 1242/1248 (i.e., 97% total PCB in small fish) and is approximately equally split in all fish (i.e., 54% of total PCBs), these fish tissue targets are considered highly conservative for both mammals and birds. The values described herein for mink and fish eating birds, will be considered for use in development of PRGs within a risk-based context.

References

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Appendix A3b
PCB USACE Theoretical Bioaccumulation Potential

CELRB-TD-EA

25 February 2009
Pickard/swp/4404

MEMORANDUM FOR RECORD

SUBJECT: Buffalo River Area of Concern (AOC) – Development of a Preliminary Remediation Goal (PRG) for total polychlorinated biphenyls (PCBs)

1. The purpose of this memorandum is to document the development of a preliminary remediation goal (PRG) for total polychlorinated biphenyls (PCBs) in Buffalo River Area of Concern (AOC) sediments relative to the protection of pelagic fish. This approach offers a single line of evidence toward the development of PRGs for total PCBs.

2. The development of this PRG is summarized as follows:

a. AOC sediment PCB contamination. Total PCB concentrations in AOC sediments range from non-detectable to 33 mg/kg based on existing data. The predominant Aroclors identified in the sediments were 1242, 1254 and 1260. Analysis of three composite surficial sediments from the AOC collected in 2003 for bioaccumulation experiments showed detectable mixtures of Aroclor 1248 and 1260, with total PCB concentrations ranging from 0.28 to 0.58 mg/kg (USAERDC 2003). A PCB profile based on congener-specific analysis of one of these sediment samples obtained near Katherine Street Peninsula is presented in Figure 1 (sum of PCB congeners = 191 µg/kg).

b. Bioaccumulation modeling. Bioaccumulation is an appropriate biological measurement endpoint to evaluate the potential exposure to PCBs in the aquatic environment. Theoretical bioaccumulation potential (TBP) is an equilibrium theory-based algorithm used to predict the potential bioaccumulation of neutral, organic compounds, such as PCBs, from sediment into benthic organisms (McFarland 1984). This model is expressed as:

$$TBP = BSAF_b\,(L_b)\,\frac{C_s}{TOC} \qquad (1)$$

Where:
TBP = Predicted whole body tissue concentration of total PCBs in target benthic organism, mg/kg wet weight
$BSAF_b$ = Benthic biota-sediment accumulation factor
L_b = Concentration of lipid in target benthic organism, percent of wet weight

C_s = Concentration of total PCBs in sediment, mg/kg dry weight
TOC = Total organic carbon concentration in sediment, percent of dry weight

In order to extrapolate fish bioaccumulation from this benthic model, a trophic transfer factor (TTF) for total PCBs was calculated. TTFs using lipid-normalized bioaccumulation experiment data on AOC sediment using the aquatic worm (oligochaete) *Lumbriculus variegatus* (USAERDC 2003), and lipid-normalized tissue residue data on AOC collected largemouth bass (*Micropterus salmoides*) (NYSDEC 2007) were determined as follows:

$$TTF = \frac{C_{tf}/L_f}{C_{tb}/L_b} \qquad (2)$$

Where:
C_{tf} = Concentration of total PCBs in whole fish, mg/kg wet weight
L_f = Concentration of lipid in fish, percent of wet weight
C_{tb} = Concentration of total PCBs in *L. variegatus* tissue, mg/kg wet weight
L_b = Concentration of lipid in *L. variegatus* tissue, percent of wet weight

A mean of these individual sample values was then calculated for an AOC-specific TTF of 1.5 for total PCBs. Note that PCB residues in fish tissue were identified as Aroclors 1242, and 1254/1260, while those identified in worm tissue were Aroclors 1248 and 1260. To estimate PCB body burden in pelagic fish, this TTF can be applied to the TBP model as follows:

$$TBP_f = (BSAF_b)\,(L_b)\,\frac{C_s}{TOC}\,(TTF) \qquad (3)$$

Where:

TBP_f = Theoretical bioaccumulation potential extrapolated to pelagic fish, mg/kg wet weight

While this approach does not employ food web modeling, it can be used as a reasonable estimate of pelagic fish bioaccumulation. In addition, it offers several advantages: (1) it is based almost entirely on site-specific data (except for the benthic organism lipid level, every variable in this model is based on measured Buffalo River AOC-specific data); (2) it addresses the site-specific bioavailability of total PCBs; (3) it is less convoluted than the typical relationship of sediment to fish through benthos; and (4) the critical benthic diet component is measured rather than estimated using sediment partitioning relationships (typical for food web bioaccumulation models).

c. Linking sediment concentration to effects-based bioaccumulation in pelagic fish. A simple manipulation of the TBP model extrapolation to pelagic fish can link a total PCB sediment concentration to a given fish body burden toxicity threshold (BBTT) by solving the equation for C_s, substituting PRG_{PCB} for C_s and $BBTT_f$ for TBP_f, yielding:

$$PRG_{PCB} = \frac{(BBTT_f)\,(TOC)}{(BSAF_b)(L_b)(TTF)} \tag{4}$$

Where:
PRG_{PCB} = Preliminary remediation goal for total PCBs in sediment, mg/kg dry weight
$BBTT_f$ = Body burden toxicity threshold in fish, mg/kg wet weight

In this case, *L. variegatus* was used as the target benthic animal and representative oligochaete worm in AOC sediments. The characteristic average lipid level in *L. variegatus* is about 1% (USAERDC 2009). For TOC, an average calculated level of 23,550 mg/kg in AOC sediments was used. A mean total PCB benthic BSAF of 0.88 for the AOC was used based on *L. variegatus* bioaccumulation experiment data from USAERDC (2003) (Pickard, unpublished data), along with the calculated TTC of 1.5.

Dyer *et al.* (1993) calculated a PCB tissue benchmark for fish (termed "toxic screening concentration" [TSC]) using a critical body-burden concept as follows (Carl Mach, personal communication):

$$BBTT_f = (FWC_c)\,(BF)\,(CF) \tag{5}$$

Where:
FWC_c = Federal chronic freshwater criterion for total PCBs in water, µg/L
BF = Average water-to-fish bioaccumulation factor
CF = Conversion factor of 1/1000 to convert µg to mg

A total PCB FWC_c of 0.014 ug/L, BF of 31,200 L/kg and CF of 1000 produces a $BBTT_f$ of 0.44 mg/kg. Based on this $BBTT_f$, a total PCB PRG of 0.79 mg/kg is yielded using Equation 4. This model could also be used to link a fish tissue concentration that is protective of pisciverous wildlife (such as mink or kingfisher) to a sediment concentration. For example, a total PCB PRG of 0.18

mg/kg is produced based on a 0.1 mg/kg total PCB concentration in whole fish that is protective of birds and animals (U.S. Environmental Protection Agency [USEPA] 2007). If a TTF of 1.33 relative to pumpkinseed sunfish (*Lepomis gibbosus*) is used in concert with the same benchmark tissue level of 0.1 mg/kg in fish, this translates to a total PCB PRG of 0.2 mg/kg that is protective of birds and mammals.

3. In summary, extrapolation of a benthic bioaccumulation model to pelagic fish using a TTF and site-specific data can be used to estimate ecologically relevant threshold sediment concentrations in fish and wildlife.

4. The POC in this matter is the undersigned, who can be reached at extension 4404.

SCOTT W. PICKARD
Ecologist

CF:
CELRB-TD-EA
CELRB-TD-EH
CELRB-PM-PB

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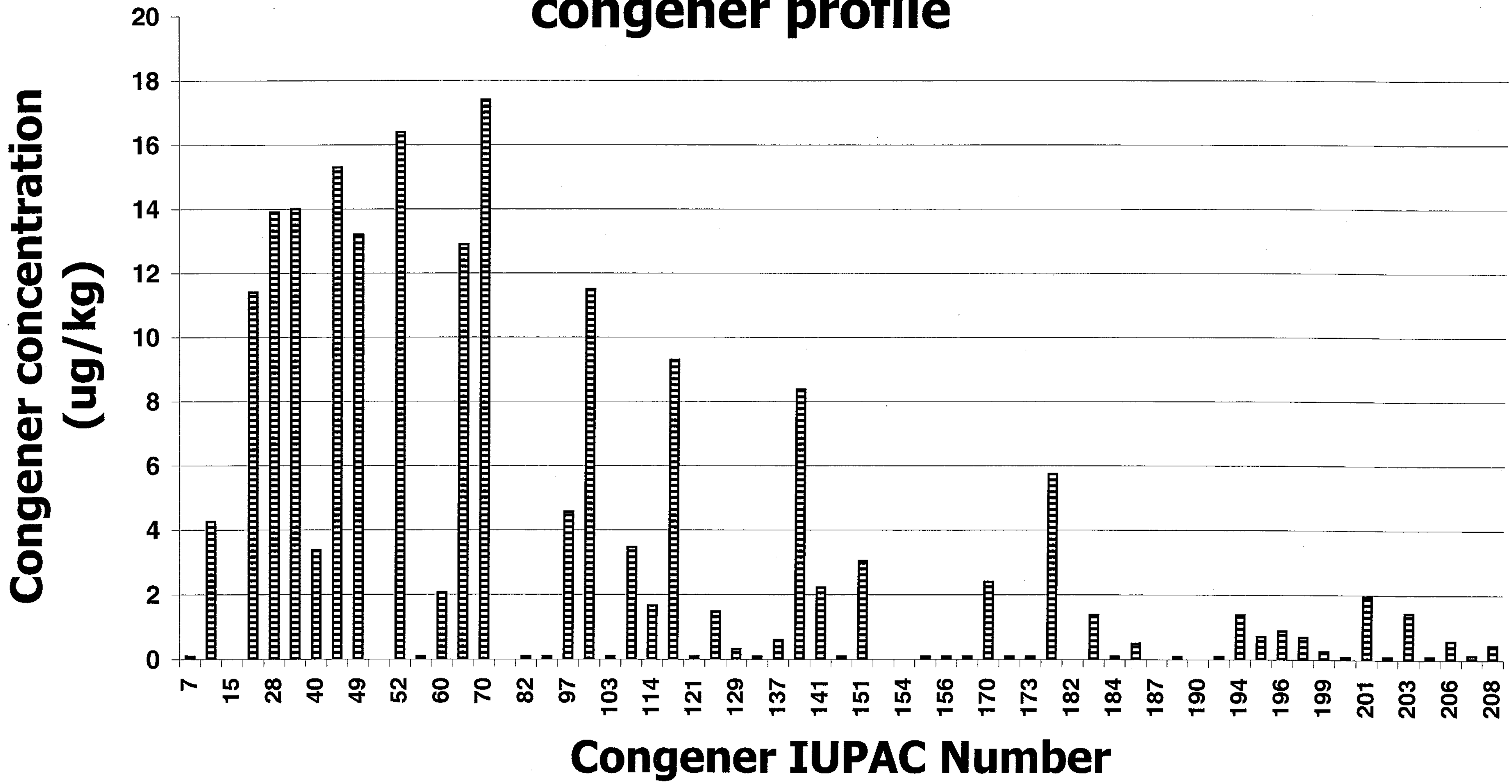
FIGURE 1. Buffalo River sediment PCB congener profile



Appendix A4
Mercury and Lead PRG Memorandum

ENVIRON

March 12, 2009

MEMORANDUM

To: Ecology Technical Subgroup

From: Mary Sorensen, Darrel Lauren, and Jen Lyndall

Re: Preliminary Remedial Goals (PRGs) for Mercury and Lead with a Streamlined Risk Evaluation for Exposed Wildlife at the Buffalo River AOC

Executive Summary

The Ecology Subgroup (Eco-Group) of the Great Lakes Legacy Act Buffalo River Project Coordination Team has collaborated on efforts to identify preliminary remedial goals (PRGs)[1] of contaminants in sediments for use in the Buffalo River Feasibility Study (FS). This memorandum (memo) is focused on mercury and lead and the fish tissue concentrations considered relevant as a basis of PRGs for Buffalo River.

This memo briefly describes the approach used for the development of sediment PRGs for mercury and lead based on target fish tissue and sediment concentrations that are protective of wildlife. The approach described herein is conservative but consistent with approaches discussed during weekly Eco-Group calls, including those already presented for polychlorinated biphenyls (PCBs) (ENVIRON 2009a). Several tables are provided to support this memo and Attachment 1 provides the electronic excel workbook of these tables in a calculational format. Supporting data used in the calculations are provided as linked worksheets to facilitate review by the Eco-Group. This memo will be included as an appendix to the Buffalo River FS report, along with supporting documentation.

Risk-based assessments were done to demonstrate that current average sediment mercury and lead concentrations in surface sediment throughout most of the Buffalo River are likely to be below levels that would result in adverse impacts to wildlife. Sediment toxicity testing results from 2005 and 2007 were also included in this analysis (USACE 2009 and CSC 2009). Based on the evaluation of data, the PRGs for mercury and lead reflect the current surface-weighted average mercury sediment concentrations so that average concentrations following the remedial action do not results in significant long term increases in surficial concentrations of mercury and lead. The ranges of mercury and lead PRGs described herein are as follows:

- Mercury: 0.41 mg/kg to 0.54 mg/kg based on average conditions which are well below the USEPA and NYSDEC fish tissue criterion
- Lead: 73 mg/kg to 103 mg/kg based on average conditions and 320 mg/kg for protective estimates of average exposures to avian species that may incidentally ingest sediment.

[1] The acronym PRG may be used interchangeably with remedial target concentration (RTC) indicating the targets being evaluated for use in the FS. Actual remedial goals will be identified in the FS.

Mercury PRG Development Approach

The lines of evidence considered by the Eco-Group to establish the Buffalo River mercury PRG were:

- NYSDEC 2007 fish tissue study showing maximum and average fish tissue concentrations at or below the USEPA and NYSDEC fish tissue criterion of 0.5 and 0.3 mg mercury/kg (wet weight), respectively
- Buffalo River sediment toxicity testing showing a no effects concentration (NOEC) at 0.43 mg mercury/kg sediment
- Current Buffalo River sediment mercury concentrations, as reflected by the 95 percent upper confidence limits (UCLs)

Mercury Fish Tissue Residues in the Buffalo River

NYSDEC (Pers. Comm. 2009) has identified USEPA's (1995) fish tissue criterion of 0.5 mg/kg wet weight as the criterion for consideration of PRGs for the Buffalo River. The available whole fish tissue concentrations of mercury collected by NYSDEC in 2007 are presented in Figure 1. Fish species collected included blunt-nose minnow, round goby, pumpkinseed sunfish, yellow perch, brown bullhead, large mouth bass, and carp. Fish sizes ranged from 8 to 7,350 grams (wet weight). Small fish (i.e., less than 50 g), and all fish had geometric mean mercury contents of 0.034, and 0.06 mg/kg wet weight, respectively (Table 1). The maximum mercury fish tissue concentration from any size fish was 0.24 mg/kg. These results show that the maximum tissue concentrations seen in the Buffalo River are lower than the NYSDEC and USEPA fish tissue criterion identified for Buffalo River (0.5 mg/kg wet weight based on USEPA Great Lakes Initiative, 1995). Given that the maximum fish tissue concentration is half the NYSDEC value and that the average mercury fish tissue concentrations are more than an order of magnitude below the fish tissue concentration, these results indicate that current conditions in the surface sediment of Buffalo River are on average below levels that would pose an adverse impact to wildlife.

Sediment Toxicity Testing Study

Sediment toxicity testing results from 2005 and 2007 were included in this analysis (USACE 2009 and CSC 2009). The USACE reported an unbounded NOEC of 0.43 mg total mercury/kg sediment on the basis of bioassays conducted in 2005 with *Hyalella azteca* and *Chironomus tentans*. Several higher NOECs from controlled and field toxicity tests have also been reported in the literature as was discussed in detail in the *Sediment Remedial Investigation Report [SRIR]* (ENVIRON and MacTec 2009). In the only study of mercury toxicity alone, Sferra et al. (1999) reported an NOEC of 3.8 mg total mercury/kg in spiked sediment bioassays with *H. azteca*. These additional studies support the conclusion that the USACE NOEC is an appropriate and conservative PRG for the Buffalo River. Toxicity testing conducted in 2007 indicated benthic impairment due to sediment mercury concentrations is possible; however, it was noted that the highest concentrations of mercury from this analysis were based on samples collected deep in the sediment column, below the average current depth where exposures might be expected for wildlife. The concentrations seen in the 2007 toxicity testing samples were well above those no effect concentrations identified in the *SRIR*. CSC performed a concentration-response analysis and reported that mercury PRGs ranged from 0.33 mg/kg to 0.85 mg/kg.

Buffalo River Mercury 95% Upper Confidence Limits

Surface-weighted average mercury sediment concentrations were used to identify current conditions in the Buffalo River. Average conditions were defined as the upper confidence limit of the mean (i.e., 95% UCL). Figure 2 shows data distributions and average estimates using the full data set organized by river mile (Figure 2a) and by decreasing concentrations (Figure 2b). Figure 2c shows the data frequency distribution in increasing concentrations wherein the 95% UCL estimates are based on values excluded from the database if they exceeded the 75th percentile or 95% UCL. The adjusted mercury UCLs, which reflect current conditions of fish tissue concentrations in a range that do not pose adverse effects to wildlife, range from 0.41 mg/kg to 0.54 mg/kg.

Lead PRG Development Approach

Three lines of evidence are available to establish the Buffalo River lead PRG:

- Buffalo River sediment toxicity testing showing a NOEC at 0.85 mg mercury/kg sediment
- Current Buffalo River sediment lead concentrations, as reflected by the 95% UCL
- A risk-based evaluation of fish ingestion for mink and kingfisher
- A risk-based evaluation of worm and incidental sediment ingestion for ducks

Sediment Toxicity Testing Study NOEC

The USACE 2009 reported an unbounded NOEC of 85 mg lead/kg sediment on the basis of bioassays conducted in 2005 with *Hyalella azteca* and *Chironomus tentans*. Several higher no effect concentrations from controlled toxicity tests have also been reported in the literature as was discussed in detail in the *SRIR* (ENVIRON and MacTec 2009). These additional studies support the conclusion that the USACE designated NOEC is a conservative but appropriatevalue that can be considered a PRG for the Buffalo River.

Buffalo River Lead 95% Upper Confidence Limits

Surface-weighted average lead sediment concentrations were used to identify current conditions in the Buffalo River in a manner consistent with that described for mercury. Figure 3 shows data distributions and average estimates using the full data set organized by river mile (Figure 3a) and by decreasing concentrations (Figure 3b). Figure 3c shows the data frequency distribution in increasing concentrations wherein 95% UCL estimates are based values excluded from the database if the exceeded the 75th percentile or 95% UCL. The adjusted lead 95% UCLs range from 73 mg/kg to 103 mg/kg.

Risk-Based Evaluation of Fish Ingestion for Mink and Kingfisher

The risk-based evaluation focused on the ingestion of fish by mink and kingfishers is consistent with the formulae and approaches presented in the PCB PRG memorandum (ENVIRON 2009a). Each of the exposure parameter estimates are identical to those already described in the PCB memo, and thus this detail is not repeated herein. The difference in the evaluation is based on site-specific exposure concentrations for lead measured in fish tissues (Table 2) and the toxicity reference value (TRVs) for lead. Associated data and spreadsheets used in the calculations are provided in Attachment 1. The two TRVs used in the analyss are those identified by NYSDEC (Pers. Comm. 2009) and USEPA (2005). Because lead does not bioaccumulate in fish tissues, the PRGs associated with mink and kingfisher are greater than 500 mg/kg of lead (Table 3) based on estimates identified in Table 4. Table 5 provides a risk-based evaluation of current conditions in the Buffalo River and shows that hazard quotient (HQs) are well below the USEPA threshold value of 1 considered protective of wildlife.

Risk-Based Evaluation of Worm and Incidental Sediment Ingestion for Ducks

Due to concerns raised by stakeholders at the Eco-Group meeting in Buffalo NY on January 16, 2009, consideration was given to potential receptors more likely to come in direct contact to sediment, such as an American wood duck. While much of the Buffalo River is beyond a depth that dabbling ducks might be exposed, this analysis was considered because concerns were raised about such hypothetical receptors. Results are presented in Tables 3, 4, and 5 showing that current conditions yield HQ below the USEPA threshold value of 1 considered protective of wildlife. PRGs were calculated using a variety of scenarios that reflect the use of NYSDEC and USEPA TRVs and various calculational methods, as described in the tables and Attachment 1. The primary difference among methods was consideration of 100% bioavailablity of sediment ingested versus a more realistic bioavailability estimate of 35% (this applies to incidental sediment ingestion and assimilation which is well documented to be less than 100%). The range of PRGs derived using these estimates and the USACE defined approach for linking sediment and worms via a bioaccumulation model presented in Attachment 1 is 185 mg/kg to 495 mg/kg with an average of 185 mg/kg.

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Table 1: Mercury in Fish Tissues from Buffalo River

LABNO	TAGNO	SPP	SDATE	LOCATION	PREP	LENMM	WGTG	PROGRAM	TISSUEWGTG	g wet weight	Whole Body All/Zone	Small/Zone	mg/kg Wwt	Hg Wwt All/Zone	Small/Zone
07-0038-H	346	RGOBY	20071002	INNER HARBOR	W		8	BUFFALO R-2007		8			0.012		
07-0037-H	437	RGOBY	20070927		W		16	BUFFALO R-2007		16			0.027		
07-0036-H	416	RGOBY	20070927		W		20	BUFFALO R-2007		20	NA	13.7	0.0194	0.018	0.018
07-0050-W	387	PKSD	20071002	ZONE 1- SHIP CANAL	W	127	33	BUFFALO R-2007	35.4	35.4			0.0476		
07-0047-W	334	PKSD	20071002		W	128	40	BUFFALO R-2007	35.2	35.2			0.0166		
07-0049-W	343	PKSD	20071002		W	130	42	BUFFALO R-2007	35.2	35.2			0.0231		
07-0044-W	371	BB	20071002		W	230	270	BUFFALO R-2007	152	270			0.0126		
07-0040-W	327	LMB	20071002		W	315	325	BUFFALO R-2007	462	325			0.11		
07-0042-W	311	LMB	20071002		W	290	350	BUFFALO R-2007	330	350			0.101		
07-0043-W	305	LMB	20071002		W	300	430	BUFFALO R-2007	430	430			0.118		
07-0041-W	386	LMB	20071002		W	295	450	BUFFALO R-2007	305	450			0.0747		
07-0039-W	339	LMB	20071002		W	450	1500	BUFFALO R-2007	1543	1500			0.217		
07-0056-W	396	YP	20071002		W	195	90	BUFFALO R-2007	76.8	90			0.0492		
07-0045-W	389	BB	20071002		W	362	520	BUFFALO R-2007	588	520			0.0469		
07-0055-W	373	CARP	20071002		W	621	3700	BUFFALO R-2007	3470	3700			0.0695		
07-0053-W	352	CARP	20071002		W	653	4500	BUFFALO R-2007	4245	4500			0.121		
07-0054-W	314	CARP	20071002		W	670	4900	BUFFALO R-2007	4745	4900			0.100		
07-0051-W	379	CARP	20071002		W	689	6180	BUFFALO R-2007	6080	6180			0.0741		
07-0052-W	388	CARP	20071002		W	768	7350	BUFFALO R-2007	7190	7350	548.85	35.27	0.117	0.064	0.026
07-0063-W	384	PKSD	20071001	ZONE 2- RM 1.5-2.2	W	132	40	BUFFALO R-2007	37.6	37.6			0.0842		
07-0062-W	341	PKSD	20071001		W	132	46	BUFFALO R-2007	41.9	41.9			0.0304		
07-0060-W	378	PKSD	20071001		W	155	70	BUFFALO R-2007	66.8	66.8			0.0639		
07-0057-H	398A	BNOSE	20071001		W		73	BUFFALO R-2007		73			0.0317		
07-0058-H	398B	BNOSE	20071001		W		73	BUFFALO R-2007		73			0.0253		
07-0069-W	333	YP	20071001		W	210	104	BUFFALO R-2007	100.3	104			0.0573		
07-0071-W	391	BB	20071001		W	253	226	BUFFALO R-2007	211	226			0.0198		
07-0066-W	377	LMB	20071001		W	282	352	BUFFALO R-2007	334	352			0.134		
07-0068-W	330	LMB	20071001		W	290	404	BUFFALO R-2007	379	404			0.164		
07-0067-W	392	LMB	20071001		W	301	428	BUFFALO R-2007	417	428			0.177		
07-0065-W	394	LMB	20071001		W	315	532	BUFFALO R-2007	484	532			0.19		
07-0064-W	399	LMB	20071001		W	367	872	BUFFALO R-2007	793	872			0.244		
07-0070-W	390	YP	20071001		W	169	60	BUFFALO R-2007	54.4	54.4			0.044		
07-0072-W	376	BB	20071001		W	240	202	BUFFALO R-2007	187	202	153.66	39.69	0.0994	0.073	0.051
07-0074-W	443	PKSD	20070927	ZONE 3 RM 3.2-5.3	W	122	32	BUFFALO R-2007	30.4	30.4			0.0728		
07-0084-W	426	YP	20070927		W	159	41.5	BUFFALO R-2007	41.9	41.9			0.0889		
07-0075-W	428	PKSD	20070927		W	137	47.5	BUFFALO R-2007	43.3	43.3			0.111		
07-0088-W	372	YP	20070927		W	161	49	BUFFALO R-2007	54.2	54.2			0.0735		
07-0087-W	432	YP	20070927		W	176	64	BUFFALO R-2007	61.5				0.0725		
07-0076-W	454	PKSD	20070927		W	154	72.5	BUFFALO R-2007	69.7	69.7			0.157		
07-0073-H	441	BNOSE	20070927		W		84	BUFFALO R-2007		84			0.0205		
07-0085-W	445	YP	20070927		W	203	100	BUFFALO R-2007	98.4	100			0.0744		
07-0086-W	433	YP	20070927		W	219	135	BUFFALO R-2007	107.6	135			0.0536		
07-0083-W	382	LMB	20070927		W	206	140	BUFFALO R-2007	118	140			0.105		
07-0091-W	440	BB	20070927		W	220	156	BUFFALO R-2007	137	156			0.0959		
07-0090-W	431	BB	20070927		W	238	195	BUFFALO R-2007	170				0.0807		
07-0079-W	430	LMB	20070927		W	302	225	BUFFALO R-2007	389	225			0.18		
07-0092-W	434	BB	20070927		W	265	225	BUFFALO R-2007	206	225			0.0152		
07-0089-W	438	BB	20070927		W	290	290	BUFFALO R-2007	268	290			0.0546		
07-0093-W	436	BB	20070927		W	275	329	BUFFALO R-2007	280	329			0.208		
07-0081-W	435	LMB	20070927		W	220	330	BUFFALO R-2007	318	330			0.173		
07-0080-W	427	LMB	20070927		W	280	360	BUFFALO R-2007	347	360			0.112		
07-0082-W	444	LMB	20070927		W	319	500	BUFFALO R-2007	588	500			0.178		
07-0096-W	381	CARP	20070927		W	580	3200	BUFFALO R-2007	3211	3200			0.119		
07-0094-W	338	CARP	20070927		W	615	3300	BUFFALO R-2007	3280	3300			0.129		
07-0095-W	308	CARP	20070927		W	618	4050	BUFFALO R-2007	3880	4050			0.0794		
07-0097-W	383	CARP	20070927		W	632	4150	BUFFALO R-2007	3950	4150	251.73	9.52	0.105	0.088	0.022
07-0105-W	411	PKSD	20070925	ZONE 4- RM 5.3-6.3	W	135	47	BUFFALO R-2007	42.7	42.7			0.084		
07-0103-W	407	PKSD	20070925		W	135	48	BUFFALO R-2007	44	44			0.0714		
07-0106-W	412	PKSD	20070925		W	130	48	BUFFALO R-2007	44.4	44.4			0.0841		
07-0109-W	415	LMB	20070925		W	271	250	BUFFALO R-2007	242	250			0.154		
07-0111-W	402	LMB	20070925		W	280	310	BUFFALO R-2007	289	310			0.19		
07-0112-W	418	LMB	20070925		W	295	320	BUFFALO R-2007	316	320			0.102		**RM 5.3-6.3**
07-0108-W	419	LMB	20070925		W	299	390	BUFFALO R-2007	390	390			0.122		**Upper River**
07-0110-W	409	LMB	20070925		W	294	410	BUFFALO R-2007	394	410			0.114		
07-0102-W	414	CARP	20070925		W	602	3300	BUFFALO R-2007	3170	3300			0.0514		
07-0099-W	403	CARP	20070925		W	615	3800	BUFFALO R-2007	3530	3800			0.0986		
07-0101-W	406	CARP	20070925		W	684	4810	BUFFALO R-2007	4600	4810			0.0597		
07-0098-W	410	CARP	20070925		W	652	5000	BUFFALO R-2007	4790	5000			0.111		
07-0100-W	405	CARP	20070925		W	750	6290	BUFFALO R-2007	6020	6290	567.105	43.694	0.19	0.102	0.080
		AOC-Wide Geometric Mean=								**281.0**	**331.2**	**24.0**	**0.076**	**0.060**	**0.034**
		AOC Maximum											**0.244**		

Table 2: Lead in Fish Tissues from Buffalo River

Zone	Species	BW g wet weight	All Fish	Small Fish	[Pb] ug/kg Wwt	All Fish	Small Fish	% Water		[Pb] ug/kg Dwt	All Fish	Small Fish
Inner Harbor	RG	20			82			77.7		367.7		
		16			140			79		666.7		
		8	NA	13.7	190	NA	129.7	81.38	137.3	1020.4	NA	630.1
Zone 1- Ship Canal	BB	152			110			75.8		454.5		
		588			114			67		345.5		
	Carp	6080			45			58.6		108.7		
		7190			83.8			65.2		240.8		
		4245			196			64.6		553.7		
		4745			32.8			61.6		85.4		
		3470			71.5			58.5		172.3		
	LMB	1543			9.25			70.9		31.8		
		462			12			73.5		45.3		
		305			4.64			75.2		18.7		
		330			16.2			75.1		65.1		
		430			10.6			73.8		40.5		
		42.3			66.1			75.5		269.8		
		35.2			68.1			77.4		301.3		
		40.1			98.9			76.1		413.8		
	YP	76.8	529.9	39.1	47.6	39.9	76.4	76.8	61.7	205.2	137.5	322.8
Zone 2 RM 1.5-2.2	BNM	73			810			77.21		3554.2		
		73			930			77.42		4118.7		
	BB	211			339			69.2		1100.6		
		187			153			72.7		560.4		
	LMB	793			32.2			74.8		127.8		
		484			24.5			74.1		94.6		
		334			25.8			73.7		98.1		
		417			10.7			73.3		40.1		
		379			18.1			74.1		69.9		
	PkS	66.78			119			74.9		474.1		
		41.9			121			73.7		460.1		
		37.6			93.9			76.2		394.5		
	YP	100.3			101			75.4		410.6		
		54.4	148.1	NA	24.7	81.0	107	75.7	200.2	101.6	317.9	NA
Zone 3- RM 3.2-5.3	BNM	84			480			76.39		2033.0		
	BB	268			331			79.3		1599.0		
		170			93.5			75.4		380.1		
		137			98.3			77		427.4		
		206			83.6			76.6		357.3		
		280			248			74.9		988.0		
	Carp	3280			186			69.2		603.9		
		3880			98.6			62.9		265.8		
		3210			185			51.8		383.8		
		3950			132			62		347.4		

Table 2: Lead in Fish Tissues from Buffalo River

Zone	Species	BW g wet weight	All Fish	Small Fish	[Pb] ug/kg Wwt	All Fish	Small Fish	% Water		[Pb] ug/kg Dwt	All Fish	Small Fish
	LMB	389			14			72.2		50.4		
		347			10.6			74.3		41.2		
		318			14.4			74.8		57.1		
		588			38.1			73.8		145.4		
		118			19.4			74		74.6		
	PkS	30.4			368.0			76.7		1579.4		
		43.3			119.0			76.1		497.9		
		68.77			115			75.4		467.5		
	YP	41.9			196			NA		NA		
		98.4			64.3			NA		NA		
		107.6			130			NA		NA		
		61.5			80.4			NA		NA		
		54.2	770.916087	41.9	228	144.9217391	196	NA	144.9	NA	572.1819937	151.7
Zone 4- RM 5.3-6.3	Carp	3790			99.9			63.3		272.2		
		3530			107			75.3		433.2		
		6020			115			77		500.0		
		4600			72.5			63.4		198.1		
		3170			82.1			69.1		265.7		
	LMB	390			43			75.8		177.7		
		242			31.8			72.5		115.6		
		394			51.6			73.1		191.8		
		289			32.4			72.2		116.5		
		316			45.9			74.3		178.6		
	PkS	44			167			76.2		701.7		
		42.7			260			75.5		1061.2		
		44.4	540.1	43.7	163.0	79.9	192.0	76.7	97.8	699.6	295.8	804.6

	BW g	[Pb] ug/kg Wwt	Water %	[Pb] ug/kg Dwt
AOC-Wide Geomean=	264.9	73.8	72.5	268.1
Small Fish AOC-Wide Geomean=	29.9	136.3	77.1	595.0

Table 3: Lead PRG Summary Matrix (a)

Scenario	Basis (b)	AUF (c)	Biota in Diet % (d)	Sediment Bioavailability (e)	HQ (f)	TRV Basis (g)	[Fish] mg/kg, wwt	[INV] mg/kg wwt	SD PRG mg/kg
Mink 1a	Fish Estimated	100	50	100	1	NYSDEC	25	NA	5926
Mink 1b	Estimated	100	90	100	1	NYSDEC	14	NA	3259
Mink 2a	Fish Estimated	100	50	100	1	USEPA	48	NA	11259
Mink 2b	Fish Estimated	100	90	100	1	USEPA	28	NA	6519
Kingfisher 3a	Fish Estimated	100	100	100	1	NYSDEC	4	NA	948
Kingfisher 3b	Fish Estimated	100	100	100	1	USEPA	3	NA	593
Duck 4a	INV Estimated	100	100	100	1	USEPA	NA	4.0	106
Duck 4b	SD Estimated	100	100	100	1	NYSDEC	NA	NA	400
Duck 4c	SD Estimated + mean INV	100	100	100	1	USEPA	NA	1.65	160
Duck 4d	SD Estimated	100	100	35	1	NYSDEC	NA	NA	1125
Duck 4e	SD Estimated + mean INV	100	100	35	1	NYSDEC	NA	8.26	850
Duck 4f	SD Estimated	100	100	35	1	USEPA	NA	NA	770
Duck 4g	SD Estimated + mean INV	100	100	35	1	USEPA	NA	8.26	490
Duck 5a	SD Estimated	100	100	100	1	USEPA	NA	7.0	185
Duck 5b	SD Estimated	100	100	100	1	NYSDEC	NA	10.42	275
Duck 5c	SD Estimated	100	100	35	1	NYSDEC	NA	12.69	335
Duck 5d	SD Estimated	100	100	35	1	USEPA	NA	18.75	495
				Minimum Duck Scenario 5 (USACE Approach)				7.01	**185**
				Maximum Duck Scenario 5 (USACE Approach)				18.8	**495**
				Average Duck Scenario 5 (USACE Approach)				12.2	**323**

Notes:

(a) The scenarios and detailed formulate and calculated values are provided in Table 2.

(b) Estimated medium; Fish, Sediment (SD), or Invertebrates (INV).

(c) AUF = 100% for all receptors.

(d) Diet is based on NYSDEC request (90%) or those average estimates based on NYSDEC (1987) wildlife narrative. 50% fish in diet is considered a conservatively high level that is biologically relevant (NYSDEC 1987).

(e) Sediment [Pb] adjusted for relative bioavailability of lead sulfide vs. lead acetate (Dieter et al. 1993; Davis et al. 1992; Ruby et al. 1992)

(f) HQ was set equal to 1 for all scenarios.

(g) NYSDEC TRVs and USEPA Eco-SSL (2005) TRVs

%	Percent
AOC	Area of Concern
AUF	Area Use Factor
BR	Buffalo River
BSAF	Biota-Sediment Accumulation Factor
HQ	Hazard Quotient
mg/kg	Milligram per Kilogram
NYSDEC	New York State Department of Environmental Conservation
PRG	Preliminary Remediation Goal
SD	Sediment
wwt	Wet Weight
INV	Invertebrate
(purple shading)	Wet Weight Fish Tissue Concentrations
(pink shading)	Sediment PRG

Table 4: Lead Sediment PRGs Estimates

Sediment PRGs Estimated Based on Mink Consumption of Fish Tissue Concentrations That Yield an HQ = 1

Scenario 1a. HQ=1; diet of 50% fish; NYSDEC TRV							**100% AUF (a)**	60% AUF (b)
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg	[Invertebrate] mg/kg	Total Dose (mg/kg/d)	TRV (mg/kg-BW-d)	**HQ**	HQ
(50% fish, 100% AUF, AOC BSAF)	1000	0.049	100	8.3	2.55	2.5	**1**	0.6
all fish are 75% water			25.000	mg wwt fish				
All AOC BSAF		0.0042						
PRG			5926	mg/kg				

Scenario 1b. HQ=1; 100% AUF; diet of 90% fish; NYSDEC TRV							**100% AUF (a)**	60% AUF (b)
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg	[Invertebrate] mg/kg	Total Dose (mg/kg/d)	TRV (mg/kg-BW-d)	**HQ**	HQ
(90% fish, 100% AUF, AOC BSAF)	1000	0.049	55	8.3	2.41	2.5	**1**	0.6
all fish are 75% water			13.750	mg wwt fish				
All AOC BSAF		0.0042						
PRG			3259	mg/kg				

Scenario 2a. HQ=1 assuming 100% AUF; diet 50% fish; USEPA TRV							**100% AUF (a)**	60% AUF (b)
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg	[Invertebrate] mg/kg	Total Dose (mg/kg/d)	TRV (mg/kg-BW-d)	**HQ**	HQ
(50% fish, 60% AUF, BR BSAF)	1000	0.049	190.00	8.3	4.74	4.7	**1**	0.6
all fish are 75% water			47.500	mg wwt fish				
BR BSAF		0.0042						
PRG			11259	mg/kg				

Scenario 2b. HQ=1 assuming 100% AUF; diet 90% fish; USEPA TRV							**100% AUF (a)**	60% AUF (b)
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg	[Invertebrate] mg/kg	Total Dose (mg/kg/d)	TRV (mg/kg-BW-d)	**HQ**	HQ
(90% fish, 60% AUF, BR BSAF)	1000	0.049	110	8.3	4.81	4.7	**1**	0.6
all fish are 75% water			27.500	mg wwt fish				
BR BSAF		0.0042						
PRG			6519	mg/kg				

Scenario 3a. HQ=1; 100% AUF; diet of 100% fish; NYSDEC TRV							**100% AUF (a)**
Kingfisher	BW (g)	IR (kg/kg/d)	[Fish] mg/kg	[Invertebrate] mg/kg	Total Dose (mg/kg/d)	TRV (mg/kg-BW-d)	**HQ**
(50% fish, 100% AUF, AOC BSAF)	150	0.157	16.00	0.0	2.51	2.4	**1**
all fish are 75% water			4.000	mg wwt fish			
All AOC BSAF		0.0042					
PRG			948	mg/kg			

Scenario 3b. HQ=1; 100% AUF; diet of 100% fish; USEPA TRV							**100% AUF (a)**
Kingfisher	BW (g)	IR (kg/kg/d)	[Fish] mg/kg	[Invertebrate] mg/kg	Total Dose (mg/kg/d)	TRV (mg/kg-BW-d)	**HQ**
(50% fish, 100% AUF, AOC BSAF)	150	0.157	10.00	0.0	1.57	1.63	**1**
all fish are 75% water			2.500	mg wwt fish			
All AOC BSAF		0.0042					
PRG			593	mg/kg			

Worm and Sediment Ingesting Bird: Risk Calculations for Buffalo River using Site-Specific Information and USEPA TRV									**100% AUF**
Scenario 4a. Invertebrate HQ=1									
American Wood Duck	BW (g)	IR (kg/kg/d)	[Sediment] mg/kg	[Invertebrate] mg/kg	Dose - Invertebrates	Dose - Sediment	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	**HQ**
	1500	0.072	43.6	20.00	1.4	0.3	1.71	1.63	**1.0**
all worms are 80% water			4.00	mg wwt worms					
All AOC worm BSAF		0.0379							
PRG			106	mg/kg					

Worm and Sediment Ingesting Bird: Risk Calculations for Buffalo River using Site-Specific Information and NYSDEC TRV									**100% AUF**
Scenario 4b. Sediment HQ=1									
American Wood Duck	BW (g)	IR (kg/kg/d)	[Sediment] mg/kg	[Invertebrate] mg/kg	Dose - Invertebrates	Dose - Sediment	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	**HQ**
	1500	0.072	400.0	0.00	0.000	2.4	2.43	2.4	**1.0**

Worm and Sediment Ingesting Bird: Risk Calculations for Buffalo River using Site-Specific Information and USEPA TRV									**100% AUF**
Scenario 4c. Sediment + Invertebrate HQ=1									
American Wood Duck	BW (g)	IR (kg/kg/d)	[Sediment] mg/kg	[Invertebrate] mg/kg	Dose - Invertebrates	Dose - Sediment	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	**HQ**
	1500	0.072	160.0	8.26	0.597	1.0	1.57	1.63	**1.0**

Table 4: Lead Sediment PRGs Estimates

Worm and Sediment Ingesting Bird: Risk Calculations for Buffalo River using Site-Specific Information and NYSDEC TRV									35% Bioavail
Scenario 4d. Sediment HQ=1									
American Wood Duck	BW (g)	IR (kg/kg/d)	[Sediment] mg/kg	[Invertebrate] mg/kg	Dose - Invertebrates	Dose - Sediment	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	**HQ**
	1500	0.072	1125.0	0.00	0.000	2.4	2.39	2.4	**1.0**

Worm and Sediment Ingesting Bird: Risk Calculations for Buffalo River using Site-Specific Information and NYSDEC TRV									35% Bioavail
Scenario 4e. Sediment + Invertebrate HQ=1									
American Wood Duck	BW (g)	IR (kg/kg/d)	[Sediment] mg/kg	[Invertebrate] mg/kg	Dose - Invertebrates	Dose - Sediment	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	**HQ**
	1500	0.072	850.0	8.26	0.597	1.8	2.40	2.4	**1.0**

Worm and Sediment Ingesting Bird: Risk Calculations for Buffalo River using Site-Specific Information and USEPA TRV									35% Bioavail
Scenario 4f. Sediment HQ=1									
American Wood Duck	BW (g)	IR (kg/kg/d)	[Sediment] mg/kg	[Invertebrate] mg/kg	Dose - Invertebrates	Dose - Sediment	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	**HQ**
	1500	0.072	770.0	0.00	0.000	1.6	1.63	1.63	**1.0**

Worm and Sediment Ingesting Bird: Risk Calculations for Buffalo River using Site-Specific Information and USEPA TRV									35% Bioavail
Scenario 4g. Sediment + Invertebrate HQ=1									
American Wood Duck	BW (g)	IR (kg/kg/d)	[Sediment] mg/kg	[Invertebrate] mg/kg	Dose - Invertebrates	Dose - Sediment	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	**HQ**
	1500	0.072	490.0	8.26	0.597	1.0	1.64	1.63	**1.0**

Worm and Sediment Ingesting Bird: USEPA TRV (USACE Linked SD and Worm Approach)									100% AUF
Scenario 5a. Sediment + Invertebrate HQ=1									
American Wood Duck	BW (g)	IR (kg/kg/d)	[Sediment] mg/kg	[Invertebrate] mg/kg	Dose - Invertebrates	Dose - Sediment	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ
BAF = 0.0379	1500	0.072	185	7.01	0.506	1.1	1.63	1.63	1.0

Worm and Sediment Ingesting Bird: NYSDEC TRV (USACE Linked SD and Worm Approach)									100% AUF
Scenario 5b. Sediment + Invertebrate HQ=1									
American Wood Duck	BW (g)	IR (kg/kg/d)	[Sediment] mg/kg	[Invertebrate] mg/kg	Dose - Invertebrates	Dose - Sediment	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ
BAF = 0.0379	1500	0.072	275.0	10.42	0.752	1.7	2.42	2.4	1.0

Worm and Sediment Ingesting Bird: USEPA TRV 35% bioavail (USACE Linked SD and Worm Approach)									100% AUF
Scenario 5c. Sediment + Invertebrate HQ=1									
American Wood Duck	BW (g)	IR (kg/kg/d)	[Sediment] mg/kg	[Invertebrate] mg/kg	Dose - Invertebrates	Dose - Sediment	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ
BAF = 0.0379	1500	0.072	335	12.69	0.916	0.7	1.63	1.63	1.0

Worm and Sediment Ingesting Bird: NYSDEC TRV 35% bioavail (USACE Linked SD and Worm Approach)									100% AUF
Scenario 5d. Sediment + Invertebrate HQ=1									
American Wood Duck	BW (g)	IR (kg/kg/d)	[Sediment] mg/kg	[Invertebrate] mg/kg	Dose - Invertebrates	Dose - Sediment	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ
BAF = 0.0379	1500	0.072	495	18.75	1.354	1.1	2.40	2.4	1.0

Notes:

AOC	Area of Concern
AUF	Area Use Factor
Bioavail	Bioavailability
BSAF	Biota-Sediment Accumulation Factor
BW	Body Weight
dwt	Dry Weight
GLI	Great Lakes Initiative
HQ	Hazard Quotient (rounded to one sig. figure)
IR	Ingestion Rate
kg/kg/d	Kilogram per Kilogram per Day
NYSDEC	NY State Department of Environmental Conservation
(blue)	Exposure Notes
(yellow)	HQ > 1
(green)	HQ ≤ 1
g; mg	Gram or Milligram
mg/kg	Milligram per Kilogram
mg/kg-BW-d	Milligram per Kilogram of Body Weight per Day
OC	Organic Carbon
PRG	Preliminary Remediation Goal
TRV	Toxicity Reference Value
ug/g-OC	Microgram per Gram Organic Carbon
USACE	United States Army Corp of Engineers
USEPA	United States Environmental Protection Division
wwt	Wet Weight
%	Percent
(pink)	Sediment
(purple)	Wet Weight Fish or Worm Tissue Concentrations

Table 5: Lead Wildlife Streamlined Risk Calculations

Kingfisher Risk Calculations for Buffalo River using Site-Specific Information and USEPA TRV							
Buffalo River Site-Specific Exposure			Average Fish Tissue Concentration from AOC				100% AUF
Belted Kingfisher	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	Dose- Fish	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ
(Average Exposure)	150	0.157	0.60	0.093	0.09	1.63	0.06

Kingfisher Risk Calculations for Buffalo River using Site-Specific Information and NYSDEC TRV							
Buffalo River Site-Specific Exposure			Average Fish Tissue Concentration from AOC				
Belted Kingfisher	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	Dose- Fish	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ
(Average Exposure)	150	0.157	0.60	0.093	0.09	2.4	0.04
						(NYSDEC)	

Mink Risk Calculations for Buffalo River using Site-Specific Information and USEPA TRV								
Buffalo River Site-Specific Exposure			90% fish; NYSDEC Request (a)				100% AUF (a)	60% AUF (b)
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	[Invertebrate] mg/kg	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ	HQ
(90% fish ingestion)	1000	0.049	0.27	8.3	0.01	4.7	0.002	0.001
						(USEPA)		
			50% fish; 30% invertebrates; remainder terrestrial (c)					
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	[Invertebrate] mg/kg	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ	HQ
(50% fish ingestion)	1000	0.049	0.27	8.3	0.13	4.7	0.03	0.02
						(USEPA)		
			60% fish; 20% invertebrates; remainder terrestrial (d)					
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	[Invertebrate] mg/kg	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ	HQ
(60% fish ingestion)	1000	0.049	0.27	8.3	0.09	4.7	0.02	0.011

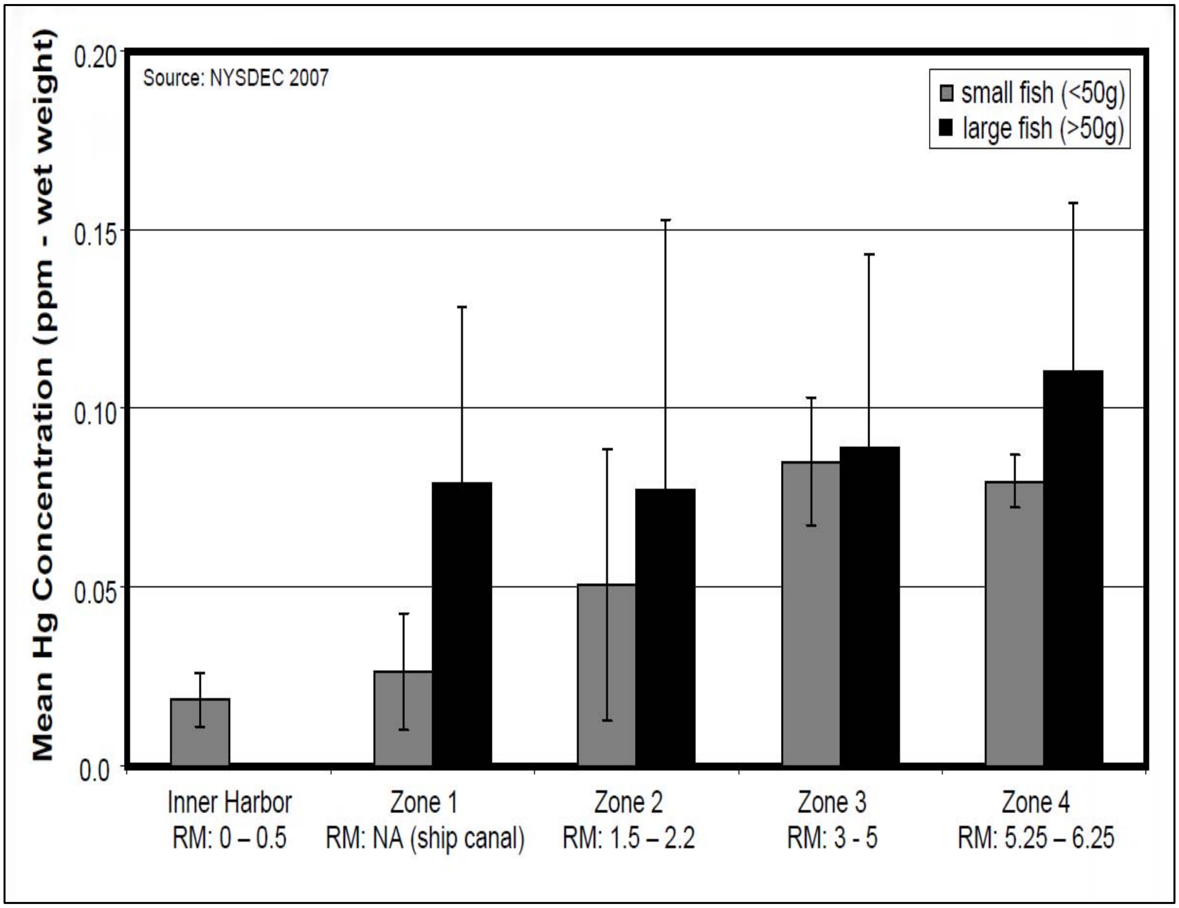
Mink Risk Calculations for Buffalo River using Site-Specific Information and NYSDEC TRV								
Buffalo River Site-Specific Exposure			90% fish; NYSDEC Request, not realistic biologically (a)				100% AUF (a)	60% AUF (b)
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	[Invertebrate] mg/kg	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ	HQ
(90% fish ingestion)	1000	0.049	0.27	8.3	0.01	2.5	0.005	0.003
						(NYSDEC)		
			50% fish; 30% invertebrates; remainder terrestrial (c)					
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	[Invertebrate] mg/kg	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ	HQ
(50% fish ingestion)	1000	0.049	0.27	8.3	0.13	2.5	0.05	0.03
						(NYSDEC)		
			60% fish; 20% invertebrates; remainder terrestrial (d)					
Mink	BW (g)	IR (kg/kg/d)	[Fish] mg/kg, dwt	[Invertebrate] mg/kg	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ	HQ
(60% fish ingestion)	1000	0.049	0.27	8.3	0.09	2.5	0.04	0.02
						(NYSDEC)		

Worm and Sediment Ingesting Bird: Risk Calculations for Buffalo River using Site-Specific Information and USEPA TRV									100% AUF
American Wood Duck	BW (g)	IR (kg/kg/d)	[Sediment] mg/kg	[Invertebrate] mg/kg	Dose - Invertebrates	Dose - Sediment	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ
	1500	0.072	43.6	8.26	0.597	0.3	0.86	1.63	0.5

Worm and Sediment Ingesting Bird: Risk Calculations for Buffalo River using Site-Specific Information and NYSDEC TRV									100% AUF
American Wood Duck	BW (g)	IR (kg/kg/d)	[Sediment] mg/kg	[Invertebrate] mg/kg	Dose - Invertebrates	Dose - Sediment	Total Dose (mg/kg/d), dwt	TRV (mg/kg-BW-d)	HQ
	1500	0.072	43.6	8.26	0.597	0.3	0.86	2.4	0.4

Notes:

%	percent	kg/kg/d	Kilogram per Kilogram per Day
AOC	Area of Concern	mg/kg	Milligram per Kilogram
AUF	Area Use Factor	IR (kg/kg/d)	IR (kg/kg/d)
BW	Body Weight	NYSDEC	New York State Department of Environmental Conservation
dwt	Dry Weight	PRG	Preliminary Remediation Goal
g	Gram	TRV	Toxicity Reference Value
GLI	Great Lakes Initiative	USEPA	United States Environmental Protection Division
IR	Ingestion Rate	wwt	Wet Weight
HQ	Hazard Quotient (rounded to one sig. figure)		
(blue)	Exposure Notes		
(yellow)	HQ > 1		
(green)	HQ ≤ 1		



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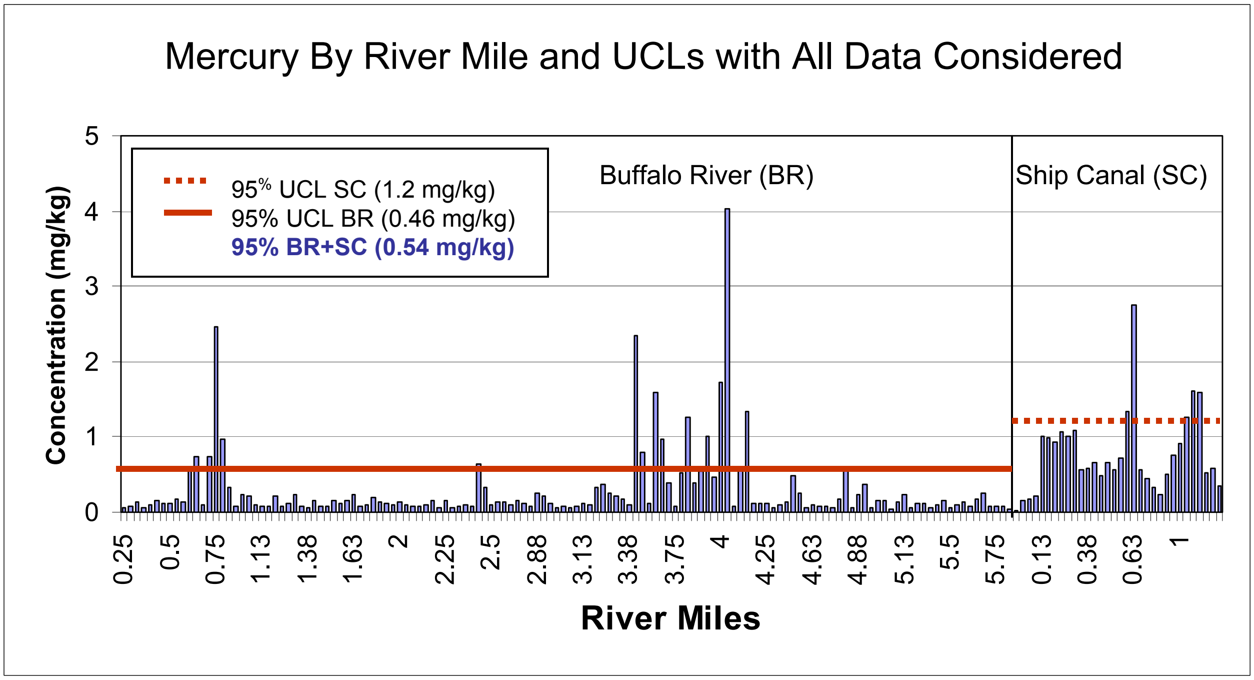
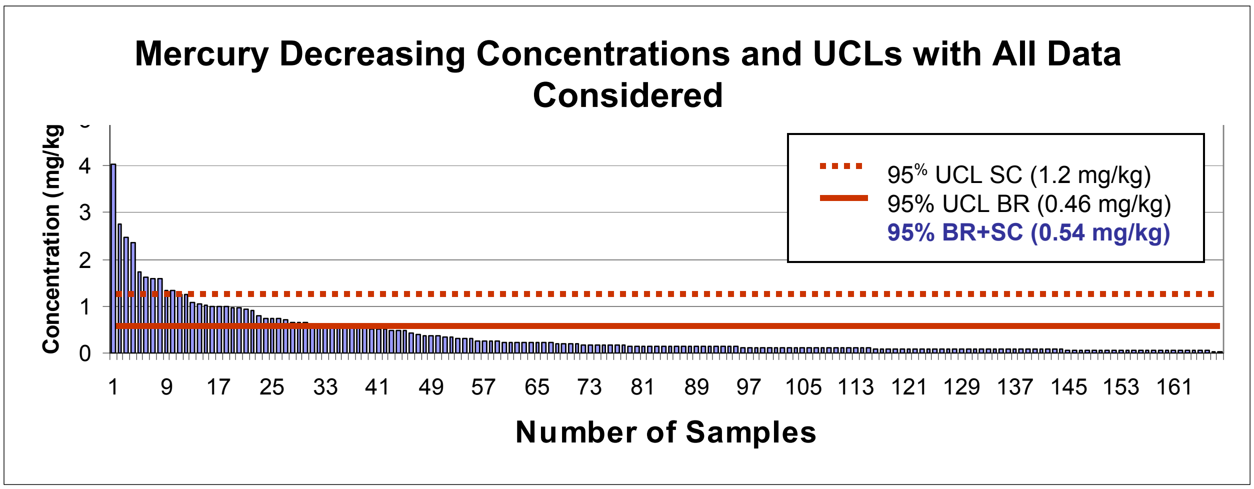
Mercury in Fish from Buffalo River

Figure 1

Figure 2: Mercury Histograms and Average Conditions in the River





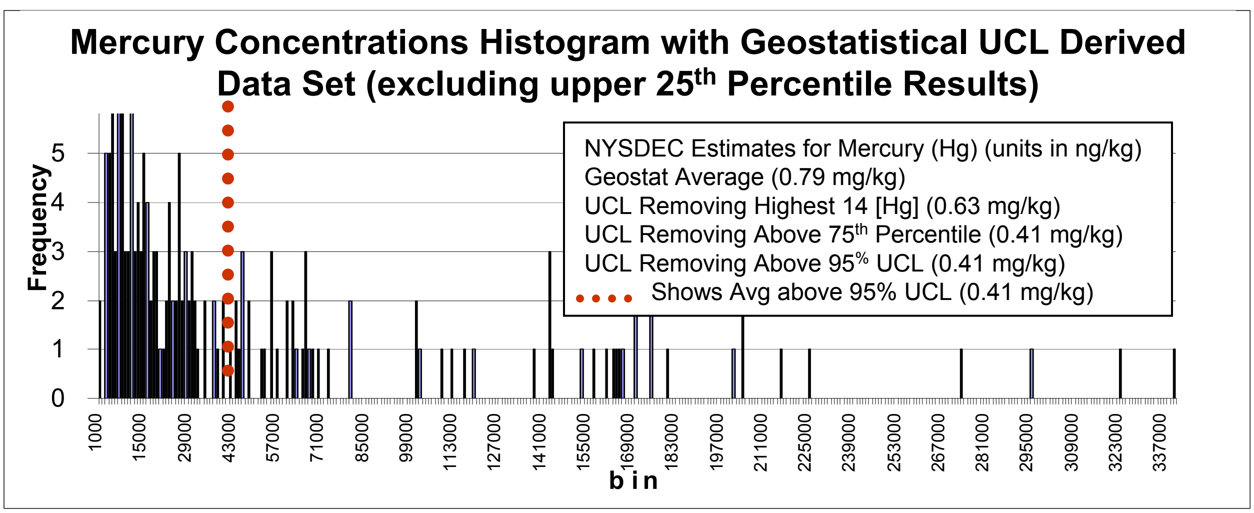


Figure 3: Lead Histograms and Average Conditions in the River