BACKGROUND DATA PROCESSING AND OUTLIER IDENTIFICATION

INTRODUCTION

As a follow-up to the EPA/LWG Background Methods Technical Meeting held on 5/29/08, the upriver bedded sediment data (background reach) for several chemicals expected to pose risk in the harbor were analyzed for outliers in accordance with the general approach described on 5/29 for total OC-normalized PCBs. Per those background calculation discussions with EPA, the objective of this memo is to detail an outlier review and evaluation approach that can be applied consistently to the background bedded sediment dataset. This memo describes the analytical and Best Professional Judgment (BPJ) steps that were taken to identify, on an analyte-by-analyte basis, outliers that should be excluded from the background dataset (hereafter referred to as primary outliers). Note that in this analysis, both dry weight and OC-normalized datasets for organic compounds are considered, and outliers from both datasets are identified independently.

For comparative purposes, this memo also presents summary statistics, including both upper background threshold and central tendency background statistics, for the full and outlier excluded datasets. The most appropriate statistic to use for a given background purpose will be the subject of future technical discussions between the LWG and EPA. As has been discussed during the meeting of 5/29/08, however, upper background threshold statistics are appropriate for identifying locations within Portland Harbor that exceed background, as defined by the upriver reach, while central tendency statistics are appropriate for estimating background exposure levels for mobile receptors including people, wildlife and some fish species.

METHODS

The following sections detail a two-step process for data processing and outlier analysis. The first step involves dataset definition, data processing, and the identification of the potential outliers. *Potential outliers* are defined here as those data points identified as outliers in the datasets based on the application of the outlier tests and graphical tools available in ProUCL. The second step includes the application of best professional judgment to identify which of the potential outliers should be considered primary outliers. *Primary outliers* are defined here as those data points recommended for exclusion from the background set prior to the calculation of statistics that would be used in the RI/FS (i.e., upper threshold or central tendency indices).

Step 1: Data Processing, Summary Statistics, and Identification of Potential Outliers

The specific steps used in the preliminary statistical evaluation of dry weight and OC-normalized datasets are outlined below.

I. Data Selection (see Figure 1)

1. Matrices:
   - upriver bedded sediment
2. Spatial extent: RM 15.3 – RM 28.5

3. Data quality: Cat1QA2 [RA dataset]
   - Includes the EPA Willamette Falls upriver data
4. Analytes evaluated in this memo include:
   Arsenic, Mercury, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenzo(a,h)anthracene, Total DDTs, Total PCB Aroclors, Dioxin TEQ–Birds $_{WHO95}$, Dioxin TEQ–Fish $_{WHO95}$, Dioxin TEQ-Mammals $_{WHO05}$, PCB TEQ–Birds $_{WHO95}$, PCB TEQ–Fish $_{WHO95}$, and PCB TEQ-Mammals$_{WHO05}$

II. Data Processing (Prior to Import into ProUCL)

1. Average field replicate values
2. Calculate analyte totals and TEQs using RA summation methods
3. Remove high-biasing nondetect data (i.e. any nondetect value for which the detection limit is greater than the maximum detected value) consistent with EPA 1989[1] and EPA comments on the Portland Harbor Comprehensive Round 2 report).

III. Data Processing (Using ProUCL)

1. Summary Statistics:
   Summary statistics that include both detected and nondetect values for the full dataset for each analyte are presented in the top section of Tables 1 (dry weight) and 2 (organics OC-normalized).

2. Identify Data Distributions:
   The distribution for each dataset was determined following the application of ROS (regression order on statistics) substitutions for the non-detects. ProUCL goodness-of-fit distribution tests for the normal, lognormal, and gamma distributions were applied, including Lilliefors, Kolmogorov-Smirnov, Shapiro-Wilks, and Anderson-Darling tests. These distributions are listed in Tables 1 and 2 and are generally non-normal.

   a. <u>Identify Potential Outliers</u>

      i. The ProUCL Technical Guide notes that classical statistical outlier tests are best used to aid in identifying potential outlier data points that require additional investigation, and should be used in company with graphical displays including quantile-quantile plots and box plots. ProUCL notes that final outlier decisions should be based on review of all relevant information (see Step 2) to determine the actual disposition of potential outlying values.

[1] Risk Assessment Guidance for Superfund (RAGS), Part A. EPA 1989.

ii. ProUCL includes the Dixon/Rosner tests for outlier identification but notes that those tests are strictly appropriate for normally-distributed datasets only. The ProUCL Technical Guide also recommends against log-transforming the data prior to outlier testing. For datasets that exhibit a normal distribution, the Dixon/Rosner outlier tests were run with ND = DL/2; ProUCL automatically selects either Dixon's or Rosner's test based on sample size (Rosner's for n >/= 25, Dixon's for n < 25). Within ProUCL the user may select the number of potential outliers to evaluate with Rosner's test. The number of potential outliers for each analyte was estimated by looking at the box plots (see Step c. iii and Figures 2 and 3) with ten being the maximum number of outliers evaluated by Rosner's test.

iii. Graphical review of the data to identify potential outliers was conducted using box plots and standard normal quantile-quantile plots with ND = DL (see Figures 2 and 3). For all non-normal data sets, the data was log-transformed prior to plotting on the quantile-quantile plots. The potential outliers identified from a visual examination of the box plots (as the primary line of evidence), and quantile-quantile plots (supporting line of evidence) for each analyte are circled in Figures 2 and 3 and listed in Tables 3 and 4. Additionally, potential outliers are identified as red symbols on concentration vs. river mile scatterplots presented in Figures 4 and 5.

b. Summary Statistics on Data with Statistical Outliers Removed

ii. Summary statistics were calculated for each dataset with the potential outliers removed and these are included in Tables 1 and 2.

Step 2: Primary Outlier Identification

The relative magnitude of each potential outlier identified in Step 1 was evaluated further to determine whether the data points should be considered primary outliers and be removed from the dataset. This BPJ evaluation was conducted by quantitative evaluation of the potential outlier concentration relative to the dataset mean concentration, coupled with visual examination and spatial analysis using scatterplots of the data (see Figures 4 and 5). A primary outlier (i.e., a value to be excluded from the background data set) was identified if the ratio between a potential outlier and the mean approached an order of magnitude. The ratios of the potential outliers to the means are included in Tables 3 and 4, and those identified as primary outliers are indicated. The outlier to mean ratios of primary outliers range from 7.7 to 16.5 (dry weight) and 9.8 to 24.2 (OC-normalized). The primary outliers are circled on the scatter plots presented in Figures 4 and 5, which also show the potential outliers as red symbols. Visual examination of these plots for comparison to the rest of the dataset corroborates the identification of these data points as primary outliers.

Figure 1 shows the mapped distribution of the twelve primary outliers identified based on the above approach. These outliers are also listed below by analyte and station, and presented in Tables 3 and 4.

Dry-Weight Basis

Benzo(a)anthracene	LW3-UG04B
Benzo(a)pyrene	LW3-UG04B
Benzo(b)fluoranthene	LW3-UG04B
Dibenzo(a,h)anthracene	WR04SD
Dioxin TEQ - Birds	WR08SD
Dioxin TEQ - Fish	WR08SD
Dioxin TEQ - Mammals 2006	WR08SD

OC Normalized

Benzo(a)pyrene	BH04SD
Dibenzo(a,h)anthracene	WR04SD
Dioxin TEQ - Birds	WR04SD
Dioxin TEQ - Fish	WR04SD
Dioxin TEQ - Mammals 2006	WR04SD

Other lines of evidence considered here and/or to be considered when additional analytes are evaluated for primary outliers from the background dataset include: (i) co-occurrence with outliers for other chemicals at single stations; (ii) small-scale heterogeneity in chemical concentrations at clustered locations; (iii) proximity to potential chemical sources; and (iv) temporal trends in concentrations.

Examples of how these other lines of evidence would be used to support the exclusion an identified primary outlier are noted in the following paragraph. These lines of evidence could also be used to call into question the exclusion of a primary outlier, but no examples of this were evident in the evaluation of outliers for these analytes.

Across both dry weight and OC-normalized datasets, only 4 stations exhibit primary outliers and 11 of the 12 primary outliers come from only three stations: LW3-UG04B (PAHs), WR04SD (PAHs, dioxins), and WR08SD (dioxins). While this trend is partly an artifact of the multiple-derived dioxin TEQs, it does suggest that these three stations are “unusual” in their sediment chemistry composition relative to other stations in the background reach supporting the primary outlier removal. In addition, two of the four outlier stations are also proximal to potential sources, LW3-UG04B is near a private dock and BH04SD is adjacent to the Blue Heron Paper Mill (Figure 1).

EXAMPLE STATISTICS

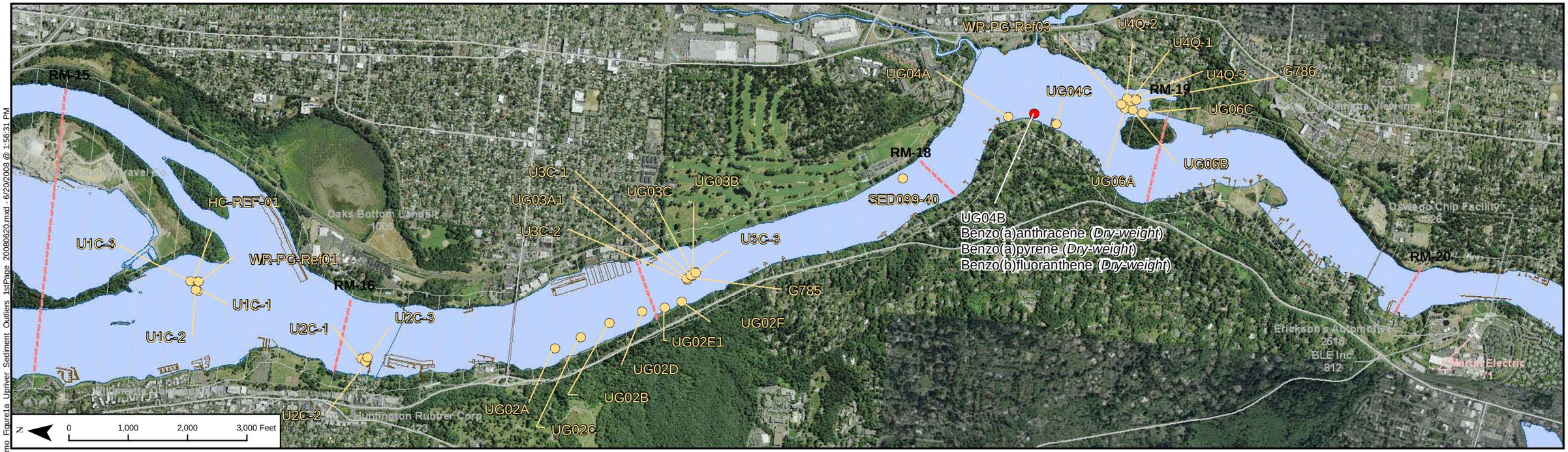
Following the definition of the background dataset based on the identification, verification, and removal of the primary outliers as described above, upper threshold and central tendency statistics are generated by ProUCL as described below (see Tables 5 and 6).

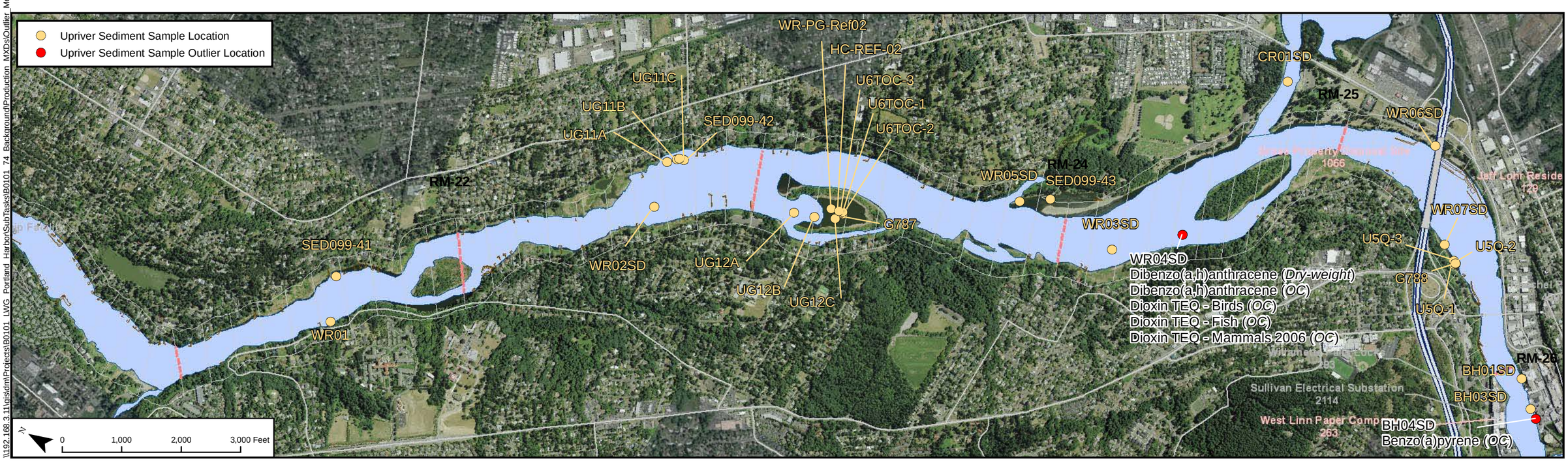
a. Upper Threshold Statistics _
    i. Import dataset at ND=DL
    ii. Use ProUCL to calculate the 95th percentile upper prediction limit (UPL95) or appropriate upper threshold statistic as follows:
        i. For nonparametric data and/or datasets with multiple detection limits, Kaplan-Meier statistics were applied.
        ii. For parametric data sets with no nondetects or a single detection limit, the ProUCL-recommended statistic for the appropriate data distribution was selected.

b. Central Tendency Statistics
    i. Import dataset at ND=DL
    ii. Use ProUCL to calculate the 95th percentile upper confidence limit on the mean (95UCL) as follows:
        i. For nonparametric data and/or datasets with multiple detection limits, Kaplan-Meier statistics were applied.
        ii. For parametric datasets with no nondetects or a single detection limit, the ProUCL-recommended statistic for the appropriate distribution was selected.

Tables 5 and 6 present the calculated values of these upper threshold and central tendency statistics for all three datasets (all data, potential outliers removed, primary outliers removed) for comparison purposes. The LWG proposal is to use the primary outlier excluded datasets, as derived here, as the primary background datasets.

FIGURES





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LWG LOWER WILLAMETTE GROUP

FEATURE SOURCES:
Transportation, Property, or Boundaries: Metro RLIS .
Channel & River miles: US Army Corps of Engineers.
Bathymetric Information: David Evans and Associates, Inc.

Bridges
Navigation Channel
Rivermiles (Tenths)
Docks & Structures
Arterial Street
Freeway

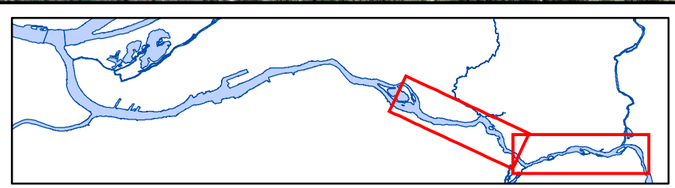

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Figure 1a
Upriver Sediment Outlier Locations
Page 1 of 2

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LWG Lower Willamette Group

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Bridges
Navigation Channel
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Freeway

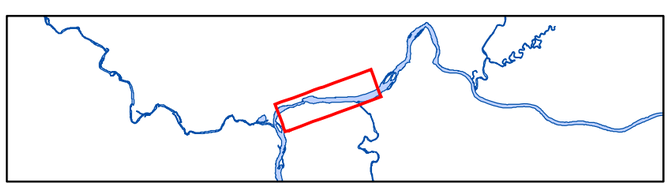

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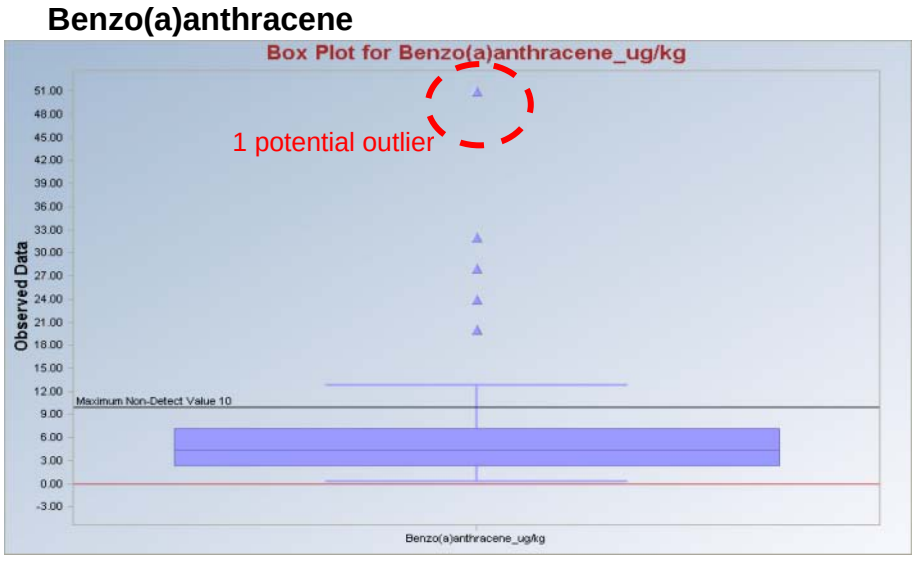
Figure 1b
Upriver Sediment Outlier Locations
Page 2 of 2

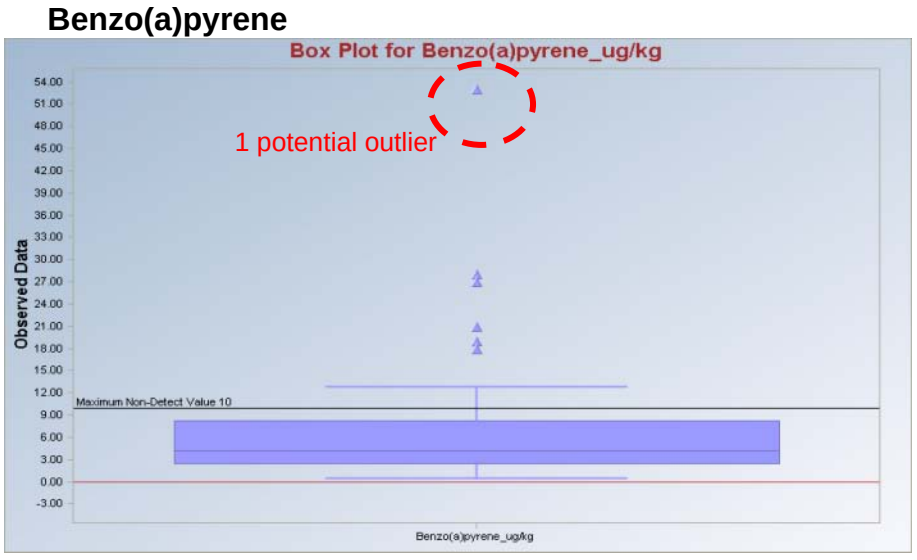
Box Plots

(Nondetect values shown at detection limit)

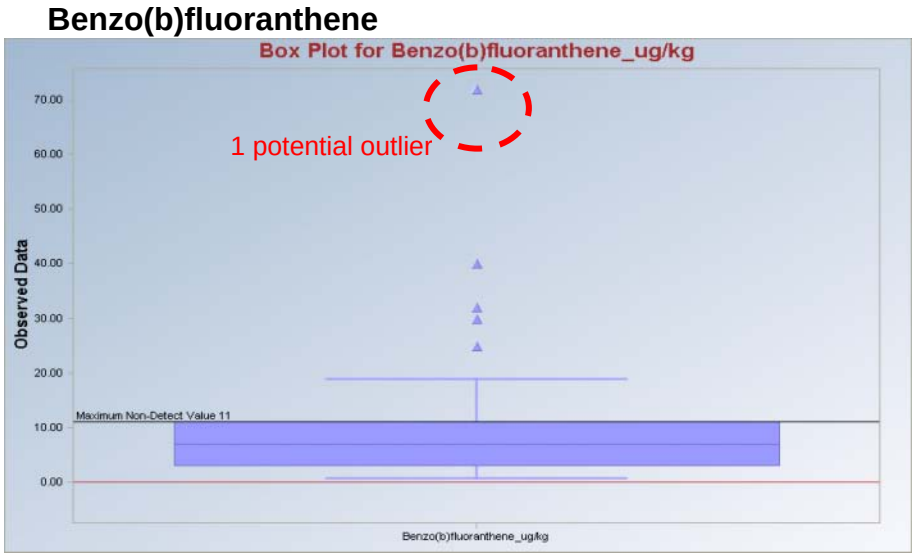
Benzo(a)anthracene



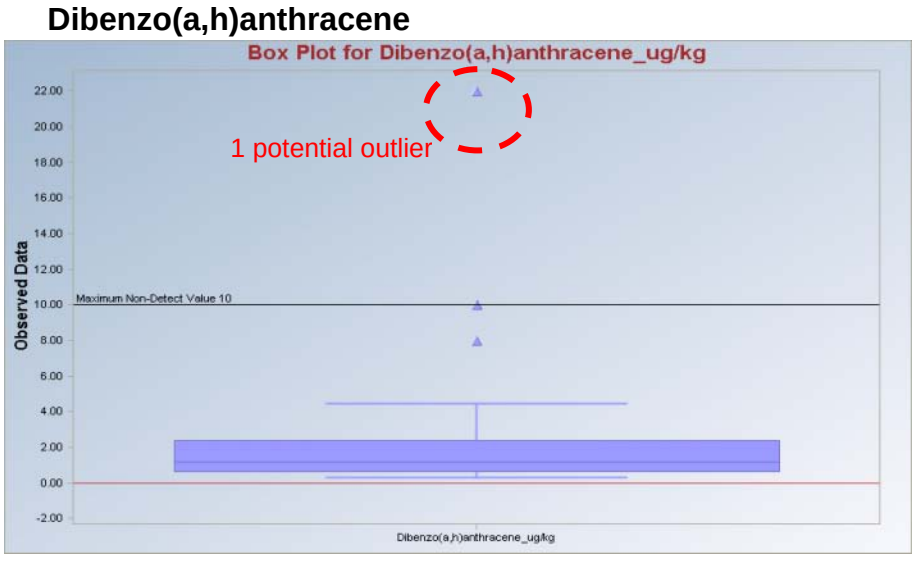
Benzo(a)pyrene



Benzo(b)fluoranthene



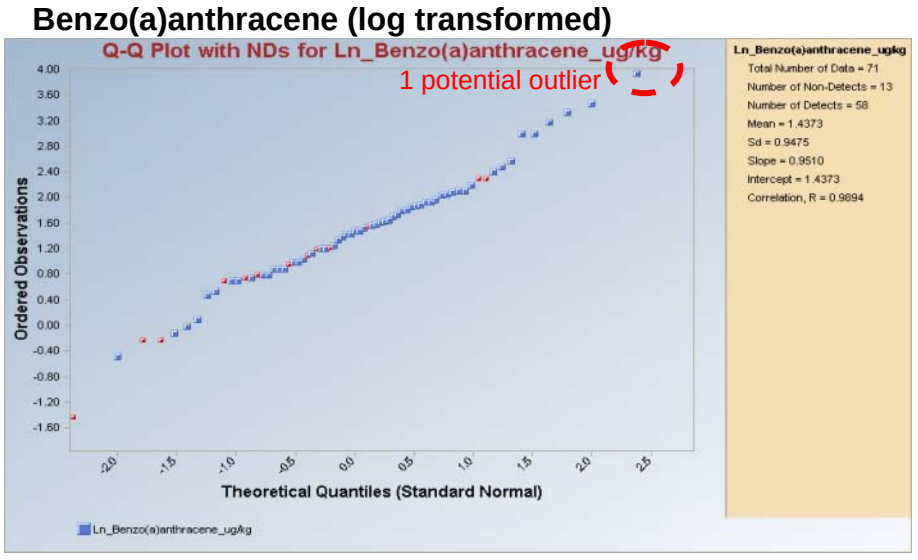
Dibenzo(a,h)anthracene



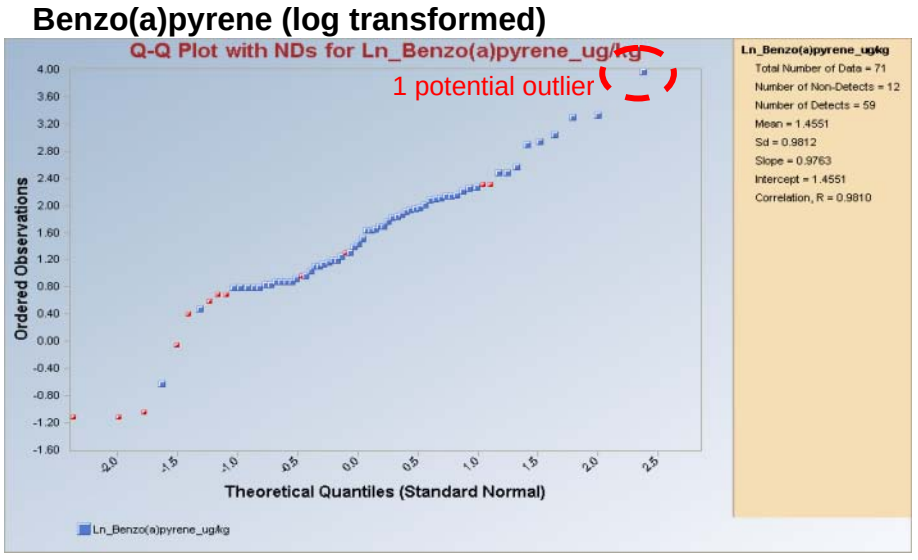
Quantile-Quantile Plots

(Nondetect values shown as red symbols at detection limit; log transformations applied to all non-normal data distributions)

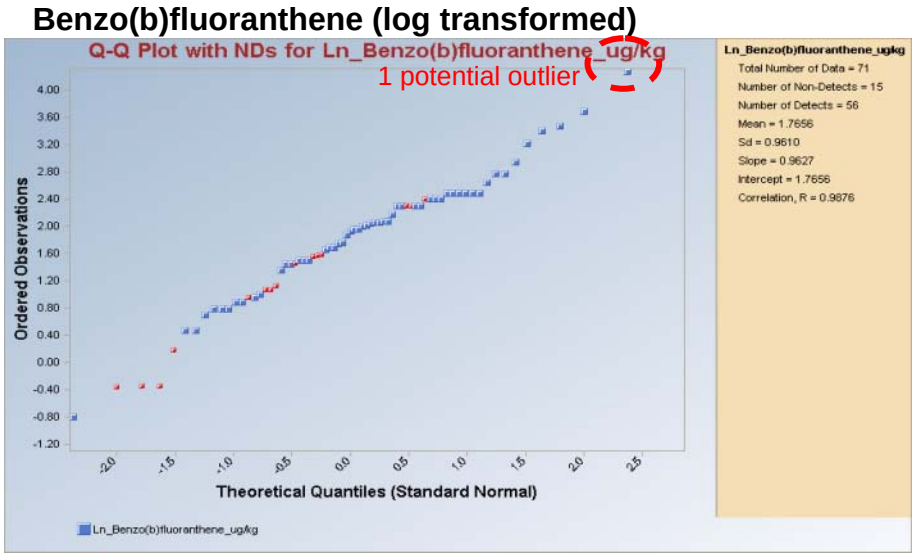
Benzo(a)anthracene (log transformed)



Benzo(a)pyrene (log transformed)



Benzo(b)fluoranthene (log transformed)



Dibenzo(a,h)anthracene (log transformed)

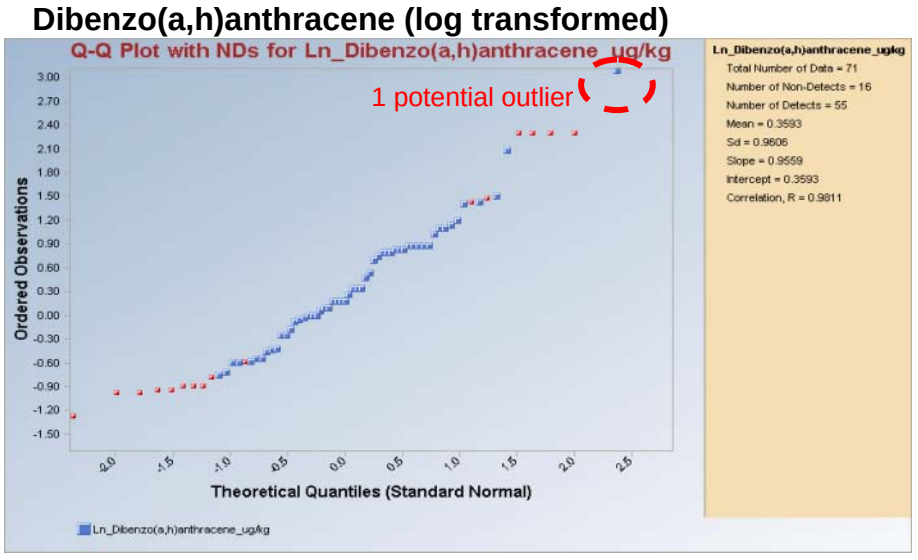
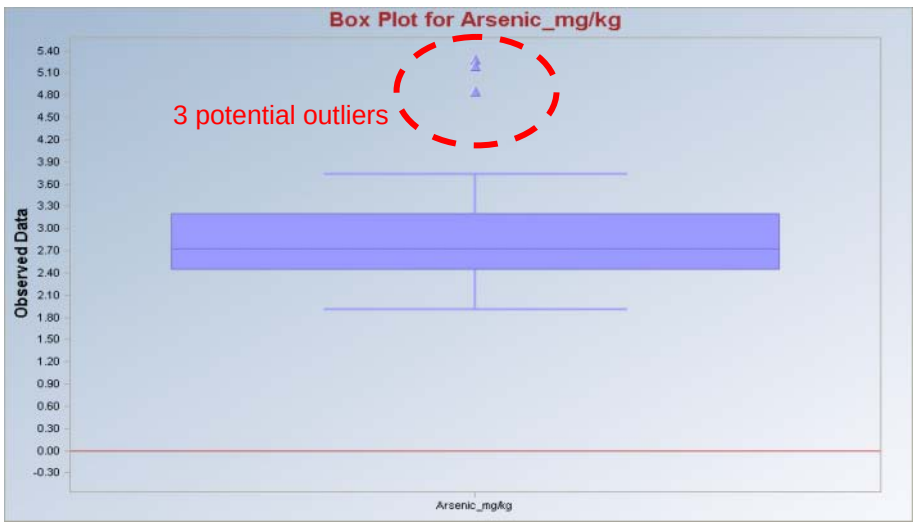


Figure 2a
Upriver Bedded Sediment
Box Plots and Quantile-Quantile Plots
PAHs
(Dry Weight)

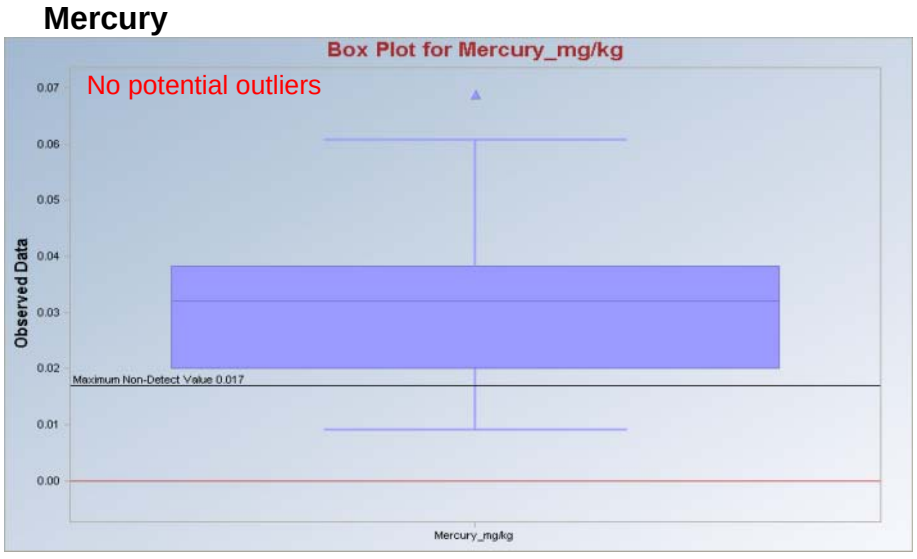
Box Plots

(Nondetect values shown at detection limit)

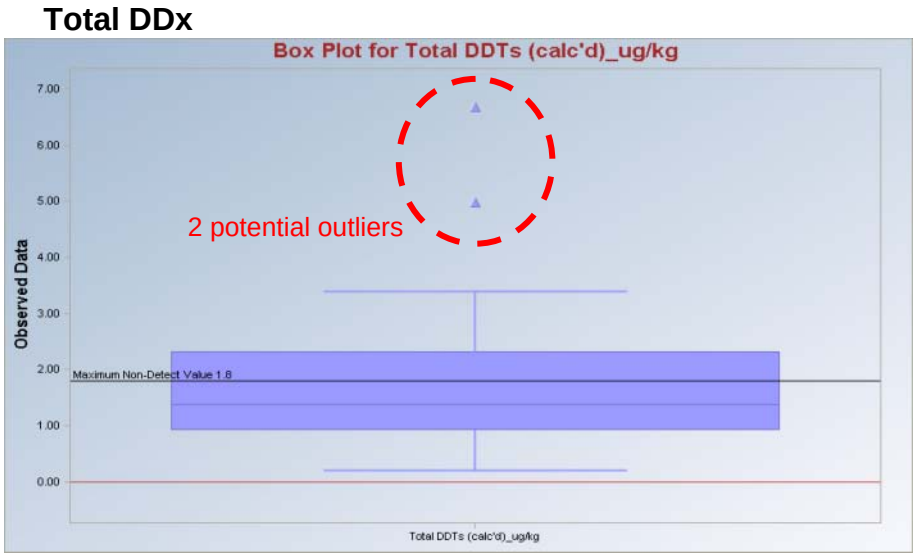
Arsenic



Mercury



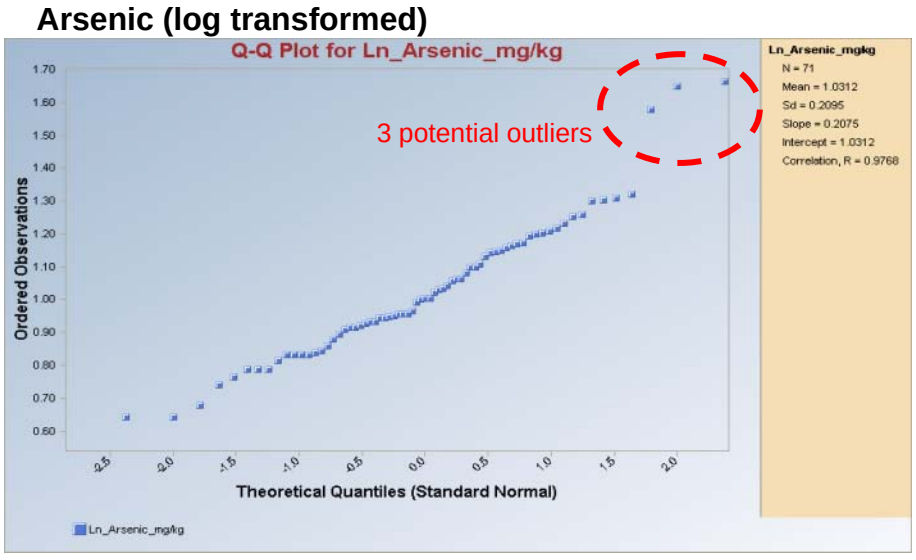
Total DDx



Quantile-Quantile Plots

(Nondetect values shown as red symbols at detection limit; log transformations applied to all non-normal data distributions)

Arsenic (log transformed)



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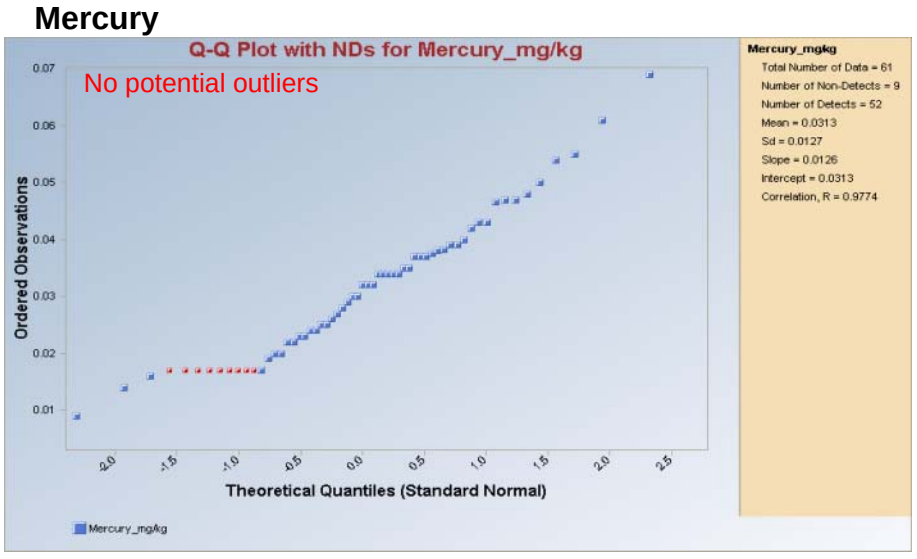


Total DDx (log transformed)

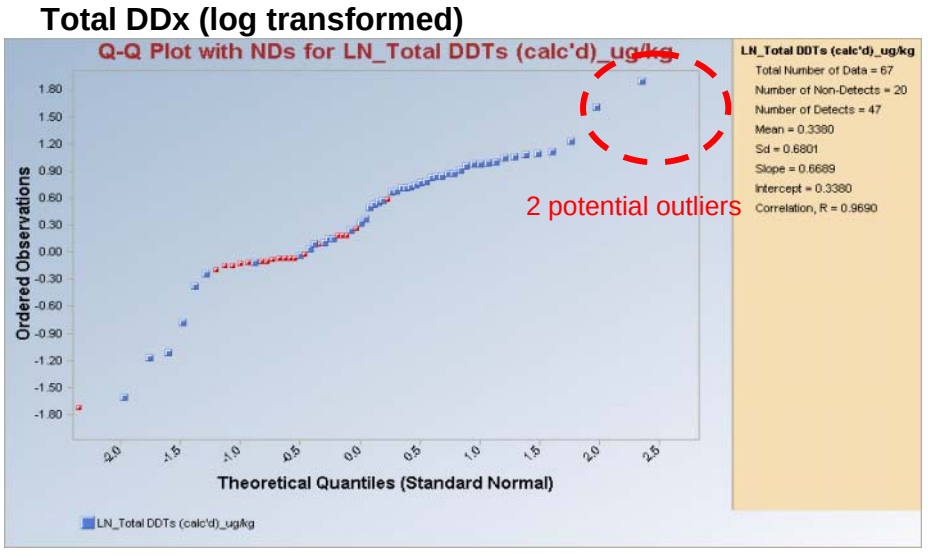
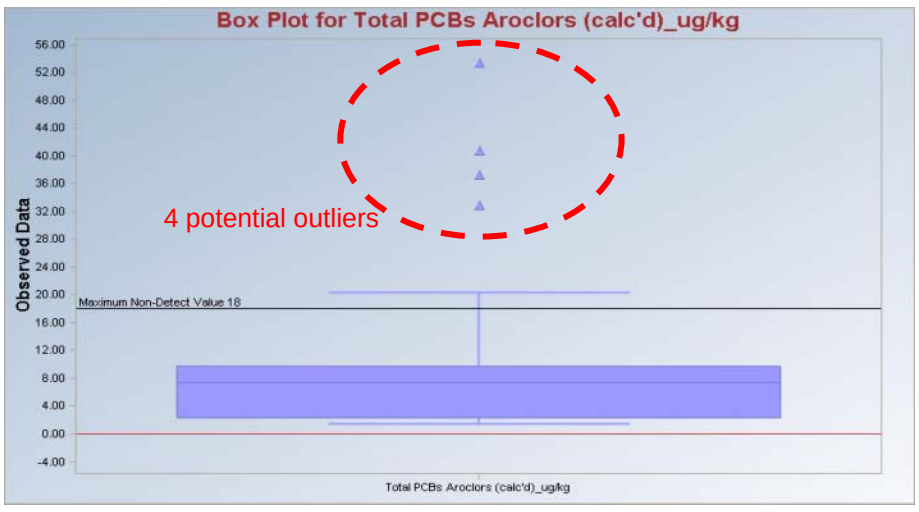


Figure 2b
Upriver Bedded Sediment
Box Plots and Quantile-Quantile Plots
Metals and Total DDx
(Dry Weight)

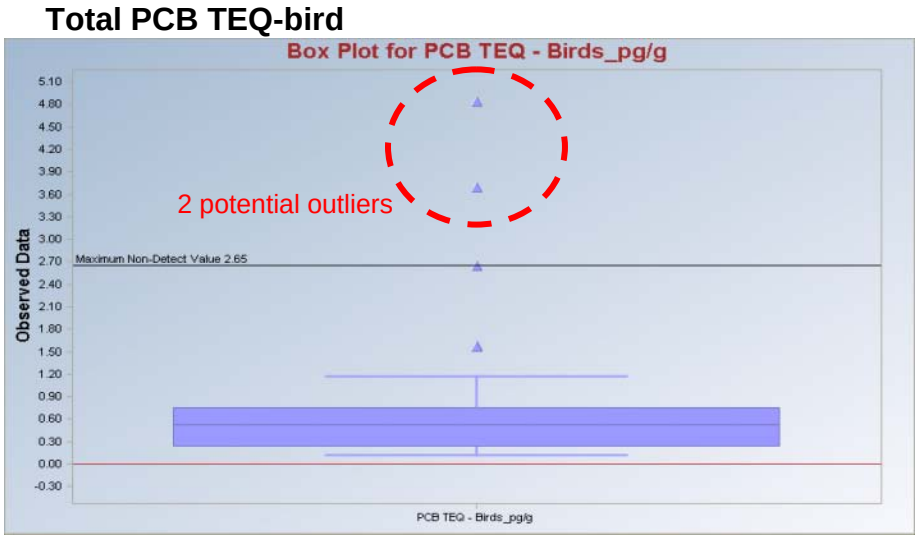
Box Plots

(Nondetect values shown at detection limit)

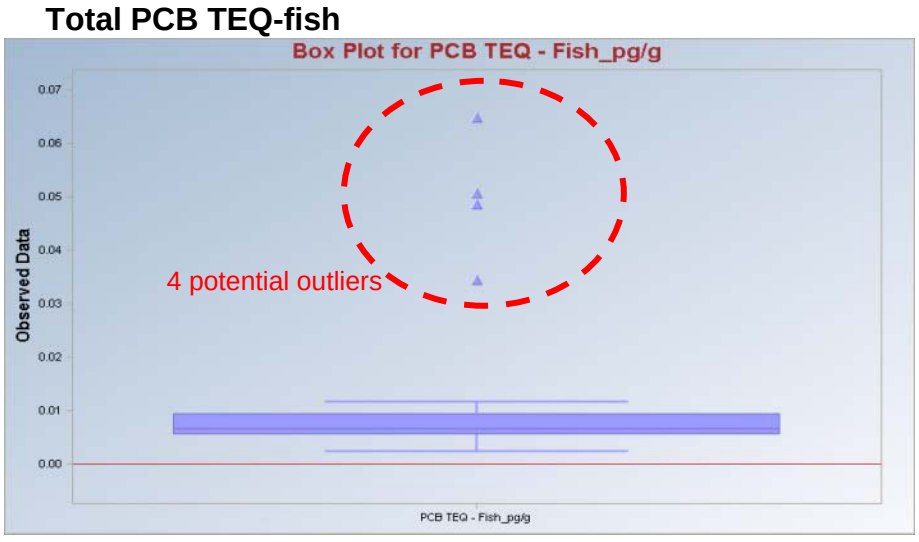
Total PCB Aroclors



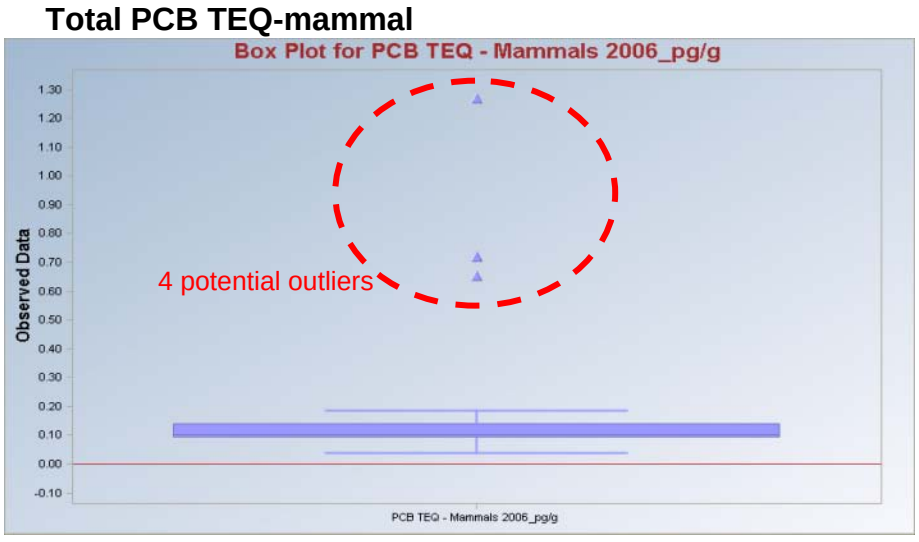
Total PCB TEQ-bird



Total PCB TEQ-fish



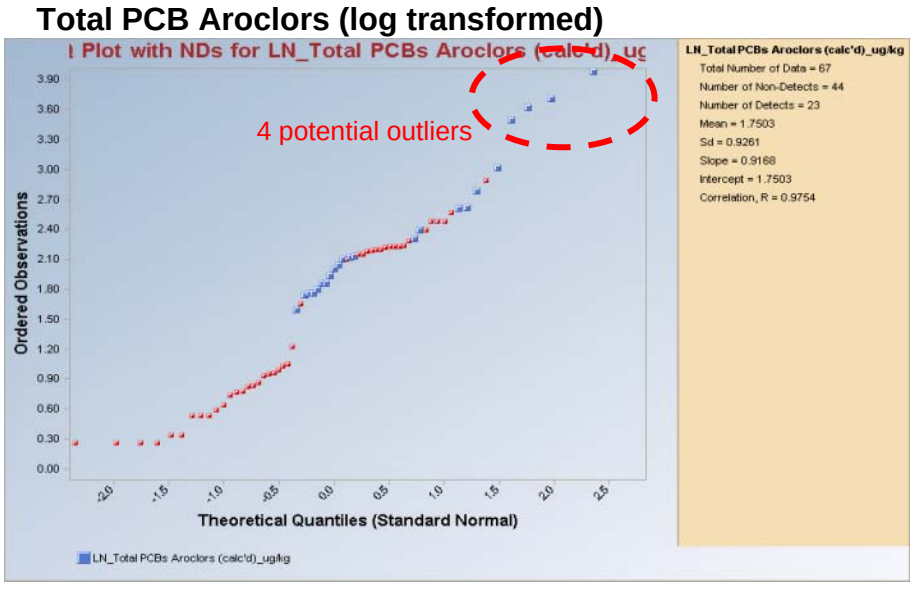
Total PCB TEQ-mammal



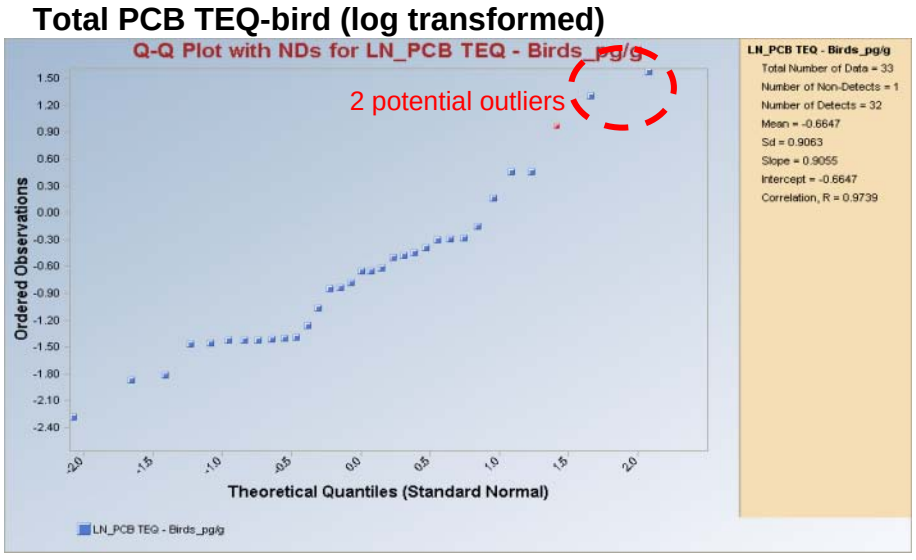
Quantile-Quantile Plots

(Nondetect values shown as red symbols at detection limit; log transformations applied to all non-normal data distributions)

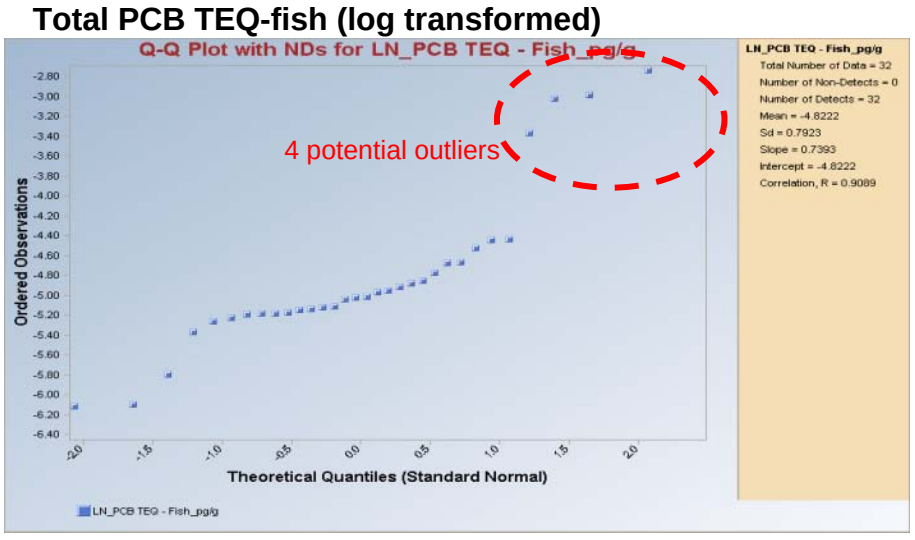
Total PCB Aroclors (log transformed)



Total PCB TEQ-bird (log transformed)



Total PCB TEQ-fish (log transformed)



Total PCB TEQ-mammal (log transformed)

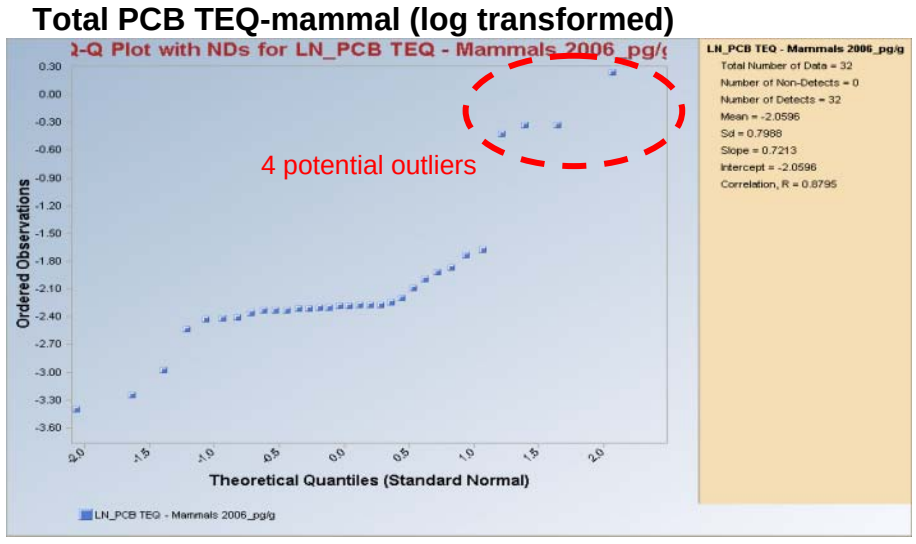
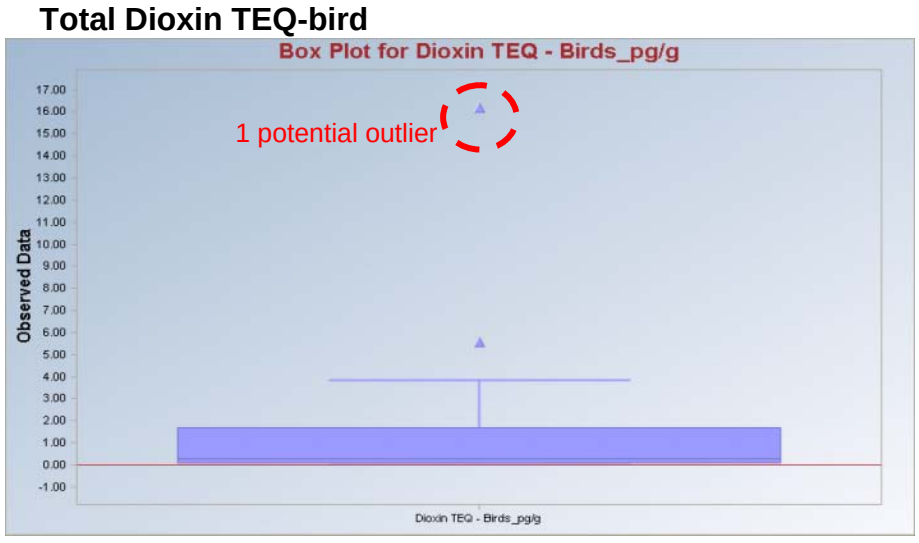


Figure 2c
Upriver Bedded Sediment
Box Plots and Quantile-Quantile Plots
Total PCB Aroclors and PCB TEQs
(Dry Weight)

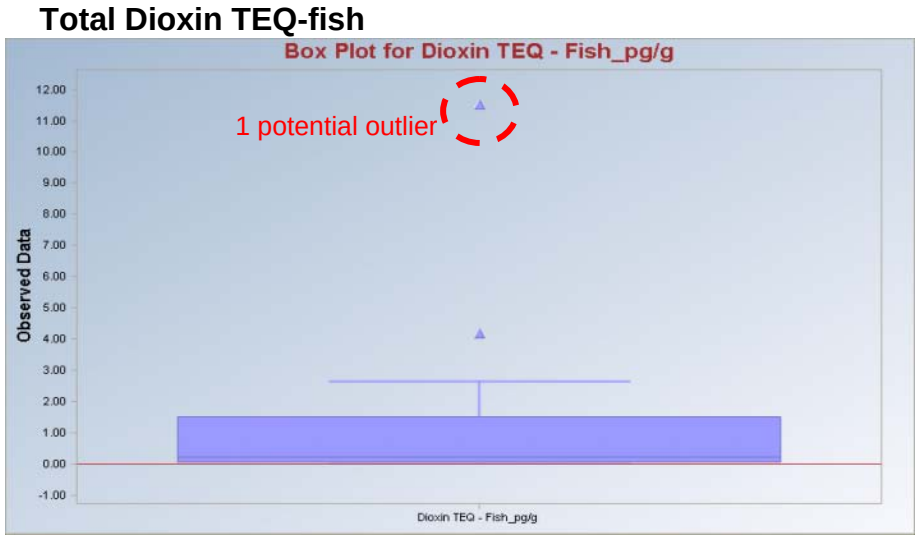
Box Plots

(Nondetect values shown at detection limit)

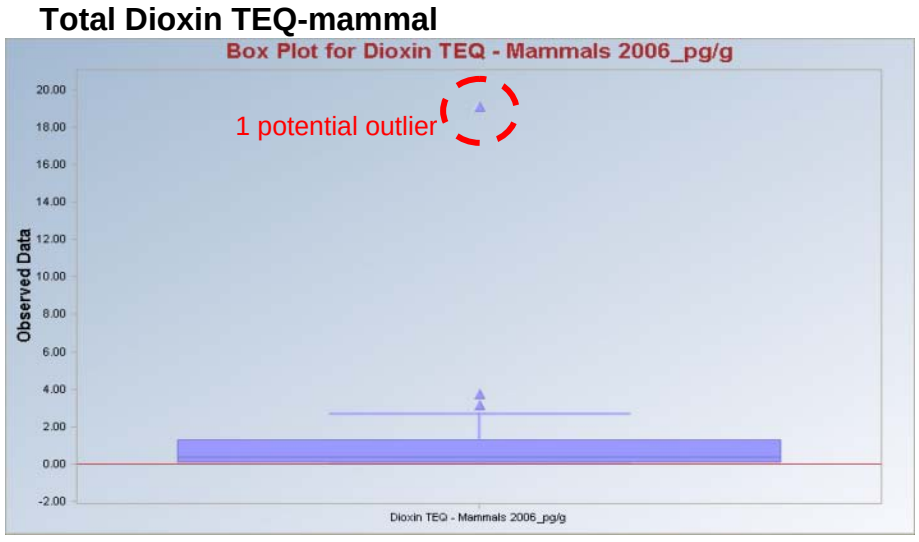
Total Dioxin TEQ-bird



Total Dioxin TEQ-fish



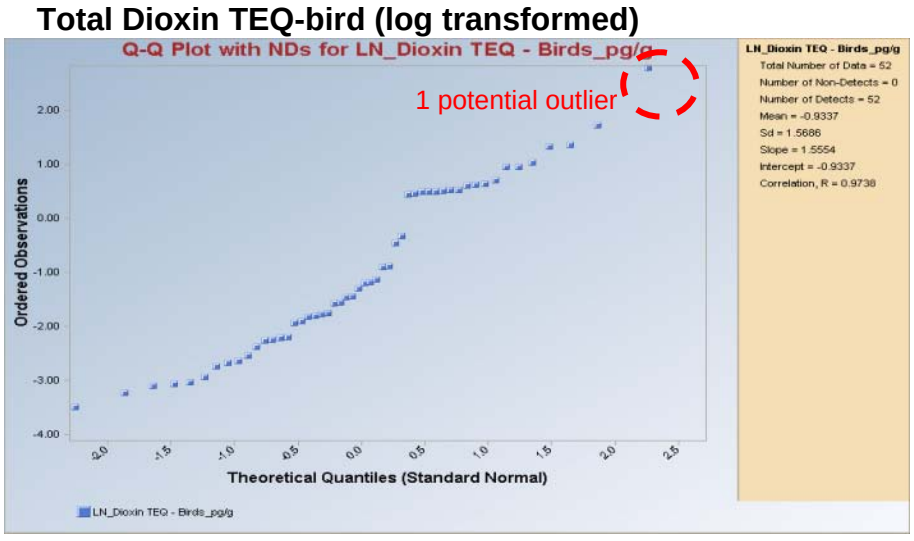
Total Dioxin TEQ-mammal



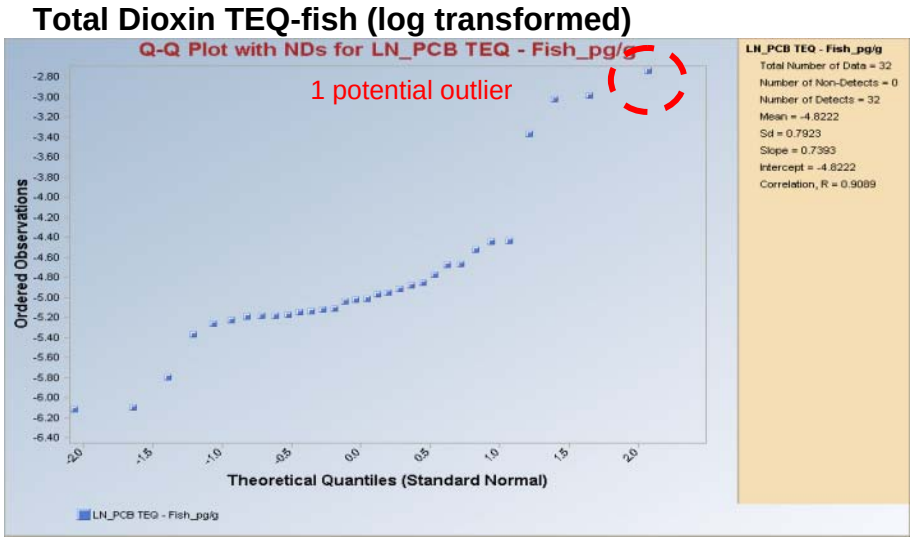
Quantile-Quantile Plots

(Nondetect values shown as red symbols at detection limit; log transformations applied to all non-normal data distributions)

Total Dioxin TEQ-bird (log transformed)



Total Dioxin TEQ-fish (log transformed)



Total Dioxin TEQ-mammal (log transformed)

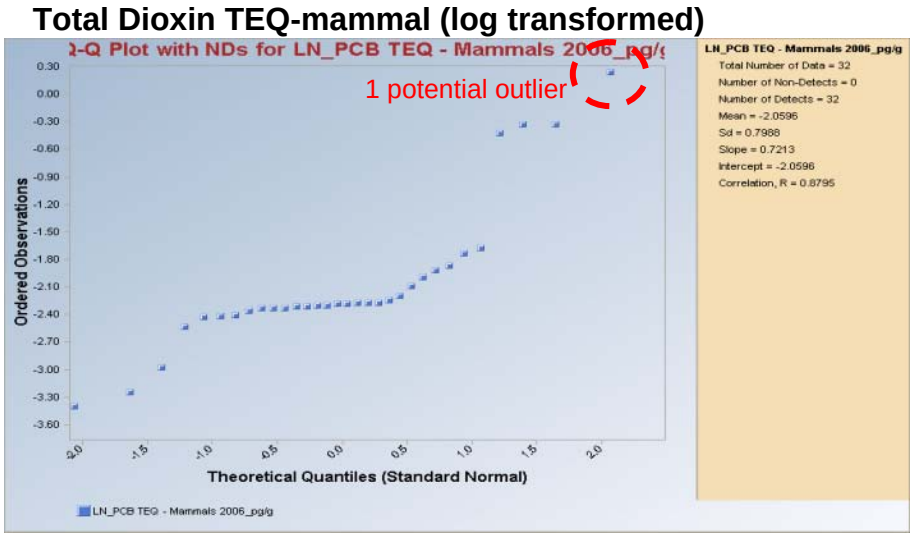
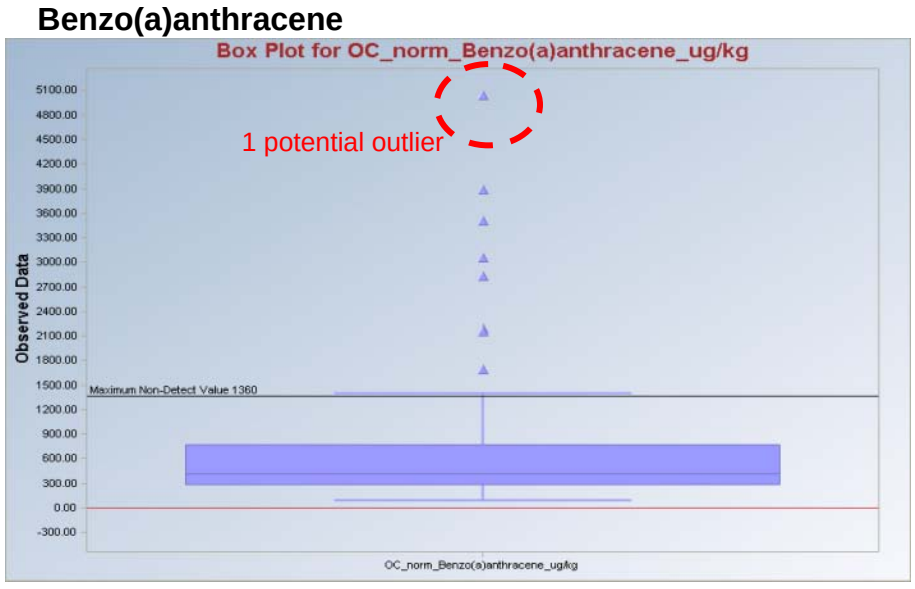


Figure 2d
Upriver Bedded Sediment
Box Plots and Quantile-Quantile Plots
Dioxin TEQs
(Dry Weight)

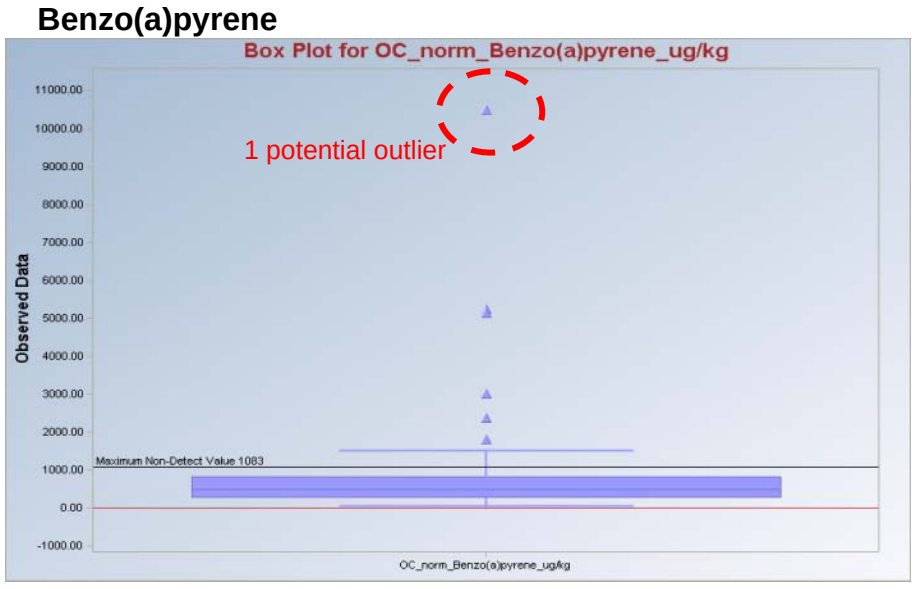
Box Plots

(Nondetect values shown at detection limit)

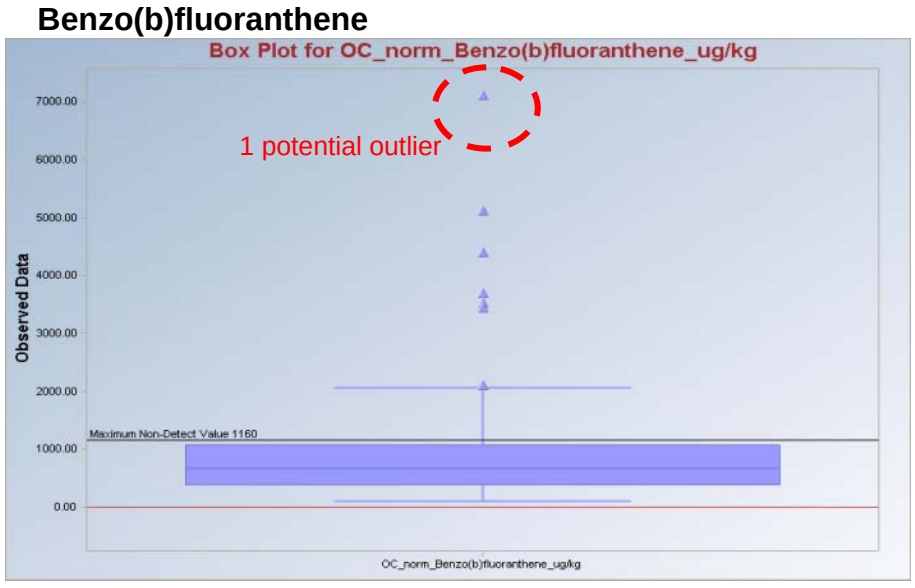
Benzo(a)anthracene



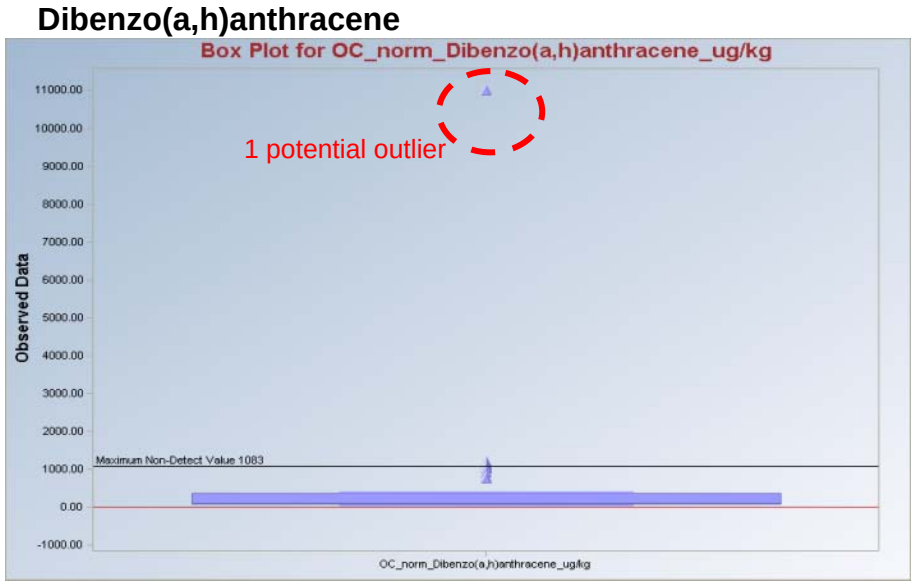
Benzo(a)pyrene



Benzo(b)fluoranthene



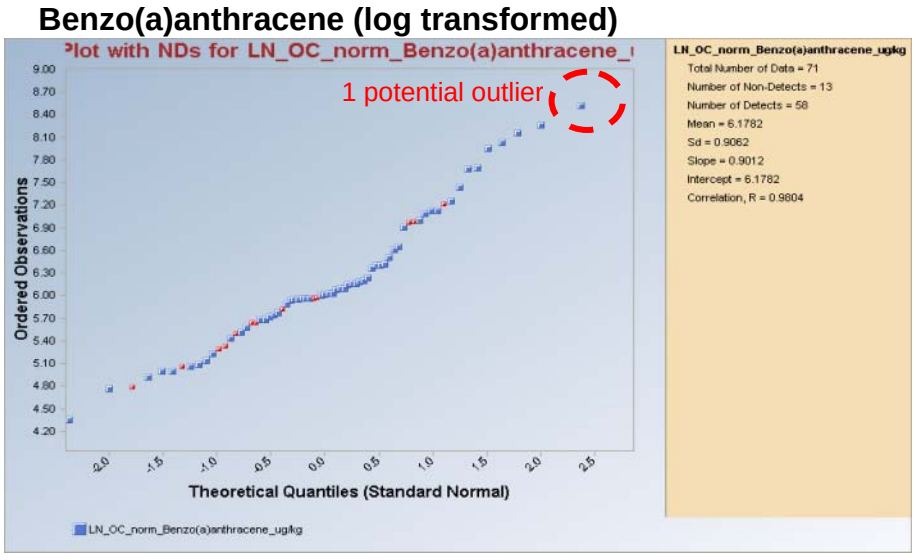
Dibenzo(a,h)anthracene



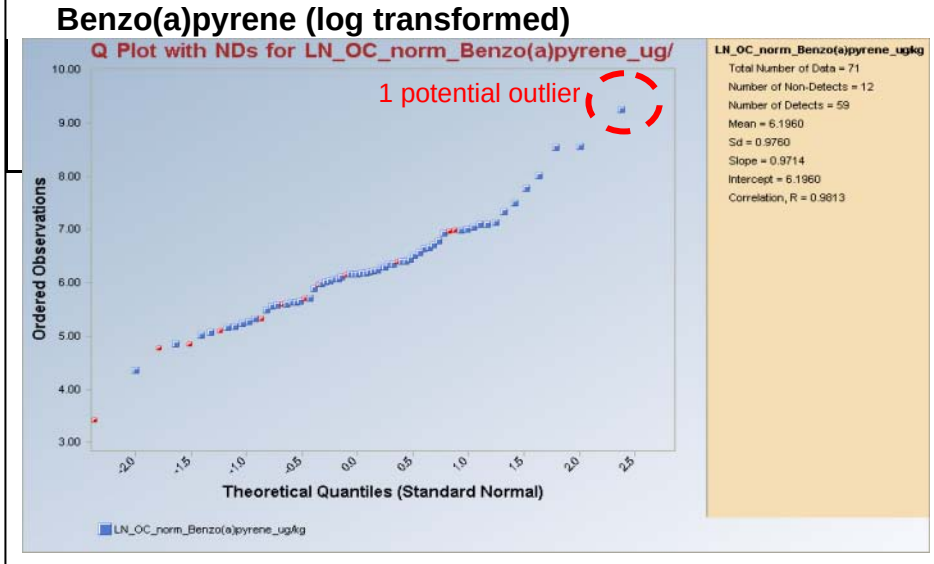
Quantile-Quantile Plots

(Nondetect values shown as red symbols at detection limit; log transformations applied to all non-normal data distributions)

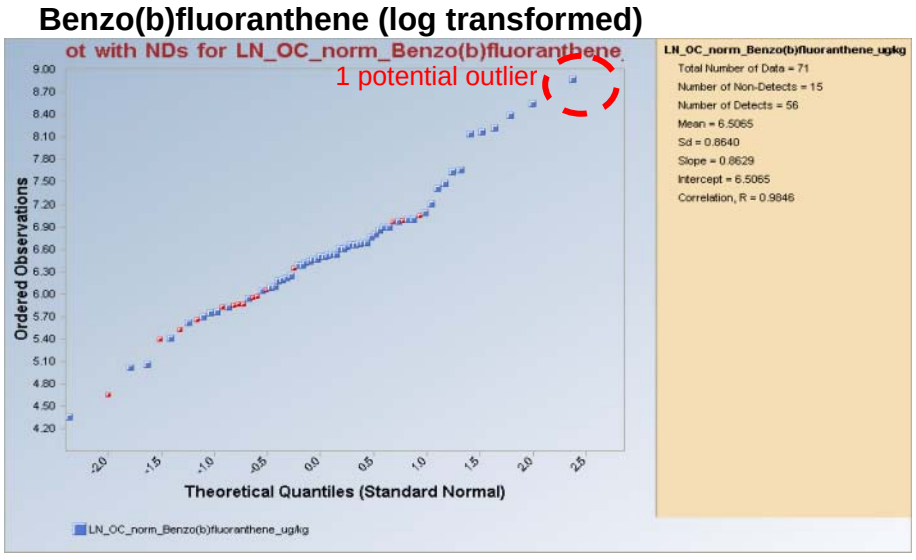
Benzo(a)anthracene (log transformed)



Benzo(a)pyrene (log transformed)



Benzo(b)fluoranthene (log transformed)



Dibenzo(a,h)anthracene (log transformed)

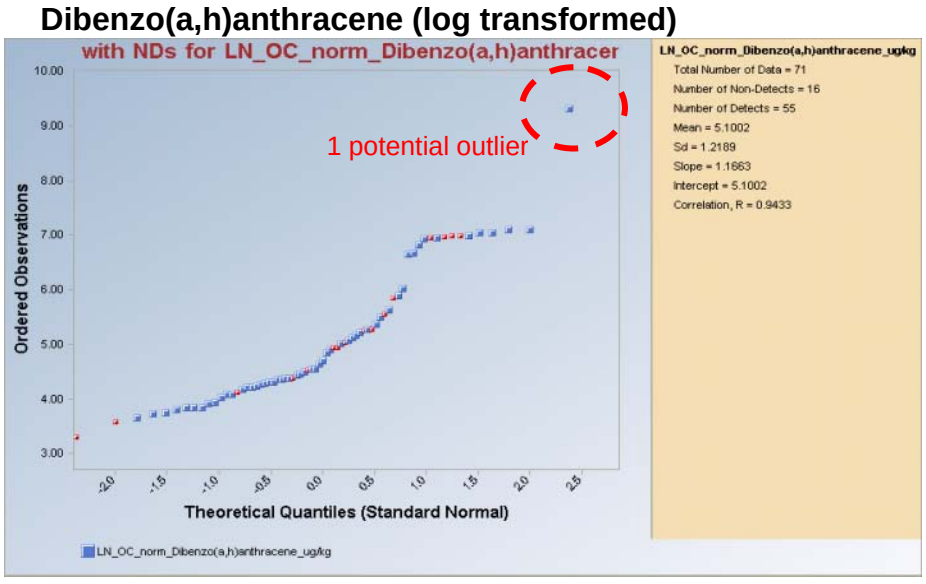
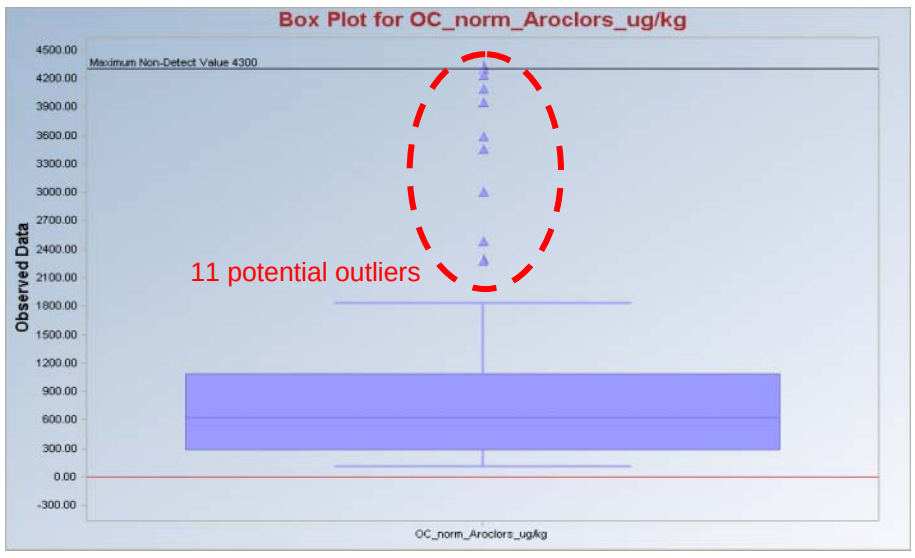


Figure 3b
Upriver Bedded Sediment
Box Plots and Quantile-Quantile Plots
PAHs
(OC-Normalized)

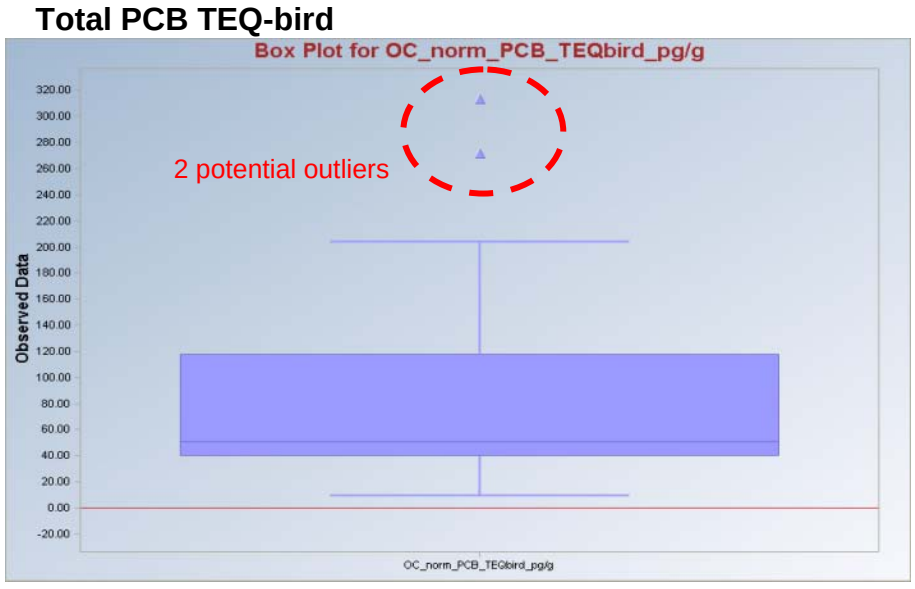
Box Plots

(Nondetect values shown at detection limit)

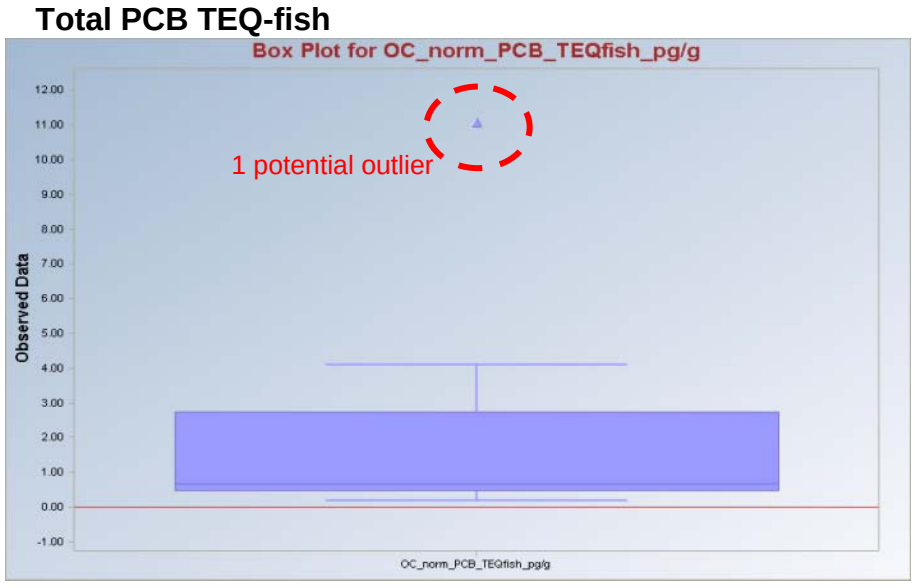
Total PCB Aroclors



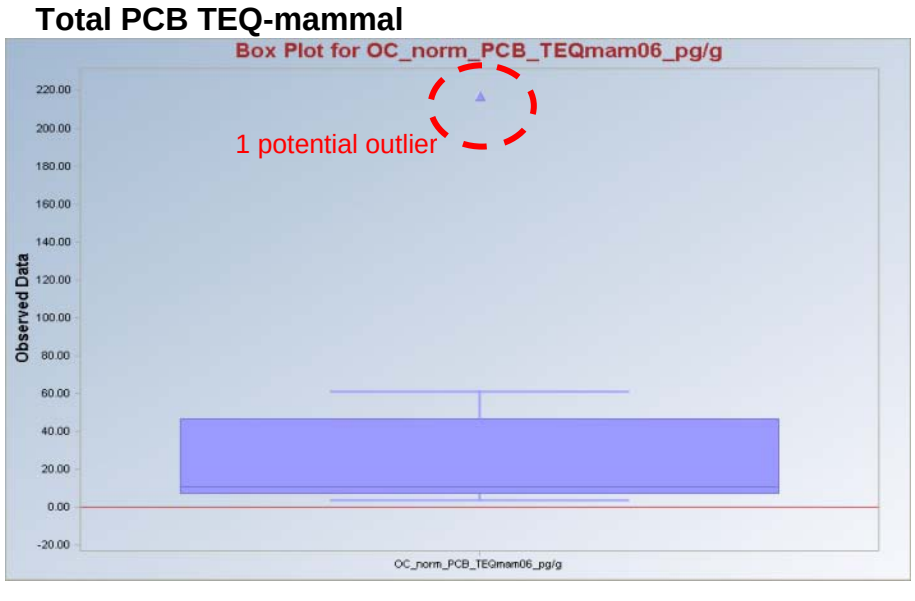
Total PCB TEQ-bird



Total PCB TEQ-fish



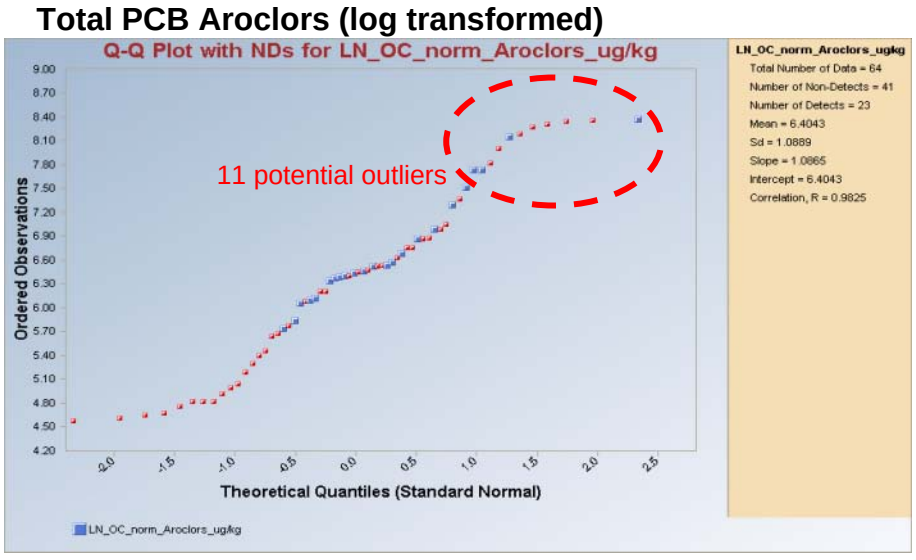
Total PCB TEQ-mammal



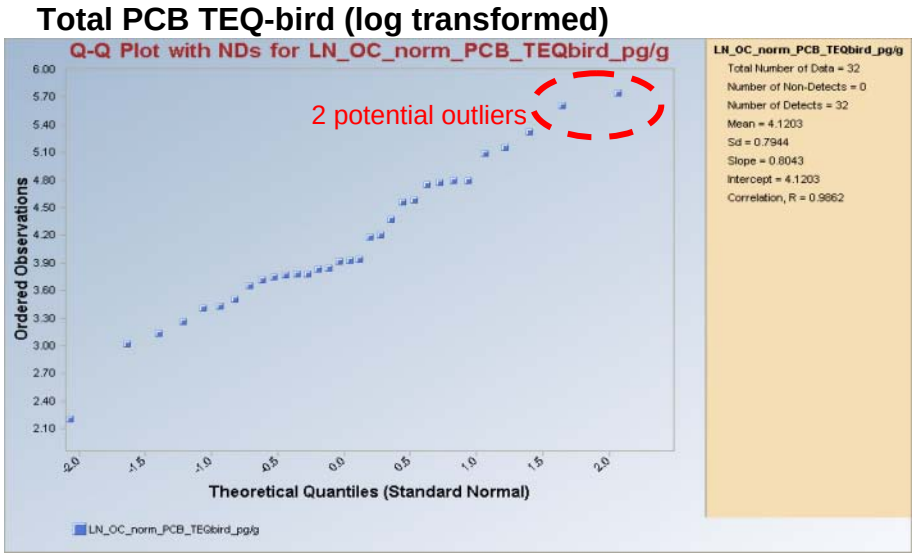
Quantile-Quantile Plots

(Nondetect values shown as red symbols at detection limit; log transformations applied to all non-normal data distributions)

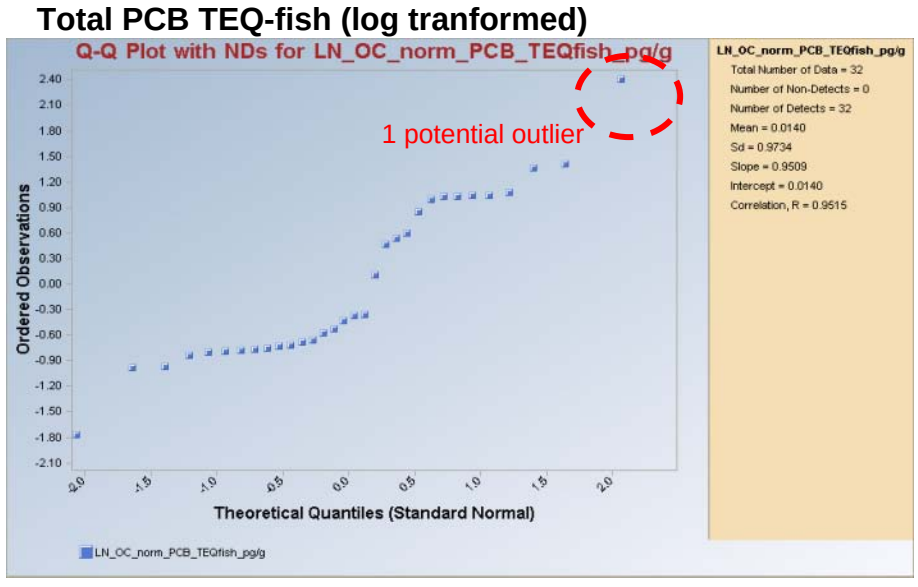
Total PCB Aroclors (log transformed)



Total PCB TEQ-bird (log transformed)



Total PCB TEQ-fish (log tranformed)



Total PCB TEQ-mammal

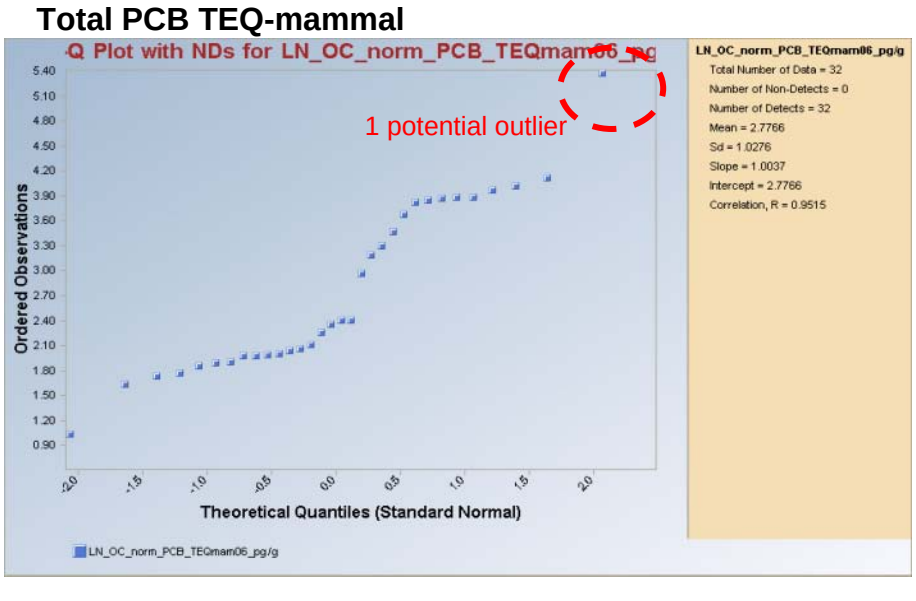
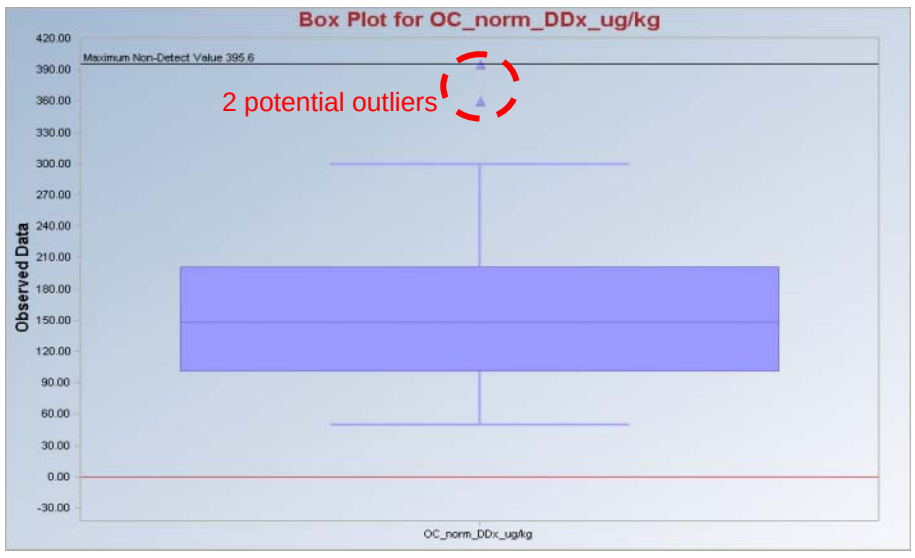


Figure 3b
Upriver Bedded Sediment
Box Plots and Quantile-Quantile Plots
PCB Aroclors and PCB TEQs
(OC-Normalized)

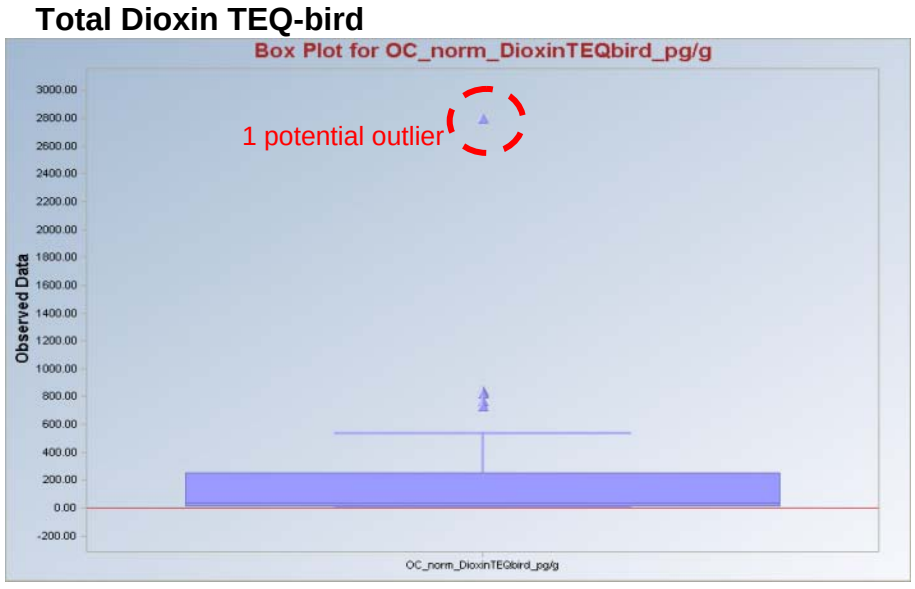
Box Plots

(Nondetect values shown at detection limit)

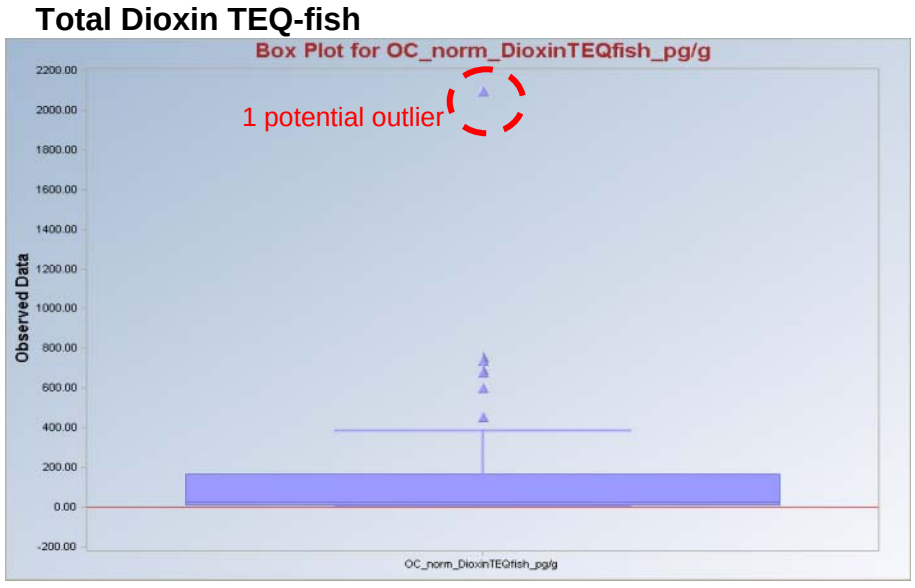
Total DDx



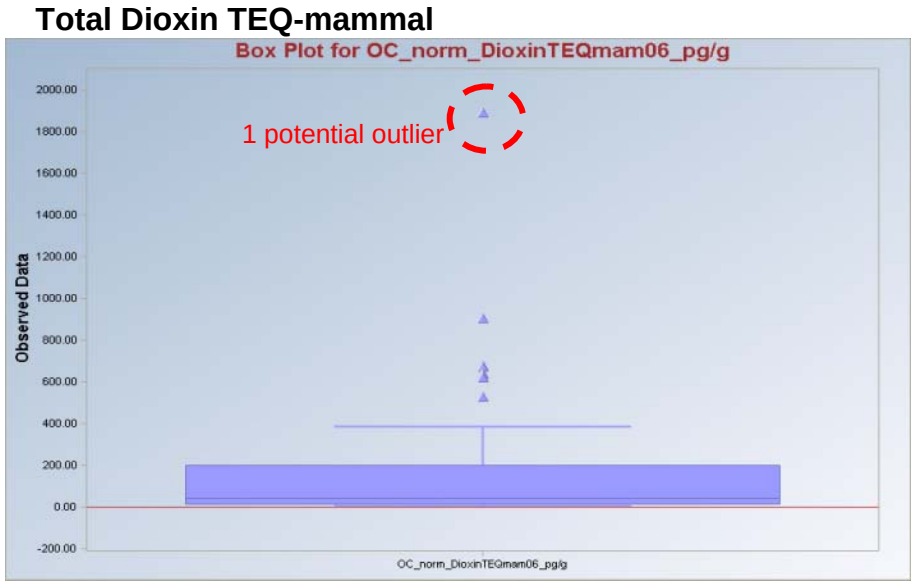
Total Dioxin TEQ-bird



Total Dioxin TEQ-fish



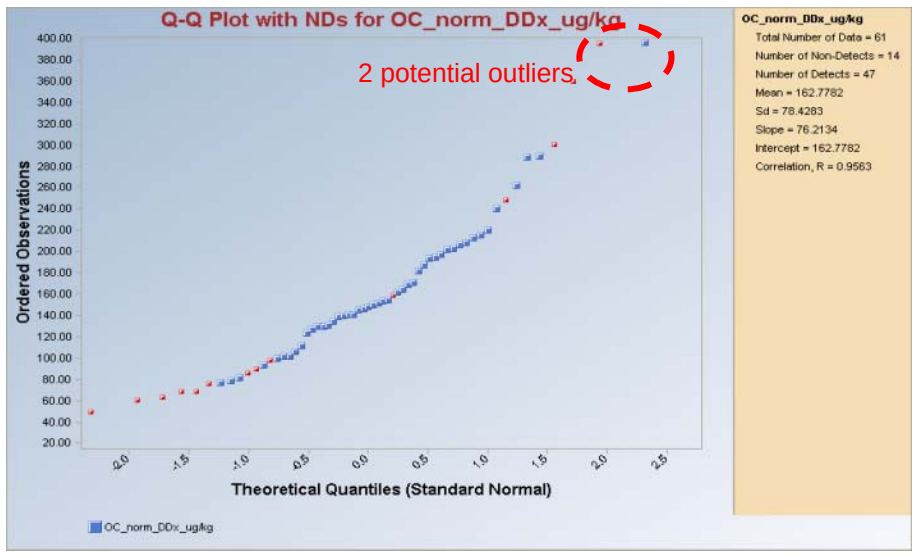
Total Dioxin TEQ-mammal



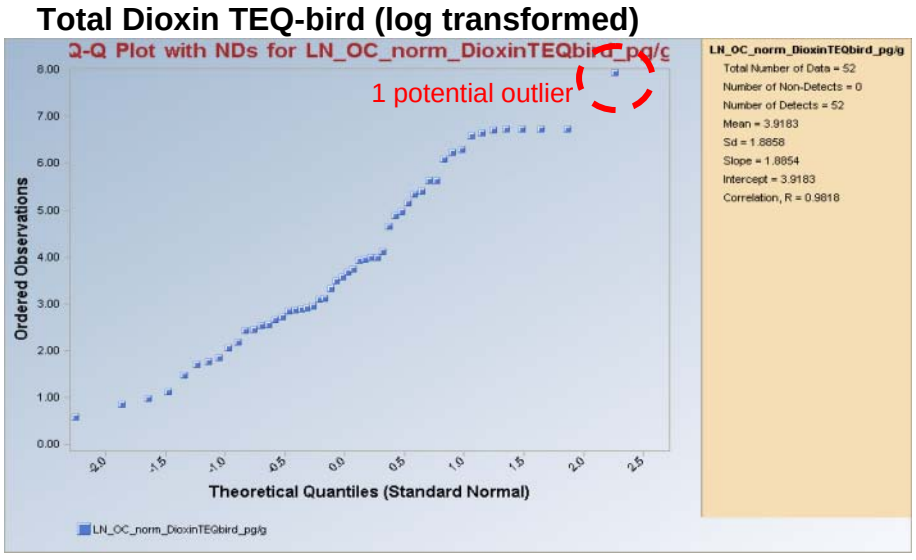
Quantile-Quantile Plots

(Nondetect values shown as red symbols at detection limit; log transformations applied to all non-normal data distributions)

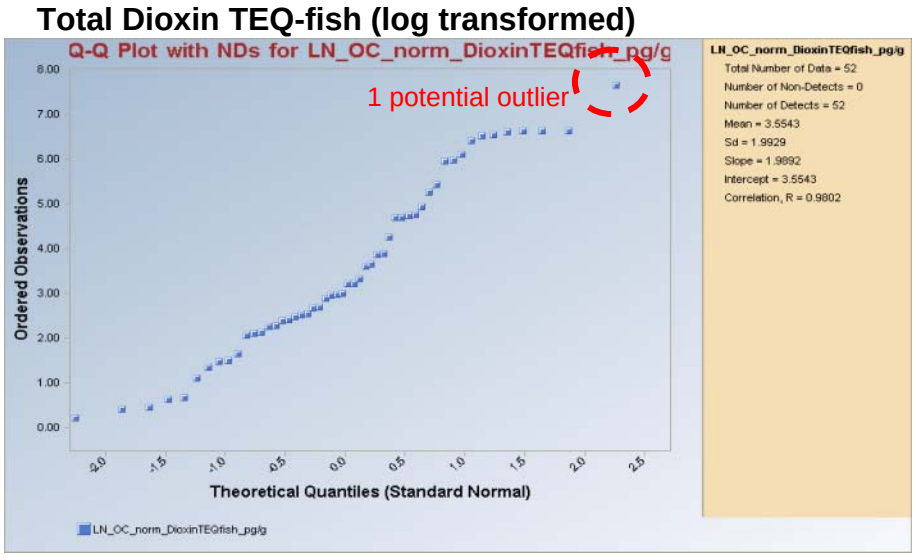
Total DDx



Total Dioxin TEQ-bird (log transformed)



Total Dioxin TEQ-fish (log transformed)



Total Dioxin TEQ-mammal (log transformed)

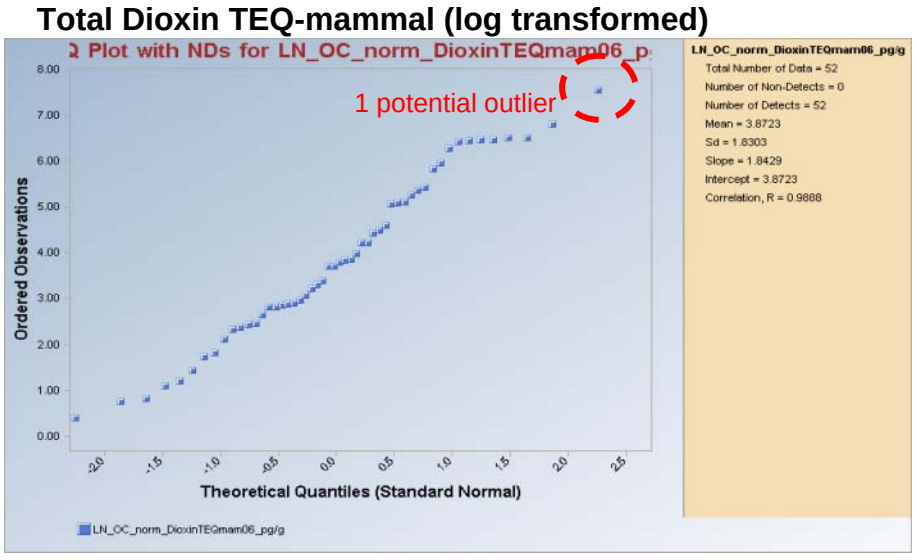
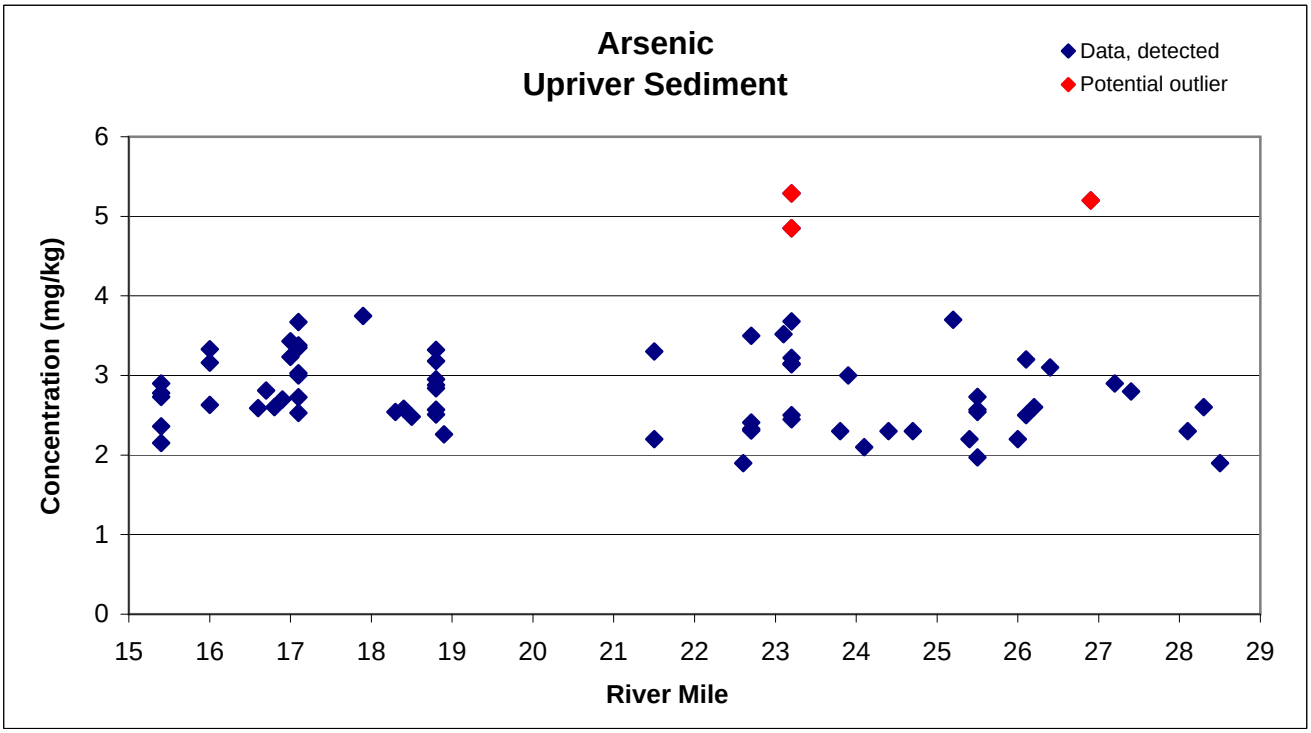


Figure 3c
Upriver Bedded Sediment
Box Plots and Quantile-Quantile Plots
Total DDx and Dioxin TEQs
(OC-Normalized)



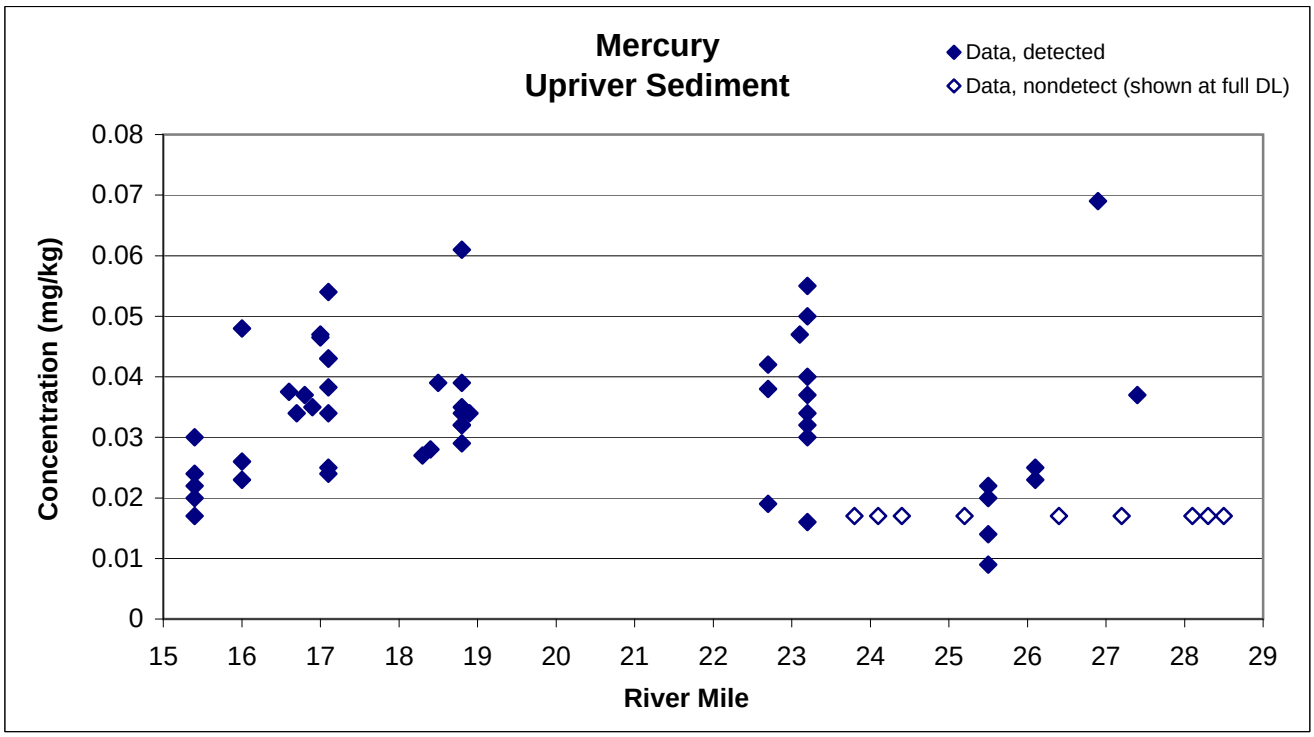
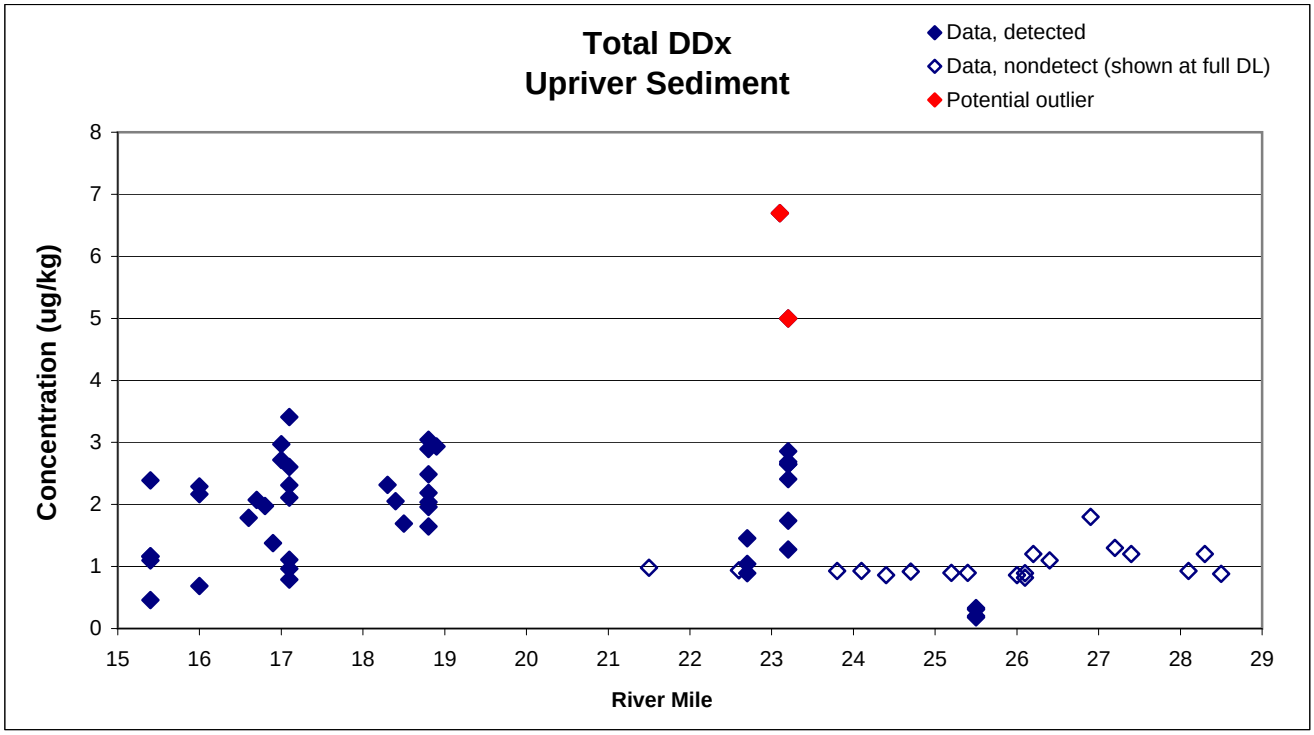


Figure 4a
Upriver Bedded Sediment
Scatter Plot
Arsenic and Mercury
(Dry Weight)



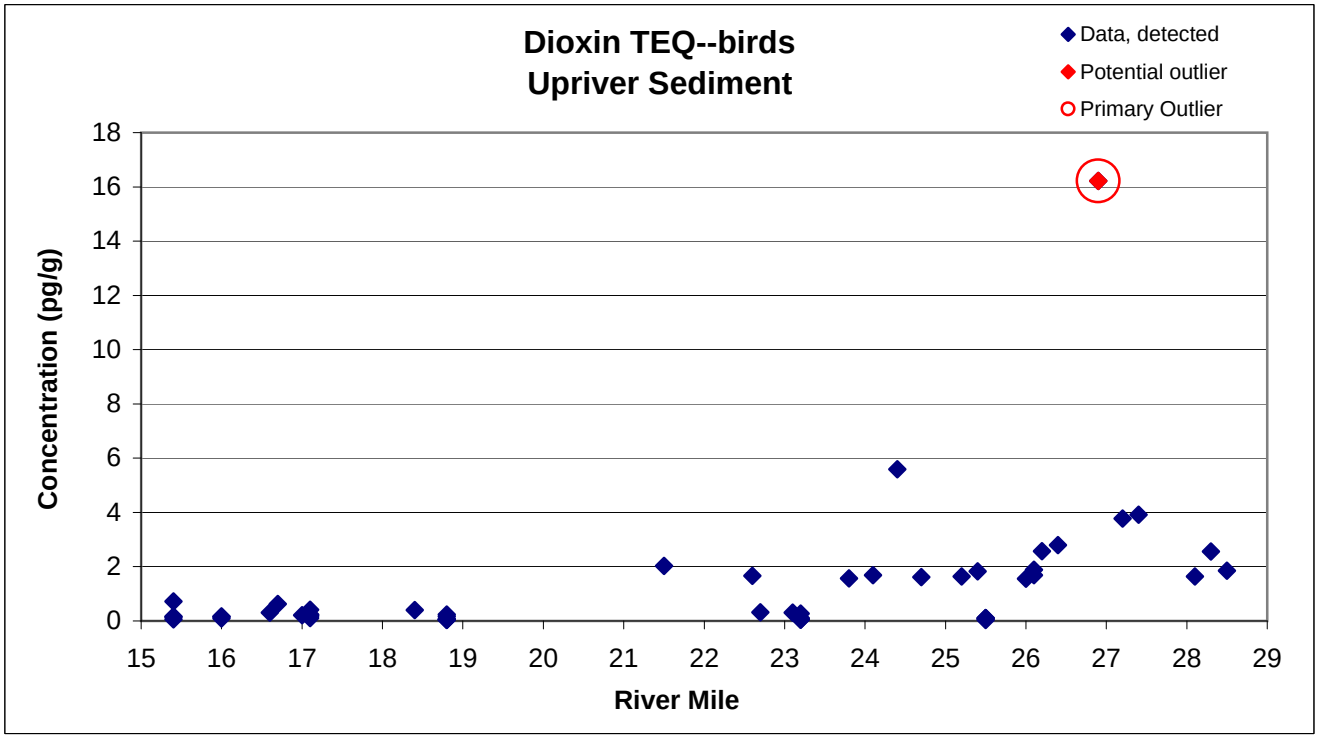
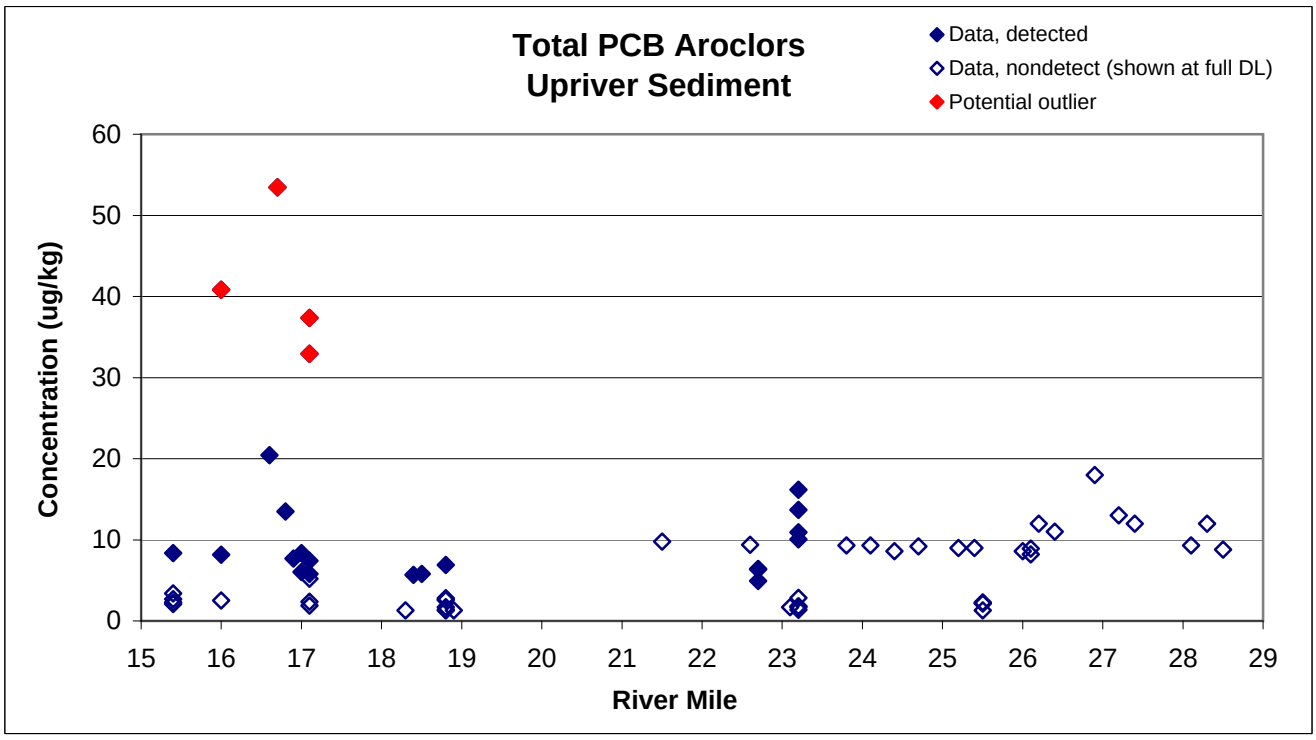


Figure 4d
Upriver Bedded Sediment
Scatter Plot
Total DDx and Total Dioxin TEQ-bird
(Dry Weight)



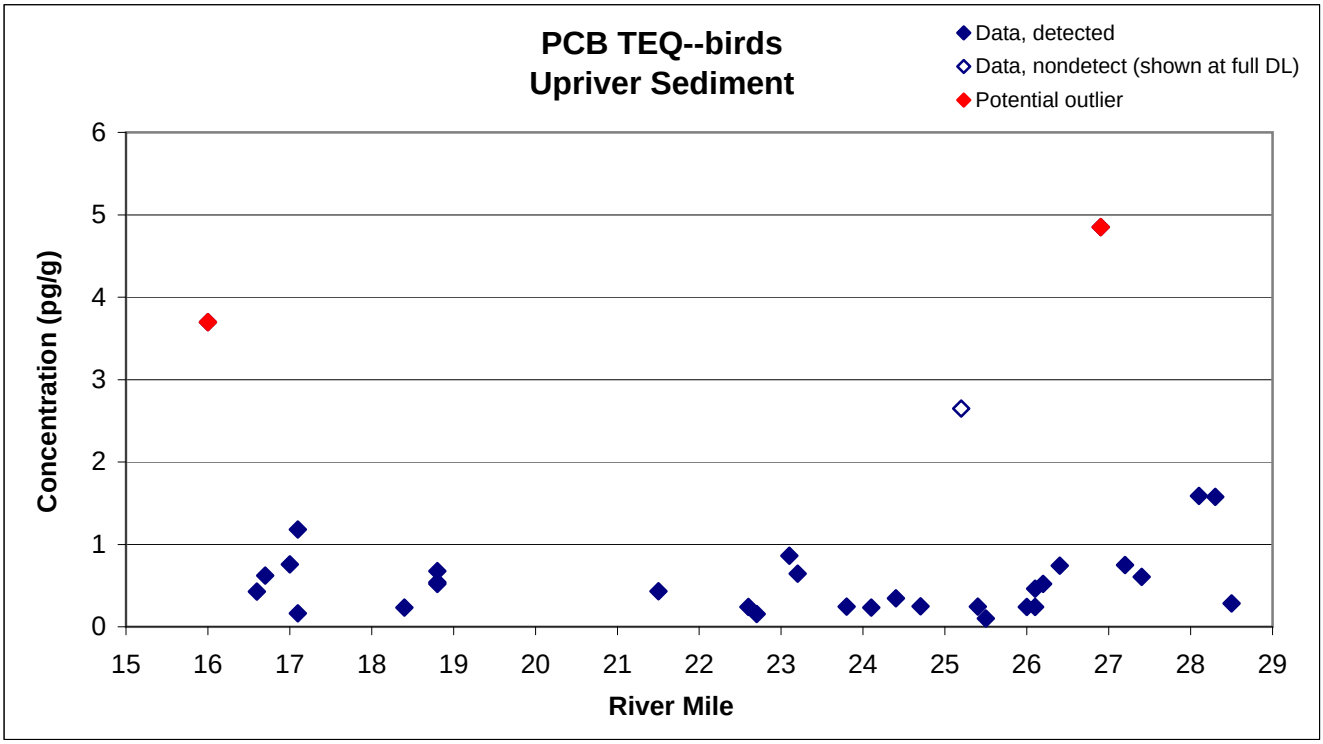
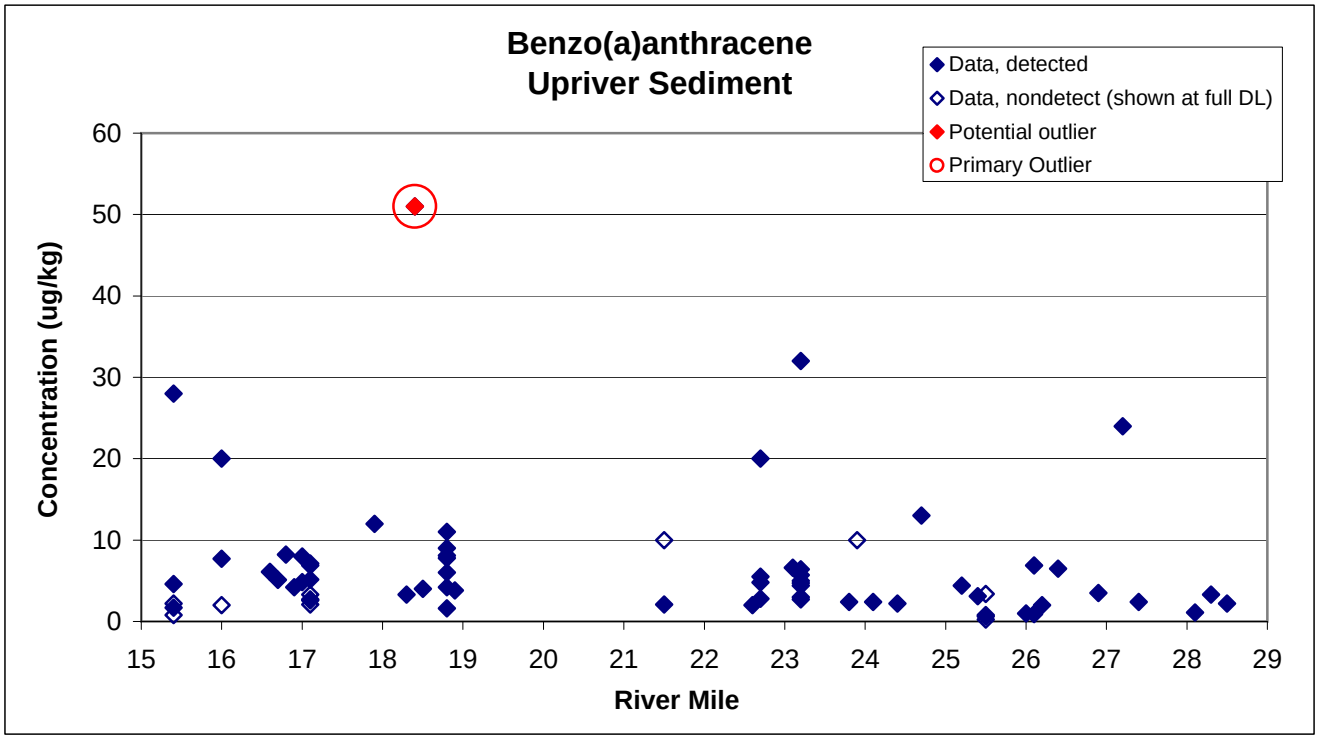


Figure 4g
Upriver Bedded Sediment
Scatter Plot
Total PCB Aroclors and Total PCB TEQ-bird



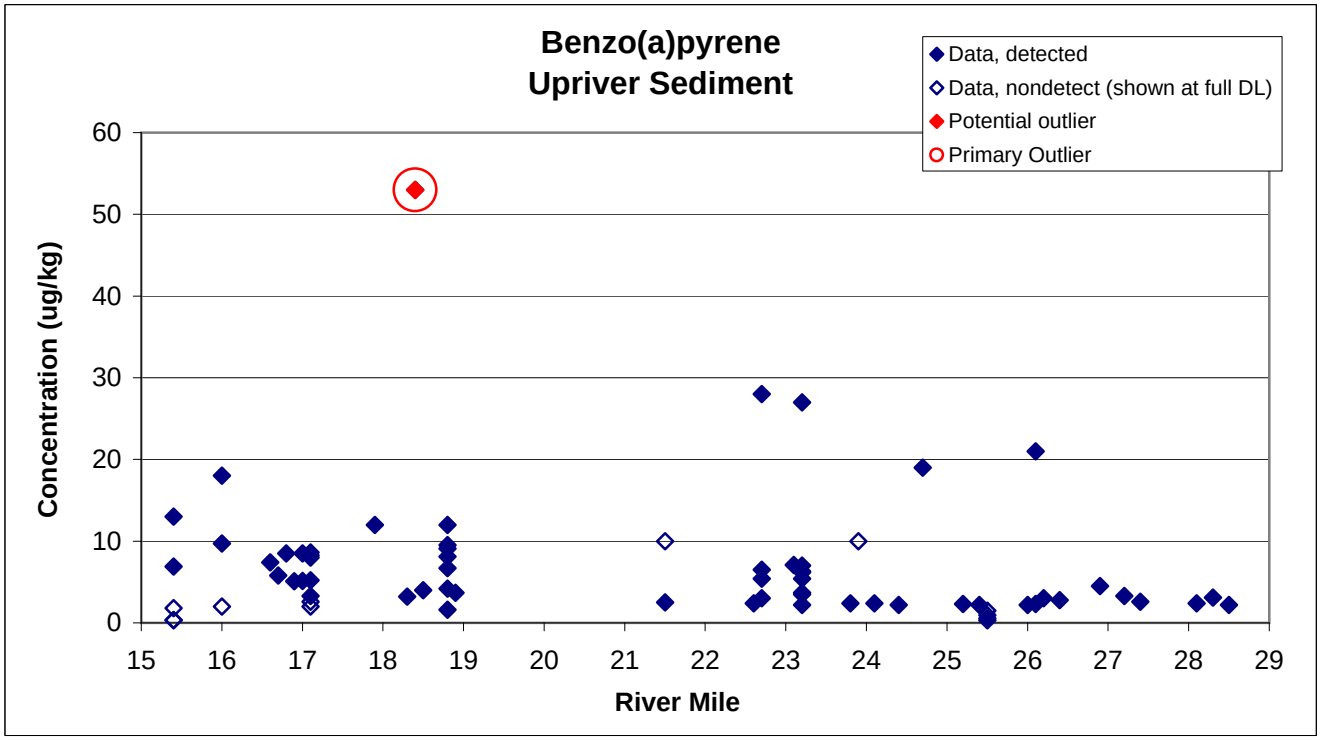
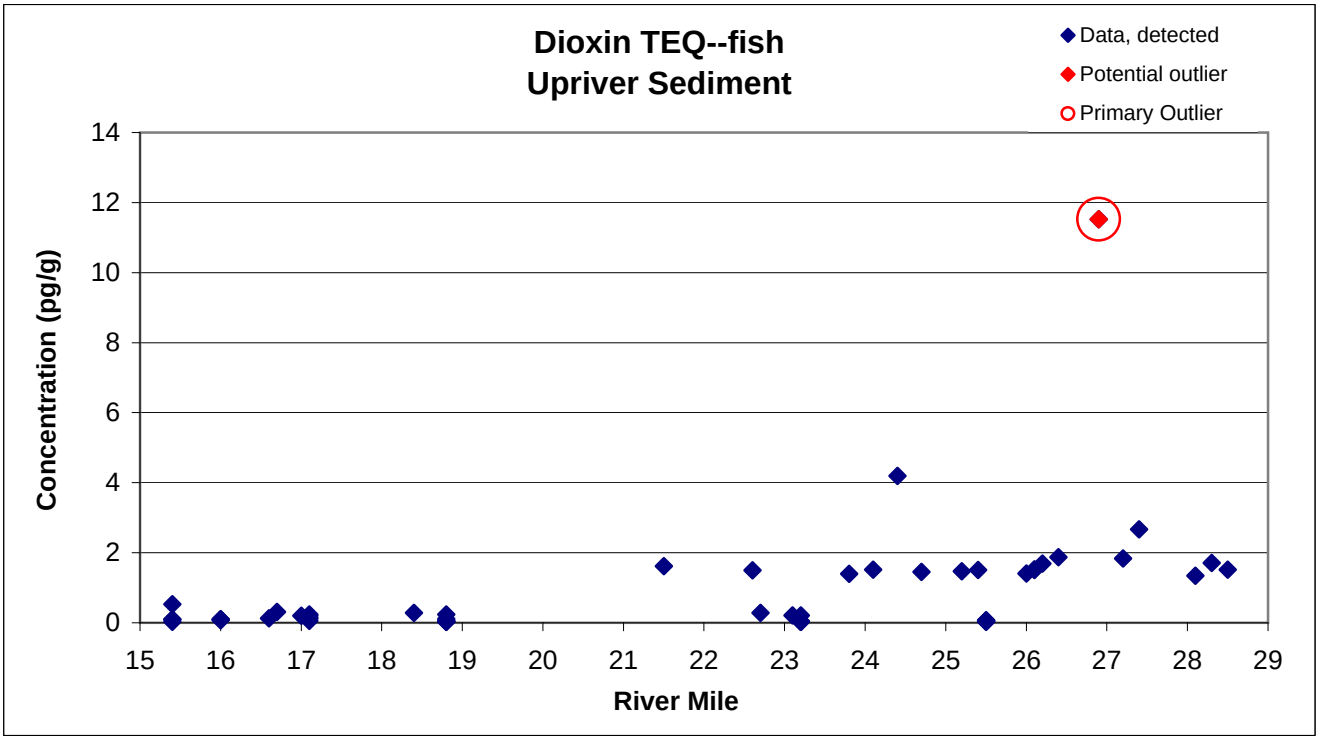


Figure 4b
Upriver Bedded Sediment
Scatter Plot
Benzo(a)anthracene and Benzo(a)pyrene
(Dry Weight)



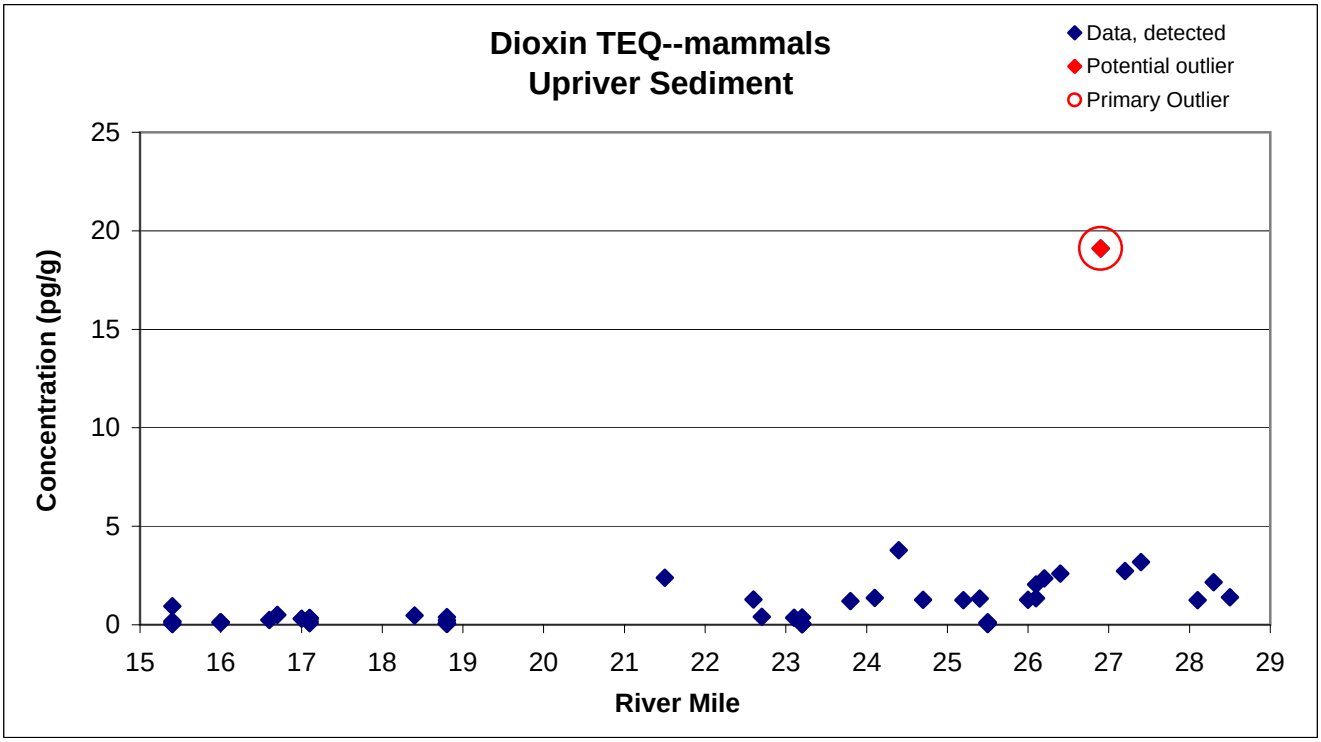
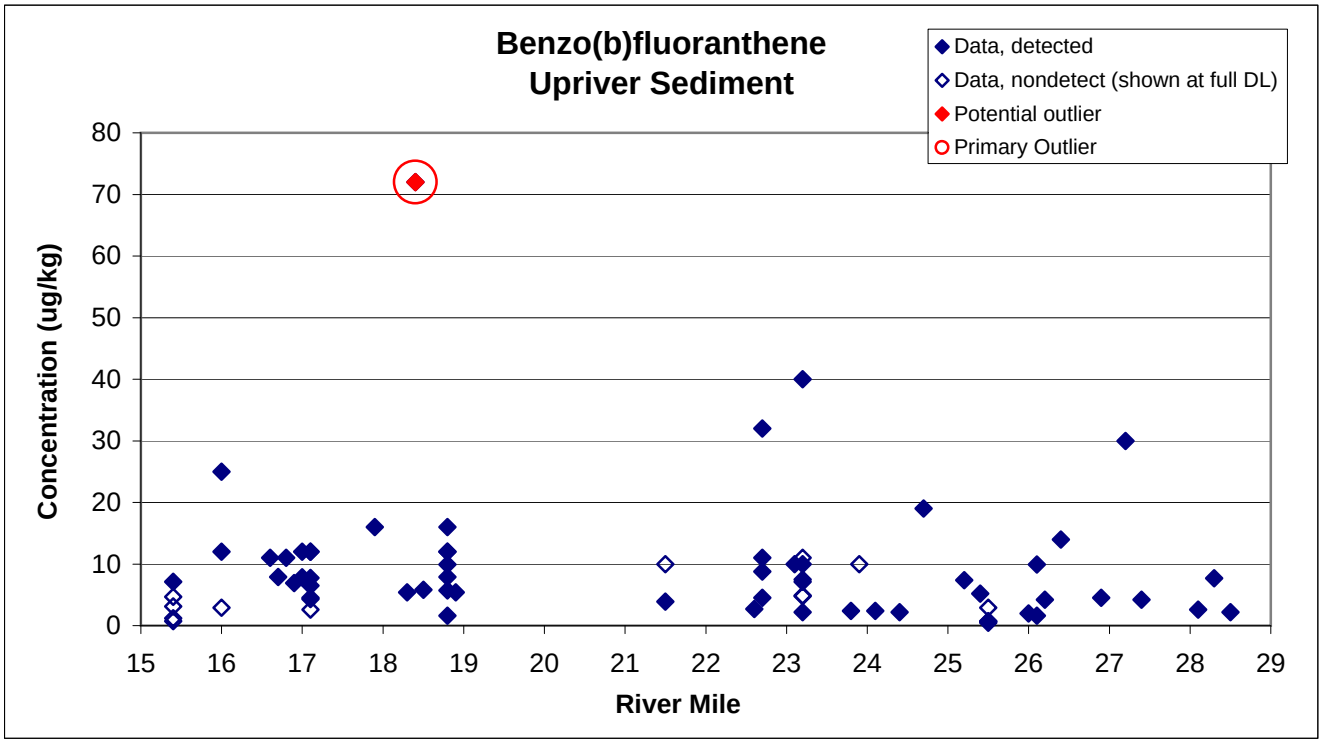


Figure 4e
Upriver Bedded Sediment
Scatter Plot
Total Dioxin TEQ-fish and TEQ-mammal
(Dry Weight)



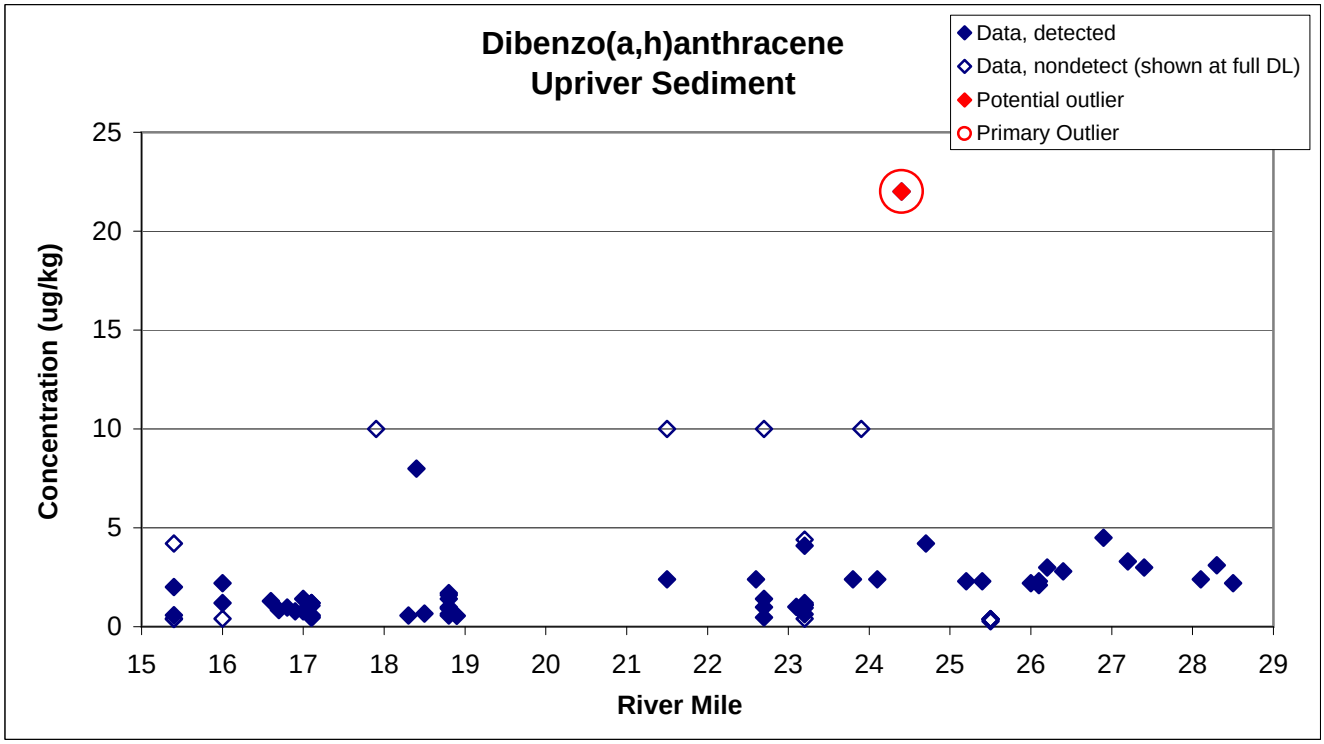
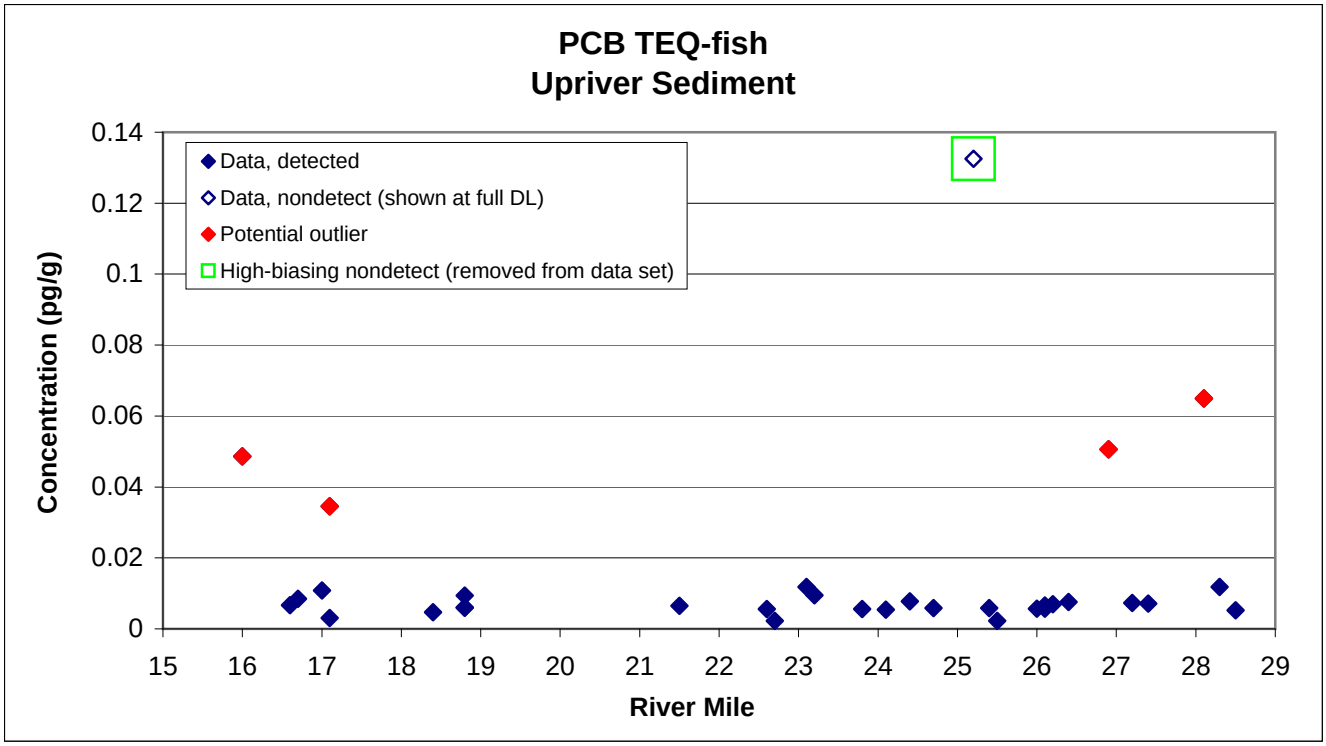


Figure 4c
Upriver Bedded Sediment
Scatter Plot
Benzo(b)flouranthene and
Dibenzo(a,h)anthracene



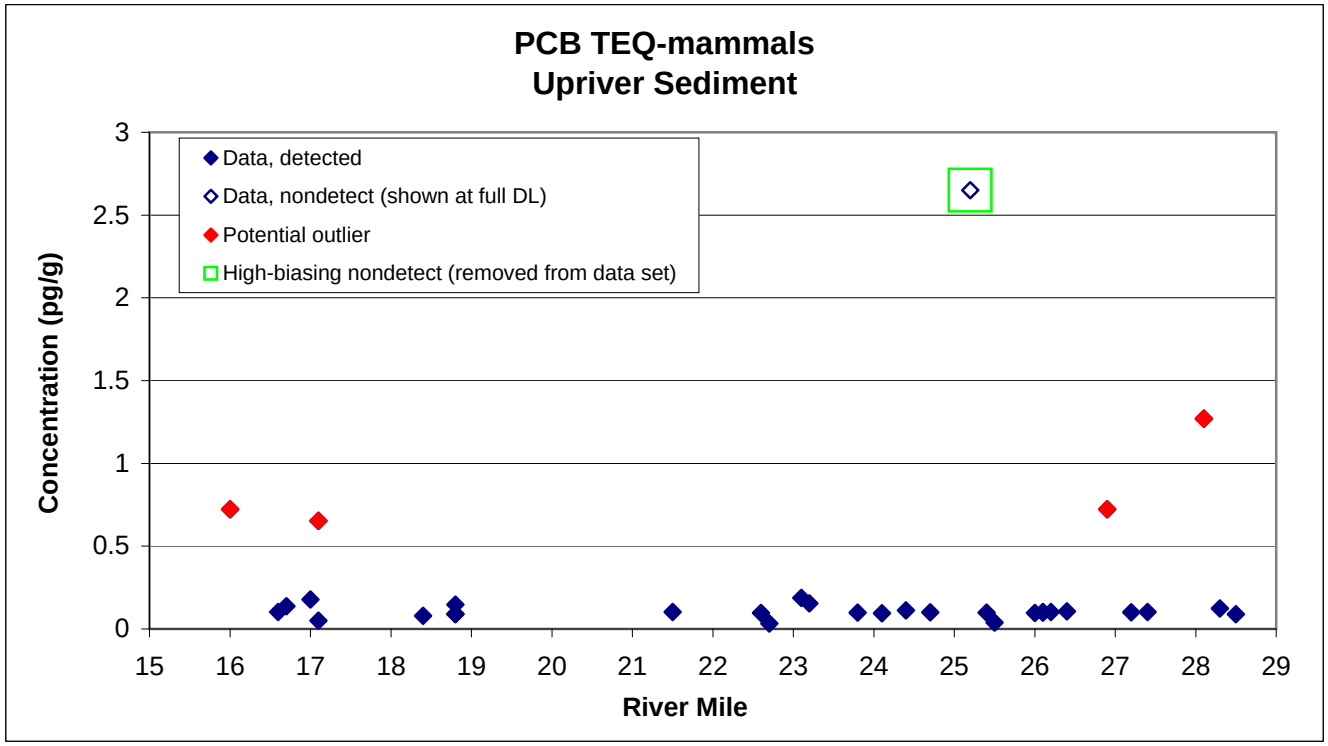
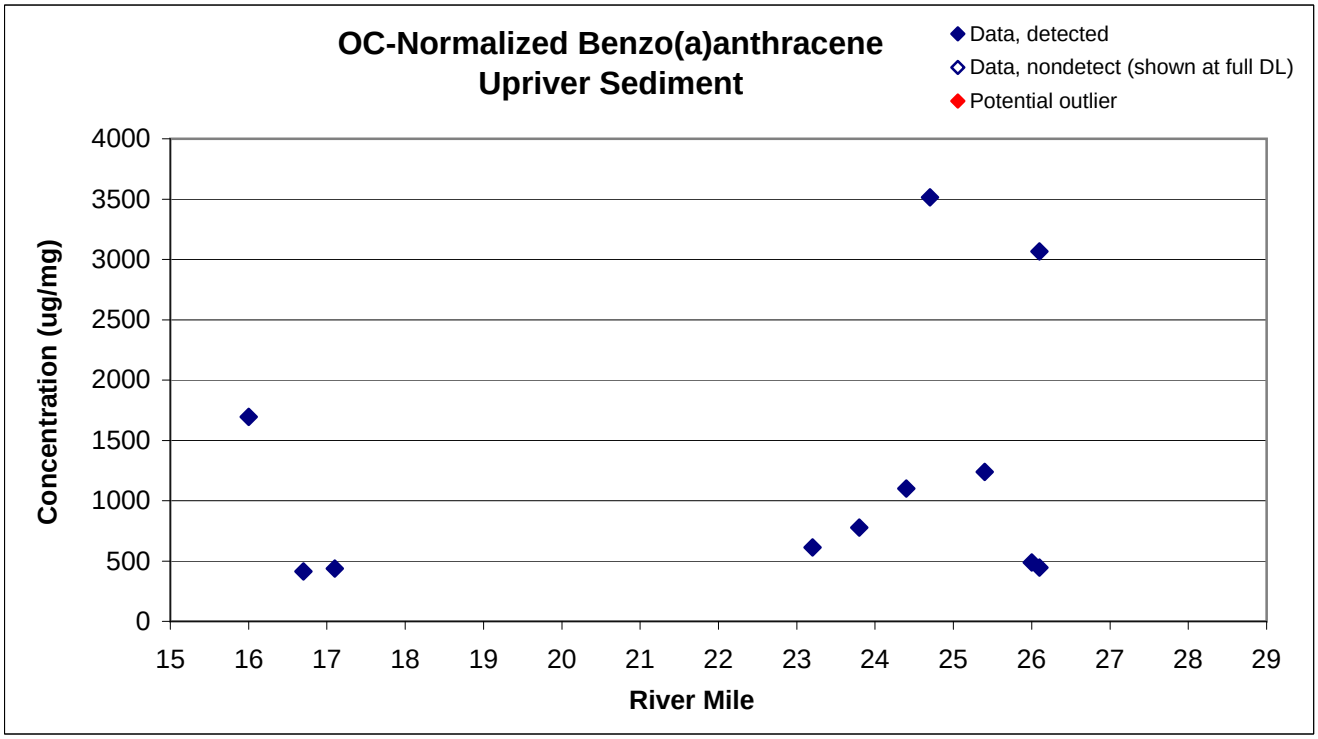


Figure 4f
Upriver Bedded Sediment
Scatter Plot
Total PCB TEQ-fish and TEQ-mammal
(Dry Weight)



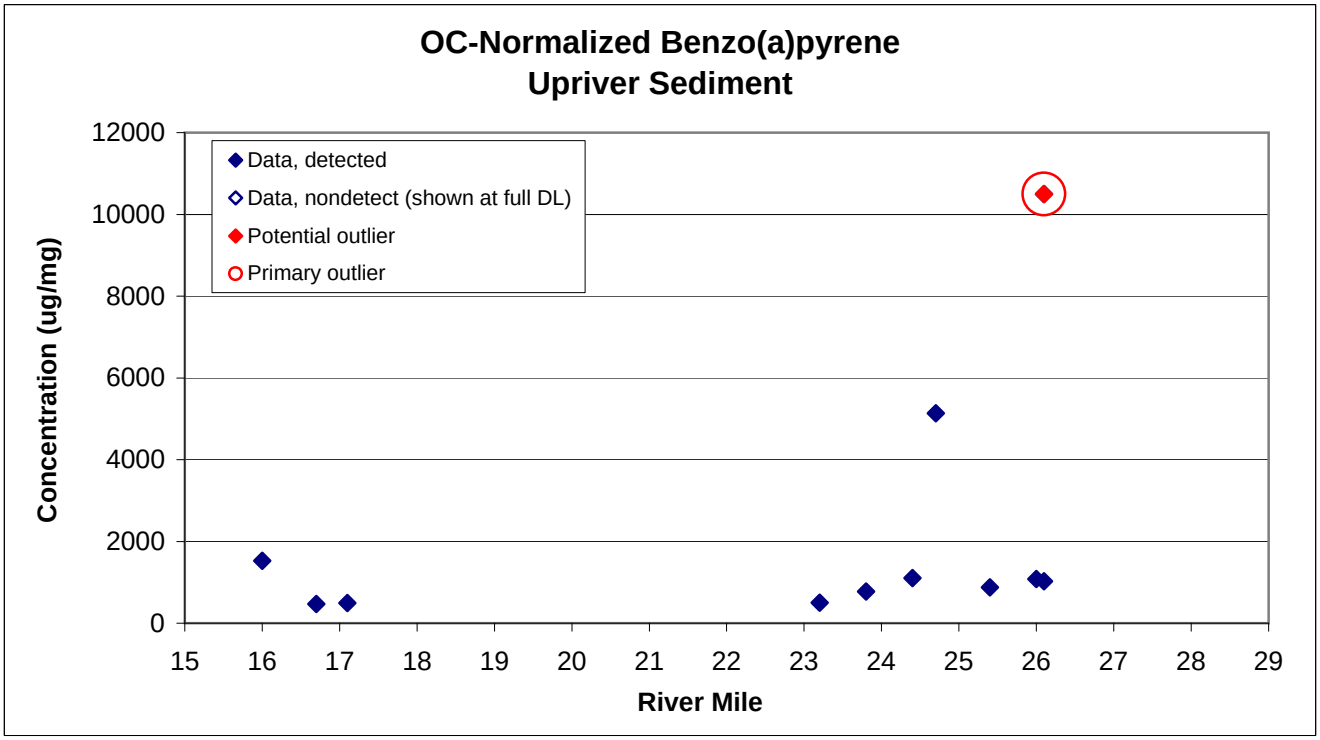
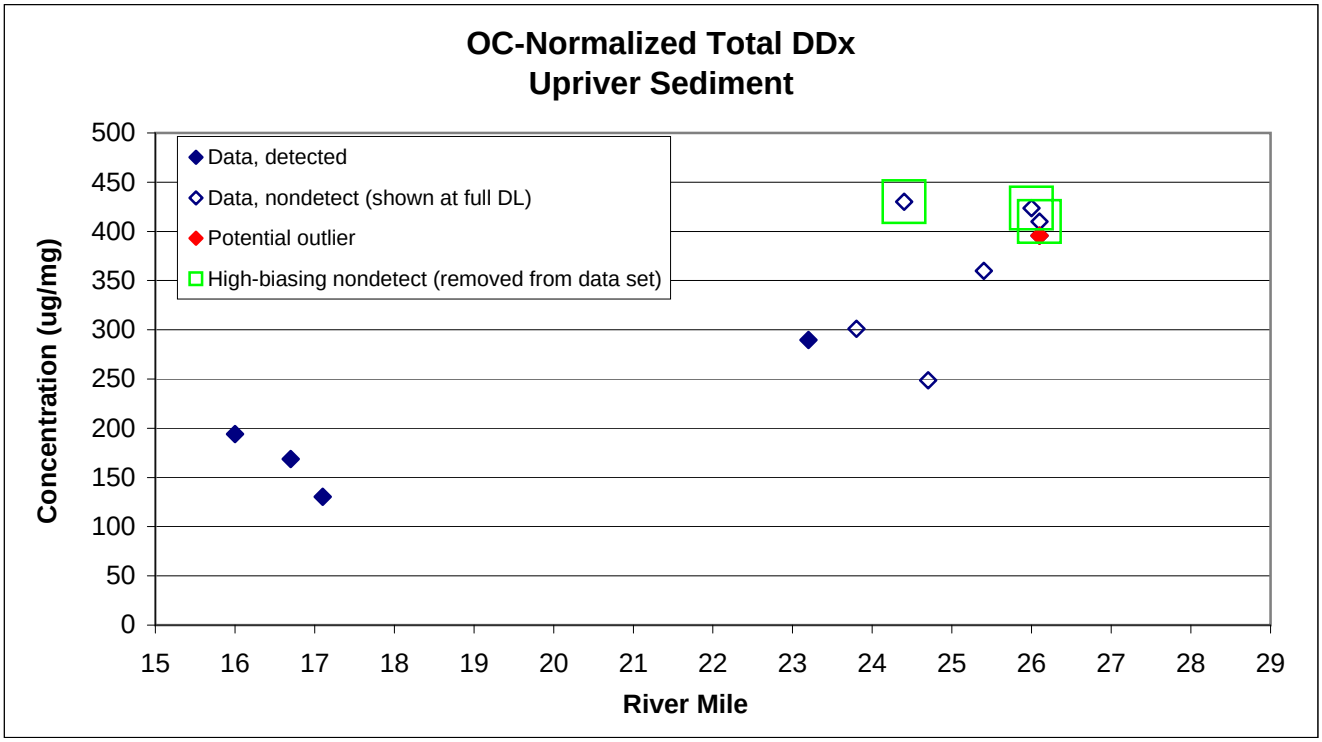


Figure 5a
Upriver Bedded Sediment
Scatter Plot
Benzo(a)anthracene and Benzo(a)pyrene
(OC-normalized)



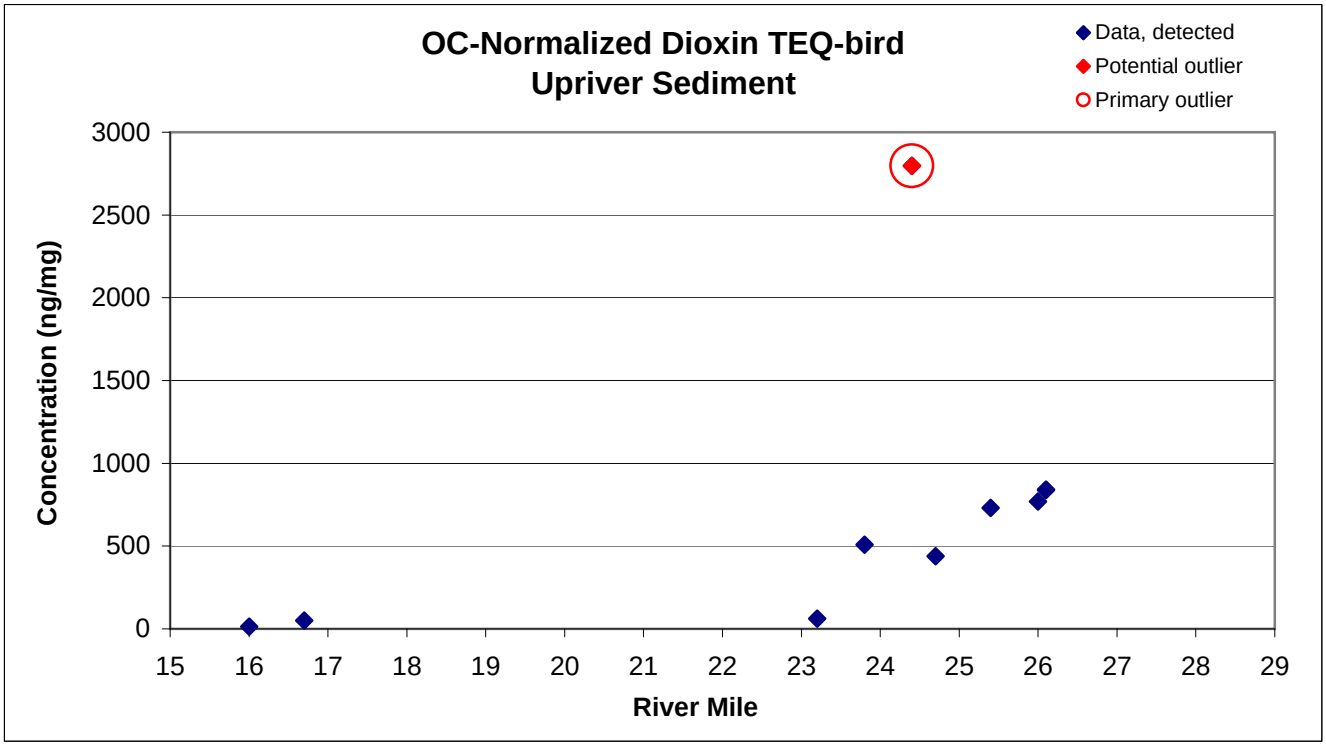
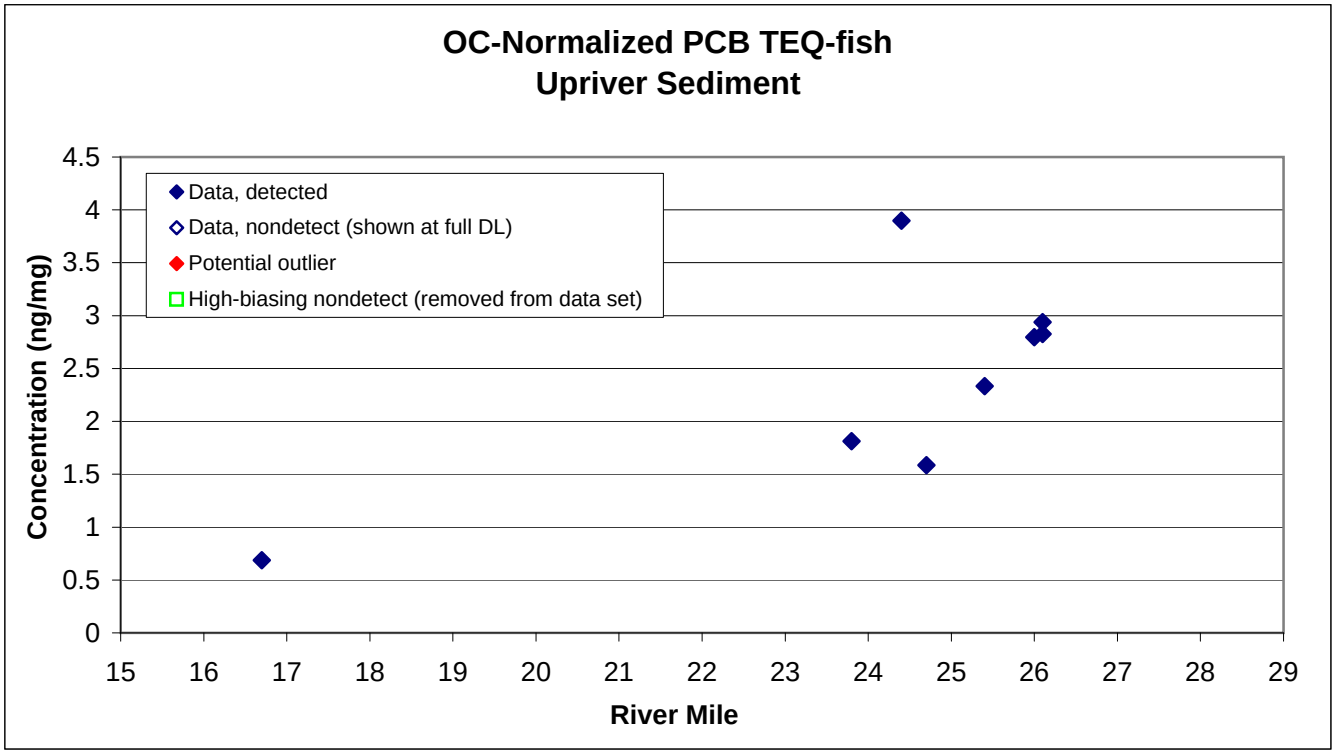


Figure 5c
Upriver Bedded Sediment
Scatter Plot
Total DDx and Total Dioxin TEQ-bird
(OC-normalized)



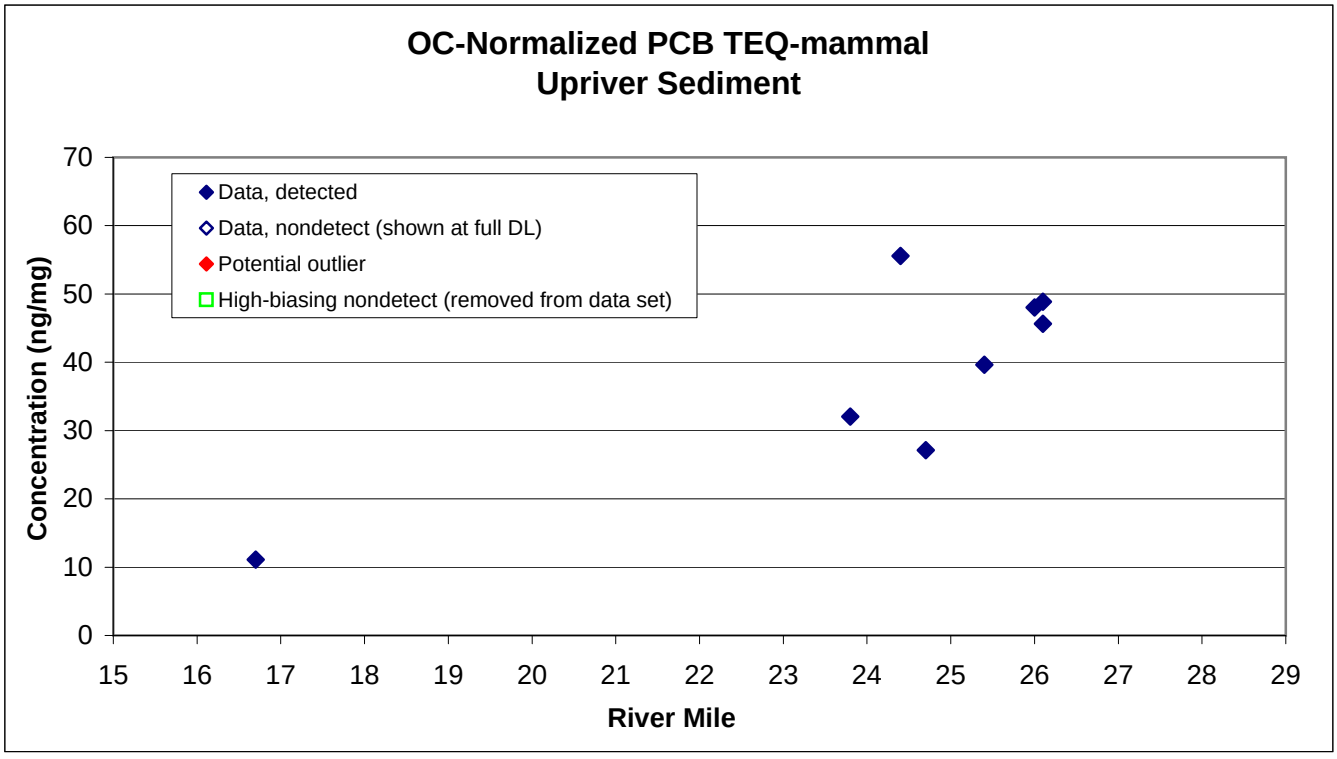
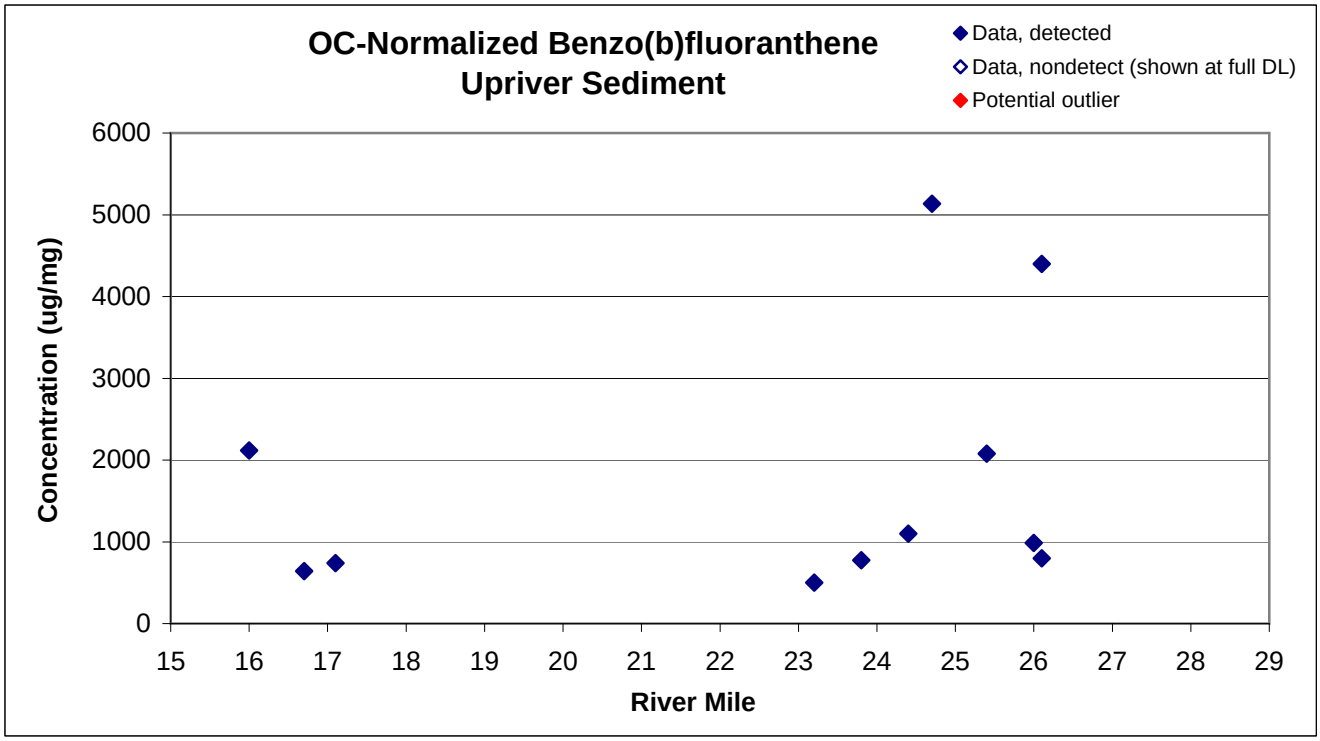


Figure 5f
Upriver Bedded Sediment
Scatter Plot
Total PCB TEQ-fish and TEQ-mammal
(OC-normalized)



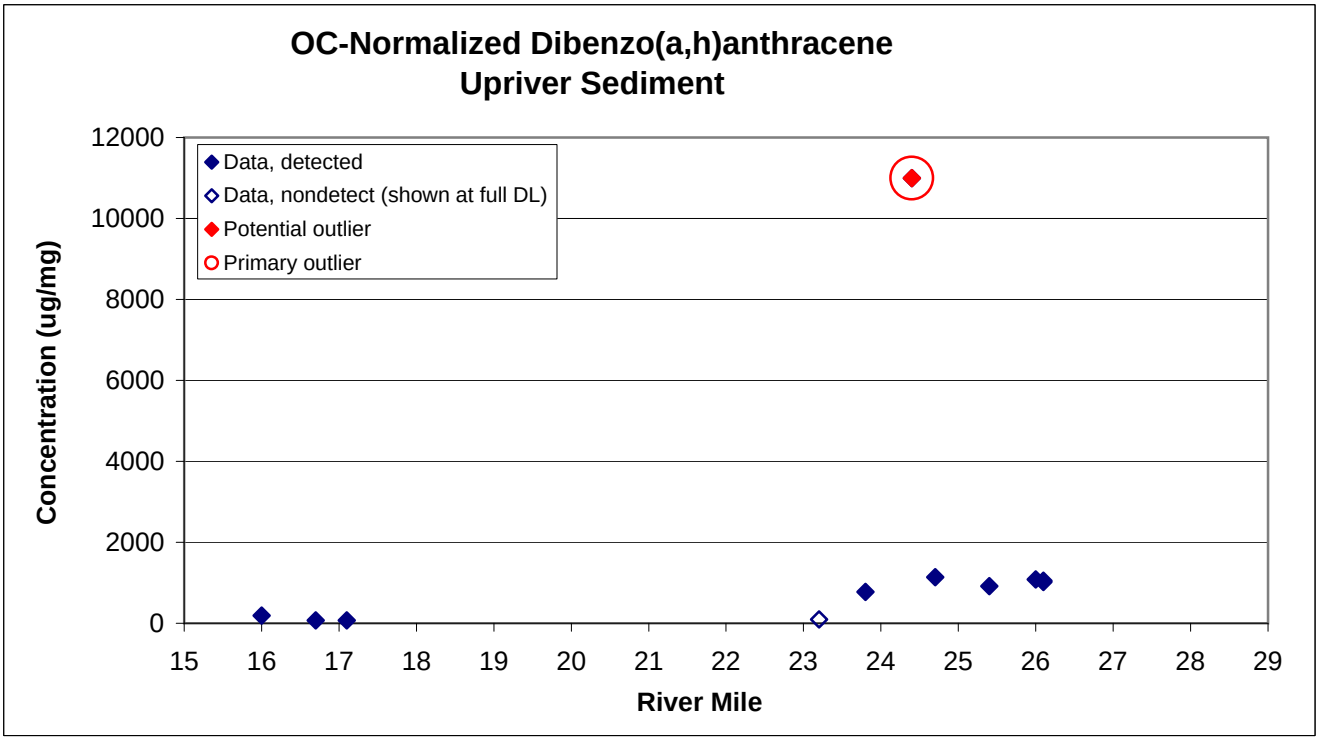
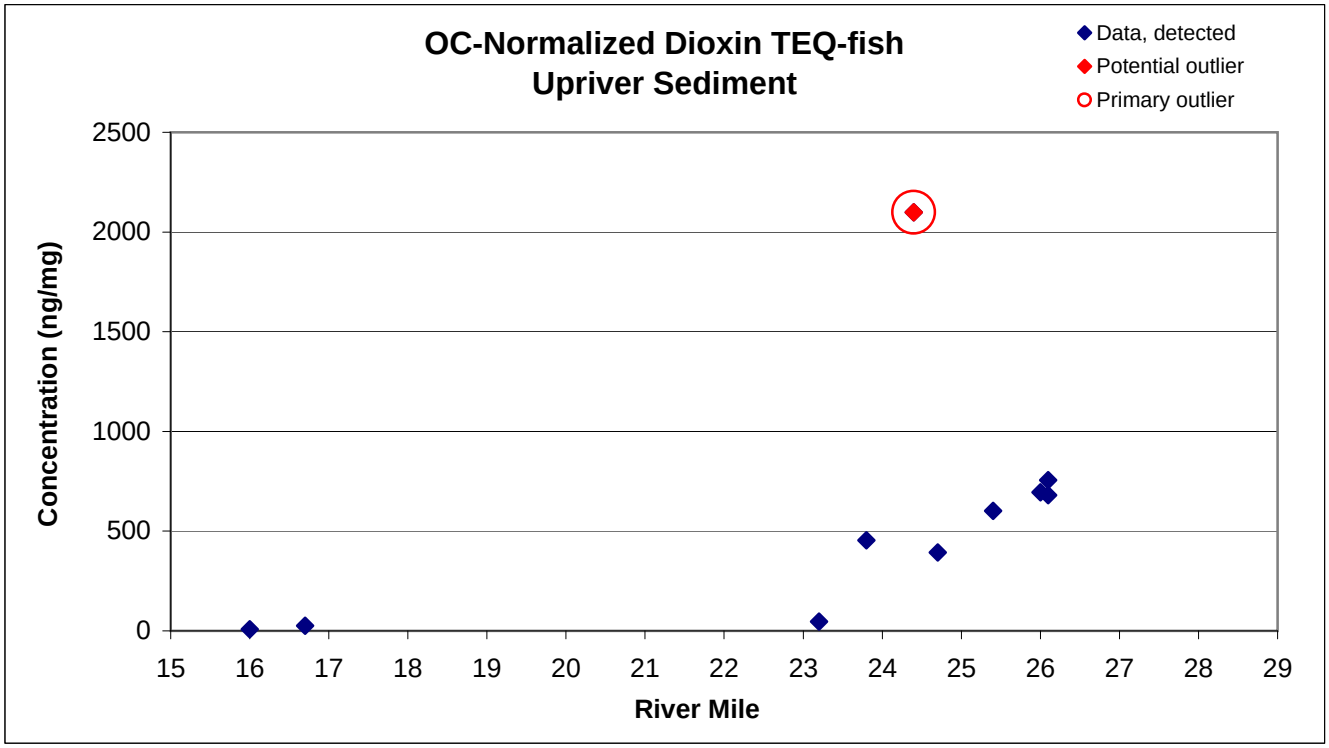


Figure 5b
Upriver Bedded Sediment
Scatter Plot
Benzo(b)flouranthene and Dibenzo(a,h)anthracene
(OC-Normalized)



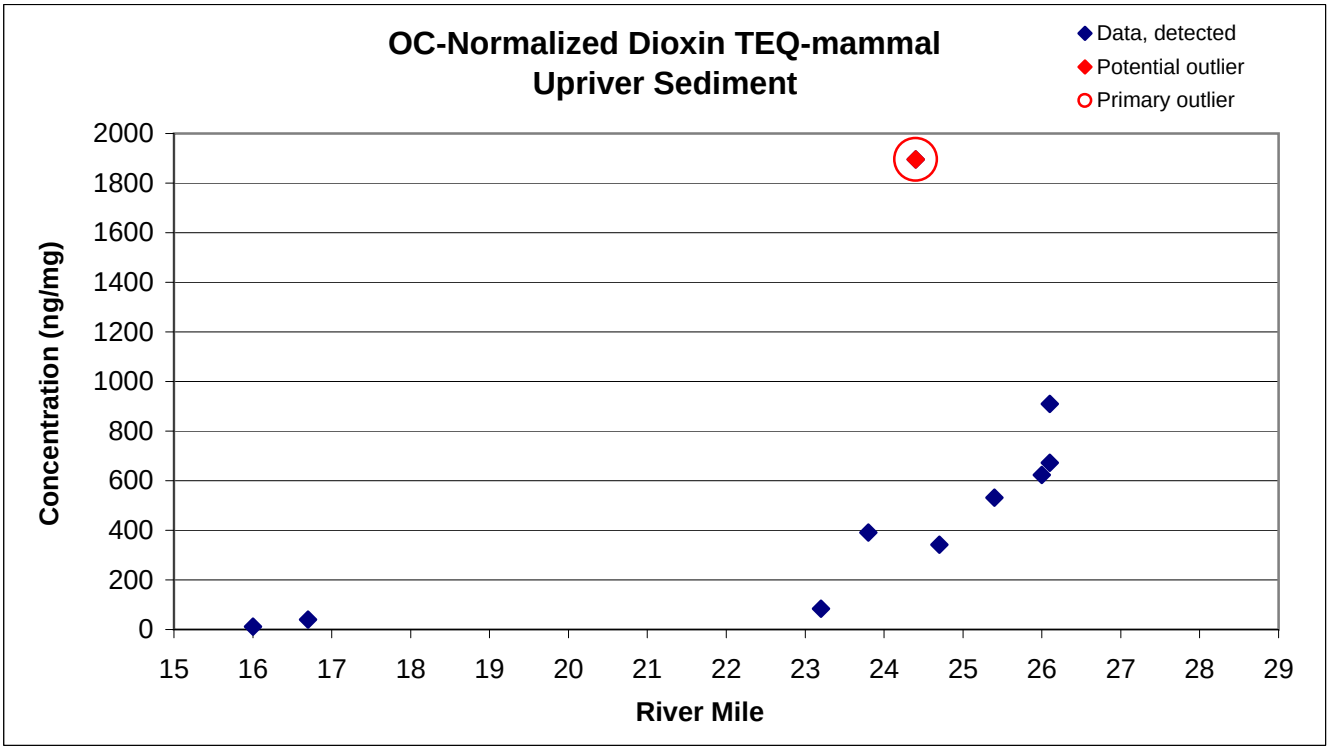
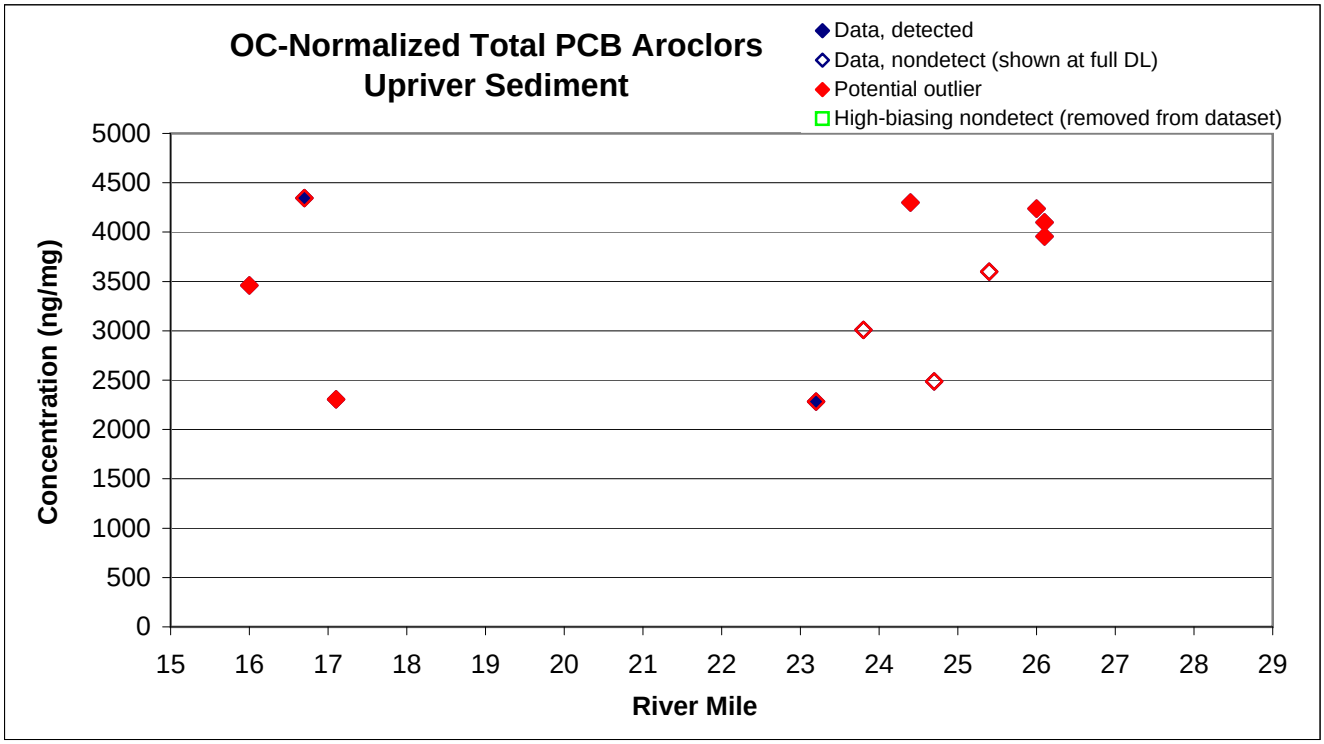


Figure 5d
Upriver Bedded Sediment
Scatter Plot
Total Dioxin TEQ-fish and TEQ-mammal
(OC-normalized)



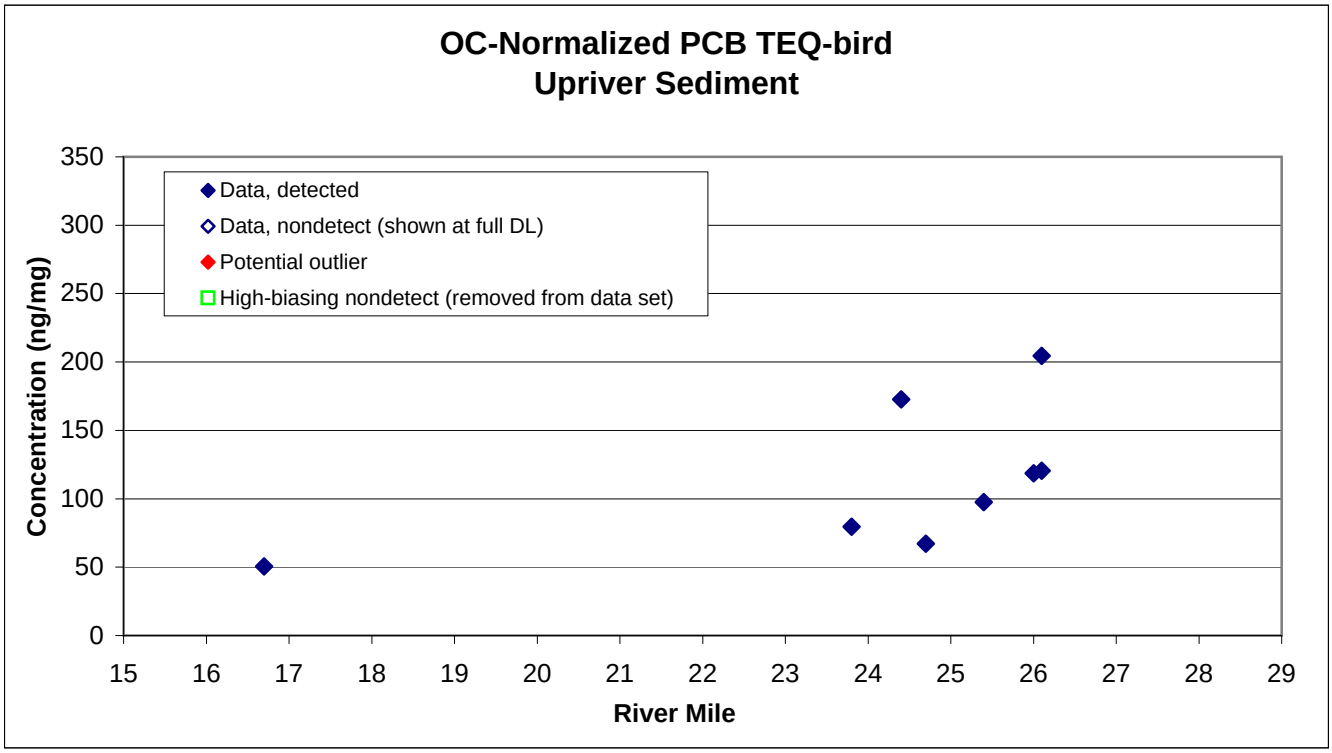


Figure 5e
Upriver Bedded Sediment
Scatter Plot
Total PCB Aroclors and Total PCB TEQ-bird
(OC-normalized)

TABLES

Table 1. Upriver Surface Sediment Summary Statistics, Dry Weight Concentrations

		Pre-Processing	Sample Counts				Distribution	Outliers		Full Data Set				Detected Values Only			
Analyte	**Units**	Num High-Biasing NDs Removed Prior to Analysis	NumObs	Num Ds	NumNDs	% NDs	(ND = ROS)	Outlier Identification Method	Num Outliers Excluded	Minimum	Maximum	Mean	Median	Minimum	Maximum	Mean	Median
All Data																	
Arsenic	mg/kg	0	71	71	0	0%	Lognormal or Approximate Gamma	--	0	1.90	5.29	2.87	2.73	1.9	5.29	2.87	2.73
Mercury	mg/kg	0	61	52	9	14.8%	Normal	--	0	0.009	0.069	0.031	0.032	0.009	0.069	0.0338	0.034
Benzo(a)anthracene	ug/kg	0	71	58	13	18.3%	Lognormal	--	0	0.24	51	6.61	4.40	0.61	51	7.31	4.825
Benzo(a)pyrene	ug/kg	0	71	59	12	16.9%	Lognormal	--	0	0.33	53	6.72	4.20	0.53	53	7.48	5.20
Benzo(b)fluoranthene	ug/kg	0	71	56	15	21.1%	Lognormal	--	0	0.45	72	9.01	6.90	0.45	72	10.3	7.60
Dibenzo(a,h)anthracene	ug/kg	0	71	55	16	22.5%	Lognormal	--	0	0.28	22	2.41	1.20	0.47	22	2.15	1.40
Total DDTs	ug/kg	0	67	47	20	29.9%	Normal	--	0	0.18	6.70	1.71	1.38	0.20	6.70	2.02	2.05
Total PCB Aroclors	ug/kg	0	67	23	44	65.7%	Nonparametric	--	0	1.30	53.5	8.77	7.42	4.95	53.5	14.7	8.35
Dioxin TEQ - Birds	pg/kg	0	52	52	0	0%	Nonparametric	--	0	0.031	16.2	1.24	0.288	0.031	16.2	1.24	0.288
Dioxin TEQ - Fish	pg/kg	0	52	52	0	0%	Nonparametric	--	0	0.023	11.5	0.914	0.210	0.023	11.5	0.914	0.210
Dioxin TEQ - Mammals	pg/kg	0	52	52	0	0%	Nonparametric	--	0	0.033	19.1	1.16	0.356	0.033	19.1	1.159	0.356
PCB TEQ - Birds	pg/kg	0	33	32	1	3.0%	Lognormal	--	0	0.103	4.85	0.821	0.521	0.103	4.9	0.763	0.49
PCB TEQ - Fish	pg/kg	1	32	32	0	0%	Nonparametric	--	0	0.002	0.065	0.012	0.007	0.002	0.065	0.012	0.007
PCB TEQ - Mammals	pg/kg	1	32	32	0	0%	Nonparametric	--	0	0.033	1.27	0.196	0.102	0.033	1.27	0.196	0.102
Potential Outliers Excluded																	
Arsenic	mg/kg	0	68	68	0	0%	Lognormal or Gamma	Graphical	3	1.90	3.75	2.77	2.71	1.90	3.75	2.77	2.71
Mercury	mg/kg	0	61	52	9	14.8%	Normal	Graphical	0	0.009	0.069	0.0313	0.032	0.009	0.069	0.0338	0.034
Mercury	mg/kg	0	61	52	9	14.8%	Normal	Rosner	0	0.009	0.069	0.0313	0.032	0.009	0.069	0.0338	0.034
Benzo(a)anthracene	ug/kg	0	70	57	13	18.6%	Lognormal	Graphical	1	0.24	32	5.97	4.30	0.61	32	6.54	4.80
Benzo(a)pyrene	ug/kg	0	70	58	12	17.1%	Lognormal	Graphical	1	0.33	28	6.06	4.10	0.53	28	6.70	5.18
Benzo(b)fluoranthene	ug/kg	0	70	55	15	21.4%	Lognormal	Graphical	1	0.45	40	8.11	6.70	0.45	40	9.14	7.50
Dibenzo(a,h)anthracene	ug/kg	0	70	54	16	22.9%	Lognormal	Graphical	1	0.28	10	2.13	1.20	0.47	8	1.79	1.35
Total DDTs	ug/kg	0	65	45	20	30.8%	Nonparametric	Graphical	2	0.18	3.41	1.59	1.30	0.2	3.41	1.85	2.04
Total DDTs	ug/kg	0	65	45	20	30.8%	Nonparametric	Rosner	2	0.18	3.41	1.59	1.30	0.2	3.41	1.85	2.04
Total PCB Aroclors	ug/kg	0	63	19	44	69.8%	Nonparametric	Graphical	4	1.3	20.5	6.72	6.40	4.95	20.5	9.10	7.70
Dioxin TEQ - Birds	pg/kg	0	51	51	0	0%	Nonparametric	Graphical	1	0.031	5.60	0.945	0.273	0.031	5.60	0.945	0.273
Dioxin TEQ - Fish	pg/kg	0	51	51	0	0%	Nonparametric	Graphical	1	0.023	4.20	0.706	0.208	0.023	4.20	0.706	0.208
Dioxin TEQ - Mammals	pg/kg	0	51	51	0	0%	Nonparametric	Graphical	1	0.033	3.79	0.807	0.347	0.033	3.79	0.807	0.347
PCB TEQ - Birds	pg/kg	0	31	30	1	3.2%	Normal, Gamma, or Lognormal	Graphical	2	0.103	2.65	0.598	0.460	0.103	1.59	0.529	0.446
PCB TEQ - Fish	pg/kg	1	28	28	0	0%	Normal or Gamma	Graphical	4	0.002	0.0118	0.007	0.006	0.002	0.012	0.007	0.006
PCB TEQ - Mammals	pg/kg	1	28	28	0	0%	Nonparametric	Graphical	4	0.033	0.188	0.104	0.100	0.033	0.188	0.104	0.100
Primary Outliers Excluded																	
Arsenic	mg/kg	0	71	71	0	0%	Lognormal or Approximate Gamma	Concentration Ratio	0	1.90	5.29	2.87	2.73	1.90	5.29	2.87	2.73
Mercury	mg/kg	0	61	52	9	14.8%	Normal	Concentration Ratio	0	0.009	0.069	0.0313	0.032	0.009	0.069	0.0338	0.034
Benzo(a)anthracene	ug/kg	0	70	57	13	18.6%	Lognormal	Concentration Ratio	1	0.240	32	5.97	4.30	0.61	32	6.54	4.80
Benzo(a)pyrene	ug/kg	0	70	58	12	17.1%	Lognormal	Concentration Ratio	1	0.330	28	6.06	4.10	0.53	28	6.70	5.18
Benzo(b)fluoranthene	ug/kg	0	70	55	15	21.4%	Lognormal	Concentration Ratio	1	0.450	40	8.11	6.70	0.45	40	9.14	7.50
Dibenzo(a,h)anthracene	ug/kg	0	70	54	16	22.9%	Lognormal	Concentration Ratio	1	0.280	10	2.13	1.20	0.47	8	1.79	1.35
Total DDTs	ug/kg	0	67	47	20	29.9%	Normal	Concentration Ratio	0	0.180	6.70	1.71	1.38	0.2	6.70	2.02	2.05
Total PCB Aroclors	ug/kg	0	67	23	44	65.7%	Nonparametric	Concentration Ratio	0	1.30	53.5	8.77	7.42	4.95	53.5	14.7	8.35
Dioxin TEQ - Birds	pg/kg	0	51	51	0	0%	Nonparametric	Concentration Ratio	1	0.031	5.60	0.945	0.273	0.031	5.60	0.945	0.273
Dioxin TEQ - Fish	pg/kg	0	51	51	0	0%	Nonparametric	Concentration Ratio	1	0.023	4.20	0.706	0.208	0.023	4.20	0.706	0.208
Dioxin TEQ - Mammals	pg/kg	0	51	51	0	0%	Nonparametric	Concentration Ratio	1	0.033	3.79	0.807	0.347	0.033	3.79	0.807	0.347
PCB TEQ - Birds	pg/kg	0	33	32	1	3.0%	Lognormal	Concentration Ratio	0	0.103	4.85	0.821	0.521	0.103	4.85	0.763	0.490
PCB TEQ - Fish	pg/kg	1	32	32	0	0%	Nonparametric	Concentration Ratio	0	0.002	0.065	0.012	0.007	0.002	0.065	0.012	0.007
PCB TEQ - Mammals	pg/kg	1	32	32	0	0%	Nonparametric	Concentration Ratio	0	0.033	1.27	0.196	0.102	0.033	1.27	0.196	0.102

Table 2. Upriver Surface Sediment Summary Statistics, OC-Normalized Concentrations

		Pre-Processing	Sample Counts				Distribution	Outliers		Full Data Set				Detected Values Only			
Analyte	Units	Num High-Biasing NDs Removed Prior to Analysis	NumObs	Num Ds	NumNDs	% NDs	(ND = ROS)	Outlier Identification Method	Num Outliers Excluded	Minimum	Maximum	Mean	Median	Minimum	Maximum	Mean	Median
All Data																	
Benzo(a)anthracene	ug/mg	0	71	58	13	18.3%	Nonparametric	--	0	78.1	5050	767	412	78.1	5050	834	440
Benzo(a)pyrene	ug/mg	0	71	59	12	16.9%	Lognormal	--	0	30.7	10500	867	476	78.1	10500	962	494
Benzo(b)fluoranthene	ug/mg	0	71	56	15	21.1%	Lognormal	--	0	78.1	7129	1014	670	78.1	7129	1154	715
Dibenzo(a,h)anthracene	ug/mg	0	71	55	16	22.5%	Nonparametric	--	0	27.3	11000	454	109	38.9	11000	478	94
Total DDTs	ug/mg	6	61	47	14	23.0%	Normal	--	0	49.6	396	163	148	76.7	396	166	151
Total PCB Aroclors	ug/mg	3	64	23	41	64.1%	Nonparametric	--	0	97.0	4346	1061	627	312	4346	1141	683
Dioxin TEQ - Birds	ng/mg	0	52	52	0	0%	Lognormal	--	0	1.82	2798	235	37.8	1.82	2798	235	37.8
Dioxin TEQ - Fish	ng/mg	0	52	52	0	0%	Lognormal	--	0	1.24	2099	190	22.4	1.24	2099	190	22.4
Dioxin TEQ - Mammals 2006	ng/mg	0	52	52	0	0%	Lognormal	--	0	1.48	1895	194	42.7	1.48	1895	194	42.7
PCB TEQ - Birds	ng/mg	1	32	32	0	0%	Lognormal	--	0	9.13	314	83.7	50.7	9.13	314	83.7	50.7
PCB TEQ - Fish	ng/mg	1	32	32	0	0%	Nonparametric	--	0	0.17	11.1	1.67	0.668	0.17	11.1	1.67	0.668
PCB TEQ - Mammals 2006	ng/mg	1	32	32	0	0%	Nonparametric	--	0	2.84	217	28.2	10.8	2.84	217	28.2	10.8
All Potential Outliers Excluded																	
Benzo(a)anthracene	ug/mg	0	70	57	13	18.6%	Nonparametric	Graphical	1	78.1	3889	706	408	78.1	3889	760	438
Benzo(a)pyrene	ug/mg	0	70	58	12	17.1%	Lognormal	Graphical	1	30.7	5248	730	474	78.1	5248	797	490
Benzo(b)fluoranthene	ug/mg	0	70	55	15	21.4%	Lognormal	Graphical	1	78.1	5135	926	656	78.1	5135	1045	691
Dibenzo(a,h)anthracene	ug/mg	0	70	54	16	22.9%	Nonparametric	Graphical	1	27.3	1200	304	107	38.9	1200	283	92
Total DDTs	ug/mg	6	59	46	13	22.0%	Normal	Graphical	2	49.6	360	155	146	76.7	290	161	150
Total DDTs	ug/mg	6	61	47	14	23.0%	Normal	Rosner	0	49.6	396	163	148	76.7	396	166	151
Total PCB Aroclors	ug/mg	3	53	19	34	64.2%	Nonparametric	Graphical	11	97.0	1841	563	564	312	1841	729	621
Dioxin TEQ - Birds	ng/mg	0	51	51	0	0%	Lognormal	Graphical	1	1.82	844	185	35.6	1.82	844	185	35.6
Dioxin TEQ - Fish	ng/mg	0	51	51	0	0%	Lognormal	Graphical	1	1.24	759	153	19.9	1.24	759	153	19.9
Dioxin TEQ - Mammals 2006	ng/mg	0	51	51	0	0%	Lognormal	Graphical	1	1.48	910	160	40.7	1.48	910	160	40.7
PCB TEQ - Birds	ng/mg	1	30	30	0	0%	Lognormal	Graphical	2	9.13	205	69.8	48.6	9.13	205	69.8	48.6
PCB TEQ - Fish	ng/mg	1	31	31	0	0%	Nonparametric	Graphical	1	0.17	4.12	1.36	0.649	0.17	4.12	1.36	0.649
PCB TEQ - Mammals 2006	ng/mg	1	31	31	0	0%	Nonparametric	Graphical	1	2.84	61.2	22.1	10.6	2.84	61.2	22.1	10.6
Primary Outliers Excluded																	
Benzo(a)anthracene	ug/mg	0	71	58	13	18.3%	Nonparametric	Concentration Ratio	0	78.1	5050	767	412	78.1	5050	834	440
Benzo(a)pyrene	ug/mg	0	70	58	12	17.1%	Lognormal	Concentration Ratio	1	30.7	5248	730	474	78.1	5248	797	490
Benzo(b)fluoranthene	ug/mg	0	71	56	15	21.1%	Lognormal	Concentration Ratio	0	78.1	7129	1014	670	78.1	7129	1154	715
Dibenzo(a,h)anthracene	ug/mg	0	70	54	16	22.9%	Nonparametric	Concentration Ratio	1	27.3	1200	304	107	38.9	1200	283	92
Total DDTs	ug/mg	6	61	47	14	23.0%	Normal	Concentration Ratio	0	49.6	396	163	148	76.7	396	166	151
Total PCB Aroclors	ug/mg	3	64	23	41	64.1%	Nonparametric	Concentration Ratio	0	97.0	4346	1061	627	312	4346	1141	683
Dioxin TEQ - Birds	ng/mg	0	51	51	0	0%	Lognormal	Concentration Ratio	1	1.82	844	185	35.6	1.82	844	185	35.6
Dioxin TEQ - Fish	ng/mg	0	51	51	0	0%	Lognormal	Concentration Ratio	1	1.24	759	153	19.9	1.24	759	153	19.9
Dioxin TEQ - Mammals 2006	ng/mg	0	51	51	0	0%	Lognormal	Concentration Ratio	1	1.48	910	160	40.7	1.48	910	160	40.7
PCB TEQ - Birds	ng/mg	1	32	32	0	0%	Lognormal	Concentration Ratio	0	9.13	314	83.7	50.7	9.13	314	83.7	50.7
PCB TEQ - Fish	ng/mg	1	32	32	0	0%	Nonparametric	Concentration Ratio	0	0.17	11.1	1.67	0.668	0.17	11.1	1.67	0.668
PCB TEQ - Mammals 2006	ng/mg	1	32	32	0	0%	Nonparametric	Concentration Ratio	0	2.84	217	28.2	10.8	2.84	217	28.2	10.8

Table 3. Summary of Upriver Bedded Outliers, Dry-weight Concentrations

Analyte	Units	Mean Concentration	Number of Potential Outliers (Graphical)	Number of Primary Outliers	Outlier Sample ID	Outlier Concentration	Potential Outlier	Primary Outlier	Outlier:Mean Concentration Ratio
Arsenic					LW2-U6TOC-2	5.29	✓		1.8
Arsenic	mg/kg	2.869	3	0	WLFLH07WR08SD	5.20	✓		1.8
Arsenic					LW2-U6TOC-3	4.85	✓		1.7
Mercury	mg/kg	0.0313	0	0	--	--	✓		--
Benzo(a)anthracene	ug/kg	6.607	1	1	LW3-UG04B	51.0	✓	✓	7.7
Benzo(a)pyrene	ug/kg	6.718	1	1	LW3-UG04B	52.0	✓	✓	7.7
Benzo(b)fluoranthene	ug/kg	9.005	1	1	LW3-UG04B	72.0	✓	✓	8.0
Dibenzo(a,h)anthracene	ug/kg	2.41	1	1	WLFLH07WR04SD	22.0	✓	✓	9.1
Total DDTs	ug/kg	1.713	2	0	LW3-UG12A	6.70 *J*	✓		3.9
Total DDTs					LW2-U6TOC-2	5.00 *J*	✓		2.9
Total PCB Aroclors	ug/kg	8.772	4	0	LW3-UG02C	53.5 *J*	✓		6.1
Total PCB Aroclors					LW2-U2C-2	40.8 *J*	✓		4.7
Total PCB Aroclors					LW3-UG03C	37.4 *J*	✓		4.3
Total PCB Aroclors					LW3-UG03B	33.0 *J*	✓		3.8
Dioxin TEQ - Birds	pg/kg	1.238	1	1	WLFLH07WR08SD	16.2	✓	✓	13.1
Dioxin TEQ - Fish	pg/kg	0.914	1	1	WLFLH07WR08SD	11.5	✓	✓	12.6
Dioxin TEQ - Mammals	pg/kg	1.159	1	1	WLFLH07WR08SD	19.1	✓	✓	16.5
PCB TEQ - Birds	pg/kg	0.821	2	0	WLFLH07WR08SD	4.85	✓		5.9
PCB TEQ - Birds					LW2-U2C-2	3.70 *J*	✓		4.5
PCB TEQ - Fish	pg/kg	0.0121	4	0	WLFLH07WR11SD	0.064	✓		5.3
PCB TEQ - Fish					WLFLH07WR08SD	0.050	✓		4.1
PCB TEQ - Fish					LW2-U2C-2	0.049 *J*	✓		4.0
PCB TEQ - Fish					LW3-UG03A-1	0.035 *J*	✓		2.9
PCB TEQ - Mammals	pg/kg	0.196	4	0	WLFLH07WR11SD	1.27	✓		6.5
PCB TEQ - Mammals					LW2-U2C-2	0.723 *J*	✓		3.7
PCB TEQ - Mammals					WLFLH07WR08SD	0.722	✓		3.7
PCB TEQ - Mammals					LW3-UG03A-1	0.654	✓		3.3

Table 4. Summary of Cat1QA2 Upriver Bedded Sediment Outliers, OC-Normalized Concentrations

Analyte	Units	Mean Concentration	Number of Potential Outliers (Graphical)	Number of Primary Outliers	Outlier Sample ID	Outlier Concentration	Potential Outlier	Primary Outlier	Outlier:Mean Concentration Ratio
Benzo(a)anthracene	ug/mg	767.4	1	0	LW3-UG04B	5050	✓		6.58
Benzo(a)pyrene	ug/mg	867.2	1	1	WLFLH07BH04SD	10500	✓	✓	12.11
Benzo(b)fluoranthene	ug/mg	1014	1	0	LW3-UG04B	7129	✓		7.03
Dibenzo(a,h)anthracene	ug/mg	454.2	1	1	WLFLH07WR04SD	11000	✓	✓	24.22
Total DDTs	ug/mg	162.8	2	0	LW3-UG12A	396	✓		2.43
Total DDTs	ug/mg	162.8		0	WLFLH07BH03SD	396 *U*	✓		2.43
Total PCB Aroclors	ug/mg	1061	11	0	LW3-UG02C	4346	✓		4.10
Total PCB Aroclors					WLFLH07WR04SD	4300	✓		4.05
Total PCB Aroclors					WLFLH07BH01SD	4236	✓		3.99
Total PCB Aroclors					WLFLH07BH04SD	4100	✓		3.86
Total PCB Aroclors					WLFLH07BH03SD	3956 *U*	✓		3.73
Total PCB Aroclors					WLFLH07WR07SD	3600 *U*	✓		3.39
Total PCB Aroclors					LW2-U2C-2	3460 *U*	✓		3.26
Total PCB Aroclors					WLFLH07WR05SD	3010 *U*	✓		2.84
Total PCB Aroclors					WLFLH07CR01SD	2486	✓		2.34
Total PCB Aroclors					WLFLH07CR01SD	2486	✓		2.34
Total PCB Aroclors					LW3-UG03C	2306 *U*	✓		2.17
Dioxin TEQ - Birds	ng/mg	235.3	1	1	WLFLH07WR04SD	2798	✓	✓	11.89
Dioxin TEQ - Fish	ng/mg	189.9	1	1	WLFLH07WR04SD	2099	✓	✓	11.05
Dioxin TEQ - Mammals 2006	ng/mg	193.7	1	1	WLFLH07WR04SD	1895	✓	✓	9.78
PCB TEQ - Birds	ng/mg	83.74	2	0	LW2-U2C-2	313	✓		3.74
PCB TEQ - Birds					WLFLH07WR11SD	272	✓		3.25
PCB TEQ - Fish	ng/mg	1.668	1	0	WLFLH07WR11SD	11.1	✓		6.65
PCB TEQ - Mammals 2006	ng/mg	28.21	1	0	WLFLH07WR11SD	217	✓		7.70

Table 5. Upriver Surface Sediment Upper Threshold Calculations, Dry Weight Concentrations

	Distribution	Kaplan-Meier Statistics		Upper Threshold Statistics			Central Tendency Statistics		
				95-UPL		95-Percentile	95-UCL		Mean
	(ND = ROS)	KM Mean	KM SD	Type	UPL	Percentile	Type	UCL	(ND = DL)
All Data									
Arsenic	Lognormal or Approximate Gamma	--	--	95% UPL	4.19	3.75	95% Approx. Gamma	3.00	2.87
Mercury	Normal	0.0307	0.0134	95% KM UPL (t)	0.0532	0.0540	95% KM (t) UCL	0.0337	0.0313
Benzo(a)anthracene	Lognormal	6.28	8.10	95% KM UPL (t)	19.9	24	95% KM (BCA) UCL	8.18	6.61
Benzo(a)pyrene	Lognormal	6.45	7.92	95% KM UPL (t)	19.8	21	95% KM (BCA) UCL	8.30	6.72
Benzo(b)fluoranthene	Lognormal	8.51	10.61	95% KM UPL (t)	26.3	30	95% KM (BCA) UCL	10.8	9.01
Dibenzo(a,h)anthracene	Lognormal	1.86	2.73	95% KM UPL (t)	6.44	10	95% KM (BCA) UCL	2.51	2.41
Total DDTs	Normal	1.56	1.21	95% KM UPL (t)	3.59	3.04	95% KM (BCA) UCL	1.83	1.71
Total PCB Aroclors	Nonparametric	8.48	8.91	95% KM UPL (t)	23.5	33.0	95% KM (t) UCL	10.4	8.77
Dioxin TEQ - Birds	Nonparametric	1.24	2.41	95% KM UPL (t)	5.32	3.91	95% KM (Chebyshev) UCL	3.35	1.24
Dioxin TEQ - Fish	Nonparametric	0.914	1.72	95% KM UPL (t)	3.83	2.67	95% KM (Chebyshev) UCL	2.42	0.914
Dioxin TEQ - Mammals 2006	Nonparametric	1.16	2.68	95% KM UPL (t)	5.69	3.19	95% KM (Chebyshev) UCL	2.80	1.16
PCB TEQ - Birds	Lognormal	0.756	0.975	95% KM UPL (t)	2.43	3.70	95% KM (Chebyshev) UCL	1.51	0.821
PCB TEQ - Fish	Nonparametric	0.0121	0.0149	95% KM UPL (t)	0.0377	0.0506	95% KM (Chebyshev) UCL	0.0237	0.0121
PCB TEQ - Mammals 2006	Nonparametric	0.196	0.261	95% KM UPL (t)	0.646	0.723	95% KM (Chebyshev) UCL	0.401	0.196
Potential Outliers Excluded									
Arsenic	Lognormal or Gamma	2.77	0.467	95% UPL (t), lognormal	3.64	3.67	95% KM (BCA) UCL	2.864	2.77
Mercury	Normal	0.0307	0.0134	95% KM UPL (t)	0.0532	0.0540	95% KM (t) UCL	0.0337	0.0313
Benzo(a)anthracene	Lognormal	5.64	6.13	95% KM UPL (t)	15.9	20	95% KM (BCA) UCL	6.97	5.97
Benzo(a)pyrene	Lognormal	5.79	5.68	95% KM UPL (t)	15.3	19	95% KM (BCA) UCL	7.22	6.06
Benzo(b)fluoranthene	Lognormal	7.61	7.47	95% KM UPL (t)	20.2	25	95% KM (BCA) UCL	9.34	8.11
Dibenzo(a,h)anthracene	Lognormal	1.58	1.29	95% KM UPL (t)	3.74	10	95% KM (Percentile Bootstrap) UCL	1.85	2.13
Total DDTs	Nonparametric	1.43	0.947	95% KM UPL (t)	3.03	2.94	95% KM (t) UCL	1.64	1.59
Total PCB Aroclors	Nonparametric	6.41	2.93	95% KM UPL (t)	11.3	13.7	95% KM (t) UCL	7.07	6.72
Dioxin TEQ - Birds	Nonparametric	0.95	1.21	95% KM UPL (t)	2.99	3.78	95% KM (Chebyshev) UCL	1.69	0.945
Dioxin TEQ - Fish	Nonparametric	0.706	0.879	95% KM UPL (t)	2.19	1.88	95% KM (Chebyshev) UCL	1.48	0.706
Dioxin TEQ - Mammals 2006	Nonparametric	0.81	0.94	95% KM UPL (t)	2.40	2.73	95% KM (Chebyshev) UCL	1.39	0.807
PCB TEQ - Birds	Normal, Gamma, or Lognormal	0.529	0.374	95% UPL (t), lognormal	1.47	1.59	95% KM (BCA) UCL	0.654	0.598
PCB TEQ - Fish	Normal or Gamma	0.00669	0.00237	95% UPL (t), normal	0.0109	0.0118	95% KM (t) UCL	0.00747	0.00669
PCB TEQ - Mammals 2006	Nonparametric	0.104	0.0337	95% KM UPL (t)	0.162	0.177	95% KM (Chebyshev) UCL	0.132	0.104
Primary Outliers Excluded									
Arsenic	Lognormal or Approximate Gamma	--	--	95% UPL	4.19	3.75	95% Approx. Gamma	3.00	2.87
Mercury	Normal	0.0307	0.0134	95% KM UPL (t)	0.0532	0.0540	95% KM (t) UCL	0.0337	0.0313
Benzo(a)anthracene	Lognormal	5.64	6.13	95% KM UPL (t)	15.9	20	95% KM (BCA) UCL	6.90	5.97
Benzo(a)pyrene	Lognormal	5.79	5.68	95% KM UPL (t)	15.3	19	95% KM (BCA) UCL	7.08	6.06
Benzo(b)fluoranthene	Lognormal	7.61	7.47	95% KM UPL (t)	20.2	25	95% KM (BCA) UCL	9.33	8.11
Dibenzo(a,h)anthracene	Lognormal	1.58	1.29	95% KM UPL (t)	3.74	10	95% KM (Percentile Bootstrap) UCL	1.85	2.13
Total DDTs	Normal	1.56	1.21	95% KM UPL (t)	3.59	3.04	95% KM (BCA) UCL	1.83	1.71
Total PCB Aroclors	Nonparametric	8.48	8.91	95% KM UPL (t)	23.5	33.0	95% KM (t) UCL	10.4	8.77
Dioxin TEQ - Birds	Nonparametric	0.95	1.21	95% KM UPL (t)	2.99	3.78	95% KM (Chebyshev) UCL	1.69	0.945
Dioxin TEQ - Fish	Nonparametric	0.706	0.88	95% KM UPL (t)	2.19	1.88	95% KM (Chebyshev) UCL	1.48	0.706
Dioxin TEQ - Mammals 2006	Nonparametric	0.81	0.94	95% KM UPL (t)	2.40	2.73	95% KM (Chebyshev) UCL	1.39	0.807
PCB TEQ - Birds	Lognormal	0.756	0.975	95% KM UPL (t)	2.43	3.70	95% KM (Chebyshev) UCL	1.51	0.821
PCB TEQ - Fish	Nonparametric	0.0121	0.0149	95% KM UPL (t)	0.0377	0.0506	95% KM (Chebyshev) UCL	0.0237	0.0121
PCB TEQ - Mammals 2006	Nonparametric	0.196	0.261	95% KM UPL (t)	0.646	0.723	95% KM (Chebyshev) UCL	0.401	0.196

Note:
95-Percentile calculations performed in Statistica. All other calculations performed in ProUCL v 4.0.

Table 6. Upriver Surface Sediment Upper Threshold Calculations, OC-normalized Concentrations

					Upper Threshold Statistics			Central Tendency Statistics		
		Distribution	Kaplan-Meier Statistics		95-UPL		95-Percentile	95-UCL		Mean
Analyte	Units	(ND = ROS)	KM Mean	KM SD	Recommended Statistic	UPL	Percentile	Recommended Statistic	UCL	(ND = DL)
All Data										
Benzo(a)anthracene	ug/mg	Nonparametric	719	944	95% KM UPL (t)	2304	3067	95% KM (BCA) UCL	902.9	3067
Benzo(a)pyrene	ug/mg	Lognormal	832	1479	95% KM UPL (t)	3314	3022	95% KM (BCA) UCL	1152	3022
Benzo(b)fluoranthene	ug/mg	Lognormal	963	1234	95% KM UPL (t)	3033	3700	95% KM (BCA) UCL	1242	3700
Dibenzo(a,h)anthracene	ug/mg	Nonparametric	390	1313	95% KM UPL (t)	2594	1150	95% KM (Chebyshev) UCL	1076	1150
Total DDTs	ug/mg	Normal	151	63.93	95% KM UPL (t)	258.3	301	95% KM (Percentile Bootstrap) UCL	165	301
Total PCB Aroclors	ug/mg	Nonparametric	660	743	95% KM UPL (t)	1910	4100	95% KM (t) UCL	825	4100
Dioxin TEQ - Birds	ng/mg	Lognormal	235	453	95% UPL (t), lognormal	1221	841	97.5% KM (Chebyshev) UCL	632	841
Dioxin TEQ - Fish	ng/mg	Lognormal	190	361	95% UPL (t), lognormal	1017	756	97.5% KM (Chebyshev) UCL	506	756
Dioxin TEQ - Mammals 2006	ng/mg	Lognormal	194	334	95% UPL (t), lognormal	1062	681	97.5% KM (Chebyshev) UCL	486	681
PCB TEQ - Birds	ng/mg	Lognormal	83.7	71.6	95% UPL (t), lognormal	242	272	95% KM (Chebyshev) UCL	140	272
PCB TEQ - Fish	ng/mg	Nonparametric	1.67	2.04	95% KM UPL (t)	5.19	4.12	95% KM (Chebyshev) UCL	3.27	4.12
PCB TEQ - Mammals 2006	ng/mg	Nonparametric	28.2	38.8	95% KM UPL (t)	95.0	61.2	95% KM (Chebyshev) UCL	71.7	61.2
All Rosner's Test Outliers Excluded										
Benzo(a)anthracene	ug/mg	Nonparametric	658	795	95% KM UPL (t)	1993	2832	95% KM (BCA) UCL	818	408
Benzo(a)pyrene	ug/mg	Lognormal	694	929	95% KM UPL (t)	2254	2389	95% KM (BCA) UCL	876	474
Benzo(b)fluoranthene	ug/mg	Lognormal	874	996	95% KM UPL (t)	2547	3540	95% KM (BCA) UCL	1092	656
Dibenzo(a,h)anthracene	ug/mg	Nonparametric	239	341	95% KM UPL (t)	811	1135	95% KM (Chebyshev) UCL	421	107
Total DDTs	ug/mg	Normal	147	56	95% KM UPL (t)	241	290	95% KM (t) UCL	159	146
Total PCB Aroclors	ug/mg	Nonparametric	486	301	95% KM UPL (t)	995	1482	95% KM (t) UCL	560	564
Dioxin TEQ - Birds	ng/mg	Lognormal	185	279	95% UPL (t), lognormal	1005	840	97.5% KM (Chebyshev) UCL	432	35.6
Dioxin TEQ - Fish	ng/mg	Lognormal	153	245	95% UPL (t), lognormal	840	752	97.5% KM (Chebyshev) UCL	369	19.9
Dioxin TEQ - Mammals 2006	ng/mg	Lognormal	160	237	95% UPL (t), lognormal	898	673	97.5% KM (Chebyshev) UCL	370	40.7
PCB TEQ - Birds	ng/mg	Lognormal	69.8	48.3	95% UPL (t), lognormal	187	173	95% KM (BCA) UCL	86.6	48.6
PCB TEQ - Fish	ng/mg	Nonparametric	1.36	1.16	95% KM UPL (t)	3.371	3.9	97.5% KM (Chebyshev) UCL	2.29	0.649
PCB TEQ - Mammals 2006	ng/mg	Nonparametric	22.1	19.1	95% KM UPL (t)	55.0	55.6	97.5% KM (Chebyshev) UCL	37.3	10.6
BPJ Outliers Excluded										
Benzo(a)anthracene	ug/mg	Nonparametric	719	944	95% KM UPL (t)	2304	3067	95% KM (BCA) UCL	903	3067
Benzo(a)pyrene	ug/mg	Lognormal	694	929	95% KM UPL (t)	2254	2389	95% KM (BCA) UCL	893	2389
Benzo(b)fluoranthene	ug/mg	Lognormal	963	1234	95% KM UPL (t)	3033	3700	95% KM (BCA) UCL	1242	3700
Dibenzo(a,h)anthracene	ug/mg	Nonparametric	239	341	95% KM UPL (t)	811	1135	95% KM (Chebyshev) UCL	421	1135
Total DDTs	ug/mg	Normal	151	64	95% KM UPL (t)	258	301	95% KM (Percentile Bootstrap) UCL	165	301
Total PCB Aroclors	ug/mg	Nonparametric	660	743	95% KM UPL (t)	1910	4100	95% KM (t) UCL	825	4100
Dioxin TEQ - Birds	ng/mg	Lognormal	185	279	95% UPL (t), lognormal	1005	840	95% KM (Chebyshev) UCL	432	840
Dioxin TEQ - Fish	ng/mg	Lognormal	153	245	95% UPL (t), lognormal	840	752	95% KM (Chebyshev) UCL	369	752
Dioxin TEQ - Mammals 2006	ng/mg	Lognormal	160	237	95% UPL (t), lognormal	898	673	95% KM (Chebyshev) UCL	370	673
PCB TEQ - Birds	ng/mg	Lognormal	83.7	71.6	95% UPL (t), lognormal	242	272	95% KM (Chebyshev) UCL	140	272
PCB TEQ - Fish	ng/mg	Nonparametric	1.67	2.04	95% KM UPL (t)	5.19	4.12	95% KM (Chebyshev) UCL	3.27	4.12
PCB TEQ - Mammals 2006	ng/mg	Nonparametric	28.2	38.8	95% KM UPL (t)	95.0	61.2	95% KM (Chebyshev) UCL	71.7	61.2

Note:
95-Percentile calculations performed in Statistica. All other calculations performed in ProUCL v 4.0.