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NBSD Credit Union Parking Lot Stormwater Monitoring Data Analysis for WinSLAMM Modeling

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Summary

This memo contains the stormwater sampling results for NBSD Navy Federal Credit Union stormwater management site, organized for use for stormwater modeling with WinSLAMM. The drainage area of the site was estimated to be 0.37 acres and is comprised of an asphalt paved parking area with two small, vegetated islands. The parking lot runoff enters a bioswale/bioinfiltration system at several curb inlets. The outlet from the treatment system is an overflow grate in the middle of the bioswale which channels overflowing water into a 6-inch PVC pipe to the stormwater system.

The inlet samples represent three events while the outlet samples were collected during two events. The average TSS and metal concentrations were reduced with the bioswale treatment. The influent median particle size was about 15 µm, reduced to about 11 µm at the effluent location. The patterns for the influent and effluent mass distributions for most of these constituents were similar. Most of the pollutants, by mass, were associated with particles less than about 20 to 50 µm. Chromium, manganese, nickel, copper, and zinc had their largest particulate strengths associated with the largest size range (>63 µm).

There were no obvious patterns comparing the influent and effluent PAH concentrations. For many of the PAHs, the patterns were similar and showed a general reduction of the median size associated with the 50th percentile of the mass, with most of the PAH mass associated with particles smaller than about 50 µm. Many of these PAHs have their greatest particulate strengths associated with the largest size range (>63 µm), although many had non-detected values for some of the size ranges.

No filterable PFAS concentrations or values associated with different particle size ranges are available due to the low concentrations observed.

The average concentrations observed at the Federal Credit Union location for TSS, copper, lead, and zinc were compared to the averages of the three inlet samples. The recent concentrations were within the range of the prior observed values, although on the lower portion of the concentration distributions.

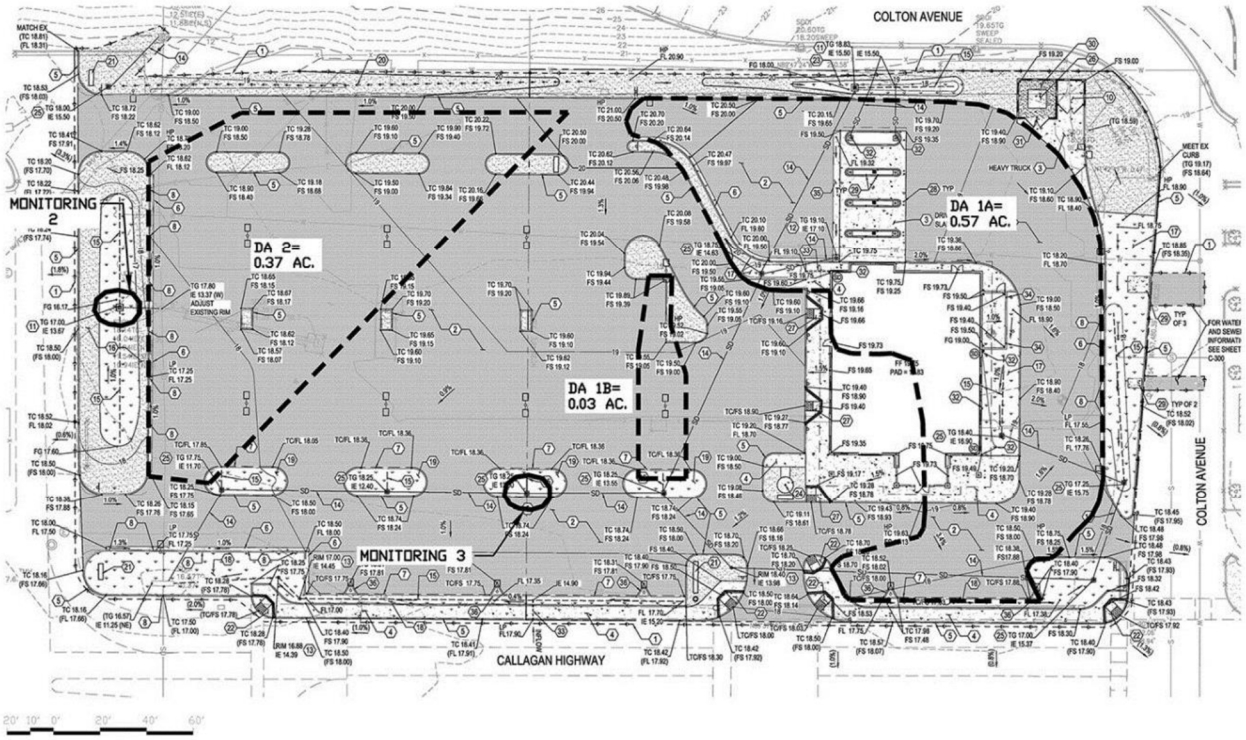
WinSLAMM was used to model the monitored Federal Credit Union location at NBSD, using the calibrated parameter files previously prepared for NBSD. The monitored inlet TSS and total lead values were less than the calculated values, while the other constituents and forms are within the expected range.

None of the outlet conditions show large (>70%) fractions of the pollutants associated with possible near-field deposition, while many of the metals would likely have most of their mass widely dispersed, depending on currents and water depths.

Site and Monitoring Description

This section contains the sampling and analytical methods for NBSD Navy Federal Credit Union stormwater management site, as provided by information from the Texas Tech research group and from a prior stormwater report from NBSD. The drainage area, as shown below on the aerial photos, was estimated as 0.37 acres and is comprised of an asphalt paved parking area with two small, vegetated islands. The runoff entered the bioswale/bioinfiltration system at several curb inlets. The outlet from the treatment system is an overflow grate in the middle of the bioswale which channels overflowing water into a 6-inch PVC pipe to the stormwater system. The curb inlet north of the inlet sampling location was closed with landscape edging and foam sealant to prevent short-circuiting of the inflowing waters at the sampling location.

The sampling inlet had an ISCO sampler and an H-flume for flow monitoring of the incoming runoff. The outlet was sampled at the end of the overflow/infiltration PVC pipe using another ISCO sampler. Three events were sampled for both flow and contaminants of concern (CoC) analysis. Only the inlet was sampled during the first event, while for the 2nd and 3rd events both had inlet and outlet samples.



The earlier SPAWAR report (Katz, *et al.* 2018. *Demonstration of Low Impact (LID) to Mitigate Stormwater Metal Contaminants in Navy Commercial Areas*. Technical Report 3092) included additional information

concerning the bioswale cells at this location. The bioswale cells at the Navy Federal Credit Union project site can be considered to be of representative size, configuration, and material that are used in the San Diego region. However, the media has not specifically been selected to reduce the loads of the targeted metals. The specifications on the media are not very clear and construction details and materials are not known. There are also outfall issues as the discharge pipes are undersized and may affect the monitoring process as water backs up into the system.

Stormwater Monitoring Data Summaries for use in WinSLAMM Modeling

TSS and Heavy Metals

The following tables summarize the stormwater quality as monitored at the Federal Credit Union location, comparing the inlet and outlet samples. The inlet samples represent three events while the outlet samples were collected during two events. The average TSS and metal concentrations were reduced with the bioswale treatment, except for the reported arsenic concentrations.

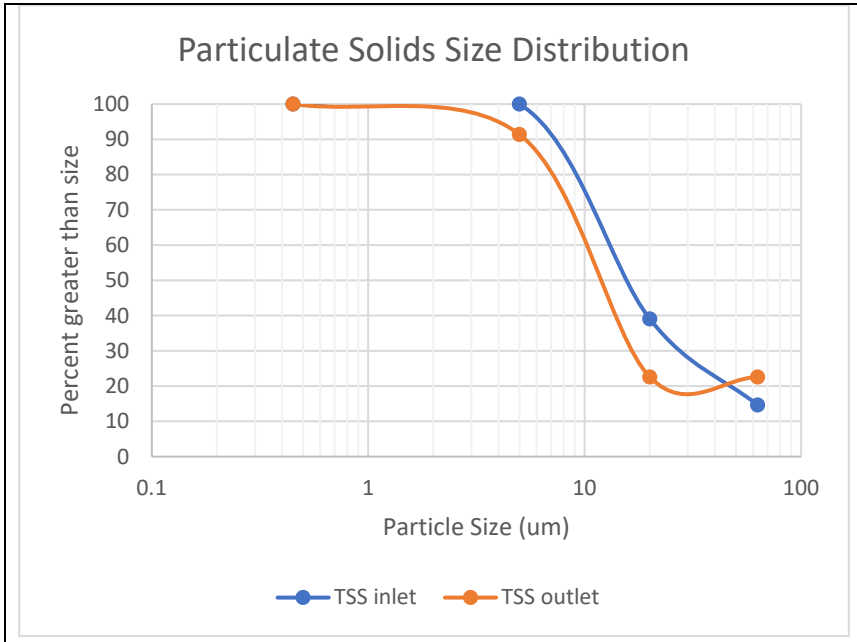
Average inlet TSS and heavy metal concentrations

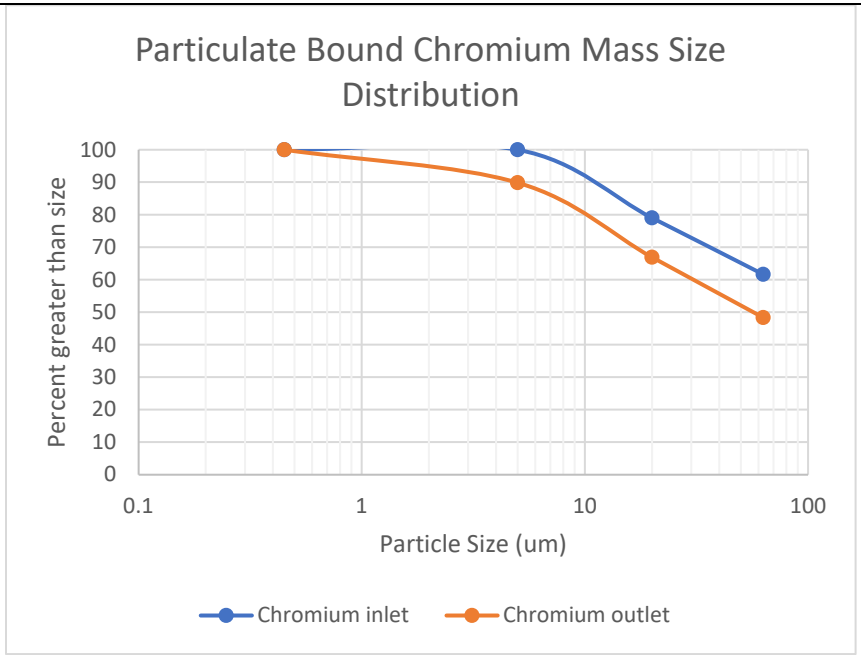
	TSS (mg/L)	Chromium (µg/L)	Manganese (µg/L)	Nickel (µg/L)	Copper (µg/L)	Zinc (µg/L)	Arsenic (µg/L)	Cadmium (µg/L)	Lead (µg/L)
Total sample		2.67	42.3	8.23	181	166	2.98	0.16	2.17
Total partic. (>0.45 µm)	27.8	1.45	27.0	1.98	36.0	40.0	0.27	0.01	0.98
filtered (<0.45 µm)		1.22	15.4	6.25	144.69	125	2.70	0.15	1.19
% filtered		45.9	36.3	76.0	80.1	75.5	90.8	92.4	54. 8
% particulate	100	54.1	63.7	24.0	19.9	24.5	9.21	7.6	45.2
0.45-5 µm	nd	nd	2.08	0.24	5.29	8.15	0.11	nd	0.06
5-20 µm	16.92	0.30	4.99	0.66	13.08	4.41	0.12	0.01	0.64
20-63 µm	6.78	0.25	9.07	0.06	2.79	2.75	0.04	nd	0.09
> 63 µm	4.05	0.89	10.85	1.01	14.88	25.29	nd	nd	0.19

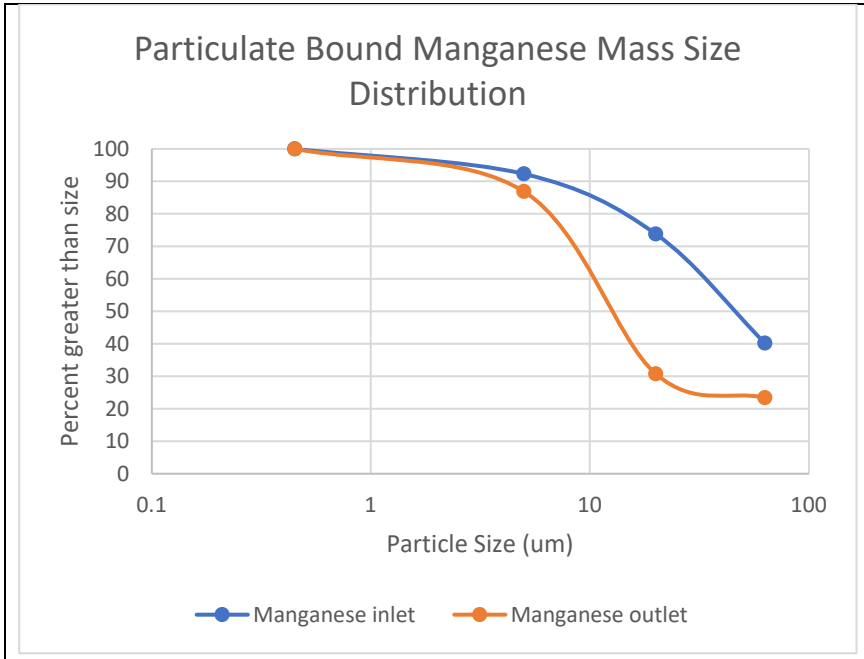
Average outlet TSS and heavy metal concentrations

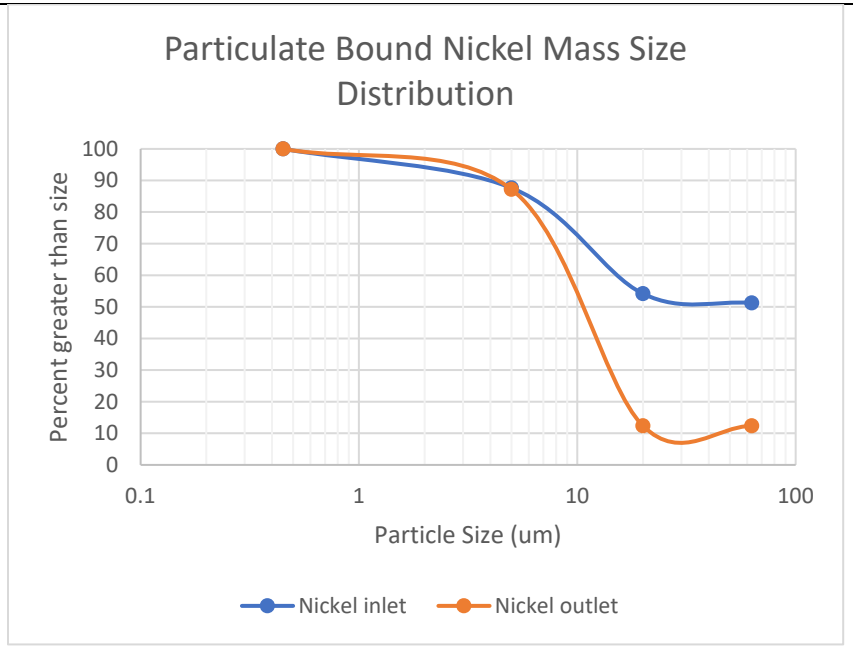
	TSS (mg/L)	Chromium (µg/L)	Manganese (µg/L)	Nickel (µg/L)	Copper (µg/L)	Zinc (µg/L)	Arsenic (µg/L)	Cadmium (µg/L)	Lead (µg/L)
Total sample		2.04	14.6	2.46	45.8	35.9	5.77	0.04	1.77
Total partic. (>0.45 µm)	15.1	0.80	11.9	0.81	14.7	14.6	1.16	0.00	1.28
filtered (<0.45 µm)		1.24	2.72	1.65	31.2	21.3	4.61	0.04	0.49
% filtered		60.7	18.7	67.2	68.0	59.4	79.8	91.9	27.8
% particulate	100	39.3	81.3	32.8	32.0	40.6	20.2	8.1	72.2
0.45-5 µm	1.30	0.08	1.55	0.10	0.52	0.32	0.21	nd	0.06
5-20 µm	10.4	0.18	6.66	0.60	6.50	9.30	0.95	nd	1.05
20-63 µm	nd	0.15	0.87	nd	5.85	0.25	0.00	nd	0.06
> 63 µm	3.40	0.39	2.77	0.10	1.77	4.70	0.00	nd	0.11

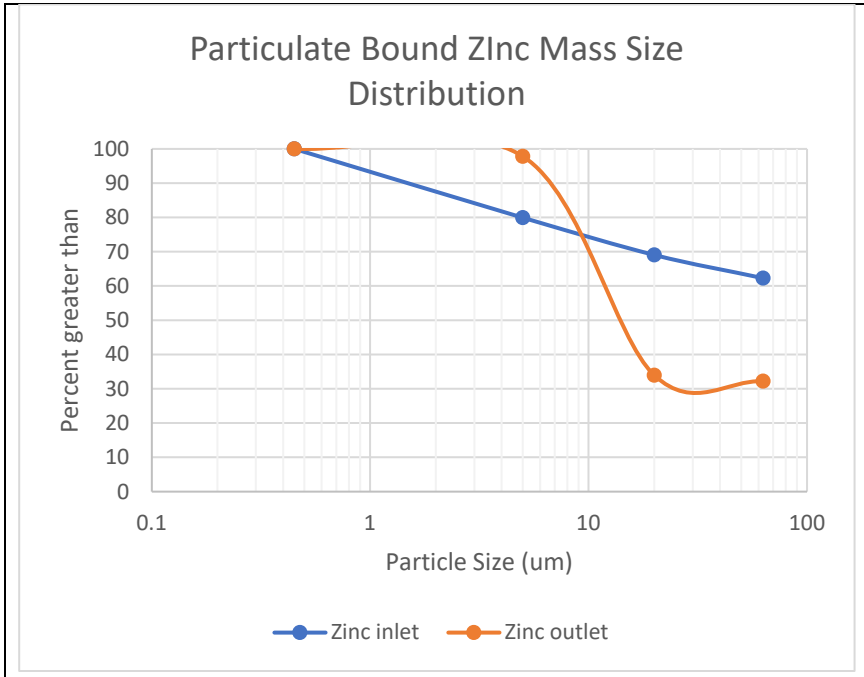
The following particle size distributions (by mass) compare the amounts of the TSS and metals by size for the influent and effluent samples. The influent median particle size is about 15 µm, reduced to about 11 µm at the effluent location. The patterns for the influent and effluent mass distributions for most of these constituents are similar. Most of the pollutants, by mass, is associated with particles less than about 20 to 50 µm.

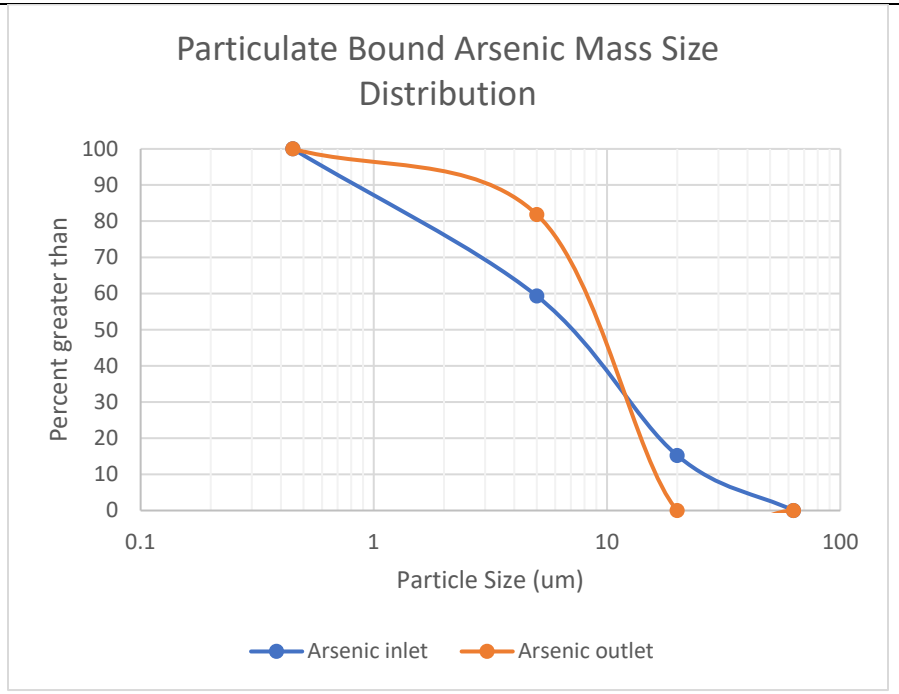


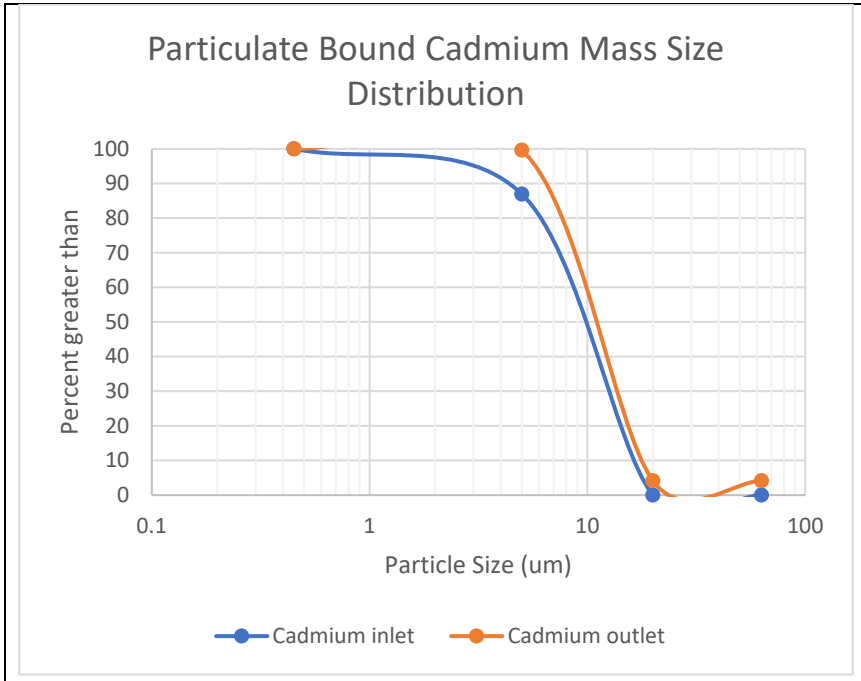


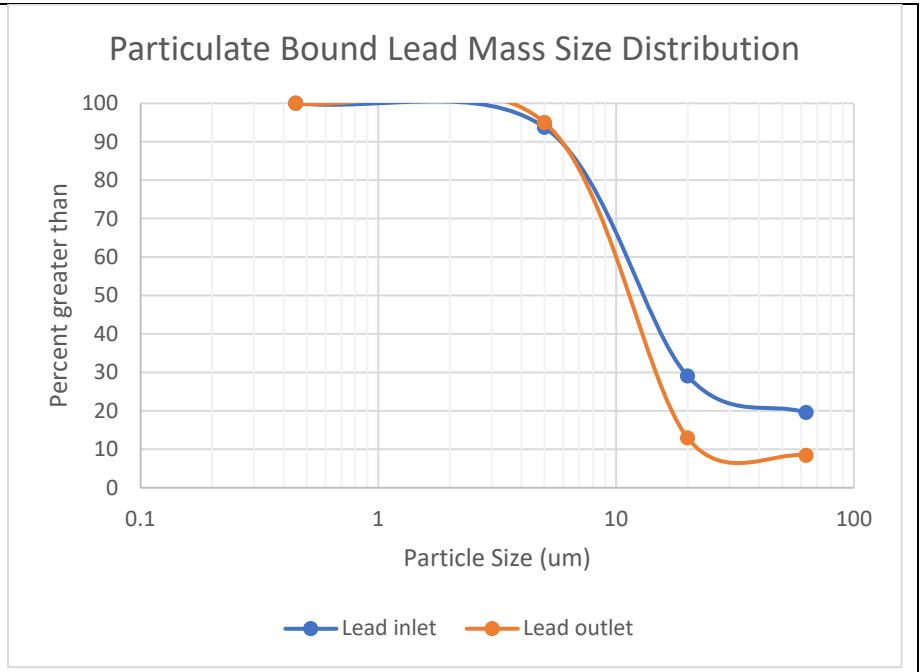

Particulate Bound Manganese Mass Size Distribution
Percent greater than size
100
90
80
70
60
50
40
30
20
10
0
0.1
1
10
100
Particle Size (um)
Manganese inlet
Manganese outlet

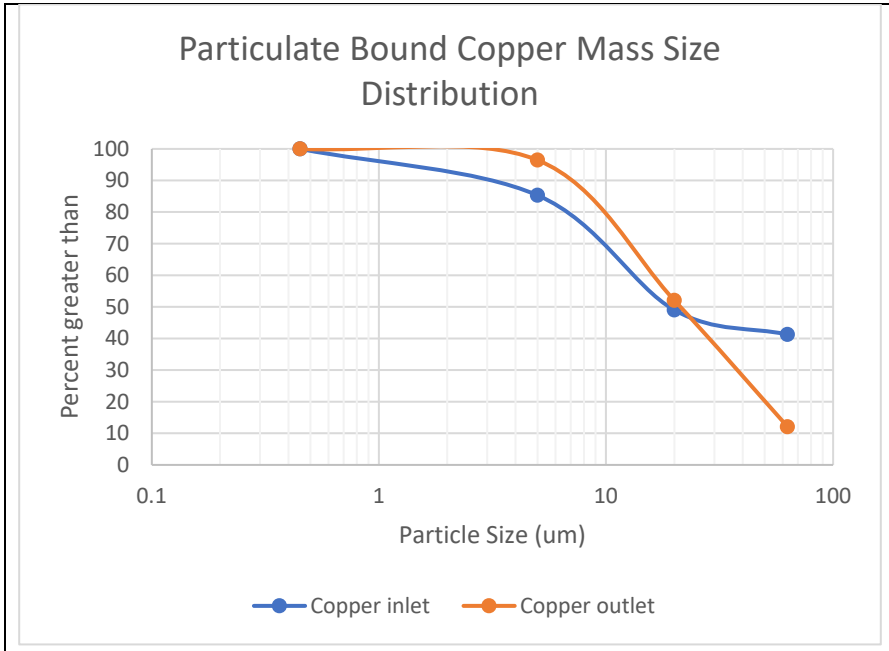

Particulate Bound Nickel Mass Size Distribution
Percent greater than size
100
90
80
70
60
50
40
30
20
10
0
0.1
1
10
100
Particle Size (um)
Nickel inlet
Nickel outlet


Particulate Bound ZInc Mass Size Distribution
Percent greater than
100
90
80
70
60
50
40
30
20
10
0
0.1
1
10
100
Particle Size (um)
Zinc inlet
Zinc outlet


Particulate Bound Arsenic Mass Size Distribution
Percent greater than
100
90
80
70
60
50
40
30
20
10
0
0.1
1
10
100
Particle Size (um)
Arsenic inlet
Arsenic outlet

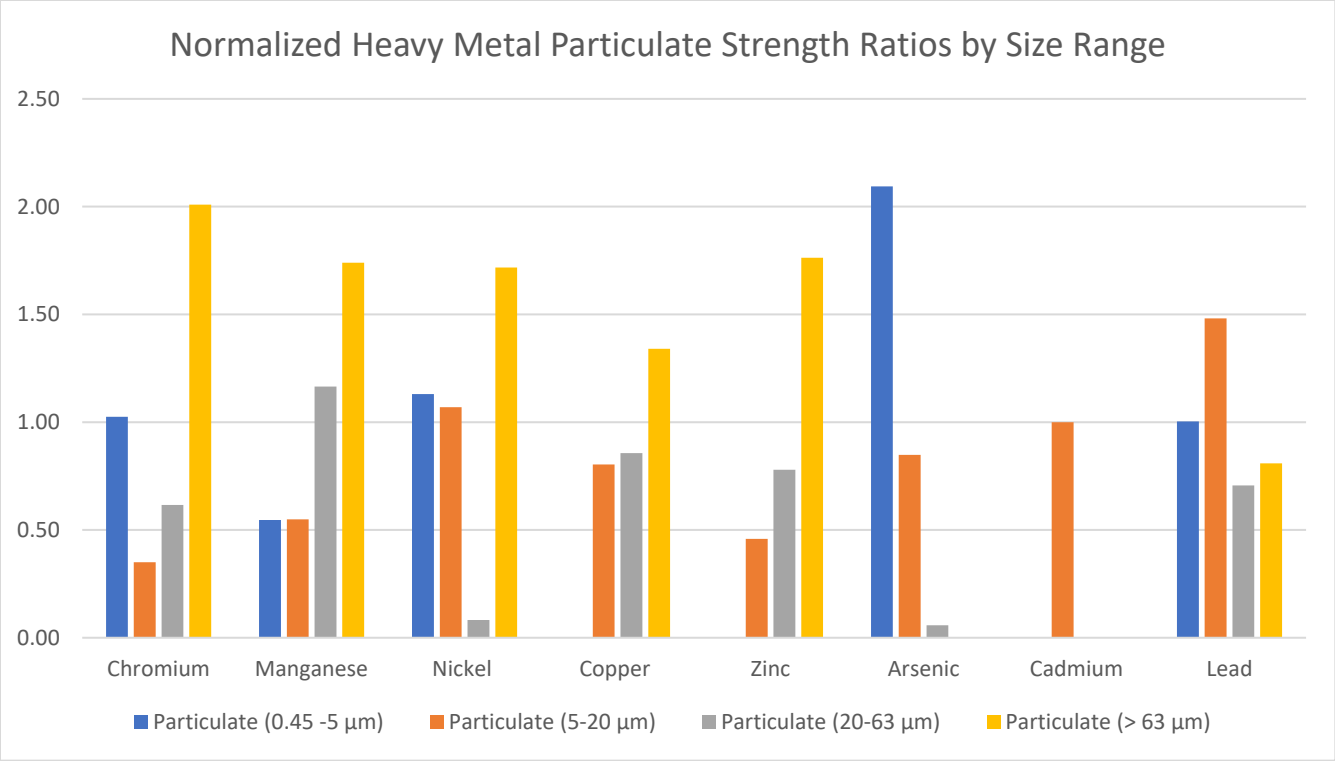

Particulate Bound Cadmium Mass Size Distribution
Percent greater than
100
90
80
70
60
50
40
30
20
10
0
0.1
1
10
100
Particle Size (um)
Cadmium inlet
Cadmium outlet


Particulate Bound Lead Mass Size Distribution
Percent greater than
100
90
80
70
60
50
40
30
20
10
0
0.1
1
10
100
Particle Size (um)
Lead inlet
Lead outlet



The following table and figure show the particulate strength relations for these metals by size range. The figure shows normalized values, with particulate strengths compared to the total particulate fraction of the sample. Chromium, manganese, nickel, copper, and zinc have their largest particulate strengths associated with the largest size range (>63 µm). Arsenic and cadmium have uncertain relationships due to missing data, while the lead particulate strength distributions show no obvious pattern.

average of all samples, mg/kg	Chromium	Manganese	Nickel	Copper	Zinc	Arsenic	Cadmium	Lead
Total Particulate (>0.45 µm), mg/kg	49.5	907	61.4	1,236	1,265	38.6	0.6	64.3
Particulate (0.45 -5 µm), mg/kg	62.6	542	54.6	nd	nd	102.4	nd	49.2
Particulate (5-20 µm), mg/kg	21.4	544	51.7	854	641	41.5	0.7	72.7
Particulate (20-63 µm), mg/kg	37.6	1,155	4.0	910	1,090	2.8	nd	34.6
Particulate (> 63 µm), mg/kg	122.8	1,724	83.0	1,425	2,466	nd	nd	39.7



PAHs

The following tables compare the influent and effluent concentrations for selected PAH compounds (those having few non detected observations). There was no obvious pattern comparing the influent and effluent PAH concentrations.

average of inlet samples	**naphthalene**	**2-methylnaphthalene**	**fluorene**	**phenanthrene**	**2-methylphenanthrene**	**fluoranthene**	**pyrene**	**benzo(a)anthracene**

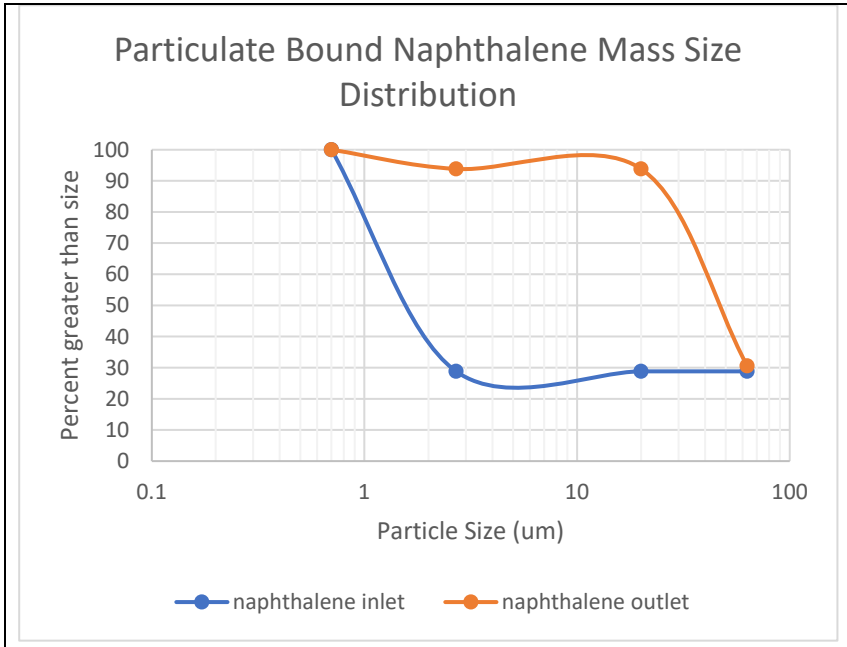
Total Particulate (>0.7 µm)	0.5	1.1	0.6	11.9	2.1	19.5	18.5	2.1
Filtered (<0.7µm)	3.7	3.6	2.3	8.8	1.0	1.9	1.4	0.1
Bulk	4.2	4.8	2.9	20.7	3.1	21.4	19.9	2.1
% filtered	88.8	76.4	79.7	42.3	32.8	9.1	6.9	4.3
% particulate	11.2	23.6	20.3	57.7	67.2	90.9	93.1	95.7

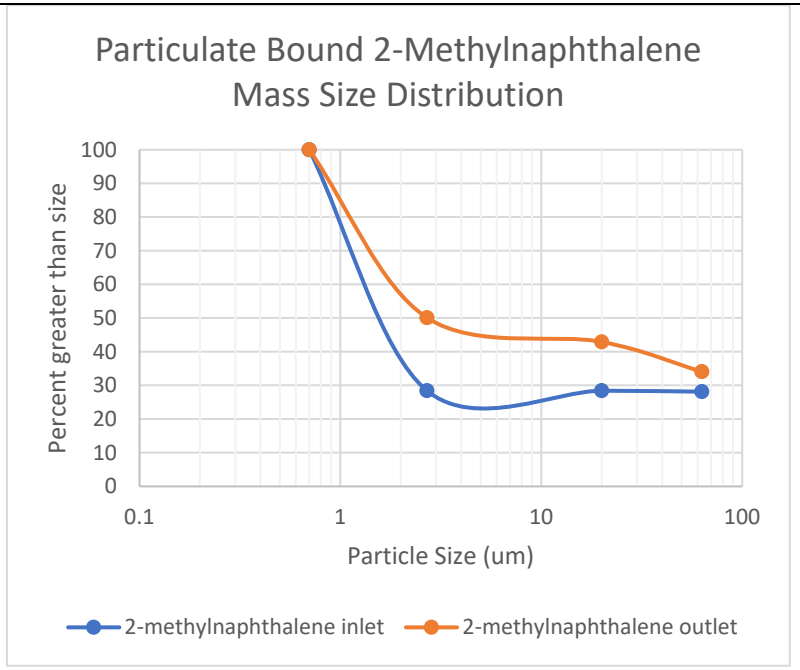
average of inlet samples	**chrysene**	**benzo(b)fluoranthene**	**benzo(k)fluoranthene**	**benzo(e)pyrene**	**indeno(123-cd)pyrene**	**benzo(ghi)perylene**	**Total PAH**
Total Particulate (>0.7 µm)	12.1	7.0	4.5	5.6	3.7	8.9	106.1
Filtered (<0.7µm)	1.3	0.2	0.2	0.2	0.1	0.1	32.9
Bulk	13.4	7.2	4.7	5.7	3.8	9.0	139.0
% filtered	9.4	3.1	4.1	2.8	3.1	0.7	23.7
% particulate	90.6	96.9	95.9	97.2	96.9	99.3	76.3

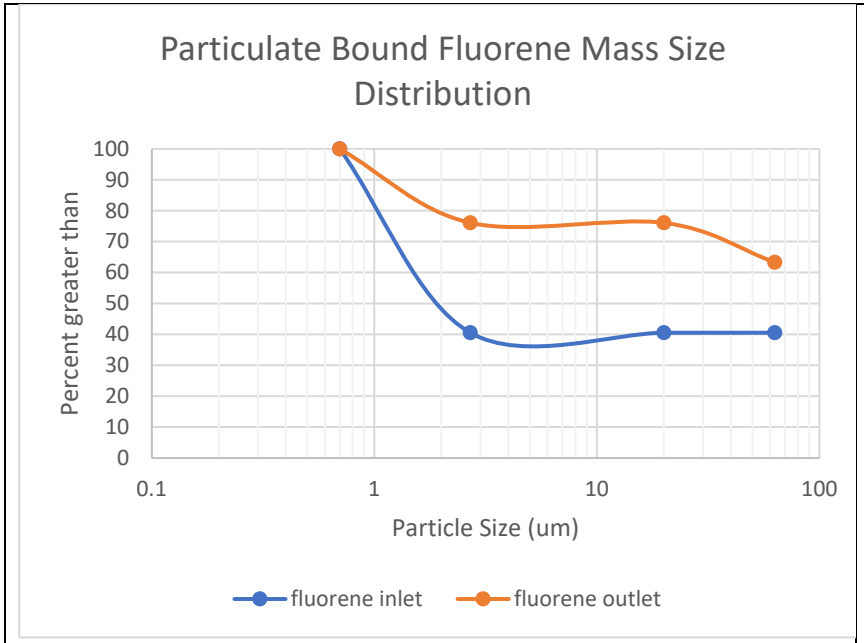
average of outlet samples	**naphthalene**	**2-methylnaphthalene**	**fluorene**	**phenanthrene**	**2-methylphenanthrene**	**fluoranthene**	**pyrene**	**benzo(a)anthracene**
Total Particulate (>0.7 µm)	2.3	3.2	1.4	7.8	1.6	5.0	8.7	1.6
Filtered (<0.7µm)	2.9	2.1	2.4	9.4	1.1	2.2	2.0	0.1
Bulk	5.2	5.3	3.8	17.2	2.7	7.2	10.8	1.7
% filtered	55.7	39.0	62.8	54.8	40.5	30.4	18.8	3.2
% particulate	44.3	61.0	37.2	45.2	59.5	69.6	81.2	96.8

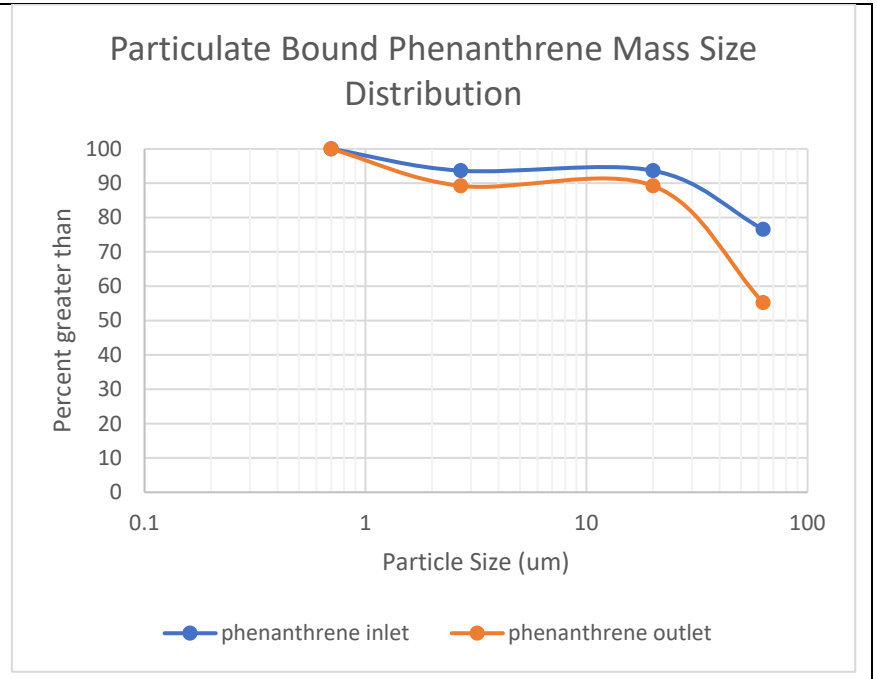
average of outlet samples	**chrysene**	**benzo(b)fluoranthene**	**benzo(k)fluoranthene**	**benzo(e)pyrene**	**indeno(123-cd)pyrene**	**benzo(ghi)perylene**	**Total PAH**
Total Particulate (>0.7 µm)	8.0	3.8	2.0	3.1	1.7	3.1	61.5
Filtered (<0.7µm)	0.6	0.1	0.1	0.1	0.1	0.1	30.5
Bulk	8.6	4.0	2.1	3.2	1.8	3.2	91.9
% filtered	6.5	3.7	5.7	2.7	6.8	2.7	33.1
% particulate	93.5	96.3	94.3	97.3	93.2	97.3	66.9

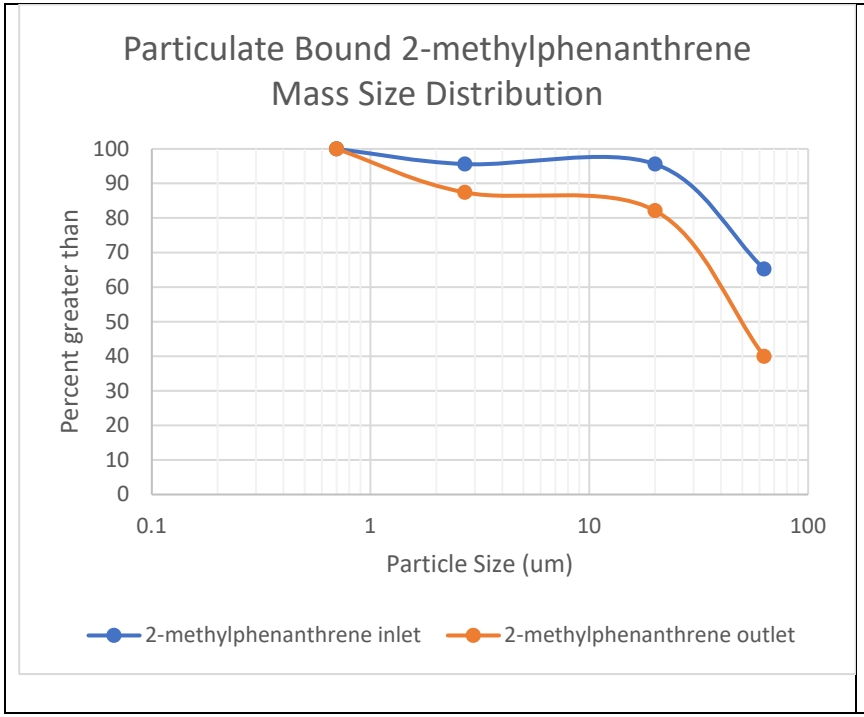
The following plots show the mass associations of PAHs by particle size. For many of the PAHs, the patterns are similar and show a general reduction of the median size associated with the 50th percentile of the mass, with most of the PAH mass associated with particles smaller than about 50 µm.

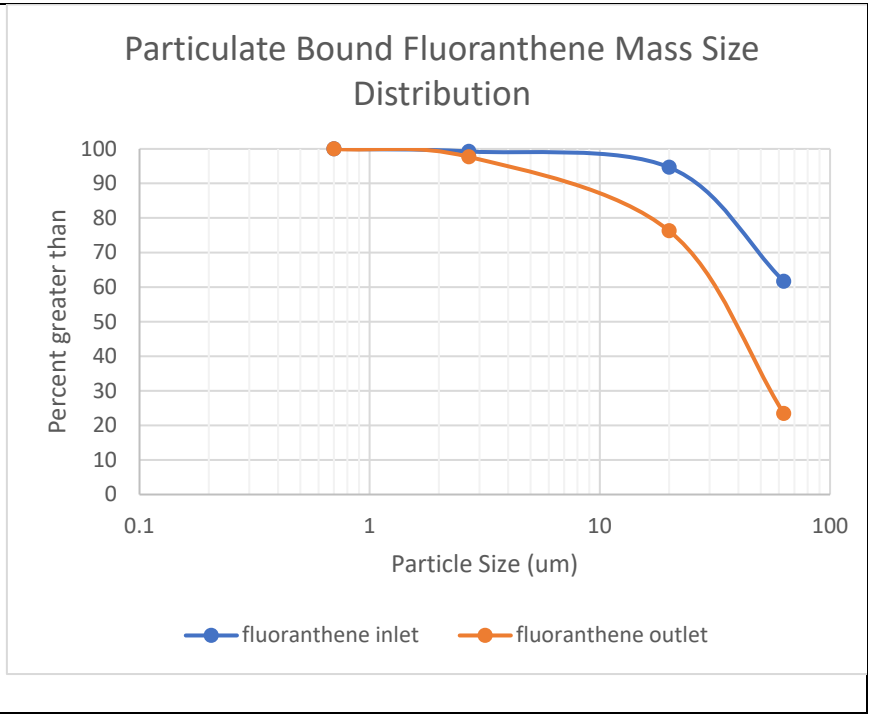


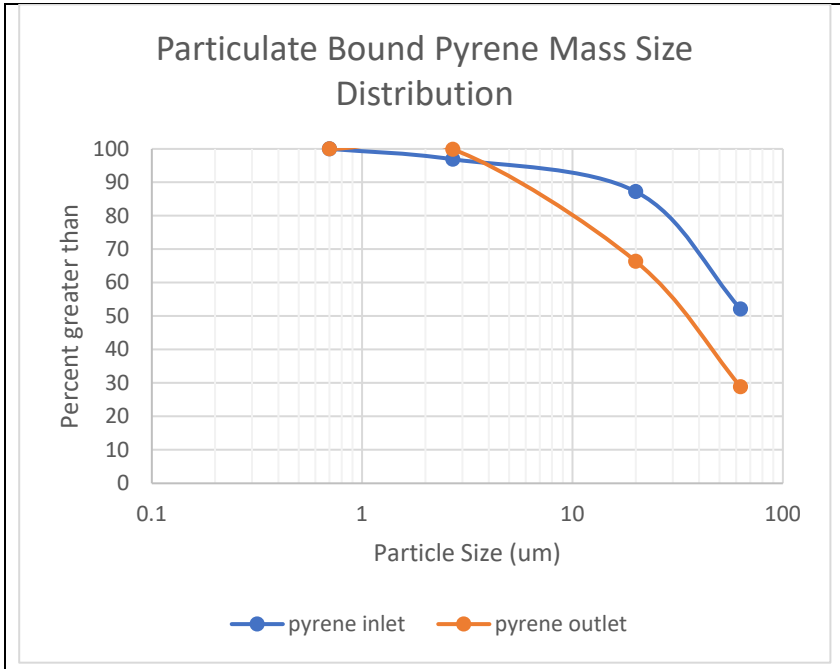


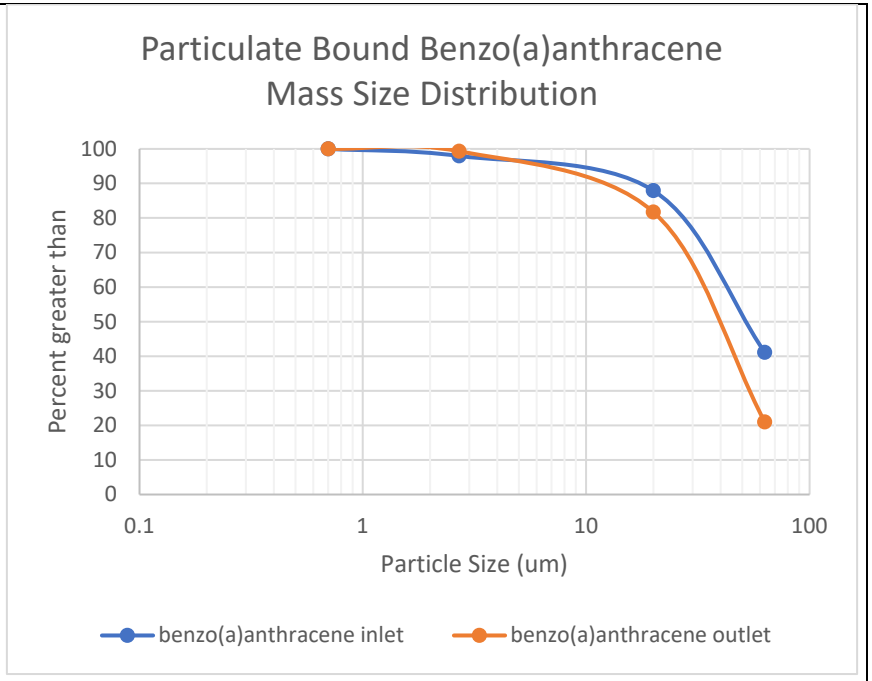

Particulate Bound Fluorene Mass Size Distribution
Percent greater than
100
90
80
70
60
50
40
30
20
10
0
0.1
1
10
100
Particle Size (um)
fluorene inlet
fluorene outlet

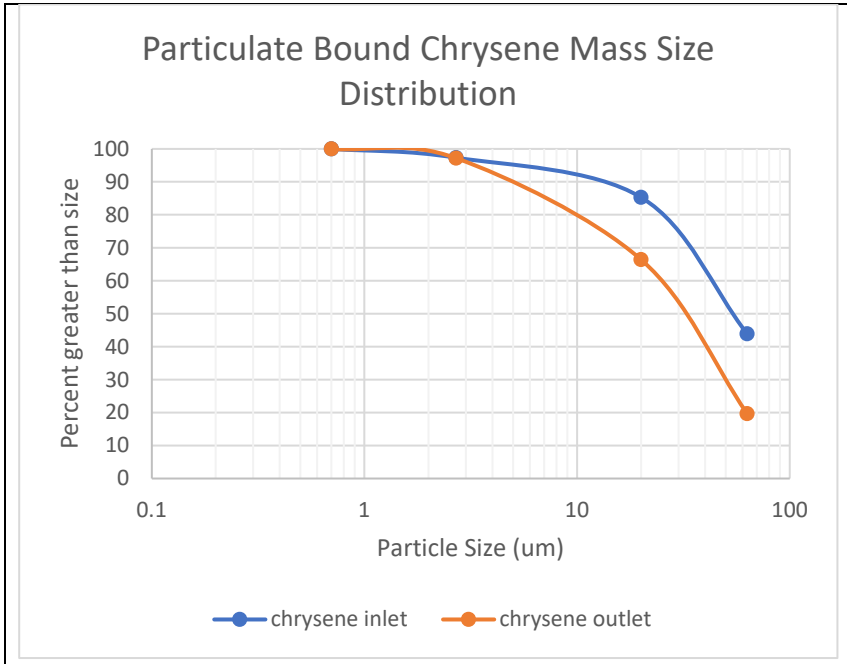

Particulate Bound Phenanthrene Mass Size Distribution
Percent greater than
100
90
80
70
60
50
40
30
20
10
0
0.1
1
10
100
Particle Size (um)
phenanthrene inlet
phenanthrene outlet

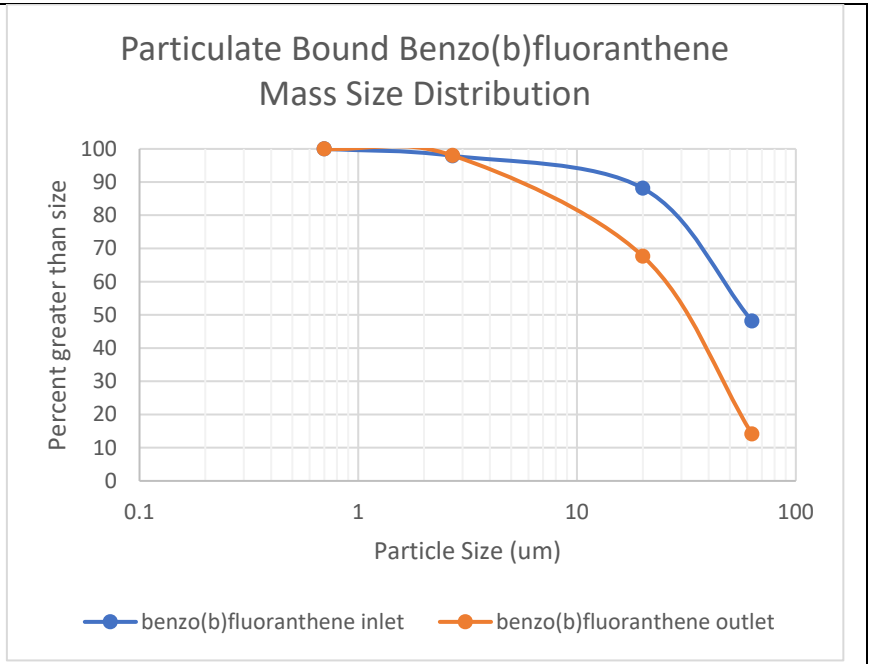

Particulate Bound 2-methylphenanthrene Mass Size Distribution
Percent greater than
100
90
80
70
60
50
40
30
20
10
0
0.1
1
10
100
Particle Size (um)
2-methylphenanthrene inlet
2-methylphenanthrene outlet

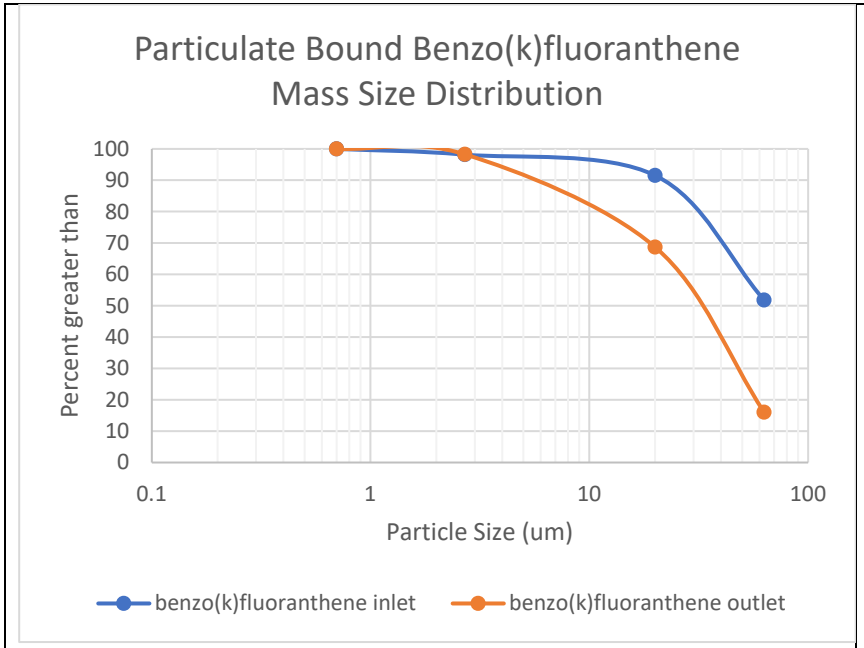

Particulate Bound Fluoranthene Mass Size Distribution
Percent greater than
100
90
80
70
60
50
40
30
20
10
0
0.1
1
10
100
Particle Size (um)
fluoranthene inlet
fluoranthene outlet

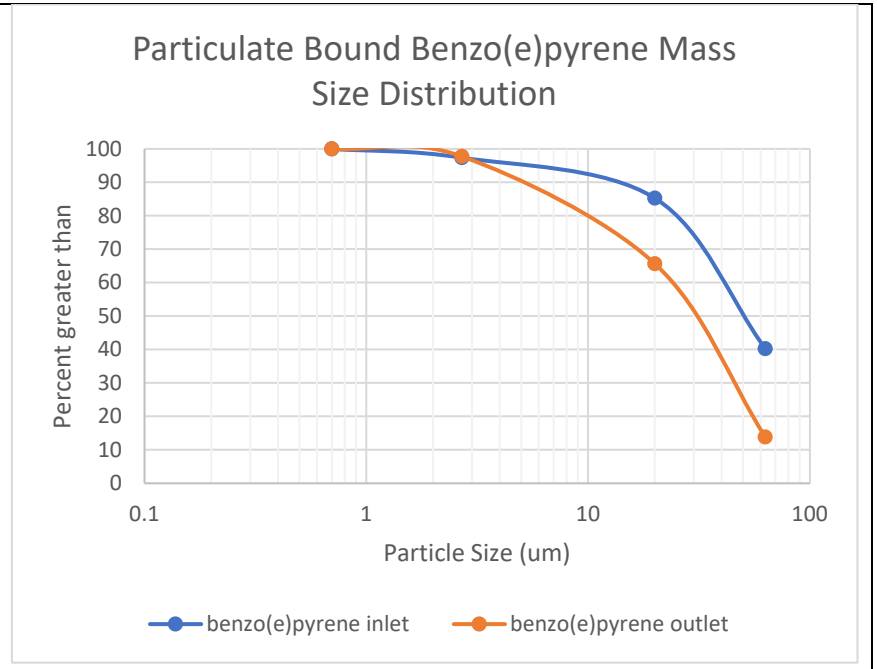

Particulate Bound Pyrene Mass Size Distribution
Percent greater than
100
90
80
70
60
50
40
30
20
10
0
0.1
1
10
100
Particle Size (um)
pyrene inlet
pyrene outlet

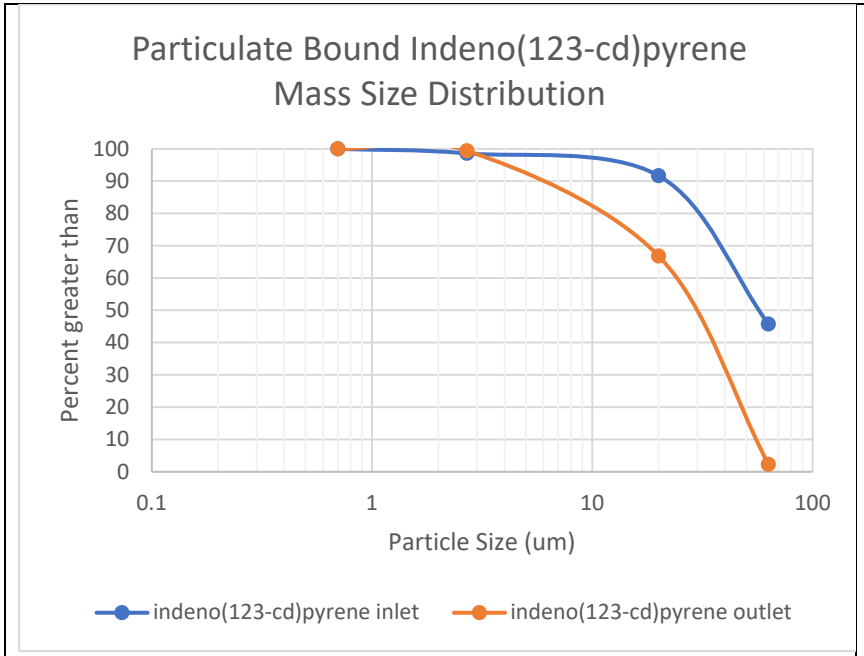

Particulate Bound Benzo(a)anthracene Mass Size Distribution
Percent greater than
100
90
80
70
60
50
40
30
20
10
0
0.1
1
10
100
Particle Size (um)
benzo(a)anthracene inlet
benzo(a)anthracene outlet

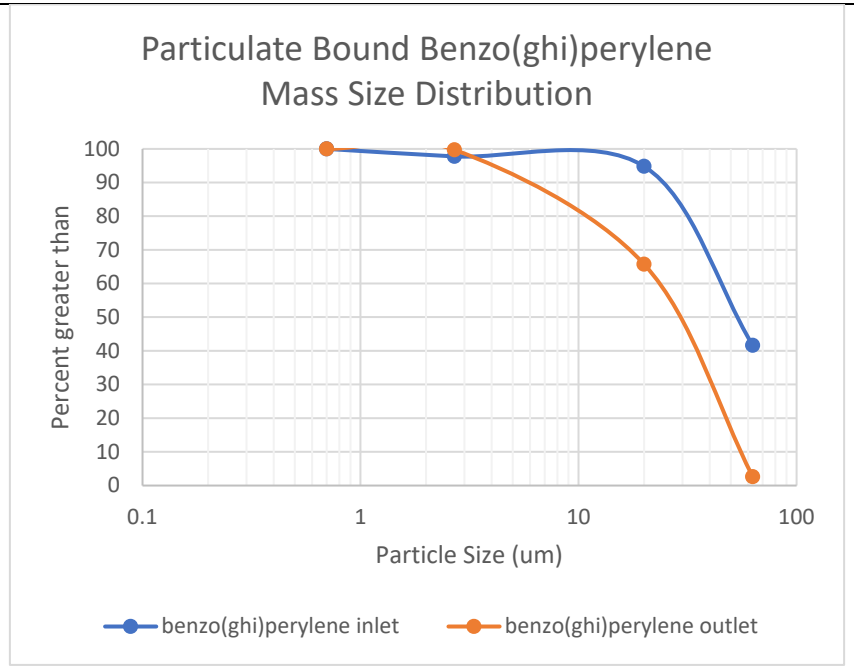

Particulate Bound Chrysene Mass Size Distribution
Percent greater than size
100
90
80
70
60
50
40
30
20
10
0
0.1
1
10
100
Particle Size (um)
chrysene inlet
chrysene outlet

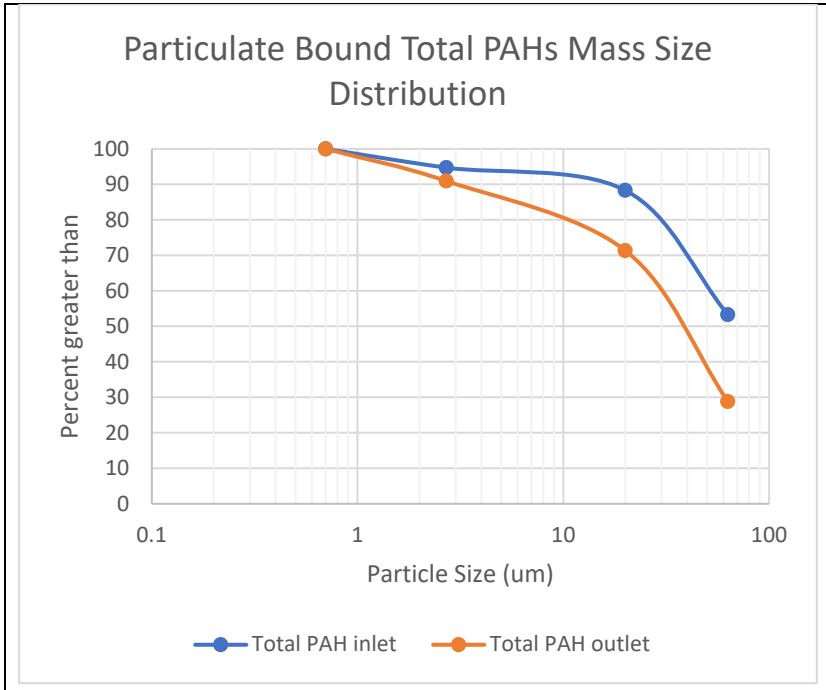

Particulate Bound Benzo(b)fluoranthene Mass Size Distribution
Percent greater than size
100
90
80
70
60
50
40
30
20
10
0
0.1
1
10
100
Particle Size (um)
benzo(b)fluoranthene inlet
benzo(b)fluoranthene outlet


Particulate Bound Benzo(k)fluoranthene Mass Size Distribution
Percent greater than
100
90
80
70
60
50
40
30
20
10
0
0.1
1
10
100
Particle Size (um)
benzo(k)fluoranthene inlet
benzo(k)fluoranthene outlet


Particulate Bound Benzo(e)pyrene Mass Size Distribution
Percent greater than
100
90
80
70
60
50
40
30
20
10
0
0.1
1
10
100
Particle Size (um)
benzo(e)pyrene inlet
benzo(e)pyrene outlet


Particulate Bound Indeno(123-cd)pyrene
Mass Size Distribution
Percent greater than
100
90
80
70
60
50
40
30
20
10
0
0.1
1
10
100
Particle Size (um)
indeno(123-cd)pyrene inlet
indeno(123-cd)pyrene outlet


Particulate Bound Benzo(ghi)perylene
Mass Size Distribution
Percent greater than
100
90
80
70
60
50
40
30
20
10
0
0.1
1
10
100
Particle Size (um)
benzo(ghi)perylene inlet
benzo(ghi)perylene outlet

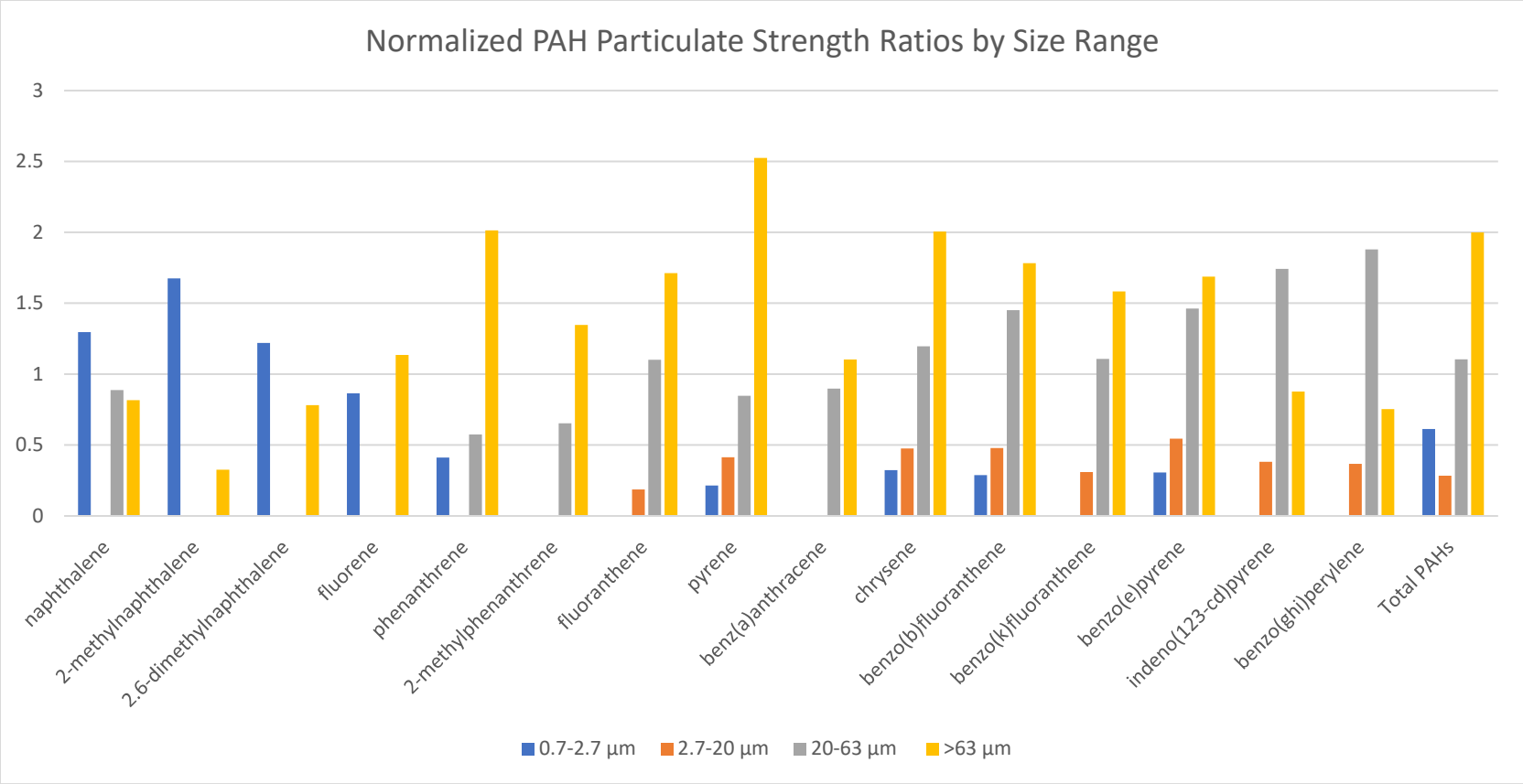


The following tables and figure show the particulate strengths for these PAHs by particle size. All samples were combined as the bioswale would not affect the particulate strengths in the size ranges. Many of these PAHs had their greatest particulate strengths associated with the largest size range (>63 µm), although many had non-detected values for some of the size ranges.

overall average	**naphthalene**	**2-methylnaphthalene**	**2.6-dimethylnaphthalene**	**fluorene**	**phenanthrene**	**2-methylphenanthrene**	**fluoranthene**	**pyrene**
0.7-2.7 µm (µg/kg)	0.2	1.1	0.2	0.1	0.3	nd	nd	0.2
2.7-20 µm (µg/kg)	nd	nd	nd	nd	nd	nd	0.1	0.3
20-63 µm (µg/kg)	0.1	nd	nd	nd	0.4	0.1	0.8	0.7
>63 µm (µg/kg)	0.1	0.2	0.1	0.2	1.4	0.2	1.3	2.0

Total Particulate (>0.7 µm) (µg/kg)	0.1	0.1	0.1	0.1	0.5	0.1	0.5	0.7

overall average	**benz(a)anthracene**	**chrysene**	**benzo(b)fluoranthene**	**benzo(k)fluoranthene**	**benzo(e)pyrene**	**indeno(123-cd)pyrene**	**benzo(ghi)perylene**	**Total PAHs**
0.7-2.7 µm (µg/kg)	nd	0.2	0.1	nd	0.1	nd	nd	2.8
2.7-20 µm (µg/kg)	nd	0.3	0.1	0.1	0.1	0.1	0.1	1.3
20-63 µm (µg/kg)	0.2	0.7	0.4	0.2	0.3	0.2	0.4	5.1
>63 µm (µg/kg)	0.2	1.2	0.5	0.3	0.4	0.1	0.2	9.2
Total Particulate (>0.7 µm) (µg/kg)	0.1	0.5	0.3	0.1	0.2	0.1	0.2	4.0



PFAS

The following table shows the PFAS compound data reported during the monitoring period. No filterable PFAS concentrations or values associated with different particle size ranges were available due to the low concentrations observed.

	PFPeA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUdA	PFOS

inlet average conc (>0.7µm) (ng/L)	nd	2.17	0.22	1.99	0.18	0.78	0.12	6.99
outlet average conc (>0.7µm) (ng/L)	1.38	2.44	nd	0.35	0.21	nd	nd	nd
overall particulate strength (mg/kg)	0.037	0.098	0.010	0.068	0.008	0.017	0.001	0.076

Comparisons with Historical Monitoring Data

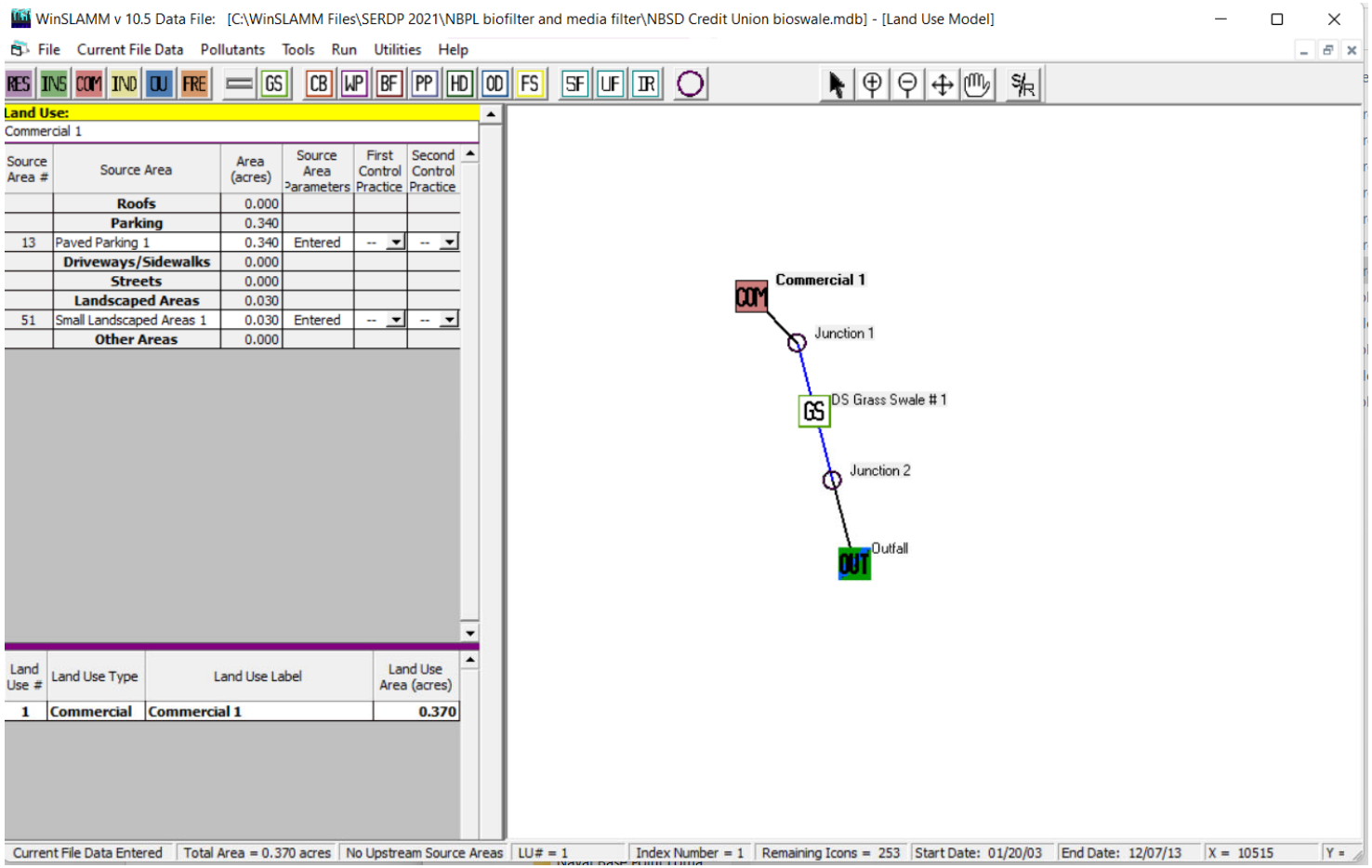
The following table compares the historical stormwater data for NBSD commercial areas as summarized by Katz, *et al*. (2018) with the average concentrations observed at the Federal Credit Union location for TSS, copper, lead, and zinc. The averages of the three inlet samples were within the range of the prior observed values, although on their lower portion of their distributions.

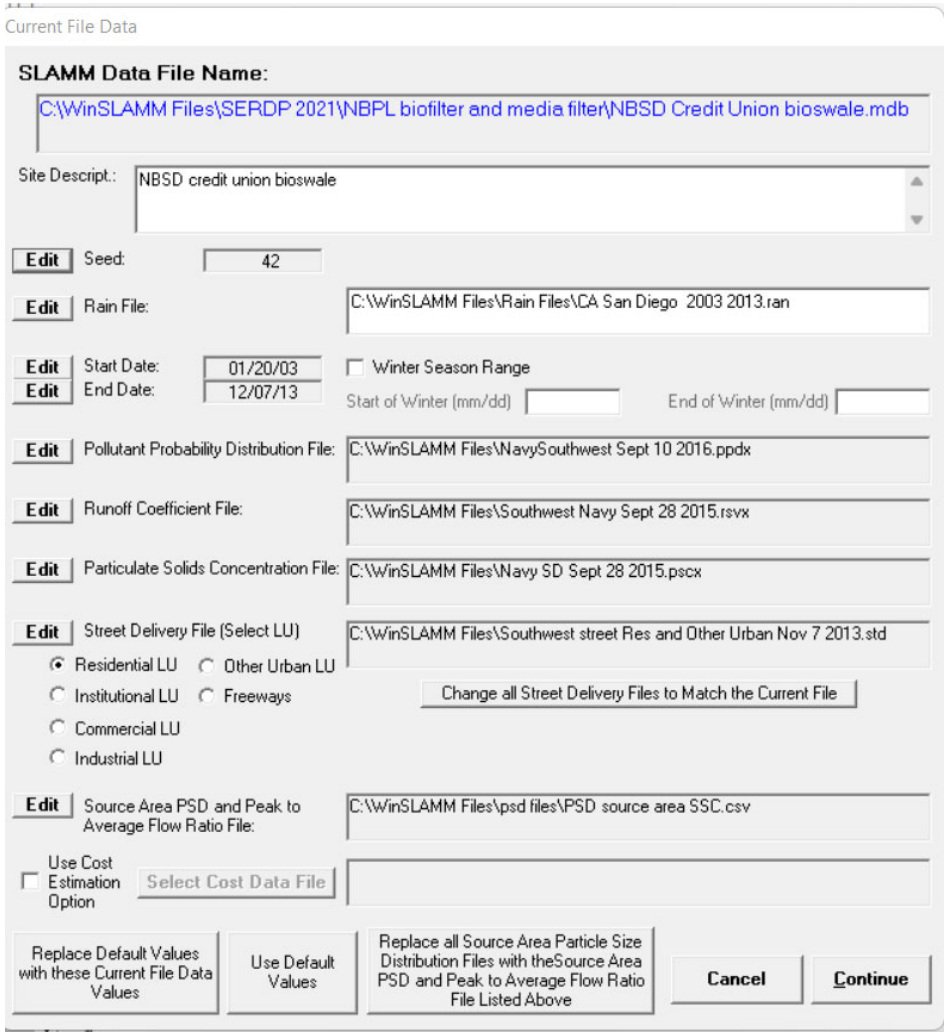
	historical data (9 reference samples)			Credit Union (3 inlet samples)
	average	minimum	maximum	average
TSS, mg/L	58	23	104	28
tota Cu, µg/L	258	29	711	181
filt Cu, µg/L	100	10	330	145
partic Cu, µg/L	158	13	544	36
% filterable Cu	46	16	94	80
% partic. Cu	54	6	84	20
overall partic strgth Cu, mg/kg	2,100	325	5,551	1,236
total Pb, µg/L	7.1	0.5	20.0	2.2
filt Pb, µg/L	2.2	1.0	5.0	1.2
partic Pb, µg/L	4.7	1.0	19.0	1.0
% filterable Pb	36	5	73	55
% partic. Pb	64	27	95	45
overall partic strgth Pb, mg/kg	104	23	250	64
total Zn, µg/L	226	80	472	166
filt Zn, µg/L	123	45	205	125

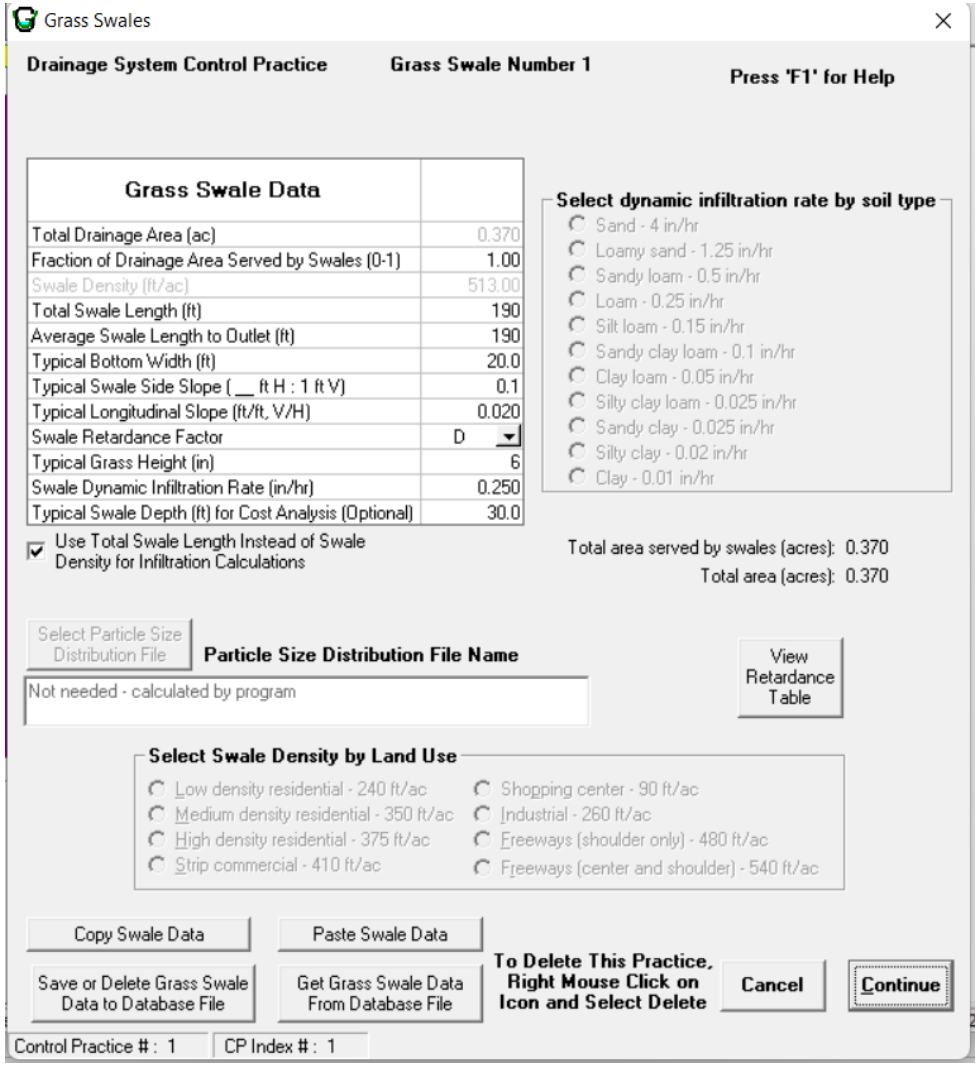
partic Zn, µg/L	104	20	267	41
% filterable Zn	61	37	90	75
% partic. Zn	39	10	63	25
overall partic strgth Zn, mg/kg	1,582	377	3,513	1,265 (average of 5 inlet and outlet samples)

Preliminary WinSLAMM Modeling

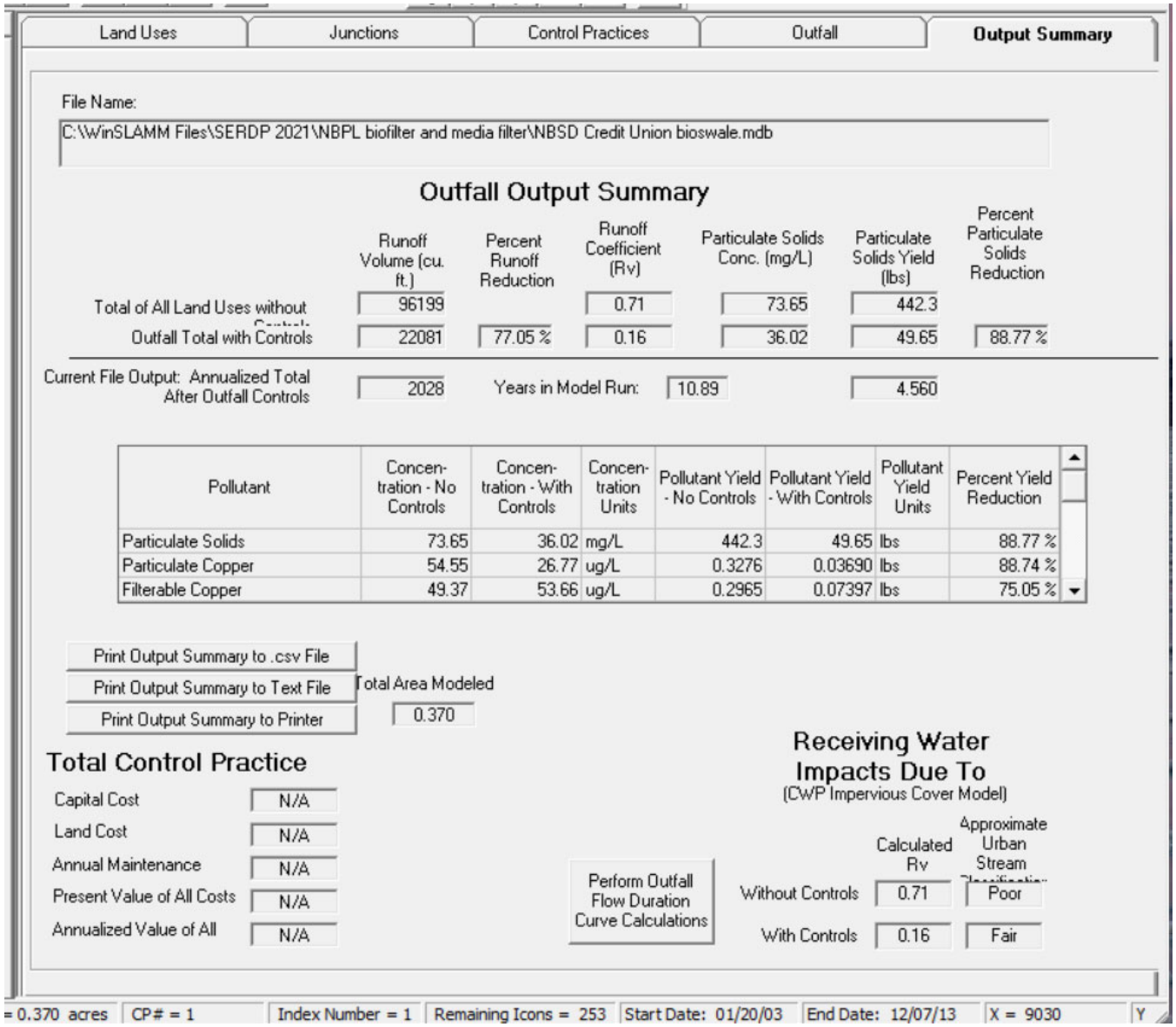
WinSLAMM was used to model the monitored Federal Credit Union location at NBSD, using the calibrated parameter files previously prepared for NBSD. The following screen shots show the site layout and input information used in these analyses.


WinSLAMM v 10.5 Data File: [C:\WinSLAMM Files\SERDP 2021\NBPL biofilter and media filter\NBSD Credit Union bioswale.mdb] - [Land Use Model]
File Current File Data Pollutants Tools Run Utilities Help
RES INS COM IND OU FRE GS CB WP BF PP HD OD FS SF UF IR
Land Use:
Commercial 1
Source Area # | Source Area | Area (acres) | Source Area Parameters | First Control Practice | Second Control Practice
Roofs 0.000
Parking 0.340
13 Paved Parking 1 0.340 Entered
Driveways/Sidewalks 0.000
Streets 0.000
Landscaped Areas 0.030
51 Small Landscaped Areas 1 0.030 Entered
Other Areas 0.000
Land Use # | Land Use Type | Land Use Label | Land Use Area (acres)
1 Commercial Commercial 1 0.370
COM
Commercial 1
Junction 1
GS
DS Grass Swale # 1
Junction 2
OUT
Outfall
Current File Data Entered
Total Area = 0.370 acres
No Upstream Source Areas
LU# = 1
Index Number = 1
Remaining Icons = 253
Start Date: 01/20/03
End Date: 12/07/13
X = 10515
Y =


Current File Data
SLAMM Data File Name:
C:\WinSLAMM Files\SERDP 2021\NBPL biofilter and media filter\NBSD Credit Union bioswale.mdb
Site Descript.:
NBSD credit union bioswale
Edit
Seed:
42
Edit
Rain File:
C:\WinSLAMM Files\Rain Files\CA San Diego 2003 2013.ran
Edit
Start Date:
01/20/03
Edit
End Date:
12/07/13
Winter Season Range
Start of Winter (mm/dd)
End of Winter (mm/dd)
Edit
Pollutant Probability Distribution File:
C:\WinSLAMM Files\NavySouthwest Sept 10 2016.ppdx
Edit
Runoff Coefficient File:
C:\WinSLAMM Files\Southwest Navy Sept 28 2015.rsvx
Edit
Particulate Solids Concentration File:
C:\WinSLAMM Files\Navy SD Sept 28 2015.pscx
Edit
Street Delivery File (Select LU)
C:\WinSLAMM Files\Southwest street Res and Other Urban Nov 7 2013.std
Residential LU
Other Urban LU
Institutional LU
Freeways
Commercial LU
Industrial LU
Change all Street Delivery Files to Match the Current File
Edit
Source Area PSD and Peak to Average Flow Ratio File:
C:\WinSLAMM Files\psd files\PSD source area SSC.csv
Use Cost Estimation Option
Select Cost Data File
Replace Default Values with these Current File Data Values
Use Default Values
Replace all Source Area Particle Size Distribution Files with theSource Area PSD and Peak to Average Flow Ratio File Listed Above
Cancel
Continue



The following screens show the overall output summary and the bioswale performance summaries.


Land Uses
Junctions
Control Practices
Outfall
Output Summary
File Name:
C:\WinSLAMM Files\SERDP 2021\NBPL biofilter and media filter\NBSD Credit Union bioswale.mdb
Outfall Output Summary
Runoff Volume (cu. ft.)
Percent Runoff Reduction
Runoff Coefficient (Rv)
Particulate Solids Conc. (mg/L)
Particulate Solids Yield (lbs)
Percent Particulate Solids Reduction
Total of All Land Uses without
96199
0.71
73.65
442.3
Outfall Total with Controls
22081
77.05 %
0.16
36.02
49.65
88.77 %
Current File Output: Annualized Total After Outfall Controls
2028
Years in Model Run:
10.89
4.560
Pollutant
Concentration - No Controls
Concentration - With Controls
Concentration Units
Pollutant Yield - No Controls
Pollutant Yield - With Controls
Pollutant Yield Units
Percent Yield Reduction
Particulate Solids 73.65 36.02 mg/L 442.3 49.65 lbs 88.77 %
Particulate Copper 54.55 26.77 ug/L 0.3276 0.03690 lbs 88.74 %
Filterable Copper 49.37 53.66 ug/L 0.2965 0.07397 lbs 75.05 %
Print Output Summary to .csv File
Print Output Summary to Text File
Print Output Summary to Printer
Total Area Modeled
0.370
Total Control Practice
Capital Cost N/A
Land Cost N/A
Annual Maintenance N/A
Present Value of All Costs N/A
Annualized Value of All N/A
Perform Outfall Flow Duration Curve Calculations
Receiving Water Impacts Due To
(CWP Impervious Cover Model)
Calculated Rv
Approximate Urban Stream
Without Controls 0.71 Poor
With Controls 0.16 Fair
= 0.370 acres
CP# = 1
Index Number = 1
Remaining Icons = 253
Start Date: 01/20/03
End Date: 12/07/13
X = 9030
Y

Data File: C:\WinSLAMM Files\Sl ter\NBSD Credit Union bioswale.mdb
Rain File: CA San Diego 2003 2(
Date: 08-07-22 Time: 2:21:26 PM
Site Description: NBSD credit unic

Col. #:	2	4	5	6	7	8	9	10	11	12
Control Practice No.	Control Practice Type	Total Inflow Volume (cf)	Total Outflow Volume (cf)	Percent Volume Reduction	Total Influent Load (lbs)	Total Effluent Load (lbs)	Percent Load Reduction	Flow Weighted Influent Conc (mg/L)	Flow Weighted Effluent Conc (mg/L)	Percent Conc. Reduction
1	Grass Swales	96198	22080	77.05	442.3	49.65	88.77	73.65	36.02	51.097

Data File: C:\WinSLAMM Files\S
Rain File: CA San Diego 2003 2(
Date: 08-07-22 Time: 2:21:26 PM
Site Description: NBSD credit unic

Col. #:	2	12	13	14	15	18	23	29	38	91
Control Practice No.	Control Practice Type	Percent Conc. Reduction	Influent Median Part. Size (microns)	Effluent Median Part. Size (microns)	Notes	Maximum Stage (ft)	Treated Volume (cf)	Volume Infiltrated (cf)	Maximum Velocity (ft/s)	Runoff Producing Events/ Ttl. Rains
1	Grass Swales	51.097	38.91	9.07		0.11	22080	74118	0.08	126/371

The following table compares the calculated concentrations for total, filtered, and particulate forms of TSS, Cu, Pb, and Zn, compared to the average monitored values. The monitored inlet TSS and total lead values were less than the calculated values, while the other constituents were within the expected range.

	J1 Average inlet conc	J1 Minimum inlet conc	J1 Maximum inlet conc	Average of 3 Credit Union inlet samples	J2 Average outlet conc	J2 Minimum outlet conc	J2 Maximum outlet conc	Average of 2 Credit Union outlet samples
TSS, mg/L	74	50	109	28	36	0	60	15

Copper, total, µg/L	104	31	486	181	80	0	268	46
Copper, filtered, µg/L	49	7	203	144	54	0	203	31
Copper, partic., µg/L	55	9	372	36	27	0	151	15
Copper, % filterable	47			80	68			68
Copper, % particulate	53			20	34			32
Lead, total, µg/L	23	7	107	2	12	0	20	2
Lead, filtered, µg/L	2	1	4	1	2	0	3	1
Lead, partic., µg/L	21	4	106	1	11	0	39	1
Lead, % filterable	9			55	17			28
Lead, % particulate	91			45	92			72
Zinc, total, µg/L	697	158	2,660	166	490	0	2,250	36
Zinc, filtered, µg/L	302	33	1,800	125	289	0	1,760	21
Zinc, partic., µg/L	395	107	1,570	40	201	0	714	15
Zinc, % filterable	43			76	59			59
Zinc, % particulate	57			24	41			41

Characteristics Affecting Fate and Transport

The following tables show the amounts of TSS, heavy metals, and PAHs associated with the particle size ranges related to near field, far field, and widely dispersed expected conditions. None of the outlet conditions show large (>70%) fractions of the pollutants associated with possible near-field deposition, while many of the metals would likely have most of their mass widely dispersed upon discharge, depending on water depth and velocities.

Transport and fate of discharged TSS and heavy metals

inlet	TSS	Chromium	Manganese	Nickel	Copper	Zinc	Arsenic	Cadmium	Lead
>63 µm (near field)	14.6	61.6	40.2	51.2	41.3	62.3	0.0	0.0	19.6
20 to 63 µm (far field)	24.4	17.4	33.6	3.0	7.7	6.8	15.2	0.0	9.5
<20 µm (widely dispersed)	61.0	21.0	26.2	45.8	51.0	30.9	84.8	100.0	71.0

outlet	TSS	Chromium	Manganese	Nickel	Copper	Zinc	Arsenic	Cadmium	Lead
>63 µm (near field)	22.6	48.4	23.4	12.4	12.1	32.2	0.0	4.2	8.4
20 to 63 µm (far field)	0.0	18.5	7.4	0.0	40.0	1.7	0.0	0.0	4.5
<20 γm (widely dispersed)	77.4	33.1	69.2	87.6	47.9	66.0	100.0	95.8	87.0

inlet	**naphthalene**	**2-methylnaphthalene**	**fluorene**	**phenanthrene**	**2-methylphenanthrene**	**fluoranthene**	**pyrene**	**benzo(a)anthracene**
>63 µm (near field)	28.8	28.1	40.5	76.6	65.3	61.7	52.1	41.1
20 to 63 µm (far field)	0.0	0.3	0.0	17.1	30.3	33.0	35.1	46.8
<20 µm (widely dispersed)	71.2	71.6	59.5	6.4	4.4	5.4	12.8	12.1

inlet	**chrysene**	**benzo(b)fluoranthene**	**benzo(k)fluoranthene**	**benzo(e)pyrene**	**indeno(123-cd)pyrene**	**benzo(ghi)perylene**	**Total PAH**
>63 µm (near field)	43.9	48.2	51.8	40.2	45.7	41.6	53.3
20 to 63 µm (far field)	41.4	40.0	39.8	45.0	46.0	53.2	35.0
<20 µm (widely dispersed)	14.7	11.9	8.5	14.8	8.3	5.2	11.7

outlet	**naphthalene**	**2-methylnaphthalene**	**fluorene**	**phenanthrene**	**2-methylphenanthrene**	**fluoranthene**	**pyrene**	**benzo(a)anthracene**

>63 µm (near field)	30.6	34.1	63.3	55.2	40.0	23.5	28.8	21.0
20 to 63 µm (far field)	63.2	8.9	12.7	34.0	42.1	52.8	37.5	60.8
<20 µm (widely dispersed)	6.2	57.1	23.9	10.8	17.9	23.7	33.7	18.3

outlet	**chrysene**	**benzo(b)fluoranthene**	**benzo(k)fluoranthene**	**benzo(e)pyrene**	**indeno(123-cd)pyrene**	**benzo(ghi)perylene**	**Total PAH**
>63 µm (near field)	19.7	14.1	16.1	13.8	2.3	2.6	28.8
20 to 63 µm (far field)	46.7	53.5	52.6	51.8	64.5	63.1	42.5
<20 µm (widely dispersed)	33.6	32.3	31.3	34.4	33.2	34.3	28.7