Additional Supporting Information, Data and Calculations for Laboratory and Full-Scale Stormwater Control Performance Comparisons and Long-Term Trends in Performance at the Santa Susana Field Laboratory

Contents

Summary of Contents of Appendices

The following material is supplemental information supporting analyses of long-term stormwater controls at SSFL, including analyses considering both comparisons of controlled laboratory experiments with the long-term full-scale field monitoring, and an examination of possible changes in performance with time at the stormwater controls. These appendices are:

- Appendix A: Stormwater Characteristics and Treatment Performance
- Appendix B: Line performance plots
- Appendix C: Influent and effluent concentration probability plots
- Appendix D: Influent and effluent concentration comparisons of laboratory column tests compared to full-scale field monitoring
- Appendix E: Performance regression equations from laboratory column tests and full-scale stormwater treatment facilities
- Appendix F: Influent and effluent concentration trends with time
- Appendix G: Particulate strength trends with time for Santa Susana Field Lab Stormwater Controls

Discussions of these data and appendices are included in two papers:

Pitt, R., M. Otto, A. Questad, S. Isaac, M. Colyar, B. Steets, R. Gearheart, J. Jones, M. Josselyn, M. Stenstrom, S. Clark, P. Costa and J. Wokurka. "Comparisons of laboratory media tests to long-term performance of biofilter, media filter and treatment train stormwater controls." *Journal of Sustainable Water in the Built Environment*. ASCE. In review.

Pitt, R., M. Otto, A. Questad, S. Isaac, M. Colyar, B. Steets, R. Gearheart, J. Jones, M. Josselyn, M. Stenstrom, P. Costa and J. Wokurka. "Changes in performance during long-term monitoring of full-scale stormwater controls at an industrial site." *Journal of Sustainable Water in the Built Environment.* ASCE. In review.

The following summaries describe the information in these appendices:

Appendix A: Stormwater Characteristics and Treatment Performance

Appendix A contains influent and effluent concentration (and percentage reduction) summaries for each of four stormwater treatment categories: (1) media filters and culvert modifications in prior industrial or developed areas B-1, CM-1, CM-9 and upper lot media filter, (2) Southern and Northern detention bioswales, (3) Lower lot biofilter with sedimentation control, and (4) ELV sedimentation and media filter treatment train, along with the background culvert modifications CM-8 and CM-11 control locations, for all of the monitored constituents. The summary tables in Appendix A also include the Wilcoxon Signed Rank test p value indicating the statistical significance of the differences in the influent and effluent concentrations.

Appendix B: Line performance plots

Appendix B contains grouped line plots for the primary constituents: TSS, TCDD TEQ no DNQ, total and filtered Cu, total and filtered Pb, conductivity, median particle size (few samples), pH, temperature, and turbidity. The stormwater controls were grouped as: background culvert modifications, prior industrial or developed area culvert modifications, detention bioswales with gravel filters, lower lot detention and biofilter, and ETV sedimentation and media filter treatment train. These line plots show how the constituent concentrations varied from the influent to the effluent for each monitored event. The lower lot system and the ETV treatment train also have intermediate sampling locations, enabling the performances of the sedimentation and media filter unit processes to be separated.

Appendix C: Influent and effluent concentration probability plots

Appendix C includes paired probability plots prepared using MiniTab (version 18) that indicate the concentration distributions for influent and effluent (and mid point) for the four categories of SSFL stormwater controls. All of the culvert modification data were combined (instead of keeping the background locations separate) as the treatment processes are all the same and combining the background data with the industrial locations expanded the range of influent concentrations and corresponding effluent values indicating how these controls function under low to high concentration conditions. These plots are for: TSS, TCDD, total and filtered Cu, total and filtered Pb, total and filtered Cd, filtered Hg, conductivity, median particle size, pH, temperature, and turbidity. These plots indicate the relative differences between the influent and effluent concentrations and show the best fit probability line and 95% confidence limits for each distribution. All of these are plotted on log-probability scales, except for pH (which is already a log scale). Also noted on these plots are the

Anderson-Darling test statistics and corresponding p values. If the p value is smaller than 0.05, the distribution can be considered significantly different from a log-normal distribution (a straight line on these plots). Most of the statistical tests conducted using these data are non-parametric and are less sensitive to the distribution types than parametric statistical tests.

Appendix D: Influent and effluent concentration comparisons of laboratory column tests compared to full-scale field monitoring

Appendix D contains comparisons of influent and effluent concentrations from the controlled laboratory column tests compared to the full-scale field monitoring. Available data include the following constituents: TSS, TCDD TEQ no DNQ, total and filtered copper and lead, and total cadmium and chromium. Grouped box and whisker plots for culvert modifications in background locations, lower lot sedimentation and biofilter, detention bioswales, ELV sedimentation and media filter treatment train, culvert modifications and other media filters in developed or industrial areas, and the laboratory column results for the R-SMZ-GAC media. These box plots are also coded by Tukey groups indicating similar values for the influent and effluent concentrations across the sample groups. The summary tables are divided into influent, effluent, and percent reduction sections for each of the 6 groups (some constituents are missing data from the background culvert modifications group) and show the sample counts and summary statistics, including the Kruskal Wallis values and the Tukey groups.

Appendix E: Performance regression equations from laboratory column tests and full-scale stormwater treatment facilities

Appendix E summarizes the results of the statistical analyses examining the relationships between the influent and effluent concentrations at the field locations. Three types of observations were noted:

1) The constituents having statistically significant removals based on the Wilcoxon Signed Rank Test ($p < 0.05$) were further examined using regression analyses (first-order polynomials), with ANOVA and residual analyses (using combinations of Microsoft Excel, Minitab ver 18 and SigmaPlot ver 14). The resulting equation coefficients were examined by ANOVA to determine the significance of the coefficients and the overall equation. If the intercept term was not significant ($p > 0.05$), it was removed from the equation which was then re-evaluated, forcing the regression through the plot's origin. If the final equation was significant based on ANOVA, residuals were calculated and examined. Equations were examined using $\log_{10}$ transformed influent and effluent concentrations and non-transformed concentration data.

2) The second scenario is when the influent vs. effluent scatterplot indicates a relatively constant effluent concentration (also confirmed by the grouped probability plots in Appendix C, and if the paired Wilcoxon Signed Rank test indicated significant differences between influent and effluent concentrations ($p < 0.05$). This scenario occurred when the slope coefficient and overall equation were not significant using ANOVA. Under this condition, the effluent concentrations are assumed to be constant, with no change associated with influent concentrations.

3) The third scenario is when the Wilcoxon Signed Rank test had a large p value ($p > 0.05$) indicating that the differences between the influent and effluent concentrations could not be

distinguished based on the number of data observations available. In these cases, it is assumed that the effluent concentrations were the same as the influent concentrations.

Table E-1 show the influent vs. effluent regression equation statistics for the different constituents and control measure group for the full-scale field controls. Table E-2 lists similar regression equation statistics for the laboratory column tests for many tested constituents.

Appendix F: Influent and effluent concentration trends with time

Appendix F contains long-term time series plots of the influent data from locations having historical industrial activity (or significant pavement or buildings) combined and plotted with time (CM-8 and CM-11 background data were not used) and effluent concentrations for the separate control categories. Regression analyses with ANOVA were conducted to identify statistically significant slope terms of the time series line. The horizontal scale is the years since the control was put in operation while the vertical scale is the concentration. Significant slope terms in the equations ($p < 0.05$) are noted on the figures.

Appendix G: Particulate strength trends with time for Santa Susana Field Lab Stormwater Controls

Appendix G contains summary tables, trend plots, and statistical analyses of the time series of particulate strengths vs. time since the control was operational. If the ANOVA analyses of the regressions indicated significant regression equations and significant equation coefficients, those regression lines and resulting equations were plotted on the time series plots. In some cases, too few influent or effluent data were available to allow the statistical analyses. Summary tables include the sampling period, the number of samples, the median particulate strengths, and the coefficients of variation (COV) of the particulate strengths. The summary tables also include the significance of the regressions and the coefficients, along with comments. In many cases, statistically significant particulate strength intercept values were observed, while the trends were not statistically significant. This would result in parallel lines representing the constant (average) particulate strength values with time.

Appendix A: Stormwater Characteristics and Treatment Performance

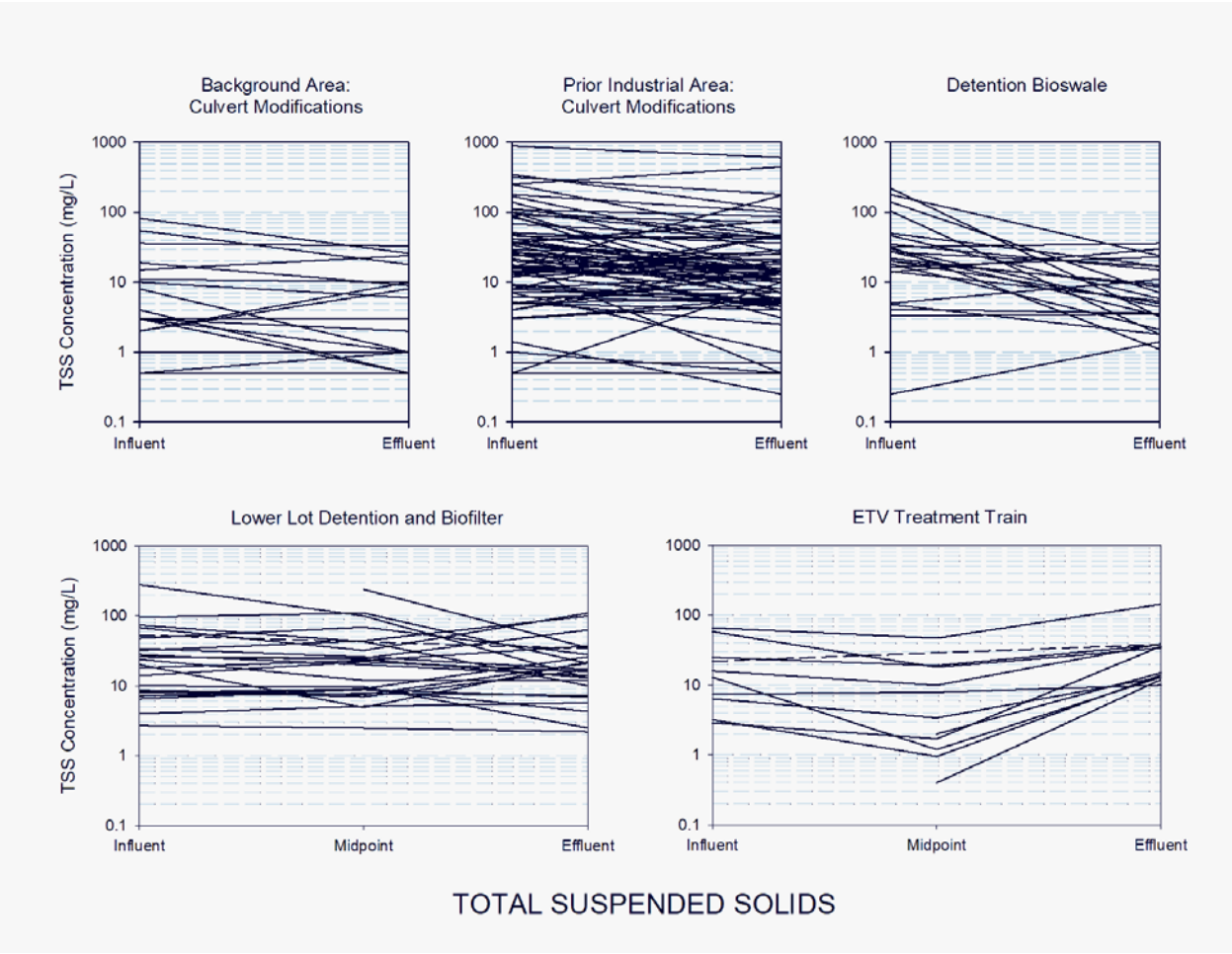
Control Location		Sample Date	TSS inf mg/L	TSS efl mg/L	TSS % reduc	TCDD inf ug/L	TCDD efl ug/L	TCDD % reduc	Cu inf ug/L	Cu efl ug/L	Cu % reduc	filt Cu inf ug/L	filt Cu efl ug/L	filt Cu % reduc
CM8 and CM11 (background locations)	count	22	22	22	18	12	12	2	0	0	0	0	0	0
	% ND		14	23		75	75							
	min	1/20/2010	1	1		1.0E-12	1.0E-12							
	max	3/21/2011	82	33		3.7E-10	3.5E-10							
	median		3	3		1.0E-12	1.0E-12							
	COV		1.57	1.22		2.04	1.99							
	Wilcoxon Signed Rank Test				0.090			0.450						
B1, CM1, CM9, and ULBF	count	126	118	88	74	111	81	56	99	62	56	88	43	38
	% ND		7	9		20	26		1	3		0	0	
	min	12/11/2009	1	1		1.0E-12	1.0E-12		0.1	0.1		1.0	0.9	
	max	3/22/2018	1,800	610		3.6E-04	4.3E-06		39.7	22.0		20.0	8.5	
	median		16	13	37.3	5.9E-08	2.6E-09	73.4	5.2	4.1	20.8	3.2	3.2	19.4
	COV		3.02	2.38		9.91	4.01		0.89	0.68		0.76	0.55	
	Wilcoxon Signed Rank Test				<0.001			<0.001			<0.001			<0.001
Southern and Northern bioswales	count	38	25	36	23	26	36	20	26	36	24	26	36	24
	% ND		4	0		12	44		0	0		0	0	
	min	5/15/2015	1	1		1.0E-12	1.0E-12		1.3	5.8		0.7	3.8	
	max	3/2/2018	220	36		2.1E-05	1.9E-07		44.9	53.0		164.1	47.0	
	median		27	6	62.5	6.6E-08	1.6E-10	99.7	8.9	16.0	-42.5	5.2	12.0	-87.4
	COV		1.24	0.94		3.31	3.08		0.91	0.59		2.50	0.65	
	Wilcoxon Signed Rank Test				<0.001			<0.001			0.007			0.004
Lower Lot Biofilter	count	25	24	25	24	24	25	24	24	25	24	24	25	24
	% ND		0	0		0	28		0	0		0	0	
	min	3/8/2013	3	2		3.8E-10	1.0E-12		5.9	5.0		3.8	1.6	
	max	3/2/2018	280	110		4.7E-07	1.5E-07		32.0	14.0		15.0	12.0	
	median		22	17		7.6E-08	2.2E-10	99.6	10.0	9.2		8.4	7.2	23.3
	COV		1.52	1.08		1.07	2.92		0.45	0.26		0.35	0.40	
	Wilcoxon Signed Rank Test				0.550			<0.001			0.120			0.003
ELV Treatment Train	count	13	10	13	10	10	13	9	9	11	7	10	13	10
	% ND		0	0		0	38		22	27		0	0	
	min	2/28/2014	3	7		1.1E-10	1.0E-12		0.1	0.1		1.6	1.3	
	max	3/22/2018	66	144		1.2E-07	4.4E-08		17.2	5.3		10.1	3.7	
	median		15	15		5.3E-09	1.2E-10	99.3	5.6	2.4	56.4	4.2	2.1	42.8
	COV		1.02	1.13		1.66	3.50		0.88	0.72		0.64	0.30	
	Wilcoxon Signed Rank Test				0.074			0.004			0.031			0.014

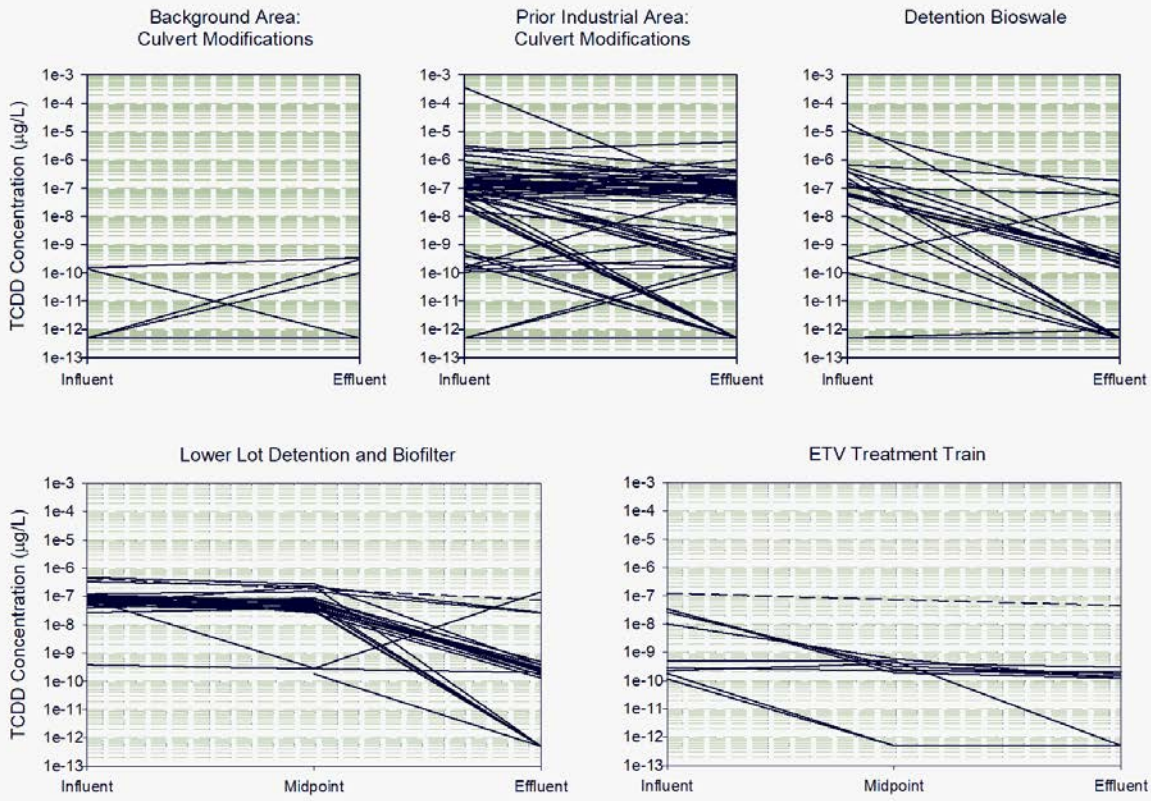
Control Location			Pb inf ug/L	Pb efl ug/L	Pb % reduc	filt Pb inf ug/L	filt Pb efl ug/L	filt Pb % reduc	Cd inf ug/L	Cd efl ug/L	Cd % reduc	filt Cd inf ug/L	filt Cd efl ug/L	filt Cd % reduc
CM8 and CM11	count		10	10	9	0	0	0	0	0	0	0	0	0
	% ND		10	20										
	min		0.2	0.2										
	max		11.0	7.0										
	median		0.6	0.3										
	COV		1.39	1.36										
	Wilcoxon Signed Rank Test				>0.5									
B1, CM1, CM9, and ULBF	count		117	88	70	88	43	19	101	65	28	88	43	7
	% ND		10	8		41	56		61	83		85	98	
	min		0.1	0.1		0.1	0.1		0.1	0.1		0.1	0.1	
	max		55.0	39.0		12.0	0.8		1.1	0.5		0.5	0.3	
	median		3.0	1.8	39.2	0.5	0.5	45.9	0.3	0.2	31.9	0.2	0.3	18.2
	COV		1.67	1.63		1.64	0.40		0.69	0.49		0.43	0.35	
	Wilcoxon Signed Rank Test				<0.001			<0.001			<0.001			0.004
Southern and Northern bioswales	count		26	36	22	26	36	5	26	36	17	26	36	11
	% ND		8	14		77	86		31	100		54	94	
	min		0.5	0.5		0.5	0.5		0.3	0.3		0.3	0.3	
	max		23.3	3.0		26.4	5.0		6.2	1.3		4.9	2.5	
	median		2.8	1.3	62.0	0.5	0.5		0.5	0.3	65.9	0.3	0.3	17.9
	COV		1.06	0.51		3.01	0.98		1.43	0.60		1.67	1.08	
	Wilcoxon Signed Rank Test				<0.001			0.063			<0.001			0.042
Lower Lot Biofilter	count		24	25	24	24	25	3	24	25	3	24	25	2
	% ND		0	0		88	48		88	100		92	96	
	min		0.8	0.7		0.3	0.4		0.3	0.1		0.3	0.1	
	max		20.0	5.6		2.5	2.5		0.8	0.5		1.3	1.3	
	median		2.0	2.6		0.5	0.5		0.3	0.3		0.3	0.3	
	COV		1.22	0.54		0.80	0.63		0.42	0.27		0.72	0.76	
	Wilcoxon Signed Rank Test				0.880			1.000			0.250			0.500
ELV Treatment Train	count		10	13	10	10	13	10	10	13	2	10	13	2
	% ND		0	0		0	8		80	92		80	92	
	min		0.8	0.6		0.2	0.1		0.1	0.1		0.1	0.1	
	max		50.2	3.7		1.0	1.3		0.3	0.3		0.6	0.5	
	median		3.6	1.3	34.4	0.5	0.4		0.1	0.1		0.1	0.1	
	COV		1.81	0.58		0.47	0.78		0.34	0.25		0.78	0.61	
	Wilcoxon Signed Rank Test				0.008			0.084			0.500			1.000

Control Location			Hg inf ug/L	Hg efl ug/L	Hg % reduc	filt Hg inf ug/L	filt Hg efl ug/L	filt Hg % reduc	Cond inf mS	Cond efl mS	Cond % reduc	Grain size inf um	Grain size efl um	Grain size % reduc
CM8 and CM11	count		0	0	0	0	0	0	20	20	19	0	0	0
	% ND								0	0				
	min								0.006	0.001				
	max								0.300	0.133				
	median								0.077	0.078				
	COV								0.73	0.53				
	Wilcoxon Signed Rank Test										0.210			
B1, CM1, CM9, and ULBF	count		102	65	6	87	43	2	105	82	70	16	7	7
	% ND		93	89		95	95		0	0		0	0	
	min		0.05	0.05		0.05	0.05		0.010	0.014		7.1	6.7	
	max		0.98	1.70		0.49	0.10		1.800	0.757		100.7	71.1	
	median		0.10	0.10		0.10	0.10		0.074	0.078	15.4	31.6	10.0	
	COV		0.86	1.57		0.58	0.18		1.52	1.19		0.66	1.08	
	Wilcoxon Signed Rank Test				0.44			0.50			0.006			0.270
Southern and Northern bioswales	count		26	36	0	26	36	0	23	34	19	17	12	9
	% ND		100	94		100	94		0	0		0	0	
	min		0.10	0.10		0.10	0.10		0.005	0.008		7.9	4.9	
	max		0.11	0.24		0.11	0.12		0.913	1.330		347.1	24.6	
	median		0.10	0.10		0.10	0.10		0.064	0.223		15.1	14.5	
	COV		0.02	0.22		0.01	0.05		1.56	0.94		1.59	0.41	
	Wilcoxon Signed Rank Test										0.053			0.120
Lower Lot Biofilter	count		24	25	1	24	25		24	24	23	9	9	8
	% ND		96	100		100	100		0	0		0	0	
	min		0.10	0.10		0.10	0.10		0.006	0.056		1.0	0.0	
	max		0.20	0.10		0.10	0.10		0.400	0.799		16.2	47.7	
	median		0.10	0.10		0.10	0.10		0.110	0.155		13.4	2.9	
	COV		0.26	0.00		0.00	0.00		0.76	0.85		0.37	1.90	
	Wilcoxon Signed Rank Test										0.086			0.300
ELV Treatment Train	count		10	13		8	12		7	7	7			
	% ND		100	92		100	92		0	0				
	min		0.05	0.05		0.05	0.05		0.020	0.042				
	max		0.10	0.10		0.10	0.10		0.053	0.129				
	median		0.05	0.05		0.05	0.05		0.030	0.076	-194.1			
	COV		0.34	0.36		0.37	0.31		0.38	0.40				
	Wilcoxon Signed Rank Test										0.031			

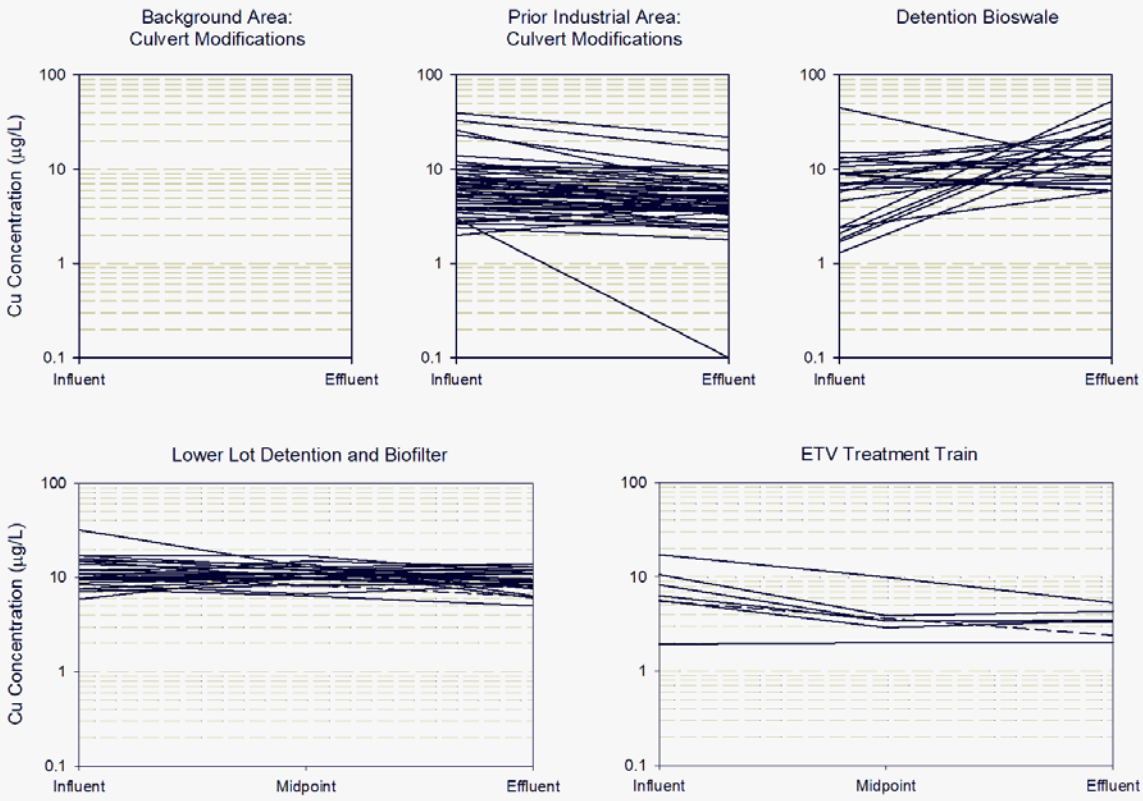
Control Location			pH inf	pH efl	pH % reduc	Temp inf oC	Temp efl oC	Temp % reduc	Turb inf NTU	Turb efl NTU	Turb % reduc
CM8 and CM11 (background locations)	count		20	20	19	18	18	17	17	18	13
	% ND		0	0		0	0		0	0	
	min		5.8	5.9		9.8	9.3		0.5	2.0	
	max		7.7	7.4		17.7	15.4		111.0	112.0	
	median		6.8	6.8		10.9	11.0		13.0	25.1	
	COV		0.07	0.06		0.18	0.15		1.17	0.92	
	Wilcoxon Signed Rank Test				0.310			0.470			0.590
B1, CM1, CM9, and ULBF	count		107	82	72	102	79	69	104	77	68
	% ND		0	0		0	0		0	0	
	min		4.2	4.6		6.5	5.9		0.2	0.2	
	max		7.9	7.9		20.0	21.1		777.0	961.0	
	median		6.6	6.6		11.4	11.6		37.5	47.5	
	COV		0.13	0.11		0.22	0.20		1.44	1.80	
	Wilcoxon Signed Rank Test				0.290			0.730			0.460
Southern and Northern bioswales	count		23	34	20	21	26	17	23	34	20
	% ND		0	0		0	0		0	0	
	min		3.8	5.2		7.0	7.7		2.1	0.1	
	max		7.3	7.9		21.3	23.5		151.9	139.0	
	median		5.2	6.5	-25.1	11.7	12.5	-3.4	44.6	17.6	
	COV		0.17	0.09		0.29	0.31		0.74	1.06	
	Wilcoxon Signed Rank Test				<0.001			0.008			0.110
Lower Lot Biofilter	count		24	24	23	23	23	22	24	24	23
	% ND		0	0		0	0		0	0	
	min		5.4	5.8		7.5	8.0		5.9	11.0	
	max		8.0	8.0		21.3	22.1		900.0	311.0	
	median		7.0	6.9		13.0	13.2		35.2	85.3	-75.6
	COV		0.12	0.08		0.22	0.21		1.87	0.79	
	Wilcoxon Signed Rank Test				0.900			0.870			0.030
ELV Treatment Train	count		7	7	7	7	7	7	7	7	7
	% ND		0	0		0	0		0	0	
	min		6.3	6.1		6.7	6.8		2.3	35.0	
	max		7.7	8.2		13.4	13.0		250.0	191.0	
	median		7.3	7.2		12.2	12.0		72.6	95.2	
	COV		0.07	0.10		0.25	0.21		1.08	0.61	
	Wilcoxon Signed Rank Test				0.690			0.940			0.300

Appendix B: Line Performance Plots

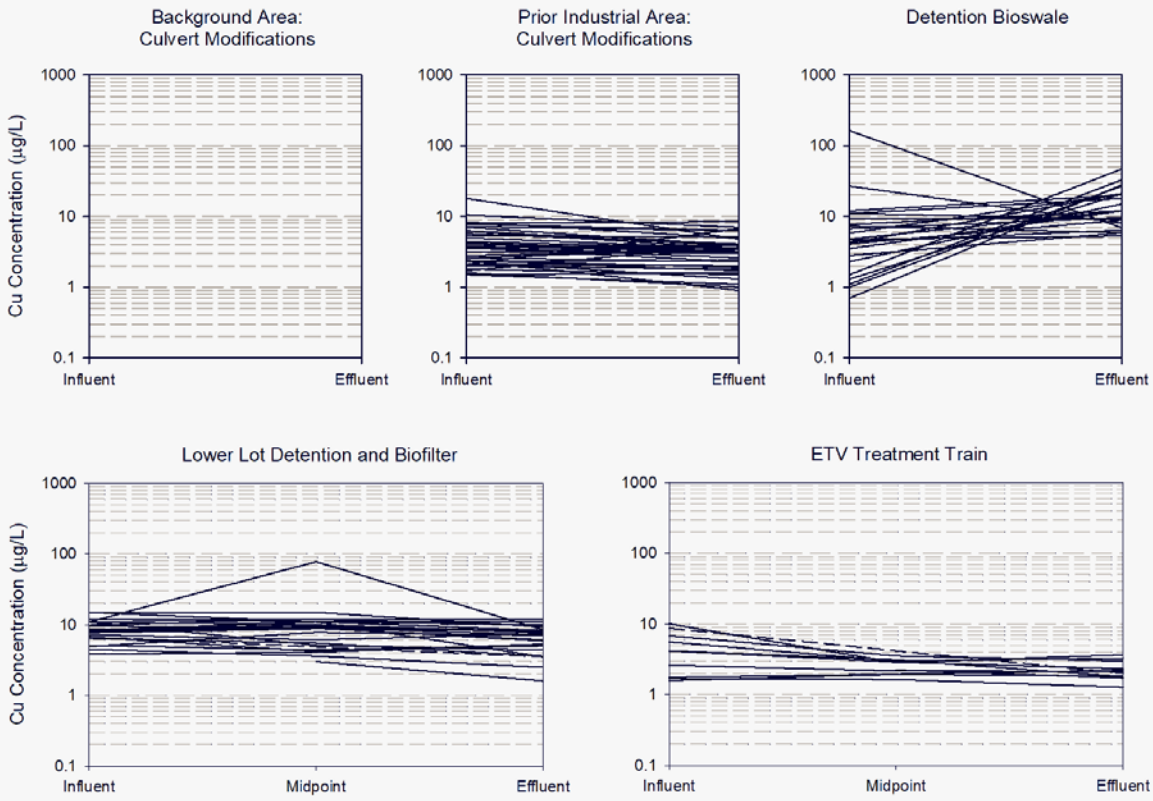



Background Area:
Culvert Modifications
Prior Industrial Area:
Culvert Modifications
Detention Bioswale
Lower Lot Detention and Biofilter
ETV Treatment Train
TCDD Concentration (µg/L)
1e-3
1e-4
1e-5
1e-6
1e-7
1e-8
1e-9
1e-10
1e-11
1e-12
1e-13
Influent
Midpoint
Effluent

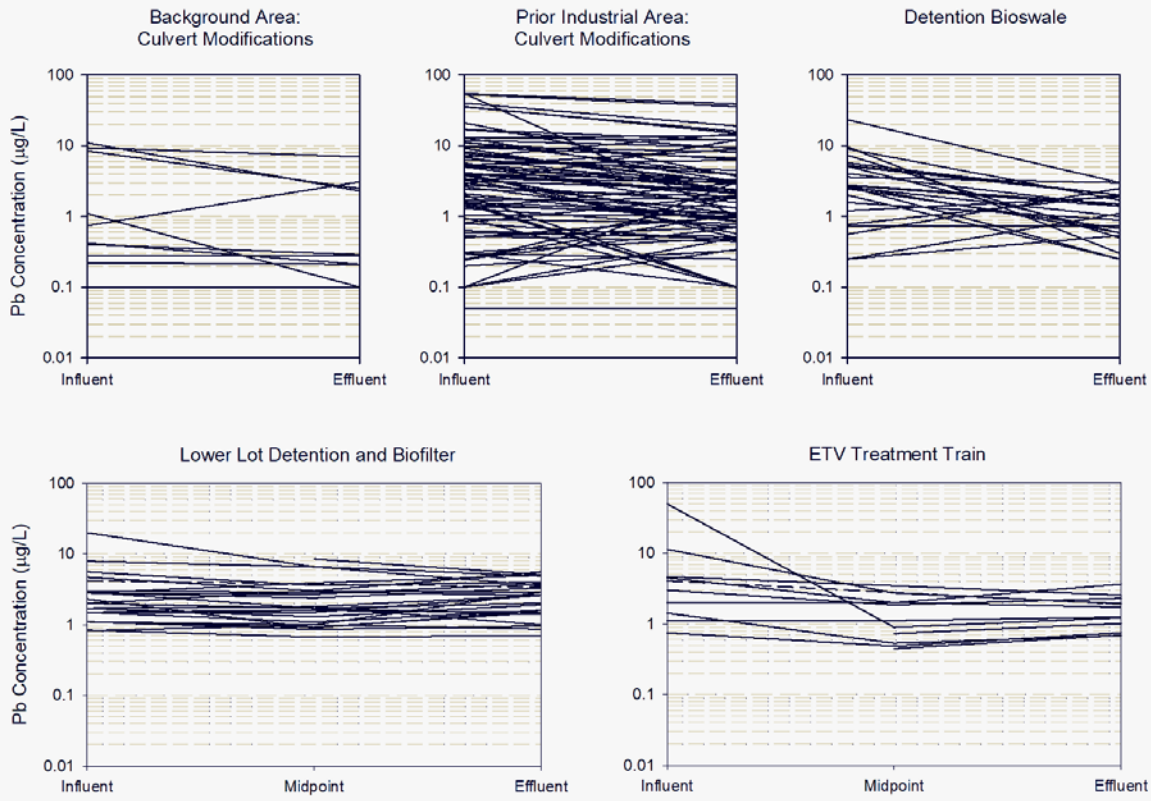
TCDD



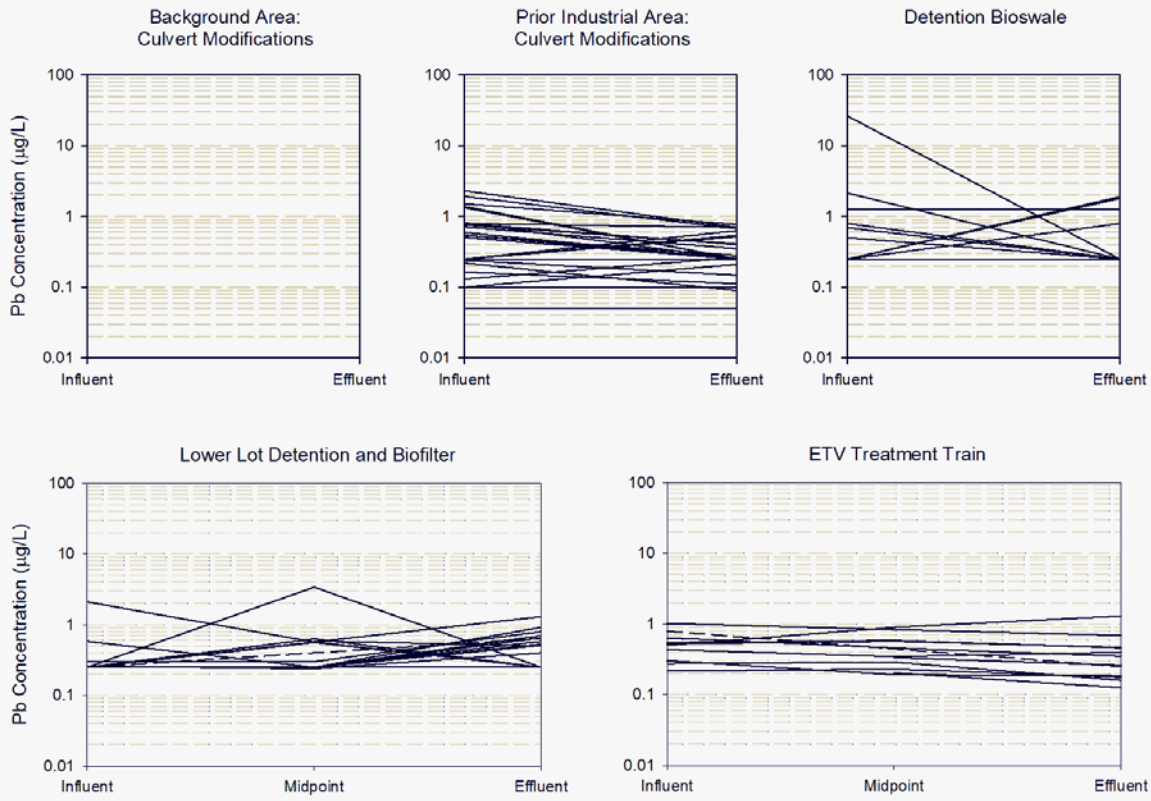
COPPER, TOTAL



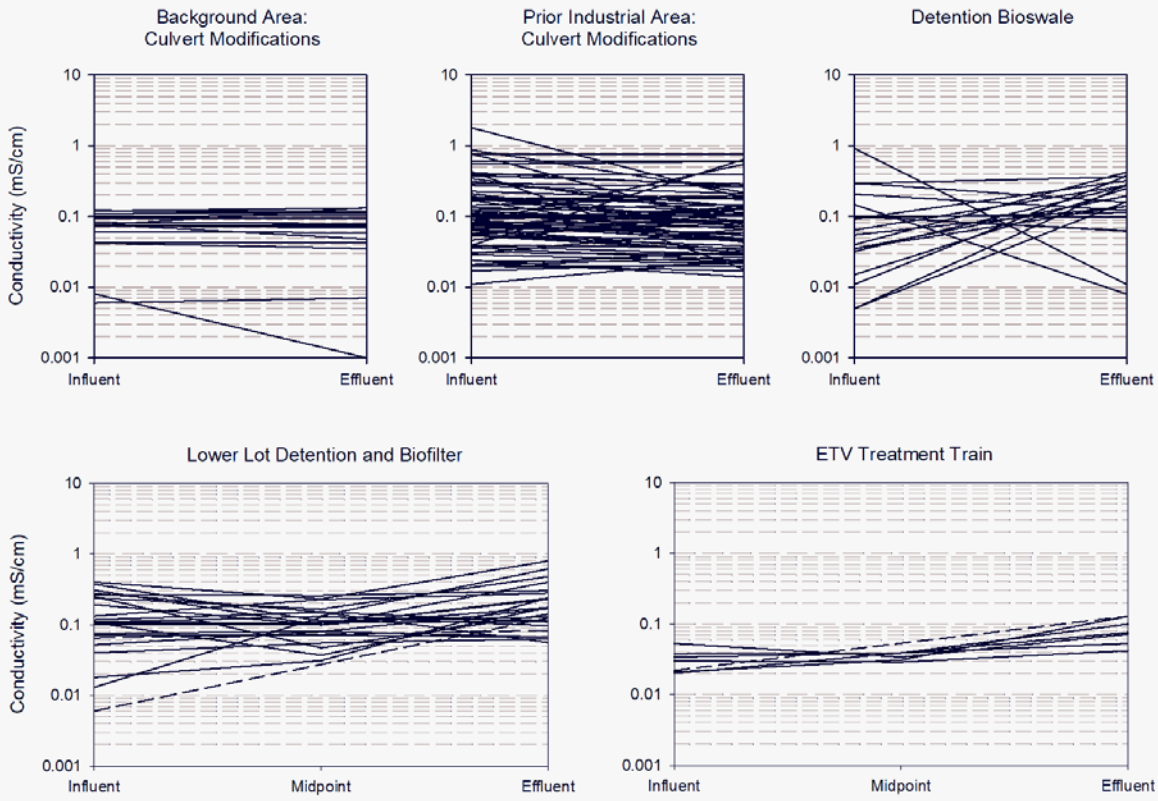
COPPER, FILTERED


Background Area:
Culvert Modifications
Prior Industrial Area:
Culvert Modifications
Detention Bioswale
Lower Lot Detention and Biofilter
ETV Treatment Train
Pb Concentration (µg/L)
100
10
1
0.1
0.01
Influent
Midpoint
Effluent

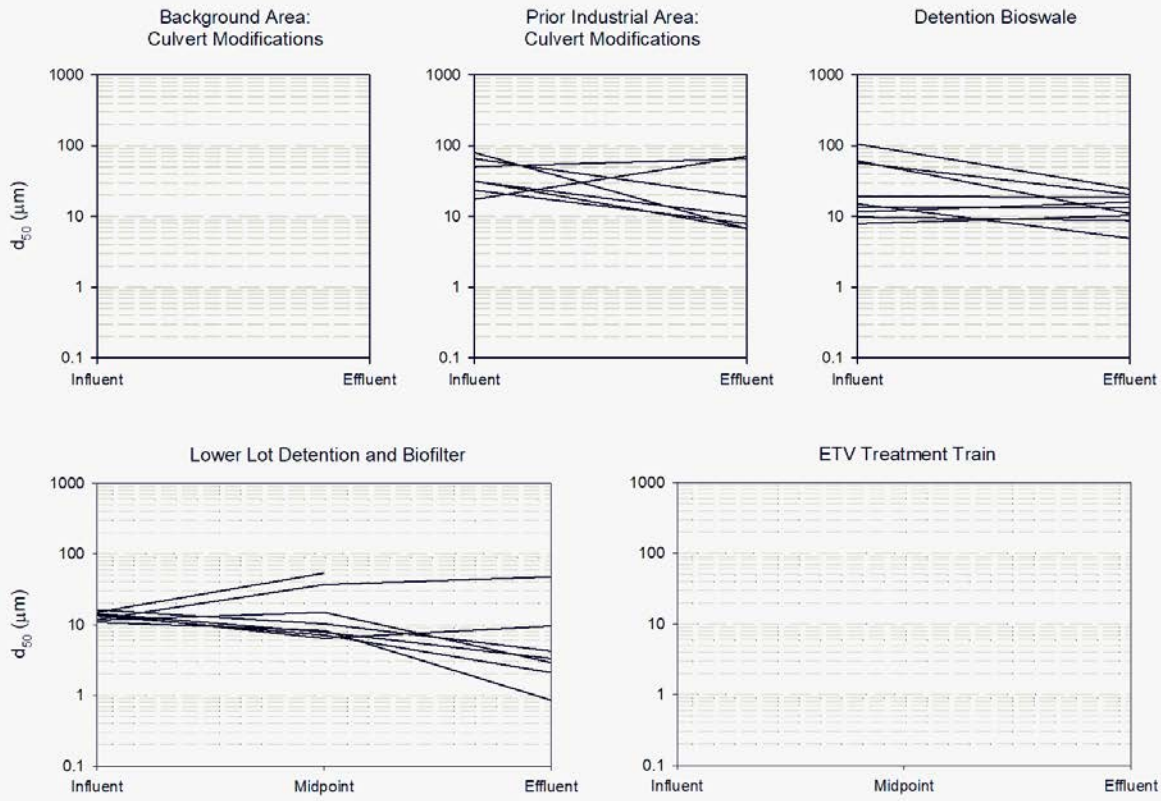
LEAD, TOTAL



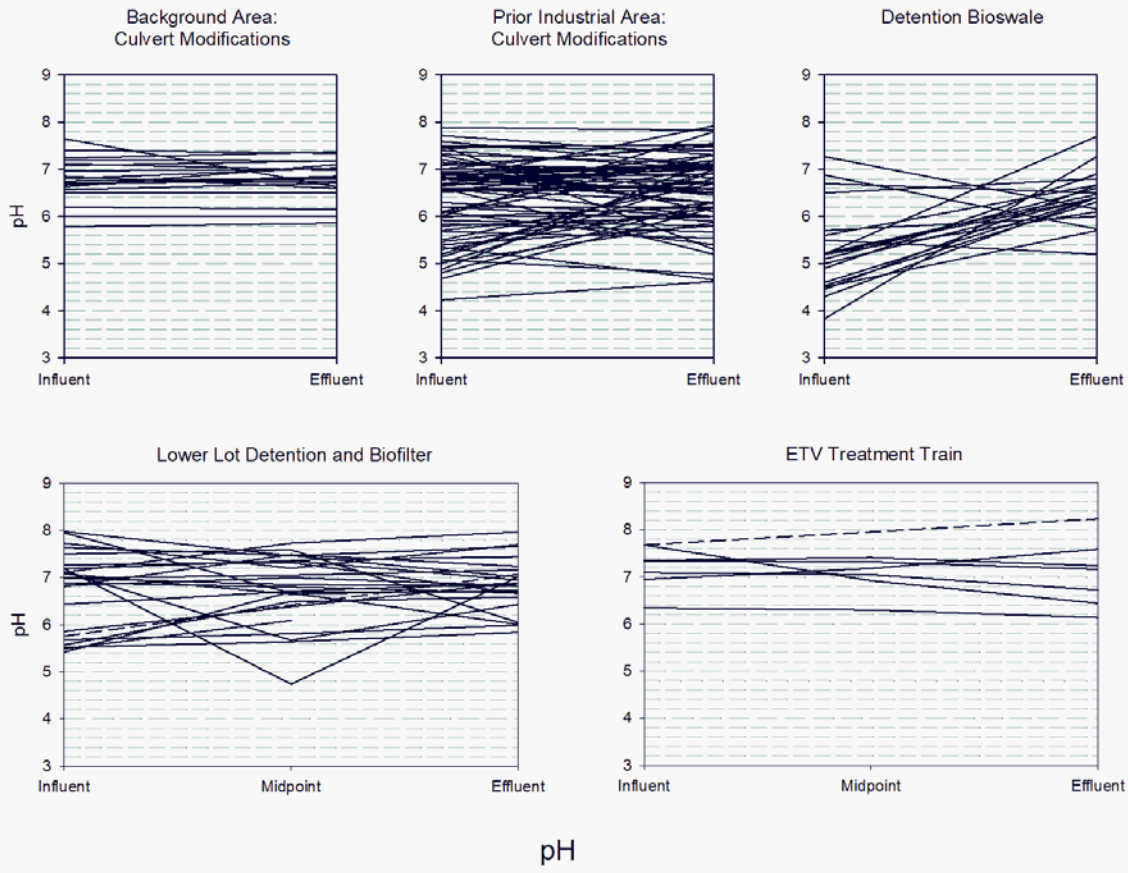
LEAD, FILTERED

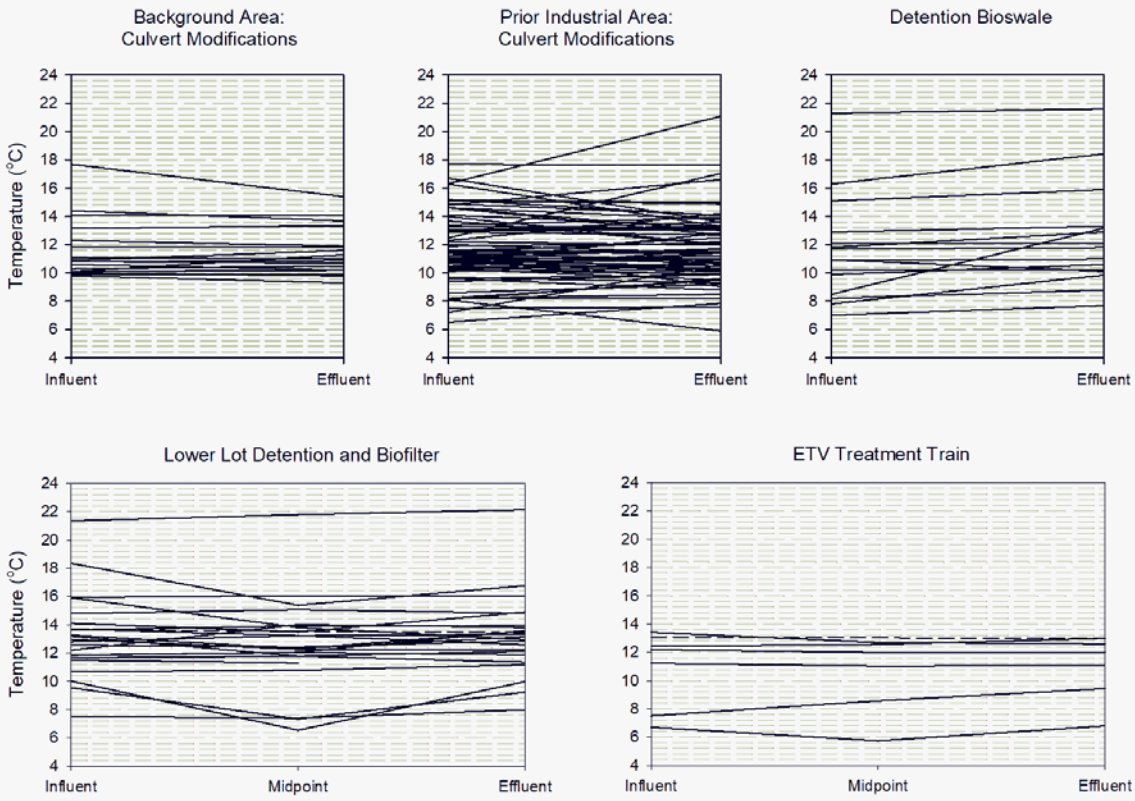


CONDUCTIVITY

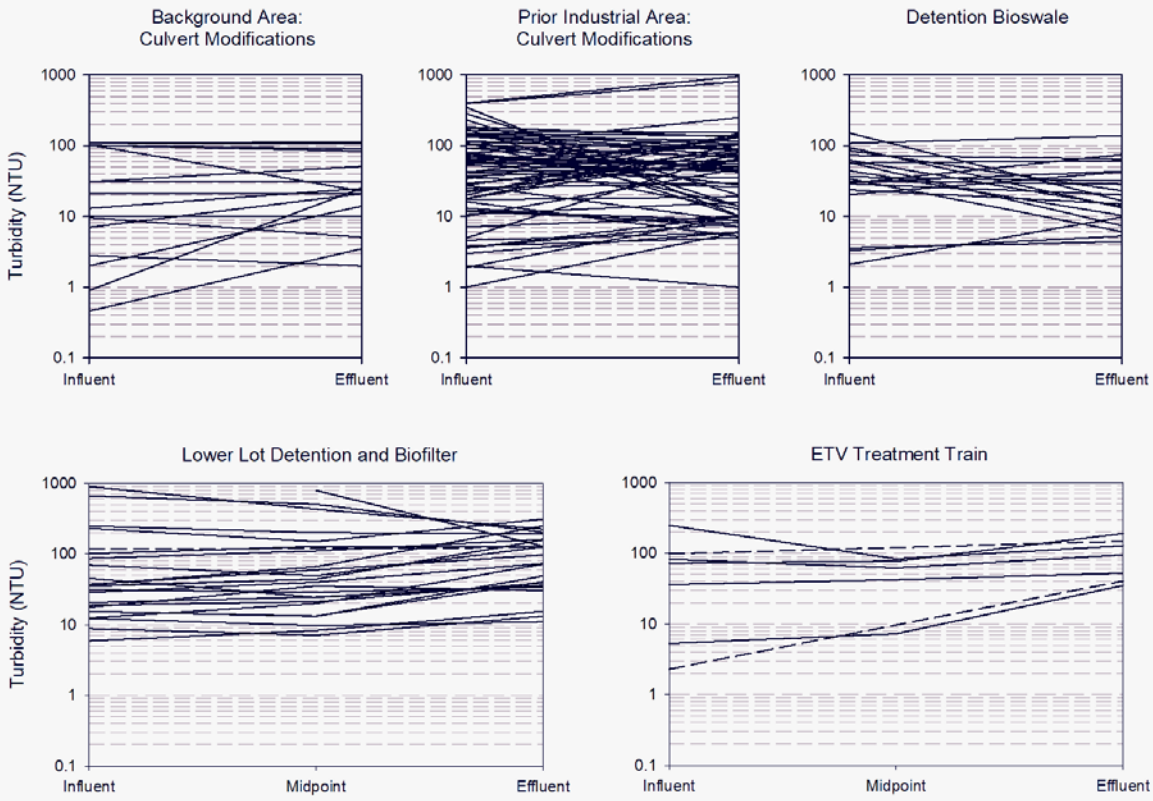


MEDIAN GRAIN SIZE


Background Area:
Culvert Modifications
Prior Industrial Area:
Culvert Modifications
Detention Bioswale
Lower Lot Detention and Biofilter
ETV Treatment Train
pH
9
8
7
6
5
4
3
Influent
Midpoint
Effluent
pH

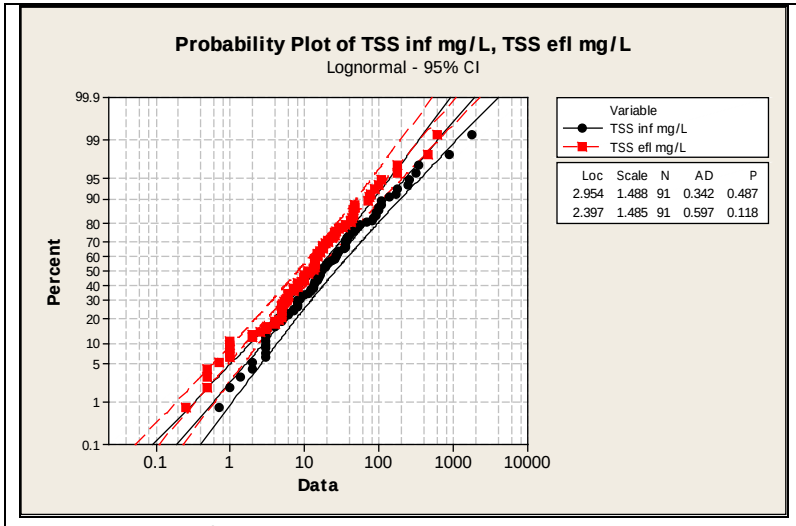


TEMPERATURE

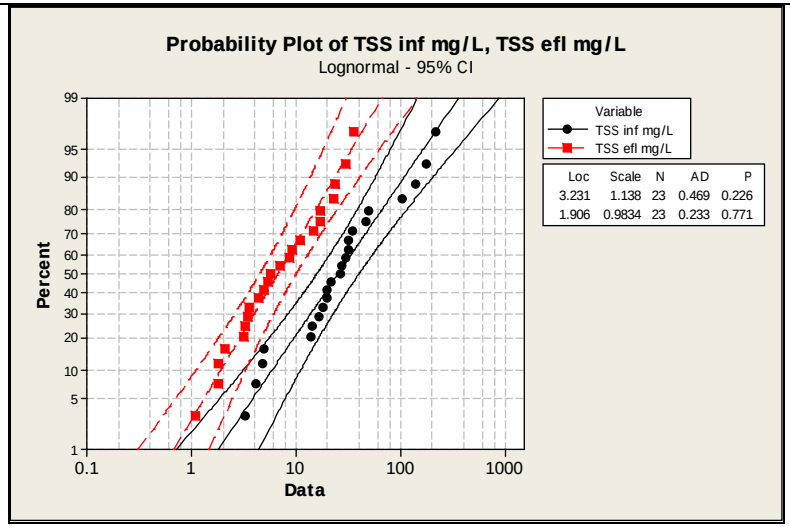

Background Area:
Culvert Modifications
Prior Industrial Area:
Culvert Modifications
Detention Bioswale
Lower Lot Detention and Biofilter
ETV Treatment Train
Turbidity (NTU)
1000
100
10
1
0.1
Influent
Midpoint
Effluent

TURBIDITY

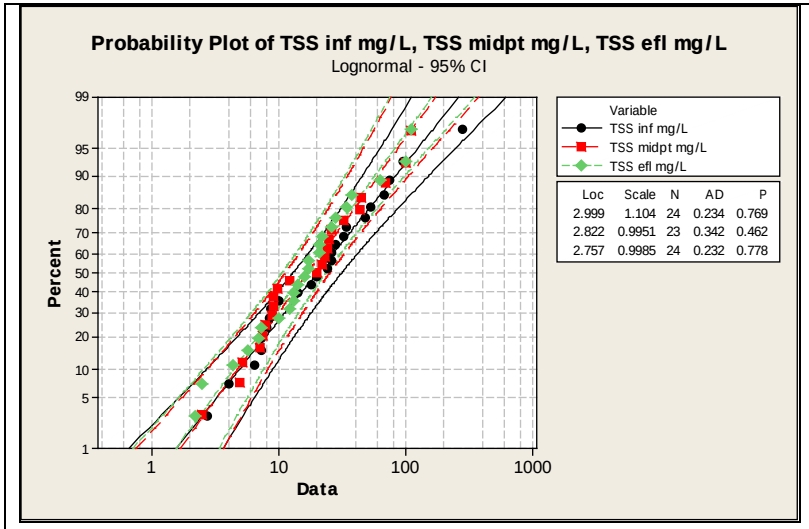
Appendix C: Influent and Effluent Concentration Probability Plots



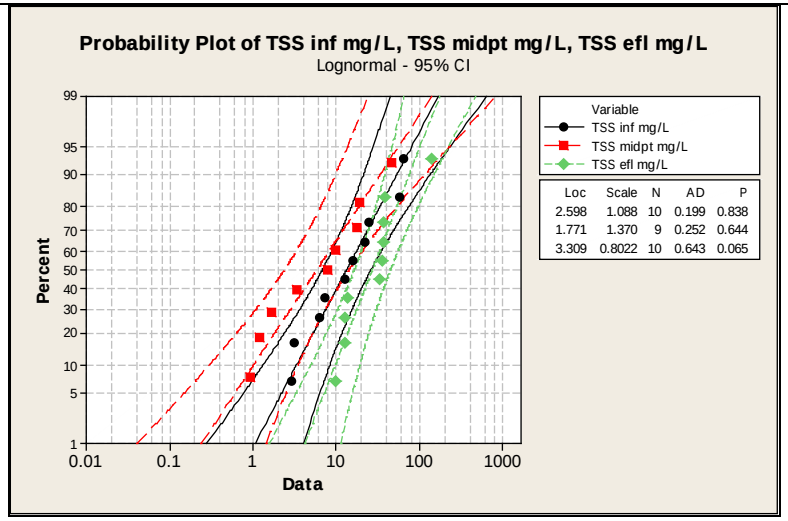
All culvert modifications combined



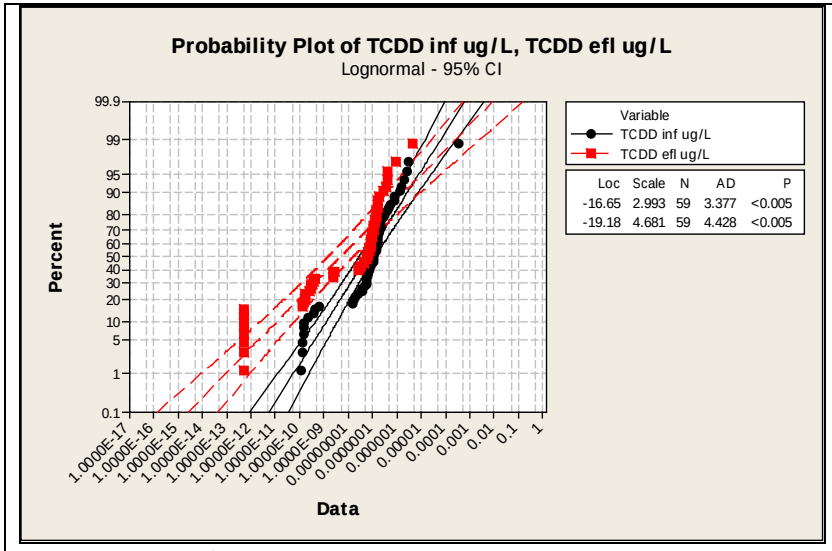
Detention bioswales



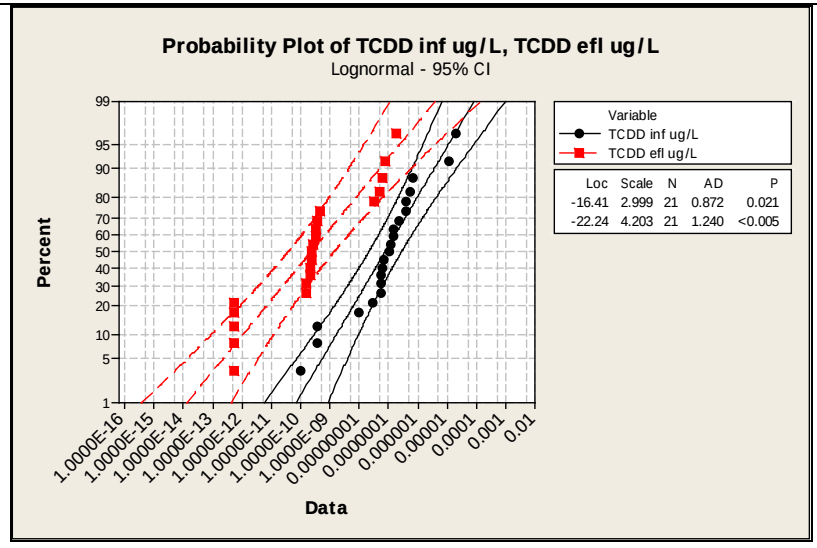
Lower lot biofilter



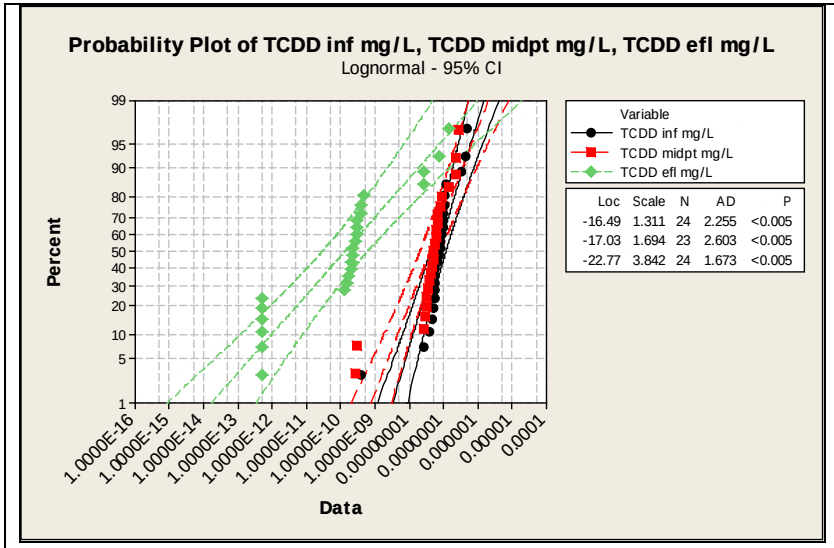
ELV treatment train



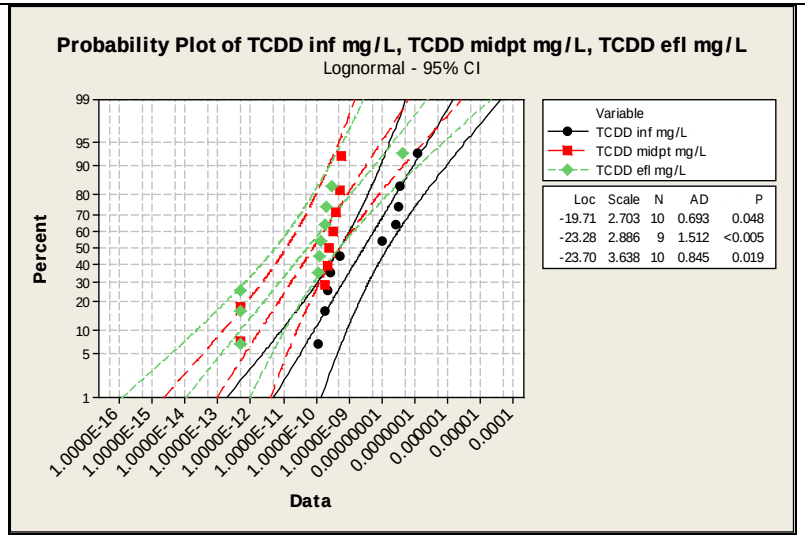
All culvert modifications combined



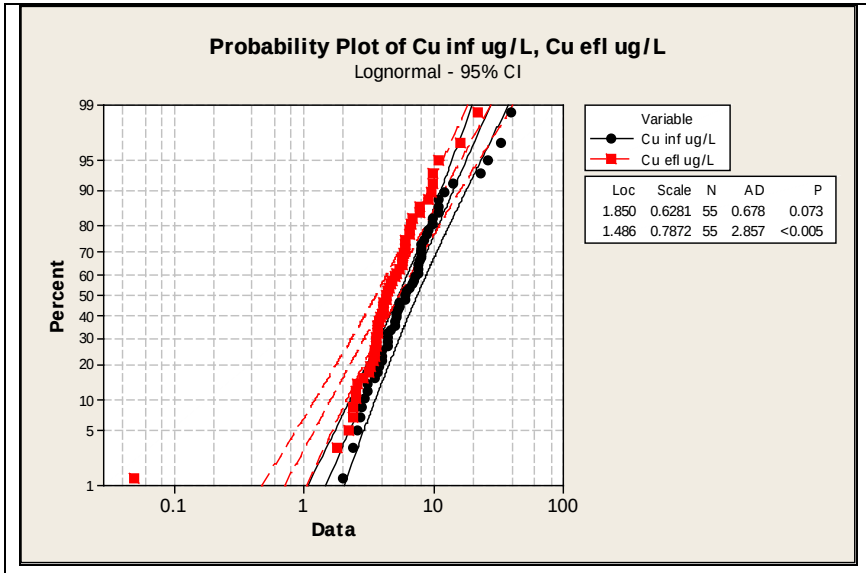
Detention bioswales



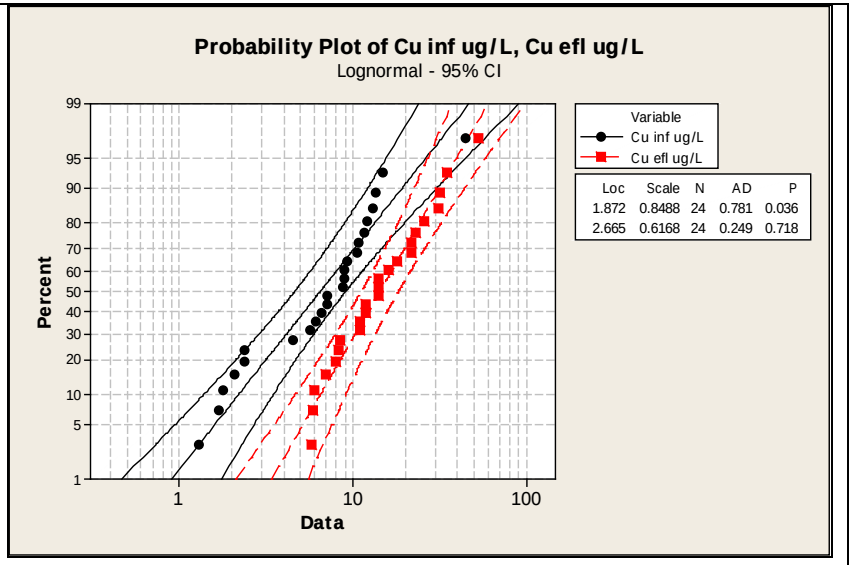
Lower Lot biofilter



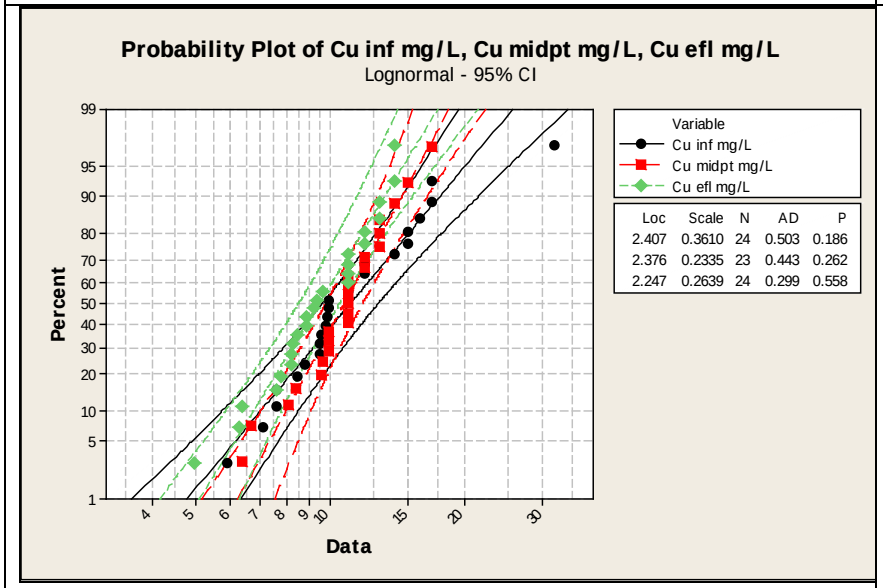
ELV treatment train



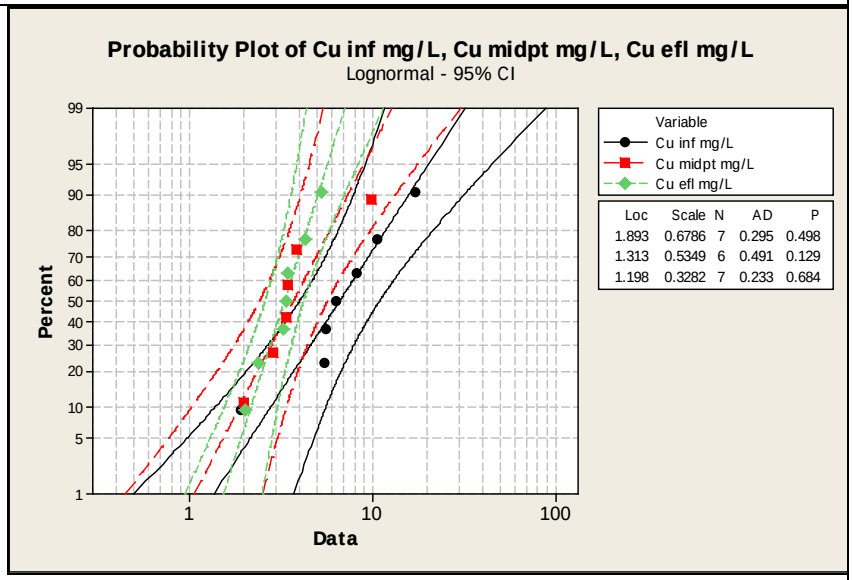
All culvert modifications combined



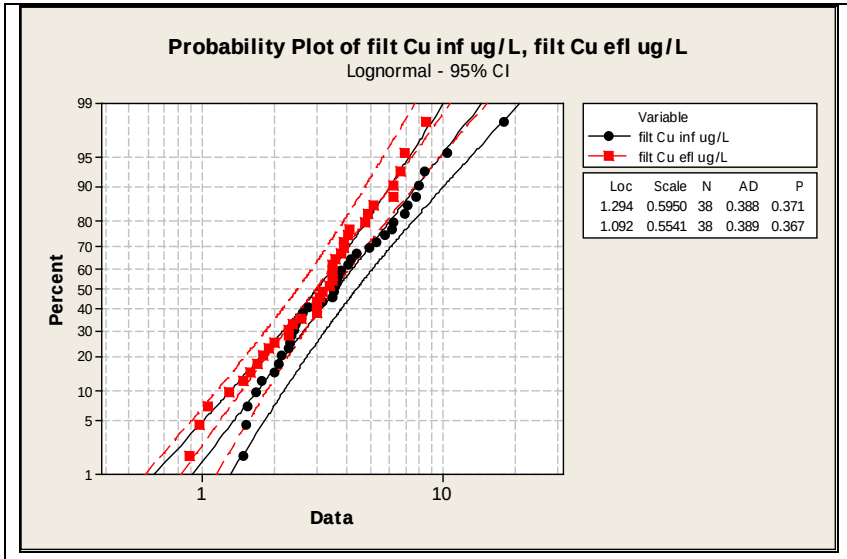
Detention bioswale



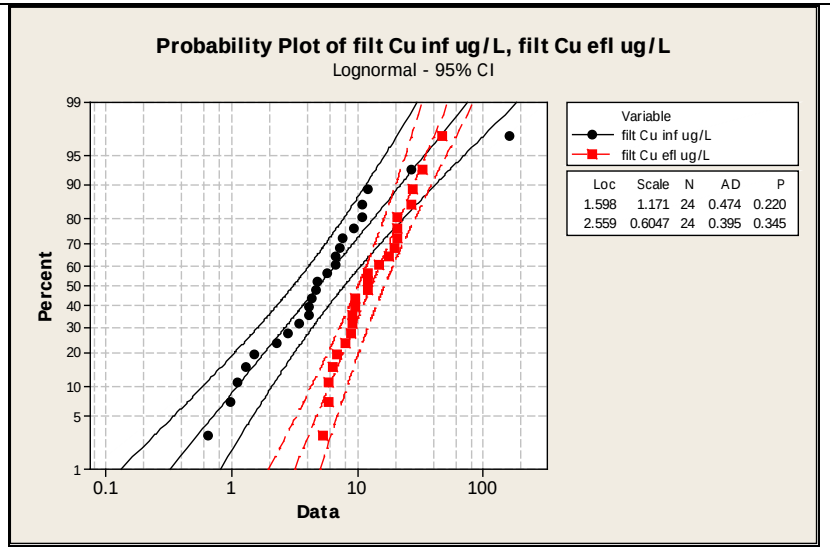
Lower Lot biofilter



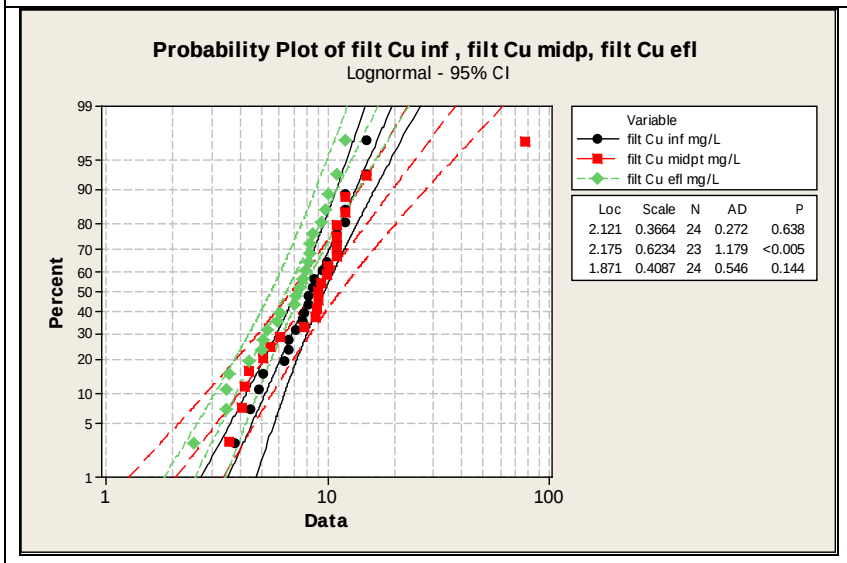
ELV treatment train



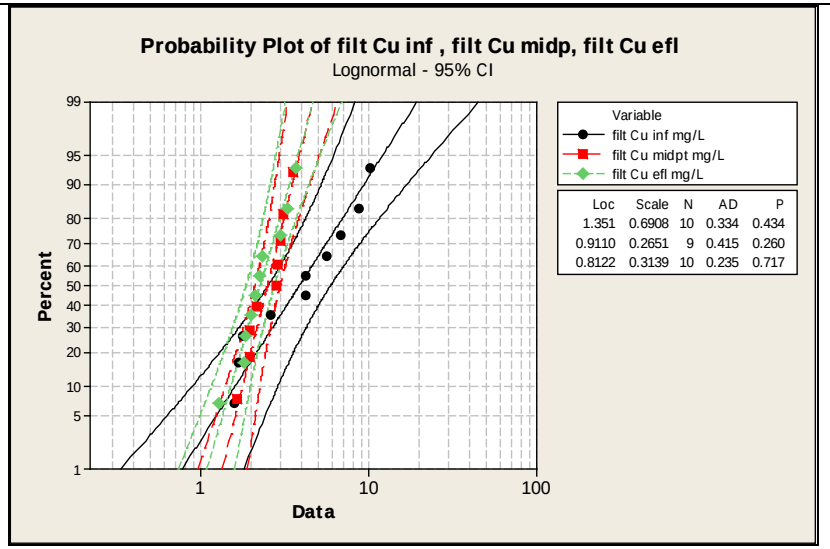
All culvert modifications combined



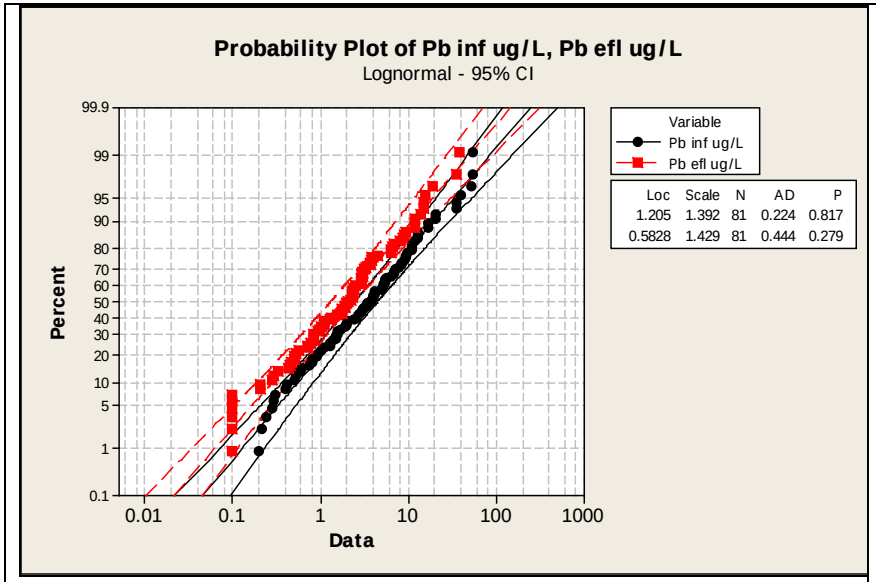
Detention bioswales



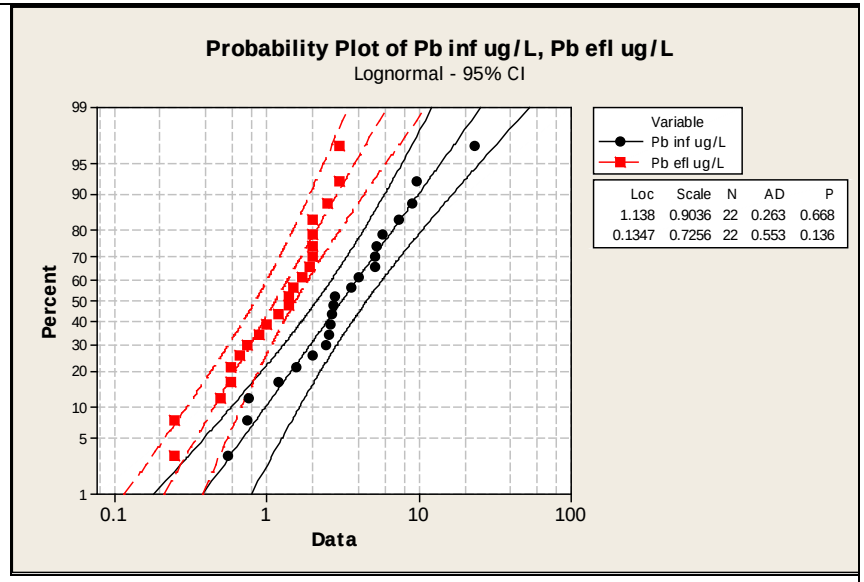
Lower Lot biofilter



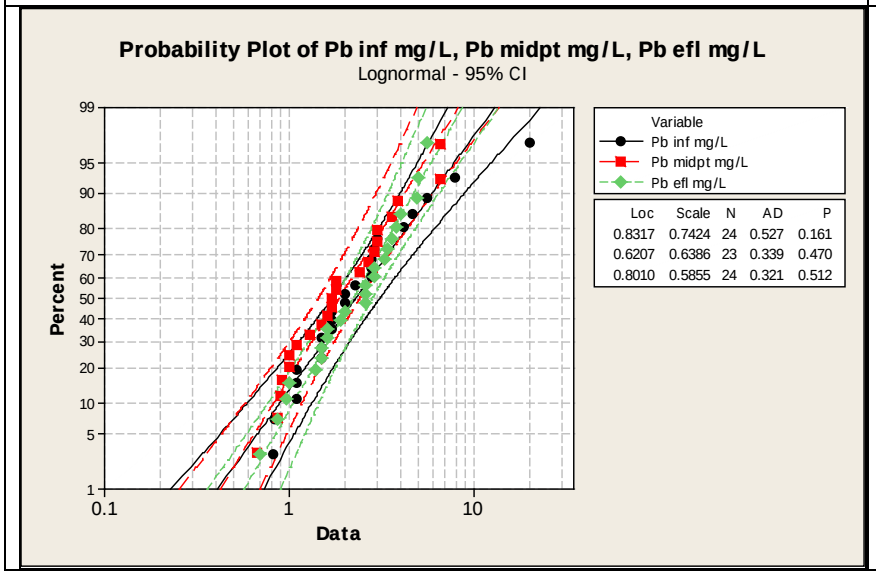
ELV treatment train

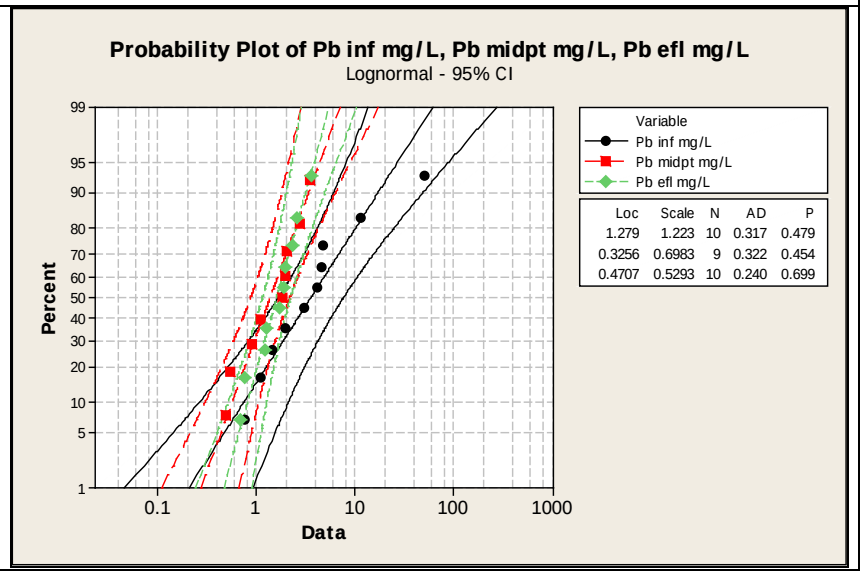


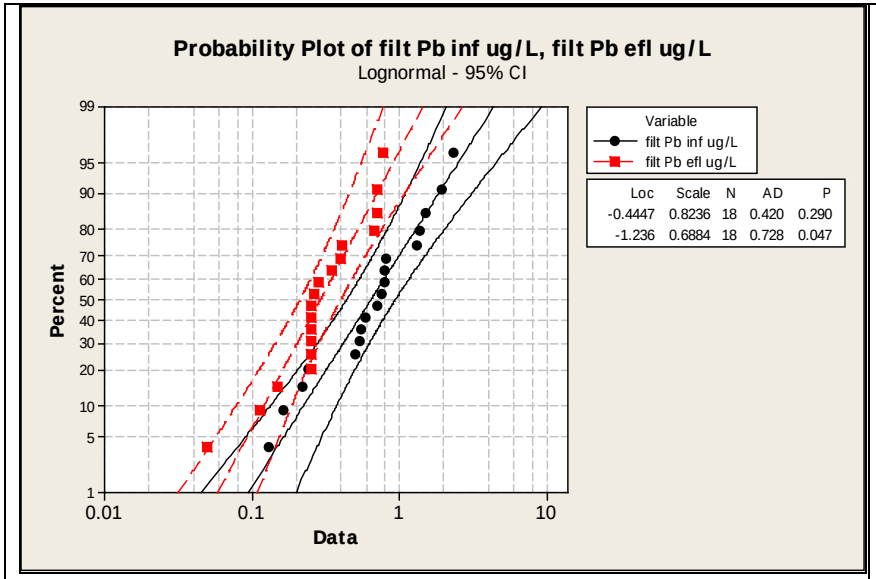
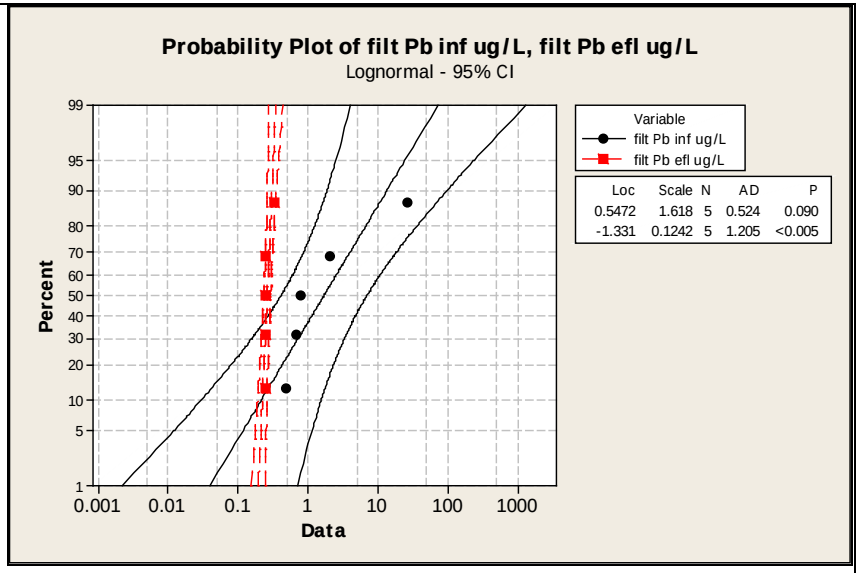
All culvert modifications combined

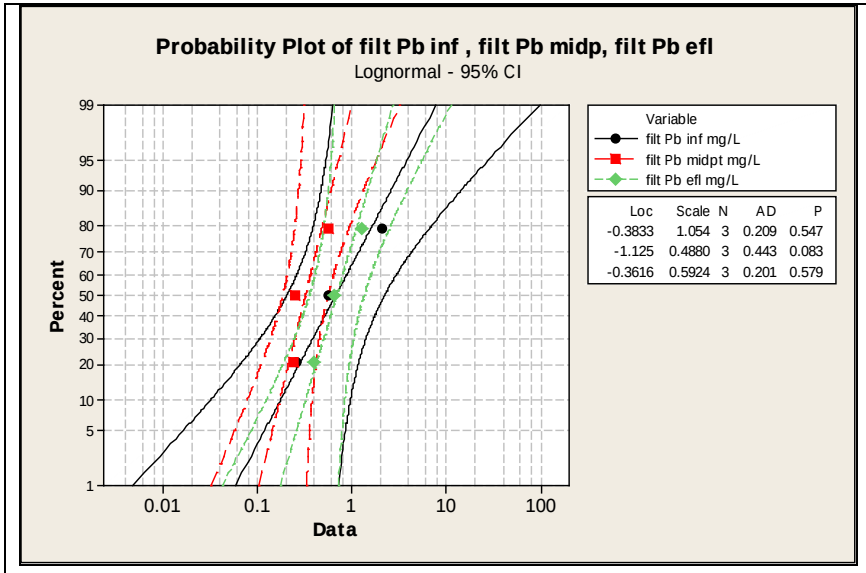


Detention bioswales

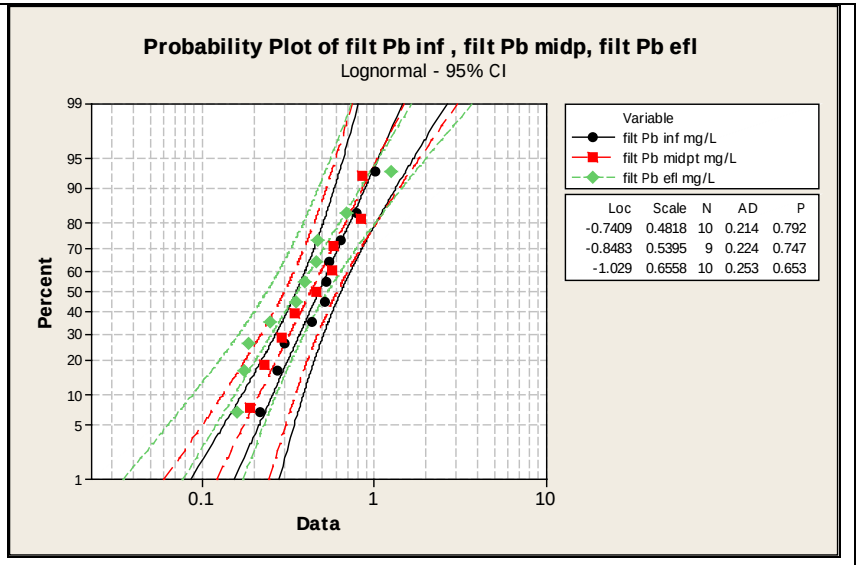




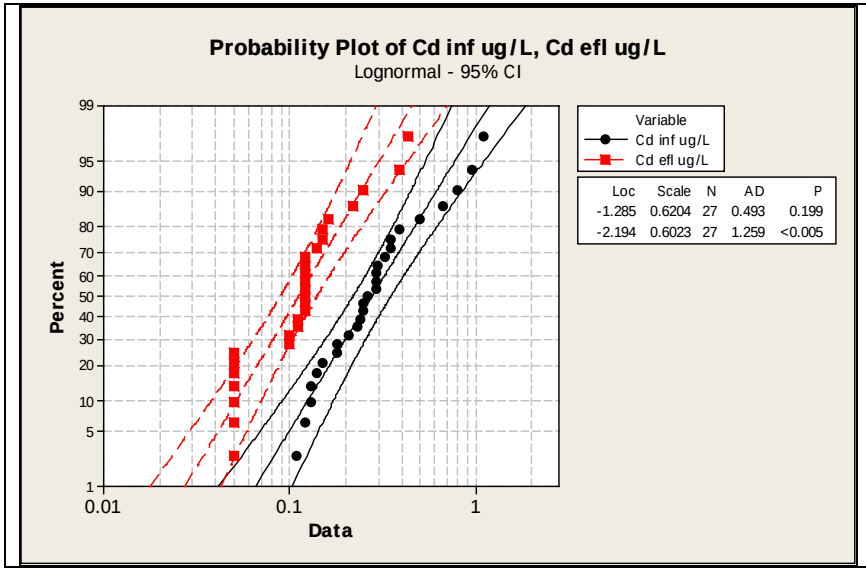
Lower Lot biofilter	ELV treatment train
	
All culvert modifications combined	Detention bioswales

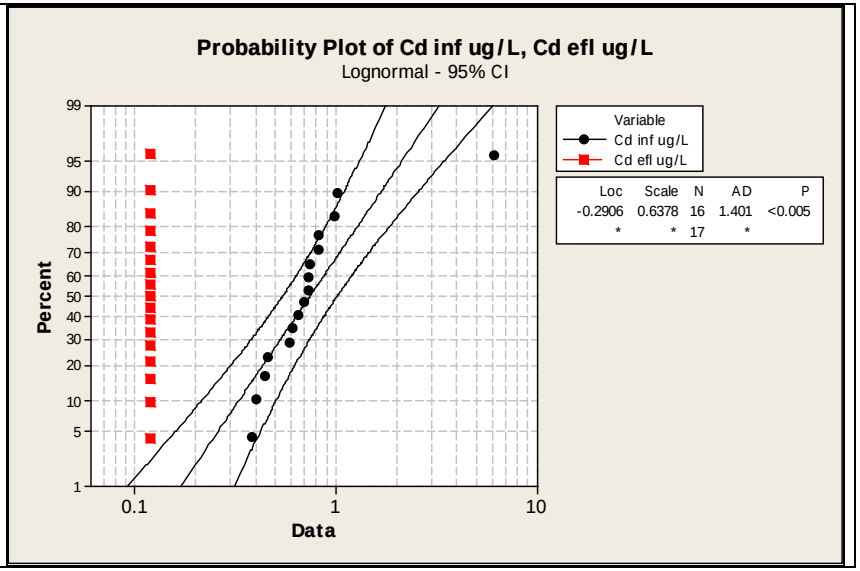


Lower Lot biofilter

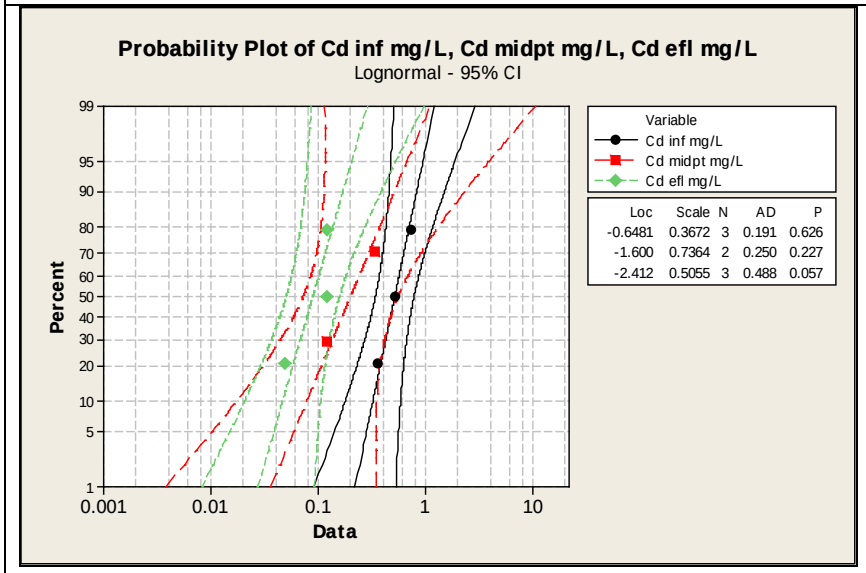


ELV treatment train



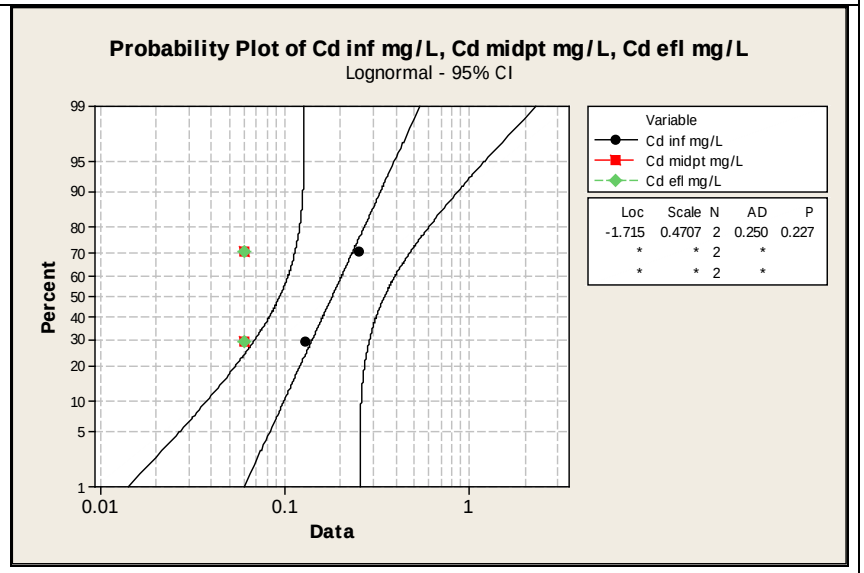


All culvert modifications combined

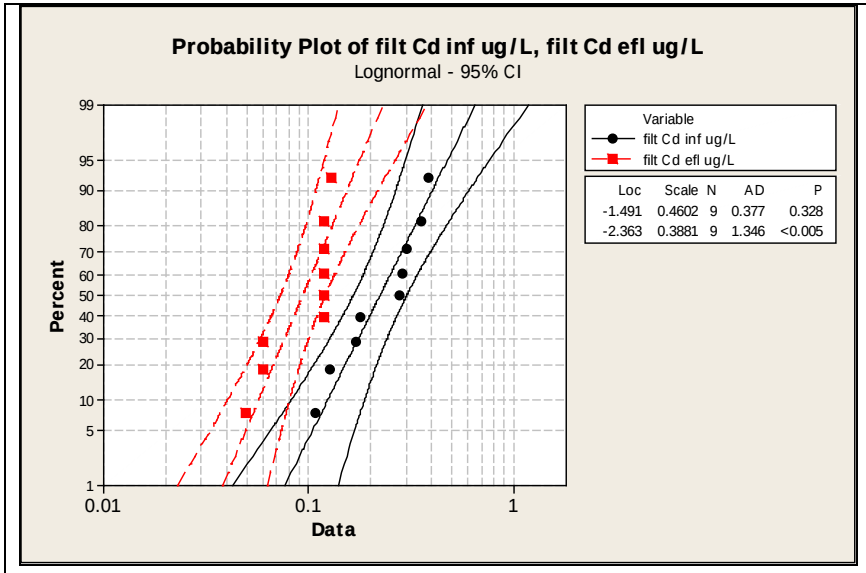


Lower Lot biofilter

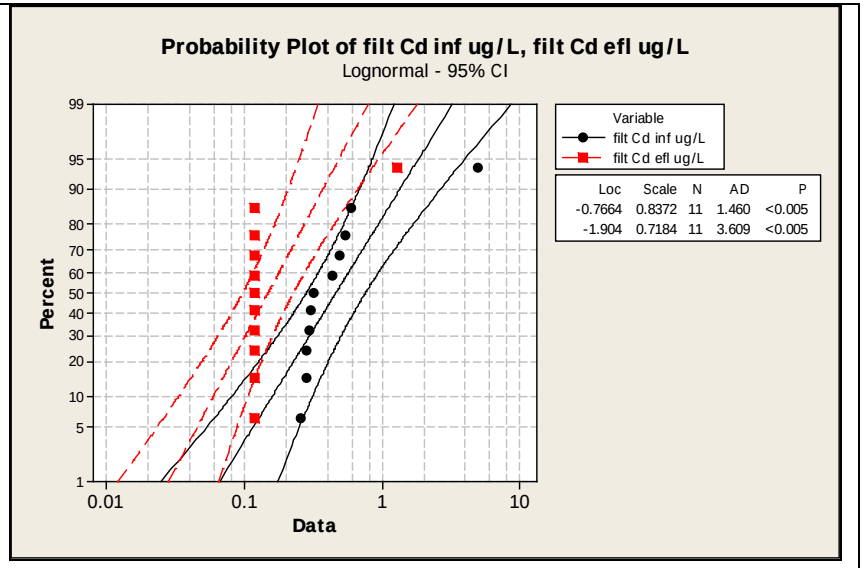
Detention bioswales



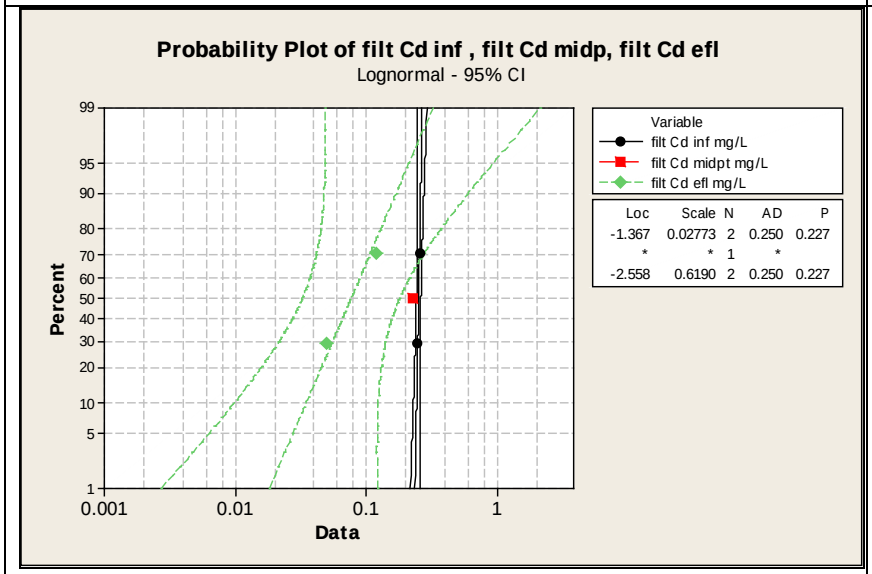
ELV treatment train



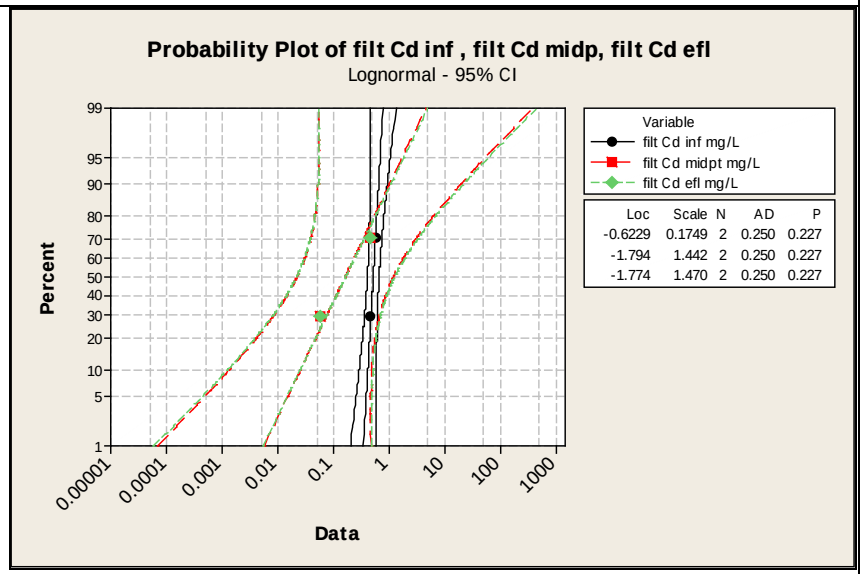
All culvert modifications combined



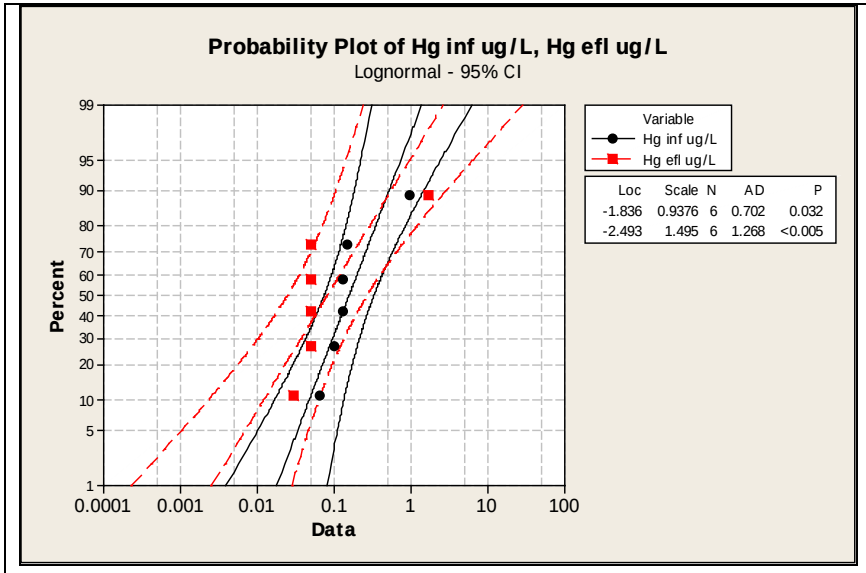
Detention bioswales



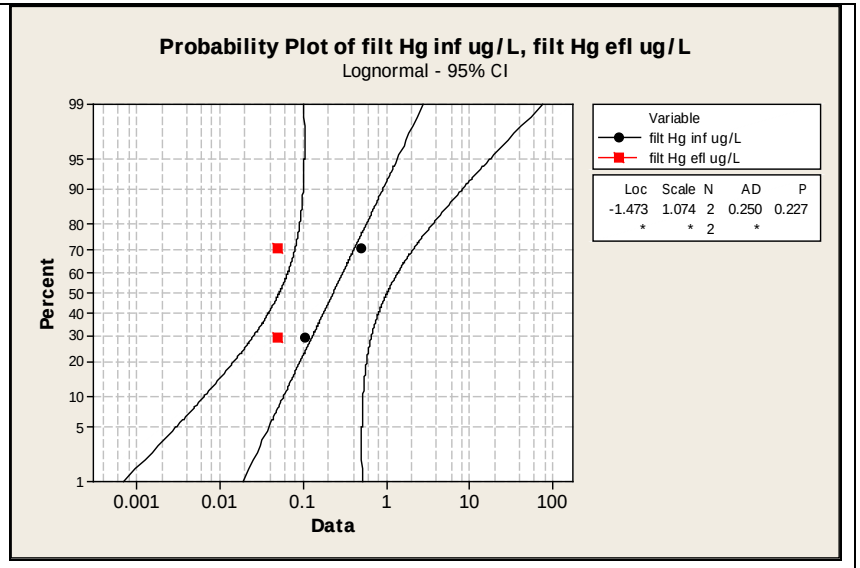
Lower Lot biofilter



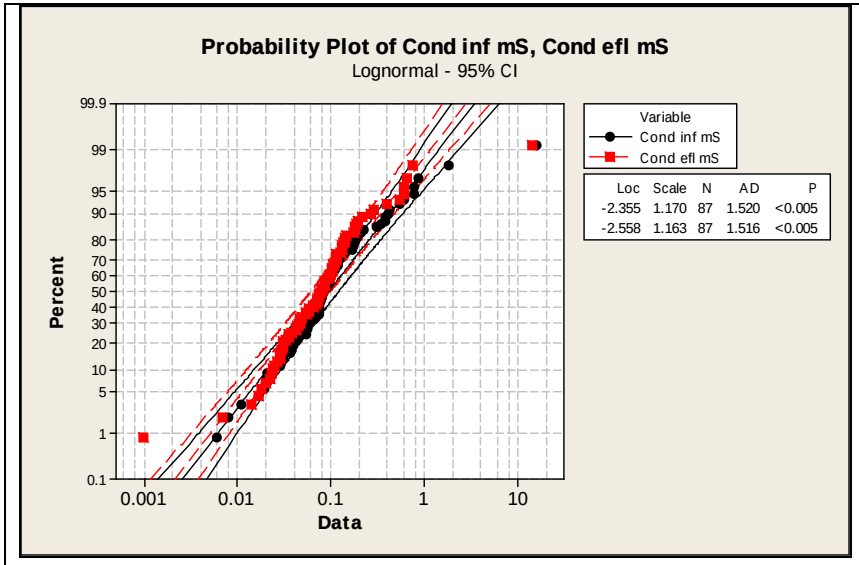
ELV treatment train



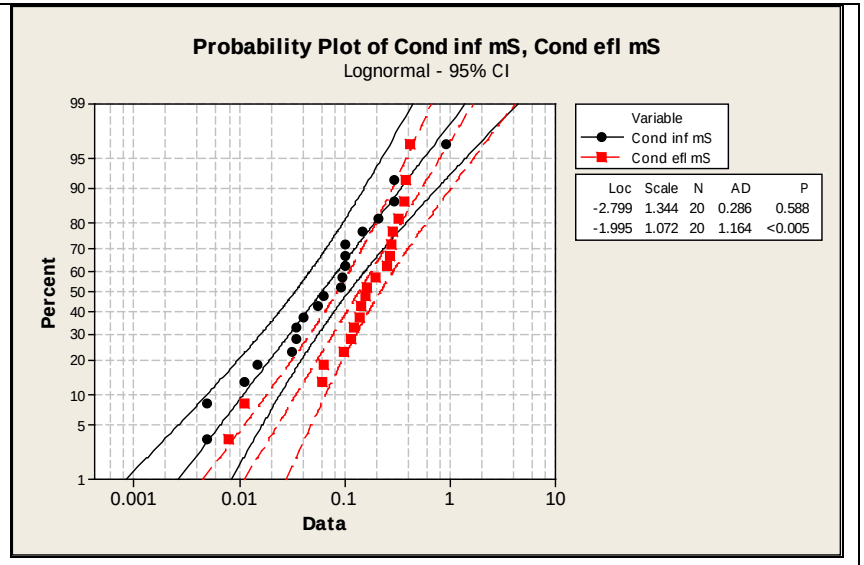
All culvert modifications combined



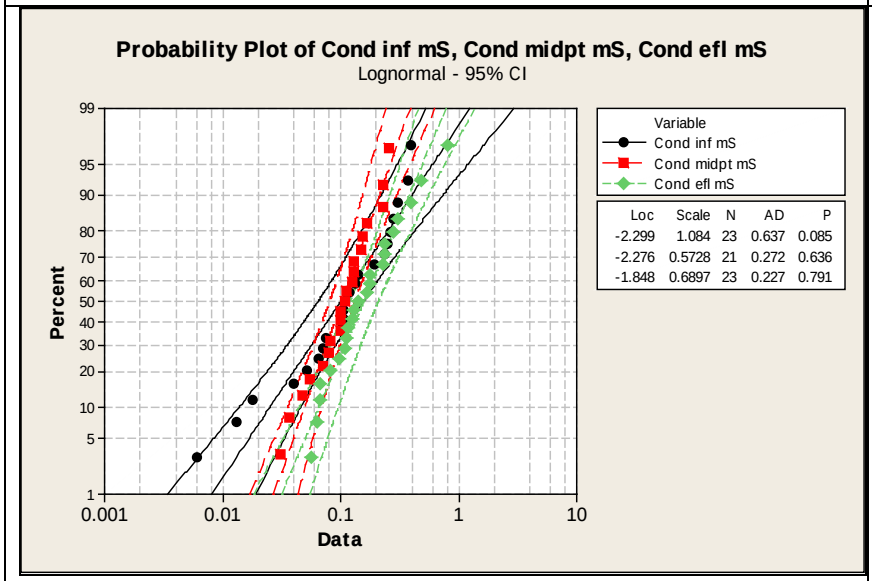
All culvert modifications combined



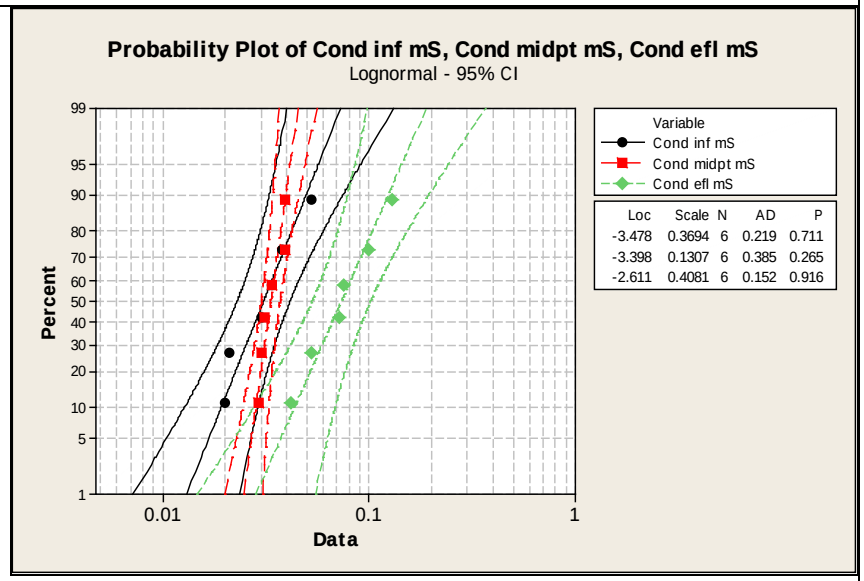
All culvert modifications combined



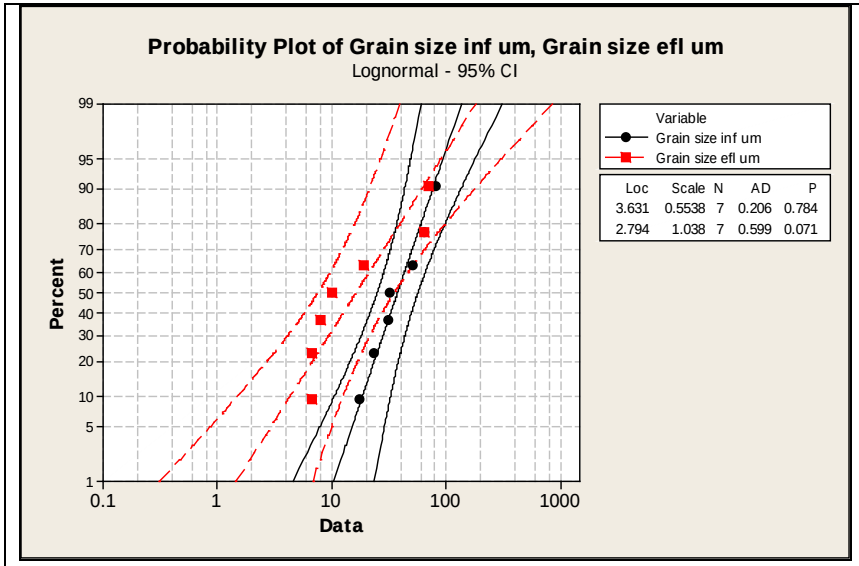
Detention bioswales



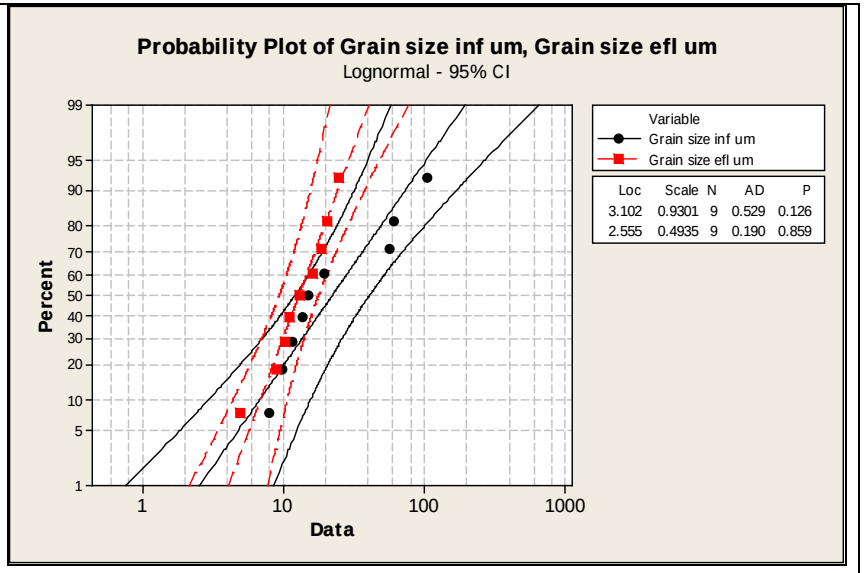
Lower Lot biofilter



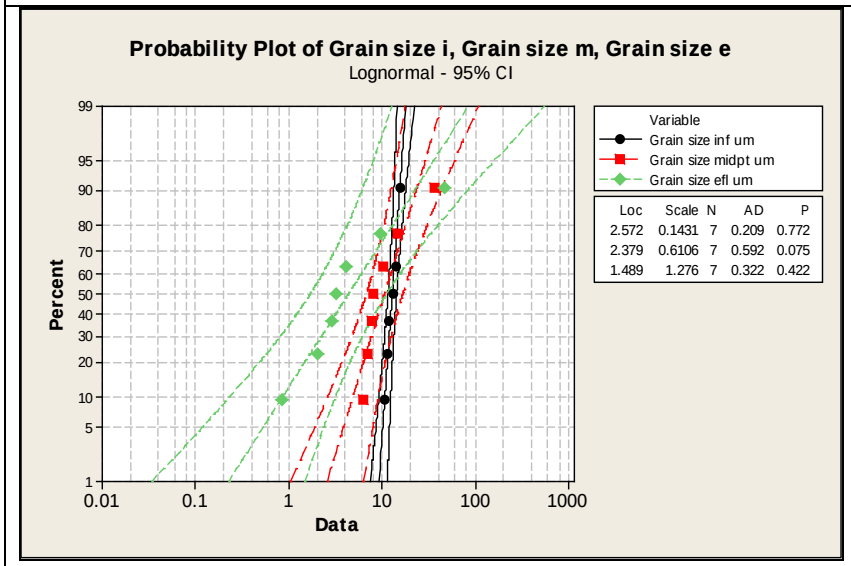
ELV treatment train



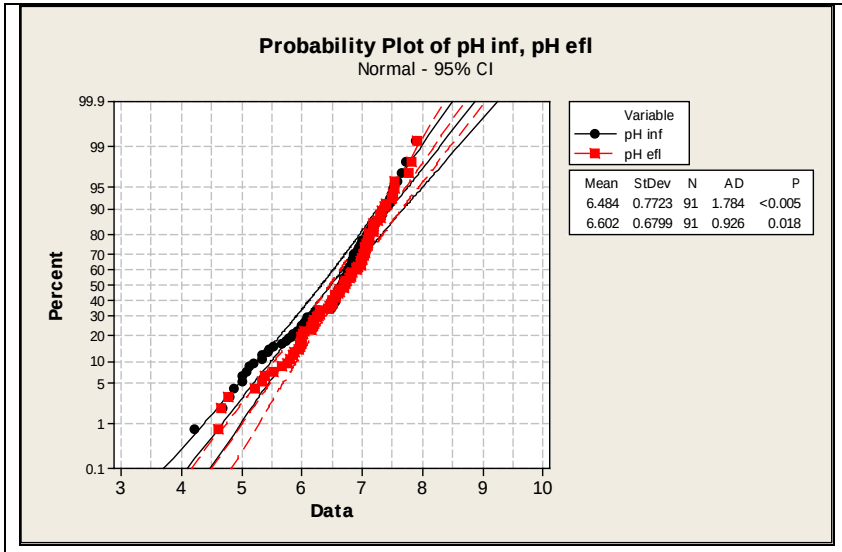
All culvert modifications combined



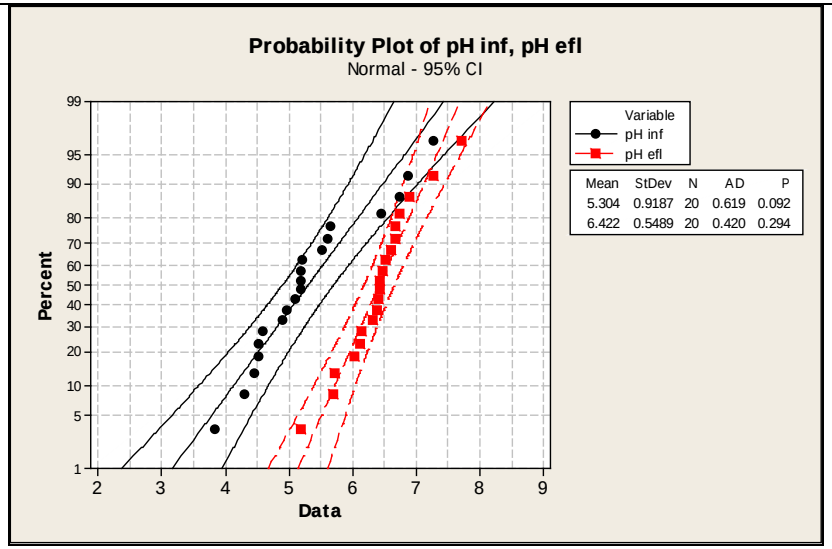
Detention bioswales



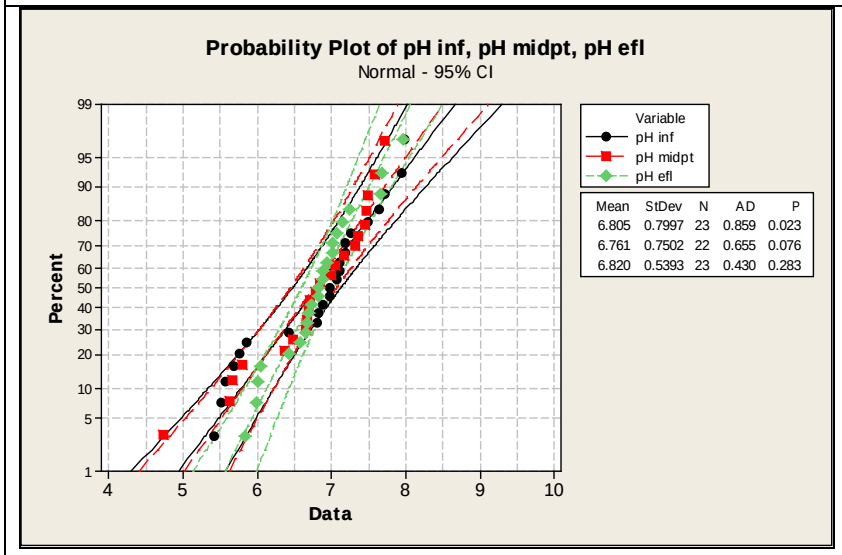
Lower Lot biofilter



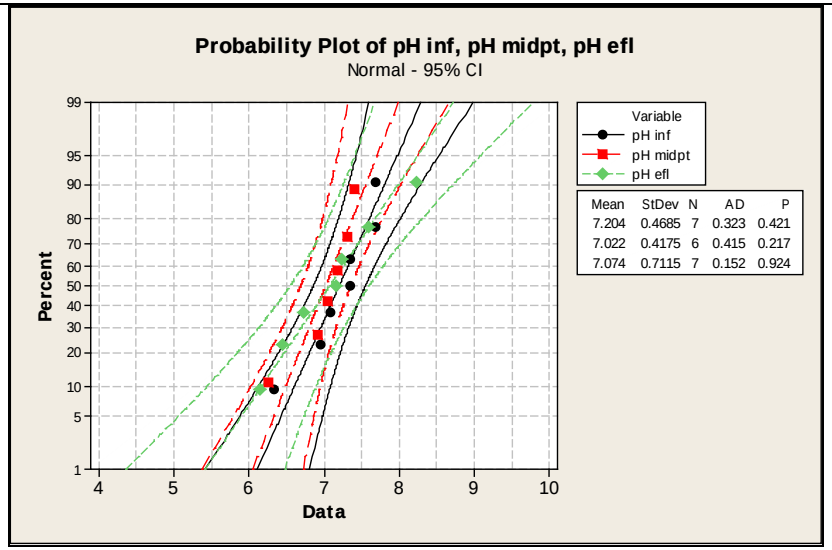
All culvert modifications



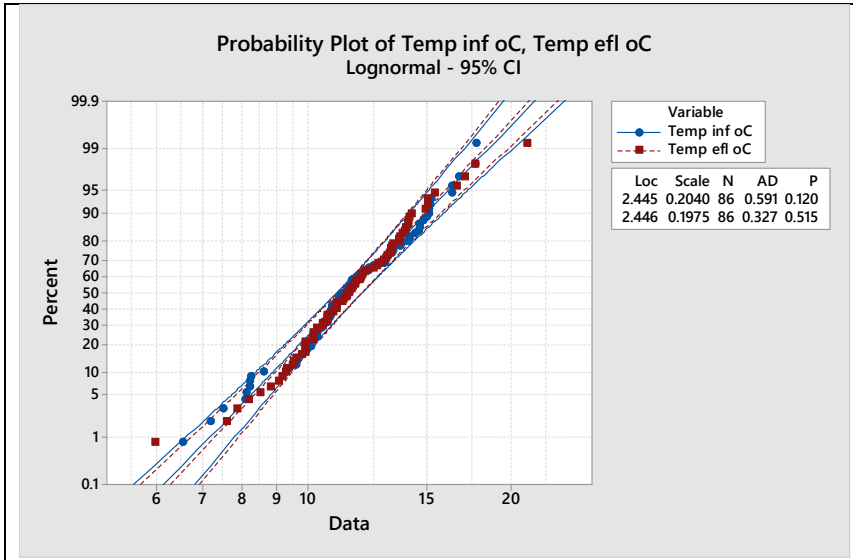
Detention bioswales



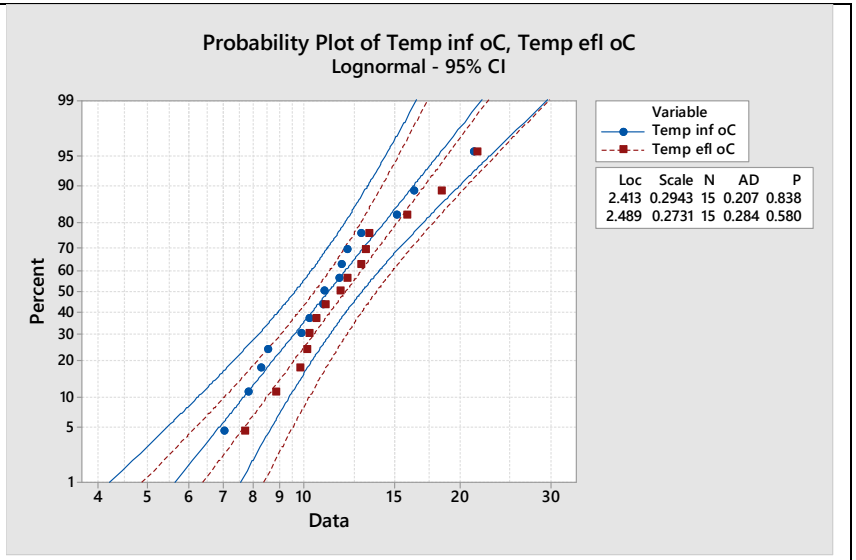
Lower Lot biofilter



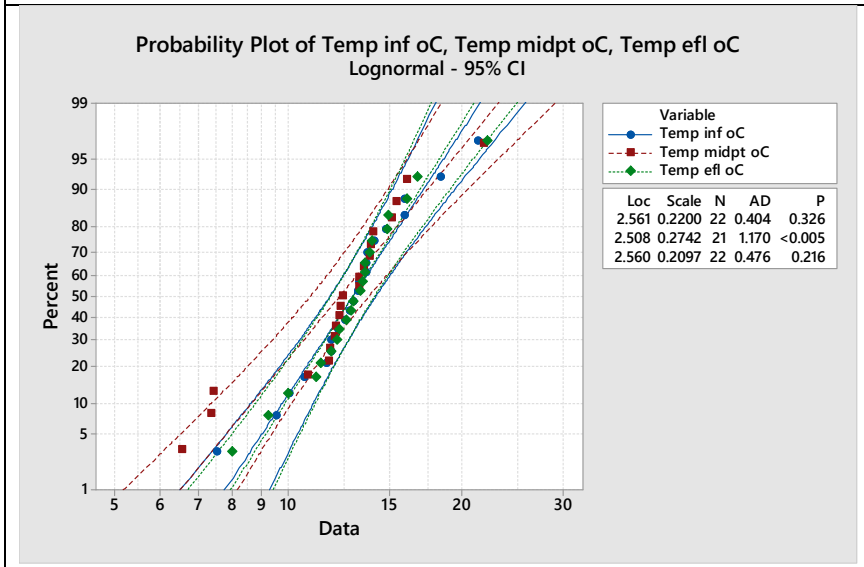
ELV treatment train



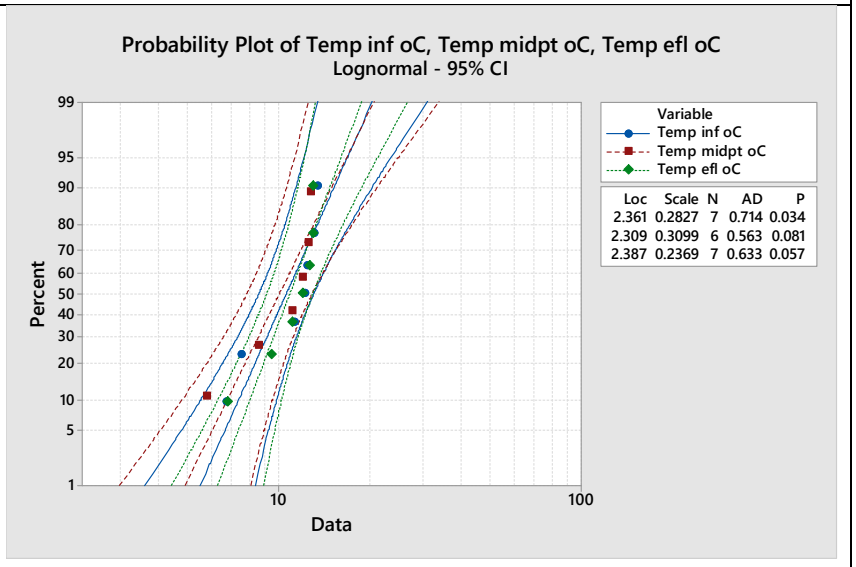
All culvert modifications combined



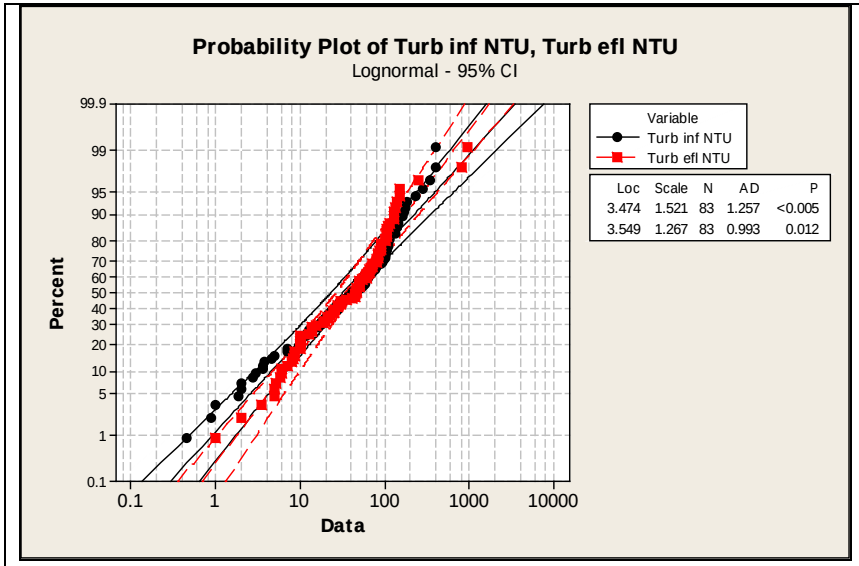
Detention bioswales



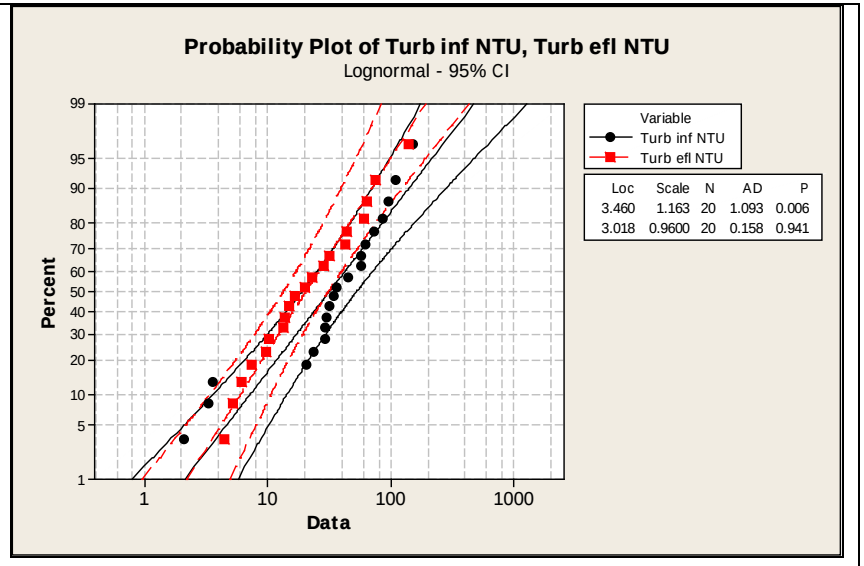
Lower Lot biofilter



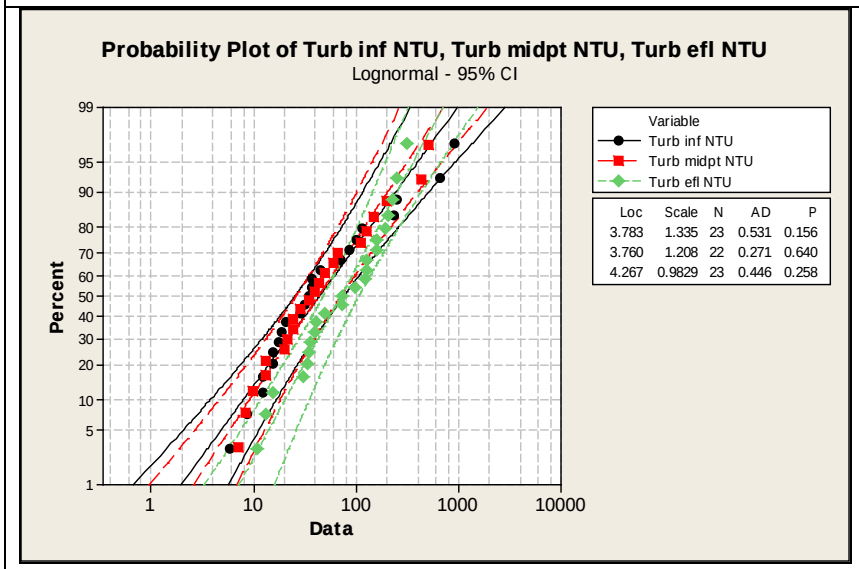
ELV treatment train



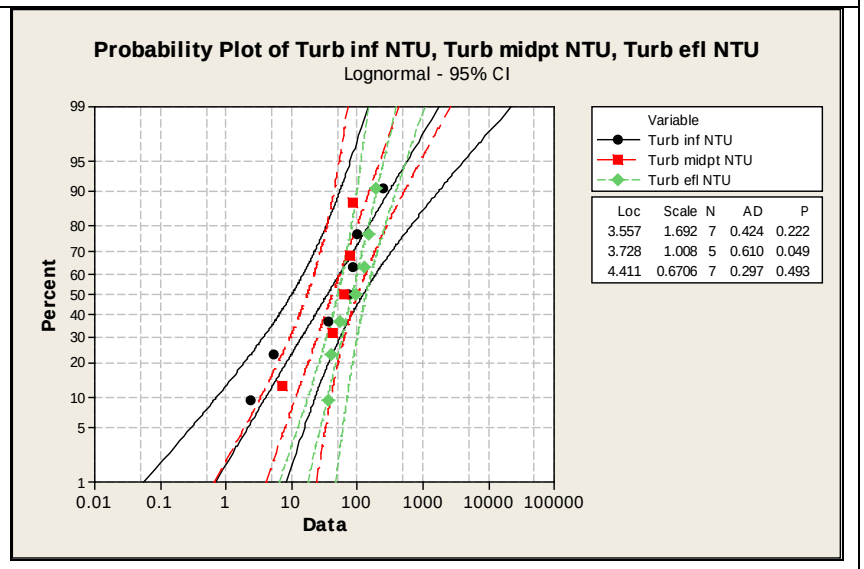
All culvert modifications combined



Detention bioswales



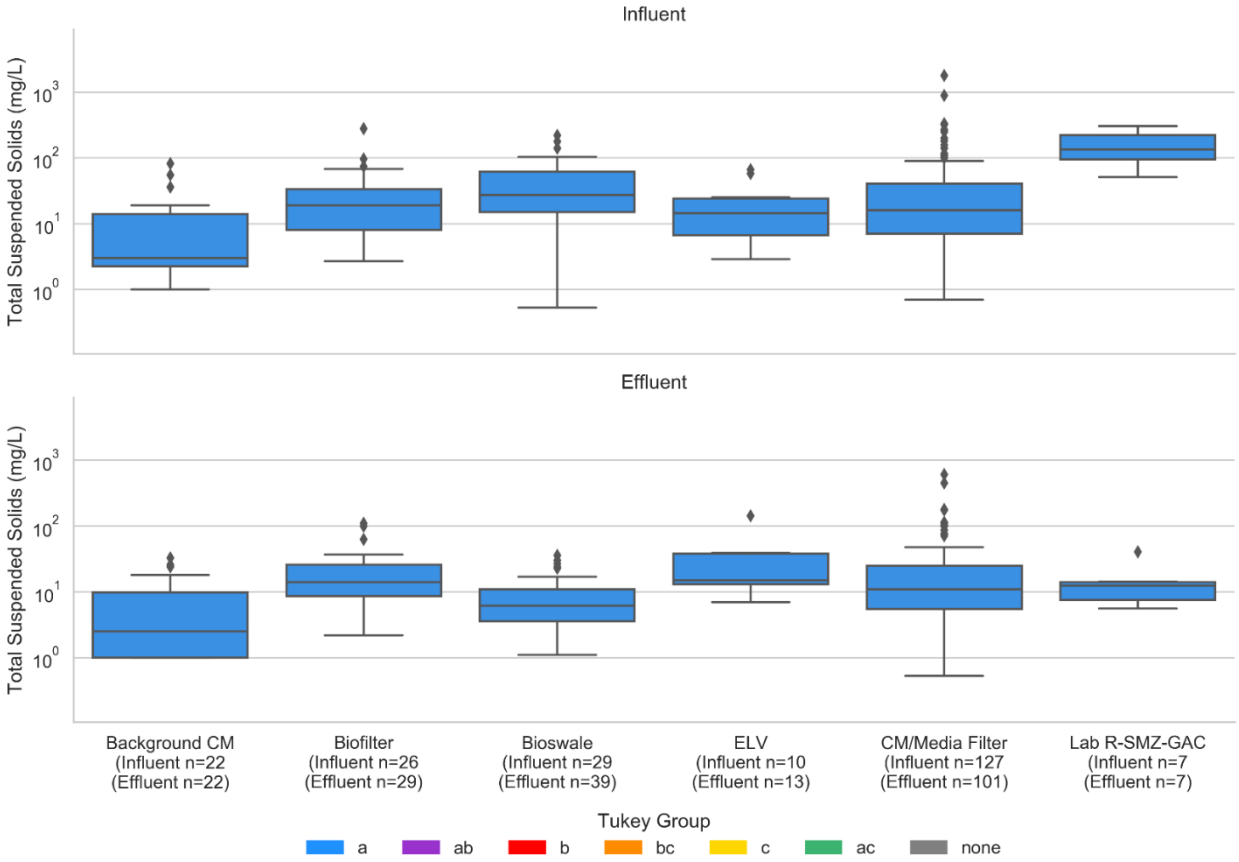
Lower Lot biofilter



ELV treatment train

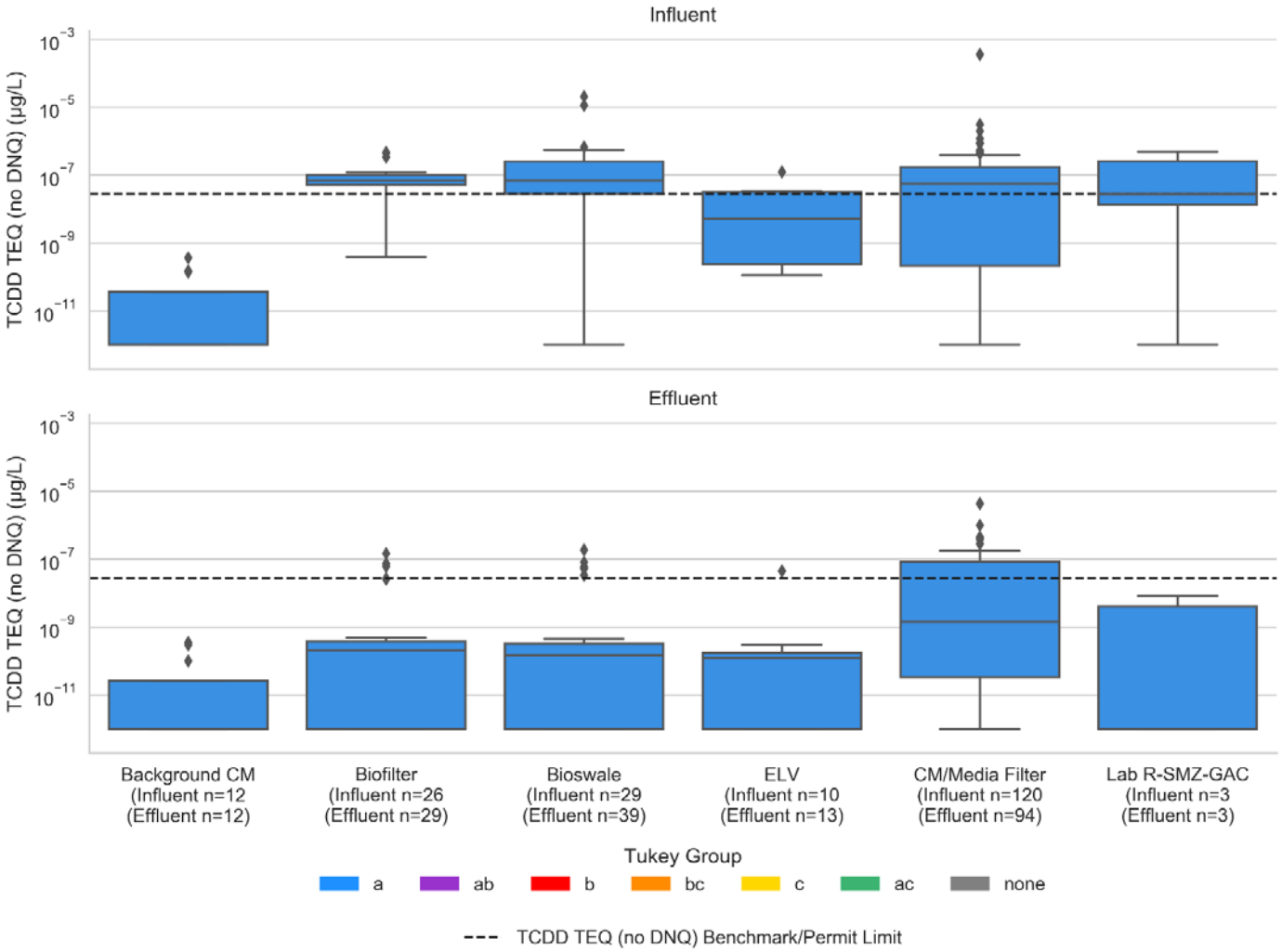
Appendix D: Influent and Effluent Concentration Comparisons of Laboratory Column Tests Compared to Full-scale Field Monotoring

Total Suspended Solids



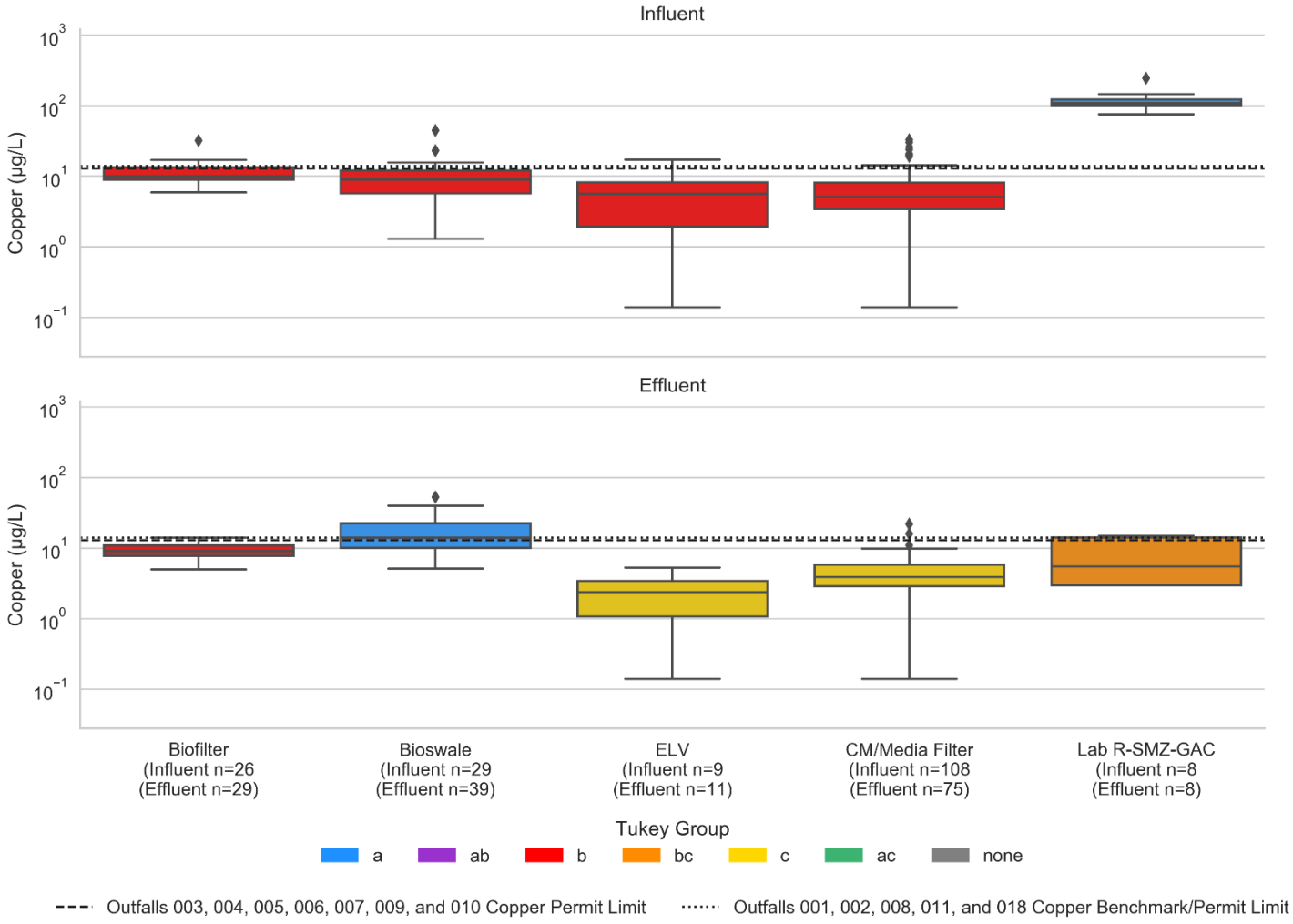
Analyte	Sample Type	Group	Units	Count	Min	Max	Mean	Median	Std. Dev.	Kruskal Wallis H	Kruskal Wallis p-value	Tukey Group
Total Suspended Solids	Influent	Background CM	mg/L	22	1.00	82	12.95	3.00	20.32	31.58	7.18E-06	a
		Biofilter	mg/L	26	2.70	280	35.63	19.00	55.29			a
		Bioswale	mg/L	29	0.53	220	47.66	27.42	53.73			a
		ELV	mg/L	10	2.90	66.00	21.99	14.50	22.44			a
		CM/Media Filter	mg/L	127	0.70	1800	59.85	16.00	183.88			a
		Lab R-SMZ-GAC	mg/L	7	51.31	304	160.69	135.37	90.58			a
	Effluent	Background CM	mg/L	22	1.00	33.00	7.68	2.50	9.40	29.96	1.50E-05	a
		Biofilter	mg/L	29	2.20	110	23.23	14.00	26.14			a
		Bioswale	mg/L	39	1.10	36.00	9.32	6.20	8.49			a
		ELV	mg/L	13	7.00	144	31.77	15.00	35.97			a
		CM/Media Filter	mg/L	101	0.53	610	33.43	11.00	79.08			a
		Lab R-SMZ-GAC	mg/L	7	5.61	40.48	14.53	12.38	11.96			a
	Percent Reduction	Background CM	mg/L	21	-400	87.50	-4.06	33.33	121.61	35.03	1.49E-06	ab
		Biofilter	mg/L	26	-261	95.36	-14.41	21.02	94.18			ab
		Bioswale	mg/L	27	-164	98.55	41.03	65.99	72.52			a
		ELV	mg/L	10	-1141	41.38	-196	-87.93	347.65			b
		CM/Media Filter	mg/L	87	-1066	99.11	-24.18	31.46	202.29			ab
		Lab R-SMZ-GAC	mg/L	7	58	96.00	87.97	93.51	13.23			a

TCDD TEQ (no DNQ)



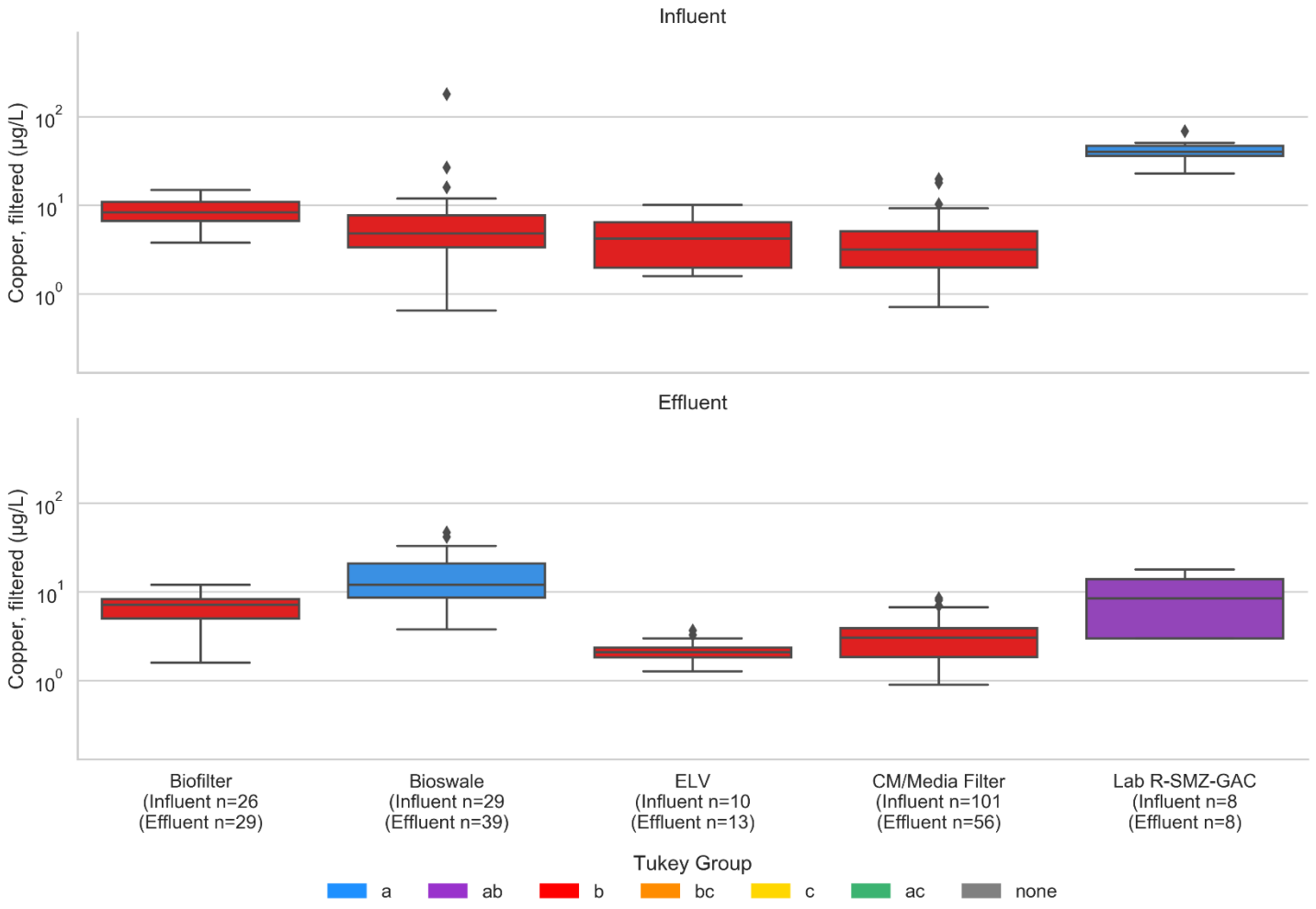
Analyte	Sample Type	Group	Units	Count	Min	Max	Mean	Median	Std. Dev.	Kruskal Wallis H	Kruskal Wallis p-value	Tukey Group
TCDD TEQ (no DNQ)	Influent	Background CM	µg/L	12	1.00E-12	3.70E-10	5.58E-11	1.00E-12	1.14E-10	28.69	2.67E-05	a
		Biofilter	µg/L	26	3.80E-10	4.72E-07	1.07E-07	6.89E-08	1.19E-07			a
		Bioswale	µg/L	29	1.00E-12	2.06E-05	1.23E-06	6.84E-08	4.27E-06			a
		ELV	µg/L	10	1.14E-10	1.22E-07	2.28E-08	5.27E-09	3.79E-08			a
		CM/Media Filter	µg/L	120	1.00E-12	3.60E-04	3.16E-06	5.59E-08	3.29E-05			a
		Lab R-SMZ-GAC	µg/L	3	1.00E-12	4.90E-07	1.72E-07	2.72E-08	2.75E-07			a
	Effluent	Background CM	µg/L	12	1.00E-12	3.50E-10	6.33E-11	1.00E-12	1.26E-10	28.13	3.43E-05	a
		Biofilter	µg/L	29	1.00E-12	1.46E-07	1.17E-08	2.10E-10	3.16E-08			a
		Bioswale	µg/L	39	1.00E-12	1.88E-07	1.07E-08	1.50E-10	3.43E-08			a
		ELV	µg/L	13	1.00E-12	4.44E-08	3.51E-09	1.22E-10	1.23E-08			a
		CM/Media Filter	µg/L	94	1.00E-12	4.33E-06	1.08E-07	1.43E-09	4.58E-07			a
		Lab R-SMZ-GAC	µg/L	3	1.00E-12	8.24E-09	2.75E-09	1.00E-12	4.76E-09			a
	Percent Reduction	Background CM	µg/L	11	-29900	99.29	-3621	0.00	9207	37.27	5.29E-07	b
		Biofilter	µg/L	26	-77.68	100	89.11	99.61	35.82			a
		Bioswale	µg/L	27	-9502	100	-271.30	99.71	1845			ab
		ELV	µg/L	10	-34.22	99.80	75.27	99.23	45.33			ab
		CM/Media Filter	µg/L	80	-23900	100	-459.77	48.61	3028			ab
		Lab R-SMZ-GAC	µg/L	3	0.00	100	56.57	69.71	51.28			ab

Copper



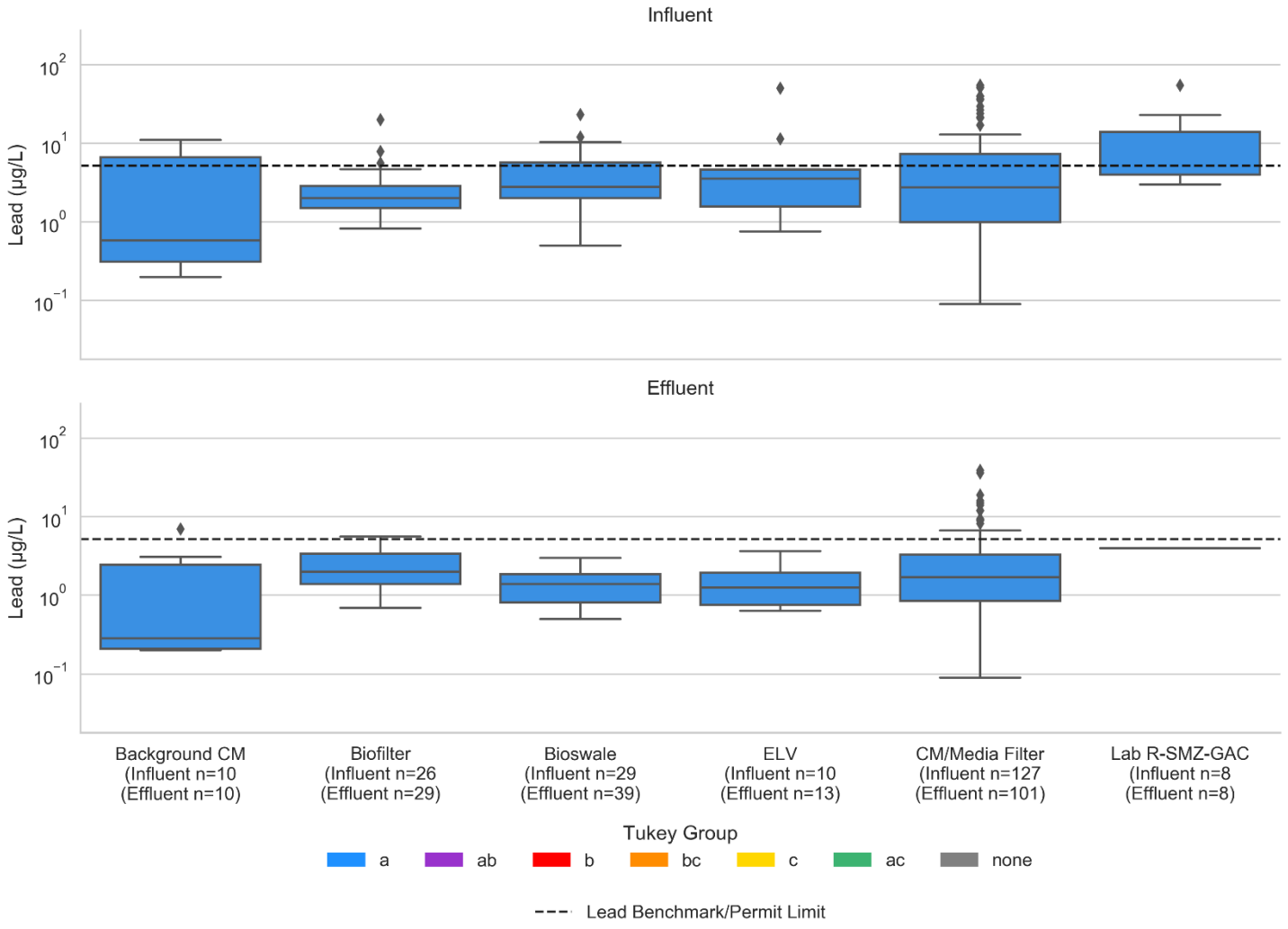
Analyte	Sample Type	Group	Units	Count	Min	Max	Mean	Median	Std. Dev.	Kruskal Wallis H	Kruskal Wallis p-value	Tukey Group
Copper	Influent	Biofilter	µg/L	26	5.90	32.00	11.69	10.00	5.18	49.72	4.12E-10	b
		Bioswale	µg/L	29	1.30	44.79	9.80	9.00	8.39			b
		ELV	µg/L	9	0.14	17.20	6.19	5.63	5.44			b
		CM/Media Filter	µg/L	108	0.14	33.00	6.82	5.10	5.72			b
		Lab R-SMZ-GAC	µg/L	8	76.00	244.00	124.88	109.00	51.95			a
	Effluent	Biofilter	µg/L	29	5.00	14.00	9.47	9.10	2.52	93.07	2.93E-19	b
		Bioswale	µg/L	39	5.10	53.00	17.52	14.00	10.53			a
		ELV	µg/L	11	0.14	5.33	2.44	2.40	1.75			c
		CM/Media Filter	µg/L	75	0.14	22.00	4.74	3.90	3.28			c
		Lab R-SMZ-GAC	µg/L	8	3.00	15.00	8.00	5.50	5.63			bc
	Percent Reduction	Biofilter	µg/L	26	-57.89	70.63	8.42	8.70	30.98	47.16	1.41E-09	a
		Bioswale	µg/L	27	-2108	75.44	-337.23	-35.59	625.59			b
		ELV	µg/L	9	-4.66	69.01	36.10	47.95	29.42			a
		CM/Media Filter	µg/L	63	-80.00	88.56	20.86	19.74	28.74			a
		Lab R-SMZ-GAC	µg/L	8	85.71	97.54	93.20	95.58	4.93			a

Copper, filtered



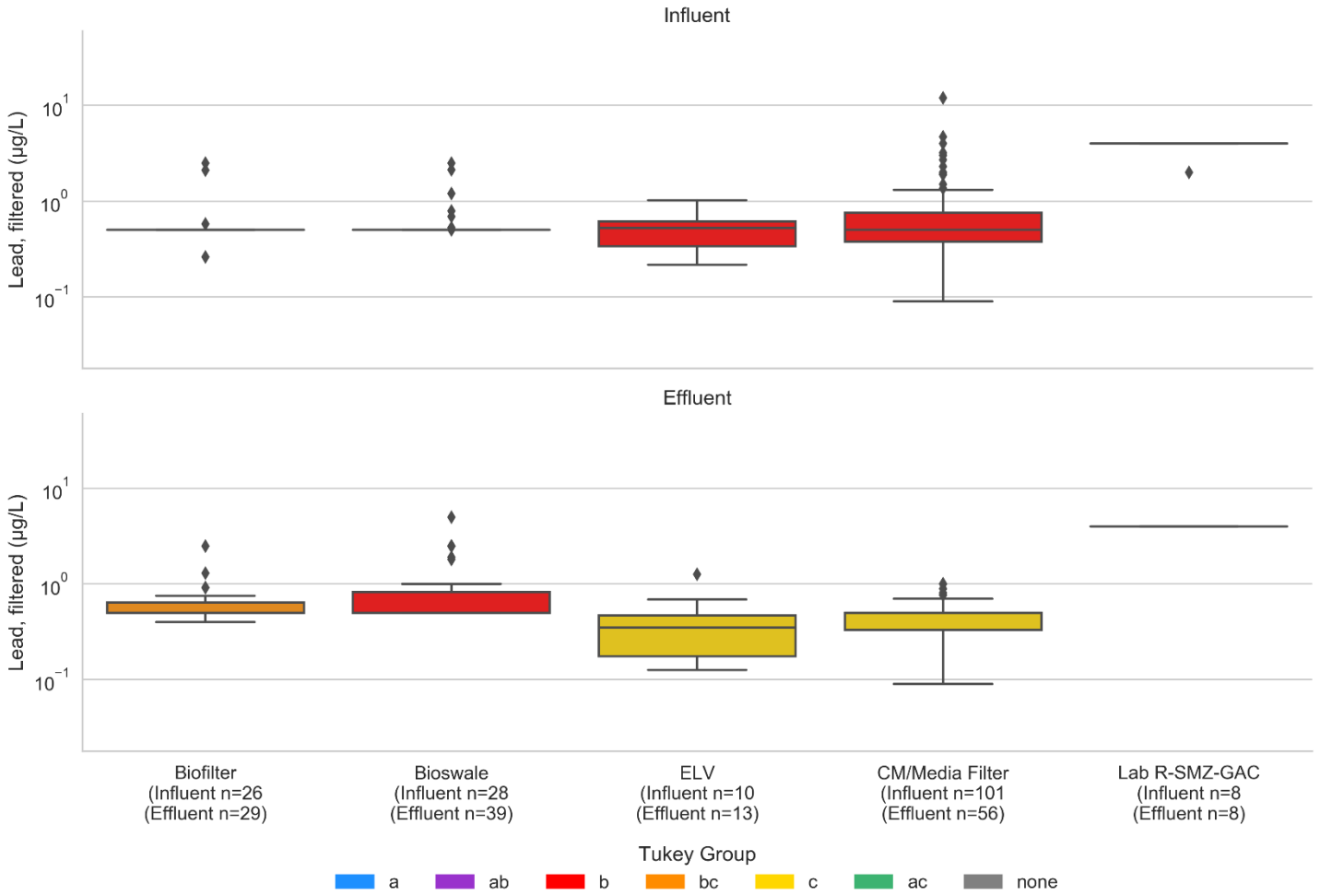
Analyte	Sample Type	Group	Units	Count	Min	Max	Mean	Median	Std. Dev.	Kruskal Wallis H	Kruskal Wallis p-value	Tukey Group
Copper, filtered	Influent	Biofilter	µg/L	26	3.80	15.00	8.74	8.35	3.01	56.63	1.48E-11	b
		Bioswale	µg/L	29	0.65	180.00	12.23	4.86	32.71			b
		ELV	µg/L	10	1.59	10.10	4.73	4.22	3.03			b
		CM/Media Filter	µg/L	101	0.71	19.91	4.14	3.19	3.50			b
		Lab R-SMZ-GAC	µg/L	8	23.00	69.00	42.13	40.50	14.13			a
	Effluent	Biofilter	µg/L	29	1.60	12.00	6.80	7.20	2.62	88.29	3.04E-18	b
		Bioswale	µg/L	39	3.80	47.00	15.44	12.00	10.14			a
		ELV	µg/L	13	1.28	3.67	2.26	2.10	0.67			b
		CM/Media Filter	µg/L	56	0.90	8.50	3.21	3.06	1.81			b
		Lab R-SMZ-GAC	µg/L	8	3.00	18.00	9.25	8.50	6.48			ab
	Percent Reduction	Biofilter	µg/L	26	-44.90	70.83	16.18	20.95	27.83	49.78	4.01E-10	a
		Bioswale	µg/L	27	-4207	96.17	-618.92	-105.58	1164			b
		ELV	µg/L	10	-26.70	77.01	34.12	42.81	33.88			a
		CM/Media Filter	µg/L	50	-436.94	73.33	-1.35	14.93	76.63			a
		Lab R-SMZ-GAC	µg/L	8	60.87	92.68	79.03	81.65	12.09			a

Lead



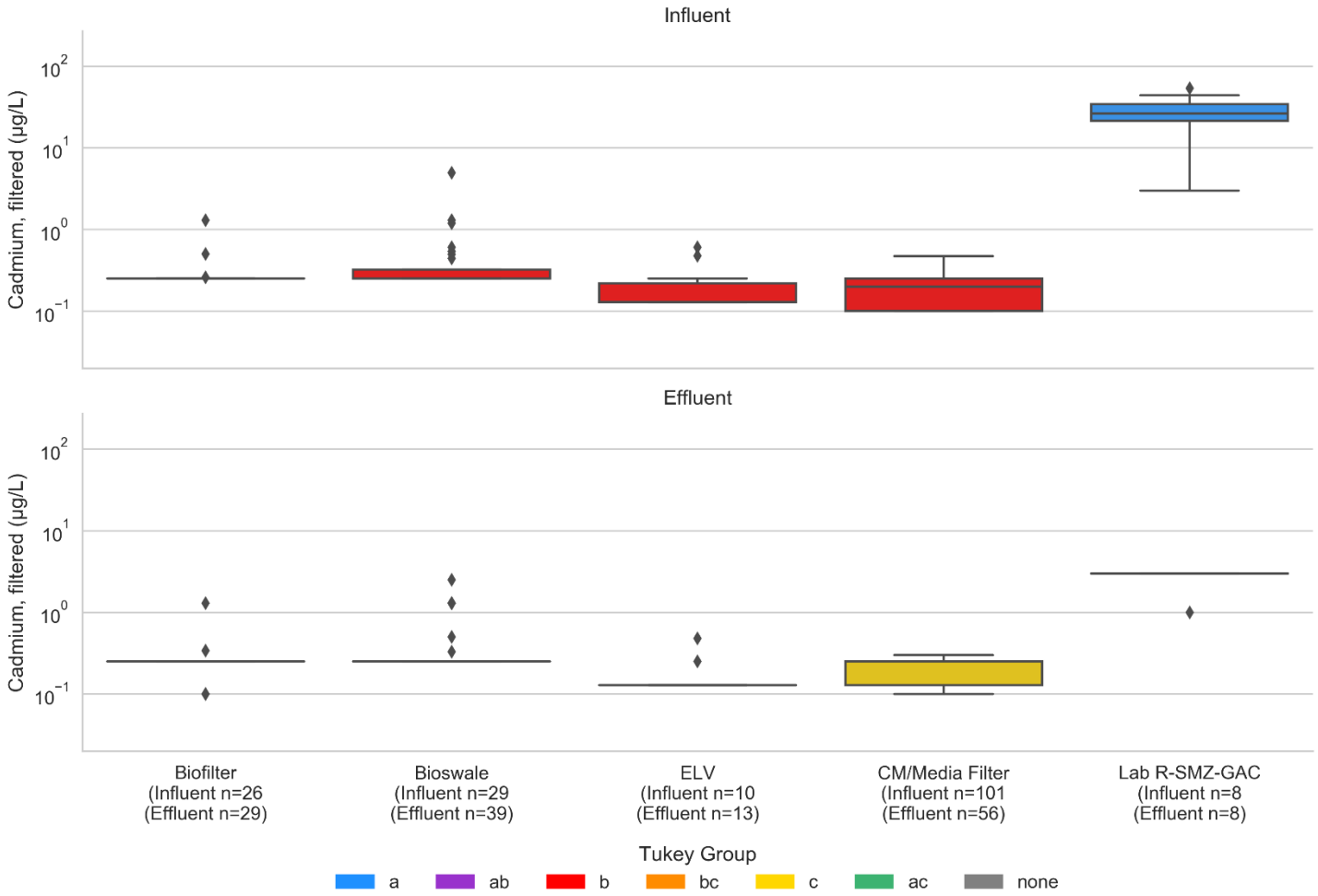
Analyte	Sample Type	Group	Units	Count	Min	Max	Mean	Median	Std. Dev.	Kruskal Wallis H	Kruskal Wallis p-value	Tukey Group
Lead	Influent	Background CM	µg/L	10	0.20	11.00	3.23	0.58	4.47	10.92	5.30E-02	a
		Biofilter	µg/L	26	0.82	20.00	3.14	2.00	3.80			a
		Bioswale	µg/L	29	0.50	23.23	4.81	2.80	4.75			a
		ELV	µg/L	10	0.75	50.20	8.32	3.56	15.03			a
		CM/Media Filter	µg/L	127	0.09	55.00	7.47	2.76	12.03			a
		Lab R-SMZ-GAC	µg/L	8	3.00	55.00	13.50	4.00	18.09			a
	Effluent	Background CM	µg/L	10	0.20	7.00	1.63	0.29	2.21	24.29	1.91E-04	a
		Biofilter	µg/L	29	0.69	5.60	2.48	2.00	1.45			a
		Bioswale	µg/L	39	0.50	3.00	1.37	1.40	0.69			a
		ELV	µg/L	13	0.64	3.67	1.57	1.26	0.90			a
		CM/Media Filter	µg/L	101	0.09	39.00	3.75	1.70	6.21			a
		Lab R-SMZ-GAC	µg/L	8	4.00	4.00	4.00	4.00	0.00			a
	Percent Reduction	Background CM	µg/L	10	-318.92	81.82	2.02	26.52	117.16	12.27	3.12E-02	a
		Biofilter	µg/L	26	-163.64	75.50	-3.33	0.00	52.52			a
		Bioswale	µg/L	27	-346.43	94.85	24.76	62.38	98.20			a
		ELV	µg/L	10	-13.51	97.55	37.38	34.44	35.51			a
		CM/Media Filter	µg/L	87	-691.67	98.18	12.71	33.33	99.26			a
		Lab R-SMZ-GAC	µg/L	8	-33.33	92.73	25.70	0.00	46.75			a

Lead, filtered



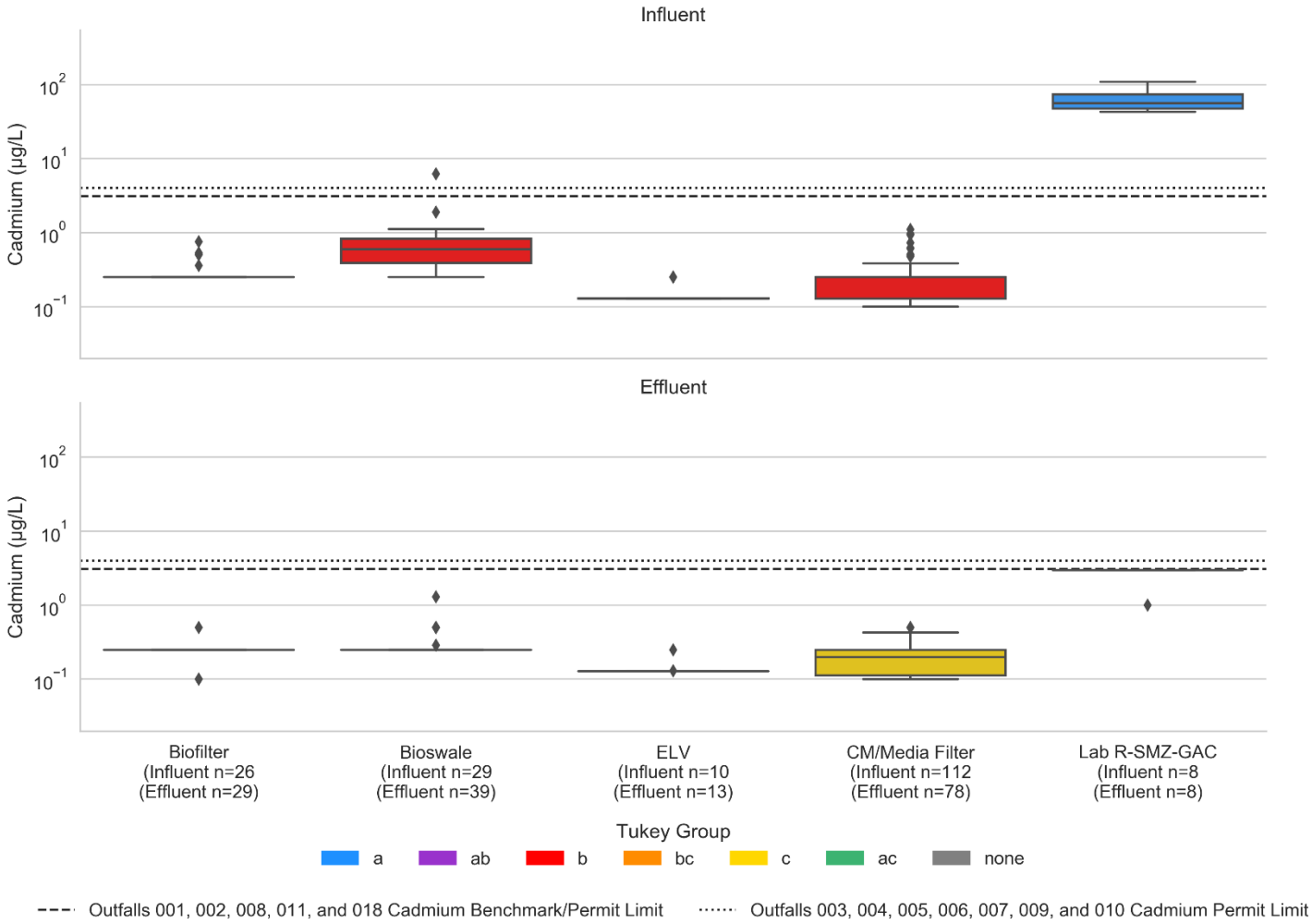
Analyte	Sample Type	Group	Units	Count	Min	Max	Mean	Median	Std. Dev.	Kruskal Wallis H	Kruskal Wallis p-value	Tukey Group
Lead, filtered	Influent	Biofilter	µg/L	26	0.26	2.50	0.63	0.50	0.50	24.23	7.17E-05	b
		Bioswale	µg/L	28	0.50	2.50	0.67	0.50	0.49			b
		ELV	µg/L	10	0.22	1.02	0.53	0.52	0.25			b
		CM/Media Filter	µg/L	101	0.09	12.00	0.84	0.50	1.37			b
		Lab R-SMZ-GAC	µg/L	8	2.00	4.00	3.75	4.00	0.71			a
	Effluent	Biofilter	µg/L	29	0.40	2.50	0.65	0.50	0.40	45.91	2.57E-09	bc
		Bioswale	µg/L	39	0.50	5.00	0.98	0.50	0.97			b
		ELV	µg/L	13	0.13	1.26	0.40	0.35	0.31			c
		CM/Media Filter	µg/L	56	0.09	1.00	0.47	0.50	0.23			c
		Lab R-SMZ-GAC	µg/L	8	4.00	4.00	4.00	4.00	0.00			a
	Percent Reduction	Biofilter	µg/L	26	-84.00	38.10	-13.15	0.00	27.79	24.53	6.25E-05	ab
		Bioswale	µg/L	26	-400.00	76.58	-50.06	0.00	128.62			b
		ELV	µg/L	10	-140.46	44.97	10.79	25.44	54.81			ab
		CM/Media Filter	µg/L	50	-97.74	77.75	11.60	0.00	33.96			a
		Lab R-SMZ-GAC	µg/L	8	-100.00	0.00	-12.50	0.00	35.36			ab

Cadmium



Analyte	Sample Type	Group	Units	Count	Min	Max	Mean	Median	Std. Dev.	Kruskal Wallis H	Kruskal Wallis p-value	Tukey Group
Cadmium, filtered	Influent	Biofilter	µg/L	26	0.25	1.30	0.30	0.25	0.21	68.86	3.95E-14	b
		Bioswale	µg/L	29	0.25	4.93	0.53	0.25	0.89			b
		ELV	µg/L	10	0.13	0.61	0.22	0.13	0.17			b
		CM/Media Filter	µg/L	101	0.10	0.47	0.19	0.20	0.08			b
		Lab R-SMZ-GAC	µg/L	8	3.00	54.00	27.88	26.50	15.96			a
	Effluent	Biofilter	µg/L	29	0.10	1.30	0.28	0.25	0.20	63.44	5.47E-13	bc
		Bioswale	µg/L	39	0.25	2.50	0.45	0.25	0.49			b
		ELV	µg/L	13	0.13	0.48	0.16	0.13	0.10			c
		CM/Media Filter	µg/L	56	0.10	0.30	0.20	0.25	0.07			c
		Lab R-SMZ-GAC	µg/L	8	1.00	3.00	2.75	3.00	0.71			a
	Percent Reduction	Biofilter	µg/L	26	-36.00	60.00	2.99	0.00	16.94	27.87	1.33E-05	b
		Bioswale	µg/L	27	-420.00	94.93	-8.12	0.00	90.44			b
		ELV	µg/L	10	-1.27	78.91	7.76	0.00	25.00			b
		CM/Media Filter	µg/L	50	-20.00	34.85	2.95	0.00	9.22			b
		Lab R-SMZ-GAC	µg/L	8	0.00	94.44	79.46	89.61	32.20			a

Chromium



Analyte	Sample Type	Group	Units	Count	Min	Max	Mean	Median	Std. Dev.	Kruskal Wallis H	Kruskal Wallis p-value	Tukey Group
Cadmium	Influent	Biofilter	µg/L	26	0.25	0.75	0.30	0.25	0.13	72.33	7.32E-15	b
		Bioswale	µg/L	29	0.25	6.20	0.81	0.60	1.10			b
		ELV	µg/L	10	0.13	0.25	0.15	0.13	0.05			b
		CM/Media Filter	µg/L	112	0.10	1.10	0.25	0.25	0.18			b
		Lab R-SMZ-GAC	µg/L	8	43.00	109.00	65.25	56.00	25.39			a
	Effluent	Biofilter	µg/L	29	0.10	0.50	0.25	0.25	0.06	71.46	1.12E-14	bc
		Bioswale	µg/L	39	0.25	1.30	0.31	0.25	0.18			b
		ELV	µg/L	13	0.13	0.25	0.14	0.13	0.03			c
		CM/Media Filter	µg/L	78	0.10	0.50	0.19	0.20	0.09			c
		Lab R-SMZ-GAC	µg/L	8	1.00	3.00	2.75	3.00	0.71			a
	Percent Reduction	Biofilter	µg/L	26	0.00	72.22	9.30	0.00	22.54	41.58	2.04E-08	b
		Bioswale	µg/L	27	-160.00	95.97	34.40	57.99	56.19			b
		ELV	µg/L	10	-1.56	49.00	4.82	0.00	15.53			b
		CM/Media Filter	µg/L	66	-100.00	88.42	12.02	0.00	31.32			b
		Lab R-SMZ-GAC	µg/L	8	93.02	98.46	95.26	94.63	2.04			a

Appendix E : Performance Regression Equations from Laboratory Column Tests and Full-Scale Stormwater Treatment Facilities

Table E-1. Equations to Predict Effluent Concentrations for Different Stormwater Controls at SSFL

		TSS (mg/L)	TCDD (µg/L)	Cu (µg/L)	filt Cu (µg/L)	Pb (µg/L)	filt Pb (µg/L)
B1, CM1, CM9, ULBF, CM8, and CM11 combined	Wilcoxon Signed Rank Test P, inf = efl	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	number of pairs	91	59	55	38	81	18
	ANOVA P for selected equation	<0.001		<0.001	<0.001	<0.001	<0.001
	selected efl equation or values	log TSS efl = 0.791 log TSS inf	1.07E-07 (4.31)*	Cu efl = 1.95 + 0.427 Cu inf	filt Cu efl = 1.89 + 0.348 filt Cu inf	Pb efl = 0.473 Pb inf	filt Pb efl = 0.303 + 0.229 filt Pb inf

		TSS	TCDD	Cu	filt Cu	Pb	filt Pb
South and North Detention Bioswales combined	Wilcoxon Signed Rank Test P, inf = efl	<0.001	<0.001	0.007	0.004	<0.001	0.063
	number of pairs	23	21	24	24	22	5
	ANOVA P for selected equation						
	selected efl equation or values	9 (0.94)	1.15E-08 (3.08)	18.1 (0.59)	16.0 (0.65)	1.38 (0.51)	1.02 (0.98)

		TSS	TCDD	Cu	filt Cu	Pb	filt Pb
Lower Lot Biofilter	Wilcoxon Signed Rank Test P, inf = efl	0.550	<0.001	0.120	0.003	0.880	1.000
	number of pairs	24	24	24	24	24	3
	ANOVA P for selected equation				0.004		
	selected efl equation or values	efl = inf	1.11E-08 (2.92) with many NDs	efl = inf	filt Cu efl = 2.83 + 0.469 filt Cu inf	efl = inf	efl = inf

		TSS	TCDD	Cu	filt Cu	Pb	filt Pb
ELV Treatment Train	Wilcoxon Signed Rank Test P, inf = efl	0.074	0.004	0.031	0.014	0.008	0.084
	number of pairs	10	10	7	10	10	10
	ANOVA P for selected equation	<0.001		<0.001	0.028	0.023	0.001

	selected efl equation or values	log TSS efl = 0.745 log TSS inf	3.51E-09 (3.50) with many NDs	Cu efl = 0.863 + 0.301 Cu inf	filt Cu efl = 1.56 + 0.167 filt Cu inf	log Pb efl = 0.269 log Pb inf	filt Pb efl = 0.840 filt Pb inf

*Average and (COV)

Table E-1. Equations to Predict Effluent Concentrations for Different Stormwater Controls at SSFL (continued)

		Cd (µg/L)	filt Cd (µg/L)	Cond (mS/cm)	pH	Temp (ºC)	Turb (NTU)
B1, CM1, CM9, ULBF, CM8, and CM11 combined	Wilcoxon Signed Rank Test P, inf = efl	<0.001	0.004	0.003	0.290	0.540	0.530
	number of pairs	27	9	87	91	86	84
	ANOVA P for selected equation			<0.001			
	selected efl equation or values	0.19 (0.49) with many NDs	mostly NDs	log cond efl = -0.320 + 0.773 log cond inf	efl = inf	efl = inf	efl = inf

		Cd	filt Cd	Cond	pH	Temp	Turb
South and North Detention Bioswales combined	Wilcoxon Signed Rank Test P, inf = efl	<0.001	0.042	0.053	<0.001	0.008	0.110
	number of pairs	16	11	20	20	15	20
	ANOVA P for selected equation					<0.001	
	selected efl equation or values	0.32 (0.60) and many ND	0.47 (1.08) with many NDs	0.29 (0.94)	6.5 (0.09)	Temp efl = 1.06 Temp inf	efl = inf

		Cd	filt Cd	Cond	pH	Temp	Turb
Lower Lot Biofilter	Wilcoxon Signed Rank Test P, inf = efl	0.250	0.500	0.086	0.900	0.870	0.030
	number of pairs	3	2	23	23	22	23
	ANOVA P for selected equation			<0.001			
	selected efl equation or values	efl = inf	efl = inf	cond efl = 1.15 cond inf	efl = inf	efl = inf	log turb efl = 0.887 + 0.588 log turb inf

		Cd	filt Cd	Cond	pH	Temp	Turb
ELV Treatment Train	Wilcoxon Signed Rank Test P, inf = efl	0.500	1.000	0.031	0.690	0.940	0.300
	number of pairs	2	2	6	7	7	7
	ANOVA P for selected equation			0.011			
	selected efl equation or values	efl = inf	efl = inf	cond efl = 2.30 cond inf	efl = inf	efl = inf	efl = inf

Table E-2. Removals for Rhyolite Sand - Surface Modified Zeolite - Granular Activated Carbon Mixture (R-SMZ-GAC) for Full-Depth Column Tests (Pitt and Clark 2010)

Constituent, mg/L unless noted otherwise	p that effluent equals influent*	regression equation (or Y = constant, and COV also shown)**	Mean Influent Concentration (approximate range)***	Mean Effluent Concentration***	Reduction (%)***
< 0.45 um particles, mg/L	0.250	Y = X	199 (80 to 250)	225	0*
0.45 to 3 um particles, mg/L	0.160	Y = X	9.9 (3 to 22)	7.2	0*
3 to 12 um particles, mg/L	0.009	Y = 4.0 (0.5)	54.9 (22 to 90)	2.9	95
12 to 30 um particles, mg/L	0.009	Y = 0.68 (0.76)	54.5 (18 to 90)	0.67	99
30 to 60 um particles, mg/L	0.009	Y = 1.1 (0.70)	37.4 (3 to 80)	1	97
60 to 120 um particles, mg/L	0.009	Y = 0.85 (0.77)	20.0 (2 to 58)	0.76	96
120 to 250 um particles, mg/L	0.009	Y = 0.08 (1.4)	5.1 (0 to 17)	0.08	98
250 to 1180 um particles, mg/L (no particles found >1180)	0.075	Y = 5.0 (0.66)	13.9 (3 to 45)	4.1	71
SSC, mg/L	0.009	Y = 10.2 (0.24)	206 (50 to 400)	13.6	93
TSS (0.45 to 75 µm), mg/L	0.009	Y = 10.2 (0.37)	171 (50 to 310)	10.2	94
TDS	0.250	Y = X	199 (80 to 250)	225	0*
Chloride	0.063	Y = 30 (0.18)	18 (1 to 34)	30	-72
Fluoride	0.063	Y = 2.2 (0.25)	2.6 (1.7 to 3.1)	2.2	14
pH	0.227	Y = X	7.7 (7.3 to 8.2)	8.1	-6
Conductivity, µS/cm	0.656	Y = X	337 (179 to 460)	360	-6
ORP, mV	0.500	Y = X	187 (161 to 225)	184	2
Color, Pt color units	0.008	Y = 46 (0.66)	212 (108 to 453)	46	78
Hardness, mg/L	0.500	Y = X	82 (50 to 106)	102	-24
Sulfate, as SO_4	0.063	Y = 37 (0.29)	45 (39 to 51)	37	18
oil and grease	most influ. <LOD	n/a	1.4 (<LOD to 2.2)	all <LOD	>29

Constituent, mg/L unless noted otherwise	p that effluent equals influent*	regression equation (or Y = constant, and COV also shown)**	Mean Influent Concentration (approximate range)***	Mean Effluent Concentration***	Reduction (%)***
COD, mg/L	0.008	Y = 5.6 (1.4)	72 (32 to 110)	5.5	92
UV-254, absorbance units	0.063	Y = 0.16 (2.0)	0.66 (0.23 to 1.08)	0.16	75
Nitrogen, Total, mg/L	0.008	Y = 2.9 (0.88)	10.9 (4 to 17.7)	2.9	74
Ammonia, as N	0.008	Y = 0.013 (1.4)	2.7 (0.3 to 3.9)	0.01	96
Nitrate, mg/L	0.063	Y = 3.0 (0.88)	6.0 (4.9 to 7.1)	3.0	50
Nitrite + nitrate as N	0.063	Y = 3.0 (0.84)	6.0 (4.9 to 7.1)	3	49
nitrite as N	0.227	Y = X	0.03 (0.015 to 0.046)	0.08	-180
Phosphorus, mg/L	0.500	Y = X	0.65 (0.42 to 1.28)	0.68	-4
Phosphate, as P, mg/L	0.500	Y = X	0.90 (0.45 to 1.43)	1.5	-66
Aluminum, µg/L	0.004	Y = 610 (1.3)	6140 (2160 to 10,040)	614	90
Aluminum, filtered, µg/L	0.008	Y = 45 (0.39)	73 (<LOD to 121)	39	46
antimony, µg/L	0.004	Y = 35 (0.49)	68 (47 to 87)	31	55
Antimony, filtered, µg/L	0.035	Y = 34 (0.39)	56 (39 to 86)	30	48
Arsenic, µg/L	0.016	Y = 14 (0.33)	56 (<LOD to 178)	16	72
Arsenic, filtered, µg/L	0.109	Y = 14 (0.34)	33 (<LOD to 109)	14	57
Boron, µg/L	0.031	almost all effluent <LOD	170 (<LOD to 509)	45	75
Boron, filtered, µg/L	0.031	all effluent <LOD	177 (<LOD to 472)	45	75
cadmium, µg/L	0.004	almost all effluent <LOD	65 (43 to 109)	1	98
Cadmium, filtered, µg/L	0.008	almost all effluent <LOD	28 (1 to 54)	1	96
Calcium, µg/L	0.363	Y = X	30,100 (23,500 to 36,300)	37,000	-23
Calcium, filtered, µg/L	0.637	Y = X	30,400 (22,150 to 42,400)	35,000	-15
Chromium, µg/L	0.004	Y = 6.1 (0.69)	64 (48 to 81)	5.4	91
Chromium, filtered, µg/L	0.004	Y = 0.27 X	14 (7 to 19)	2.8	80
Copper, µg/L	0.004	Y = 16 (0.46)	125 (76 to 244)	7	94
Copper, filtered, µg/L	0.004	Y = 13 (0.40)	42 (23 to 69)	9	80
Iron, µg/L	0.004	Y = 210 (1.0)	4830 (1820 to 8620)	210	96
Iron, filtered, µg/L	0.008	Y = 0.37 X	63 (44 to 109)	21	66
Lead, µg/L	0.063	all effluent <LOD	13 (<LOD to 55)	2	84

Constituent, mg/L unless noted otherwise	p that effluent equals influent*	regression equation (or Y = constant, and COV also shown)**	Mean Influent Concentration (approximate range)***	Mean Effluent Concentration***	Reduction (%)***
Lead, filtered, µg/L	n/a	almost all influent and effluent <LOD	2 (<LOD to 2)	2	0
Magnesium, µg/L	0.145	Y = X	3250 (2710 to 4140)	4570	-41
Magnesium, filtered, µg/L	0.004	Y = 4300 (0.39)	2480 (2140 to 3520)	4310	-74
Manganese, µg/L	0.004	Y = 6 (1.1)	66 (33 to 120)	5.3	92
Manganese, filtered, µg/L	0.125	almost all effluent <LOD	3.4 (<LOD to 13)	0.6	81
Mercury, µg/L	0.125	Y = 2.4 (0.41)	63 (43 to 76)	2	96
Nickel, µg/L	0.004	Y = 4.3 (0.33)	51 (35 to 62)	4	92
Nickel, filtered, µg/L	0.004	Y = 0.3 X	27 (7 to 68)	7.6	71
Potassium, µg/L	0.004	Y = 12,800 (0.23)	3450 (2650 to 4240)	8990	-160
Potassium, filtered, µg/L	0.004	Y = 8000 (0.23)	2410 (1960 to 3250)	7990	-230
Sodium, µg/L	0.145	Y = X	17,000 (15,400 to 19,000)	21,400	-26
Sodium, filtered, µg/L	0.145	Y = X	17,200 (14,200 to 27,300)	19,600	-14
zinc, µg/L	0.035	Y = 48 (0.31)	77 (62 to 92)	48	37
Zinc, filtered, µg/L	0.363	Y = X	52 (32 to 87)	44	14
TCDD, µg/L	0.250	Y = 9.4 X 10^{-9} (0.11)	1.8X10^{-7} (1X10^{-8} to 5X10^{-7})	9.4 X 10^{-9}	95
Perchlorate, µg/L	all infl. < LOD	n/a	all infl. <LOD	all effl. <LOD	all infl. < LOD
Thallium, µg/L (LOD>PL)	0.004	almost all effluent <LOD	79 (46 to 125)	4	96
Thallium, filtered, µg/L	0.004	almost all effluent <LOD	64 (27 to 94)	5.5	91
Gross alpha radioactivity, pCi/L	0.125	all effluent <LOD	5.3 (3.9 to 6.8)	0.5	90
Gross beta radioactivity, pCi/L	0.500	Y = X	9.4 (8.1 to 10.1)	8.7	7
Radium 226 + 228, pCi/L	0.125	Y = 0.31 (1.2)	0.92 (0.67 to 1.2)	0.31	66
Strontium-90, pCi/L	all infl. < LOD	n/a	0.45 (0.4 to 0.8)	all effl. <LOD	all infl. < LOD

Constituent, mg/L unless noted otherwise	p that effluent equals influent*	regression equation (or Y = constant, and COV also shown)**	Mean Influent Concentration (approximate range)***	Mean Effluent Concentration***	Reduction (%)***
Tritium, pCi/L	all infl. < LOD	n/a	all infl. <LOD	all effl. <LOD	all infl. < LOD
Uranium, pCi/L	0.125	all eff. <LOD	1.2 (1.1 to 1.5)	all eff. <LOD	>80

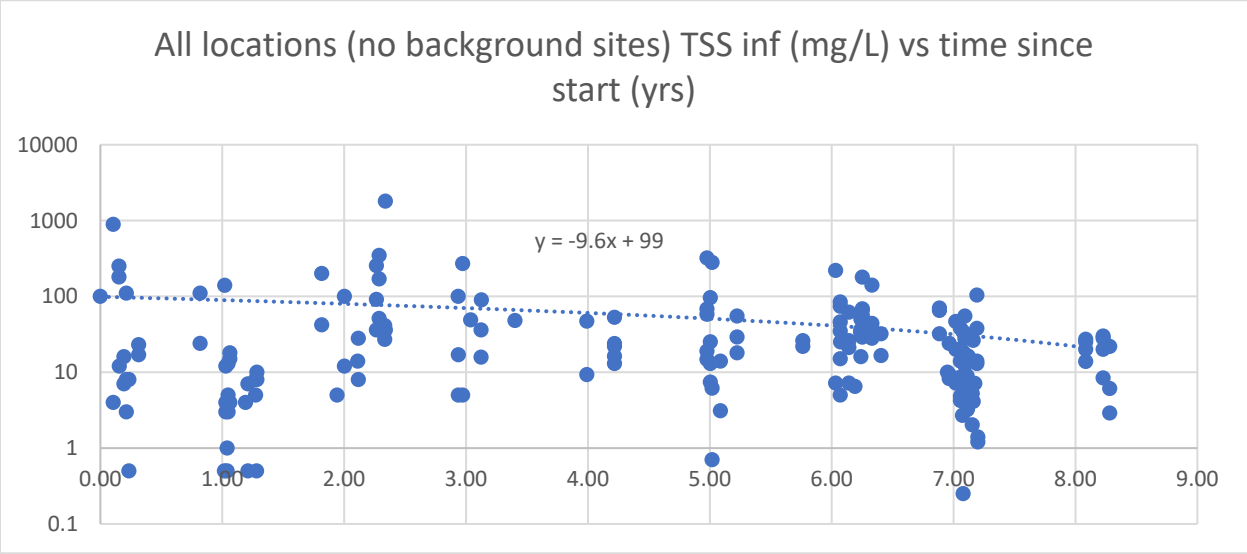
* calculated using the sign test, ties ignored in the count; "no data" is when no samples were analyzed

** <LOD substituted with half of the detection limits for these calculations; if predicted effluent is > influent, then use influent concentration (except for pH, and when significant increases are noted in the % removal column)

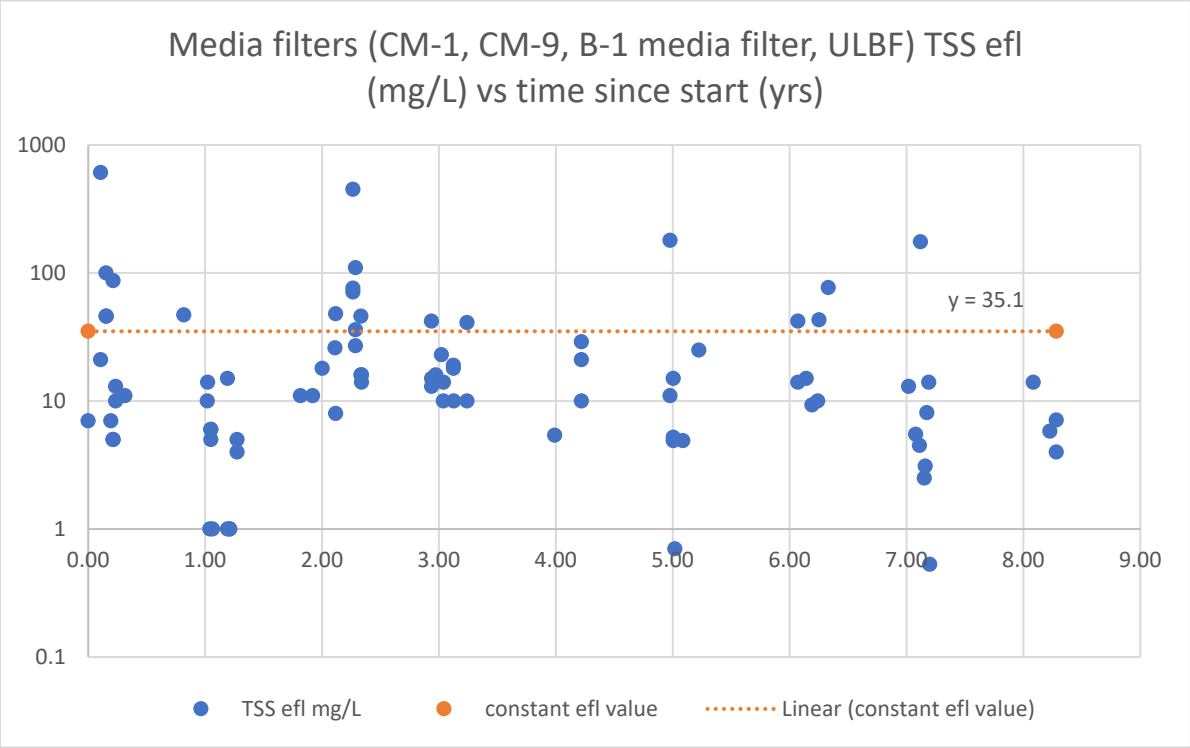
*** <LOD substituted with half of the detection limits for these calculations

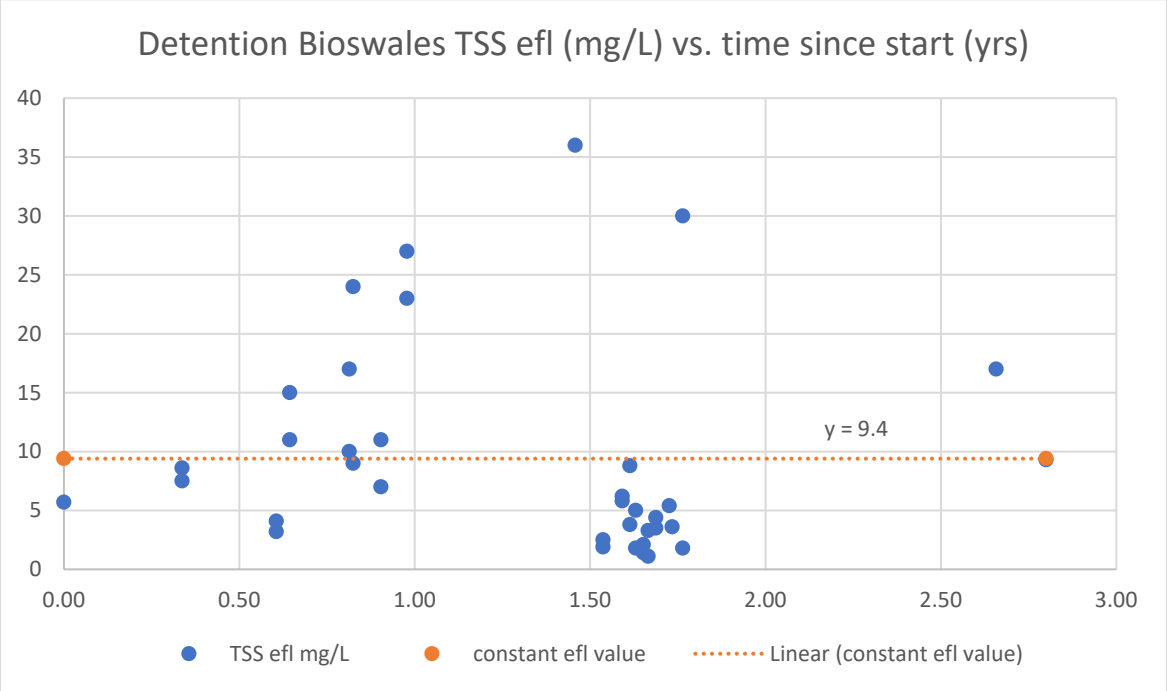
Appendix F: Influent and Effluent Concentration Trends with Time

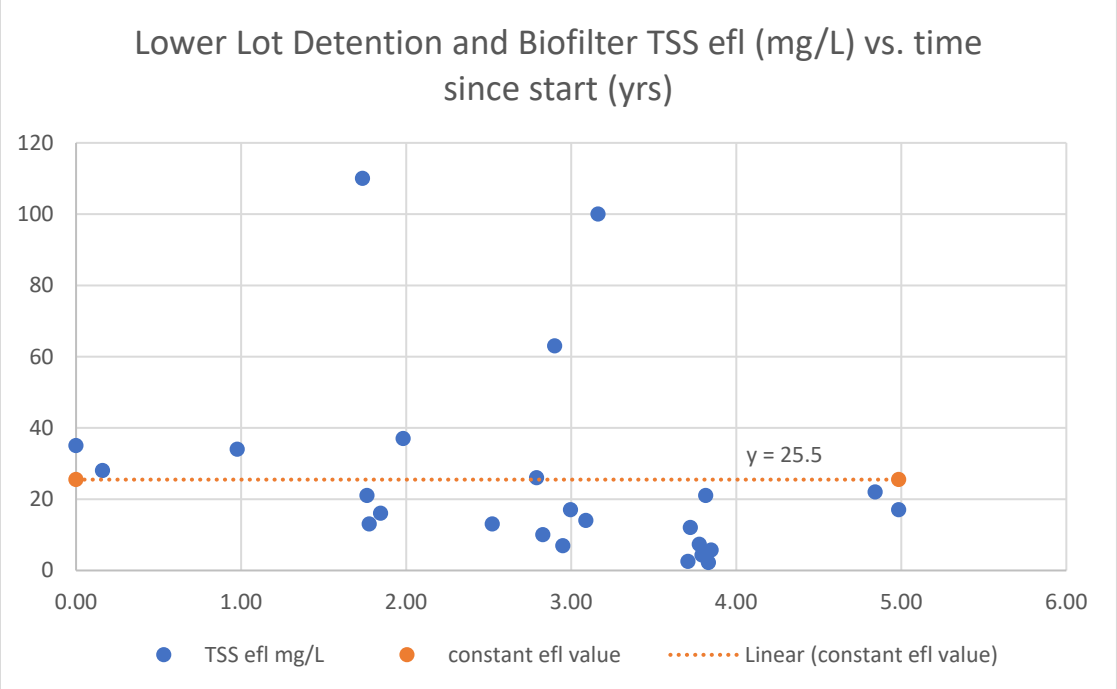
TSS Influent Trend

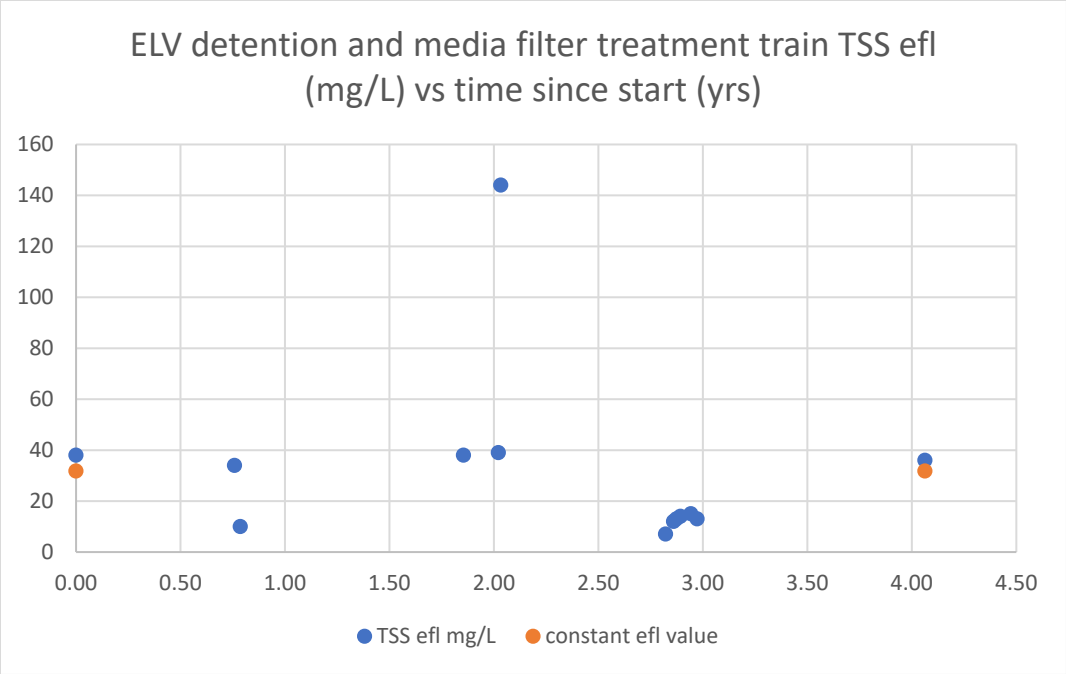


TSS Effluent Trends

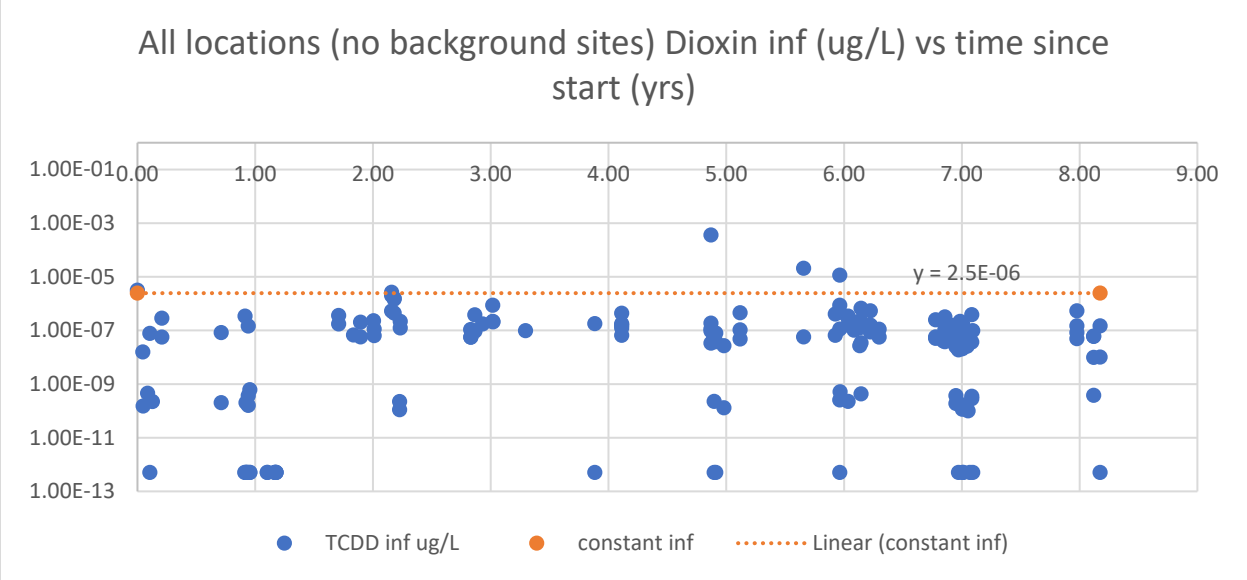



Detention Bioswales TSS efl (mg/L) vs. time since start (yrs)
40
35
30
25
20
15
10
5
0
0.00
0.50
1.00
1.50
2.00
2.50
3.00
y = 9.4
TSS efl mg/L
constant efl value
Linear (constant efl value)

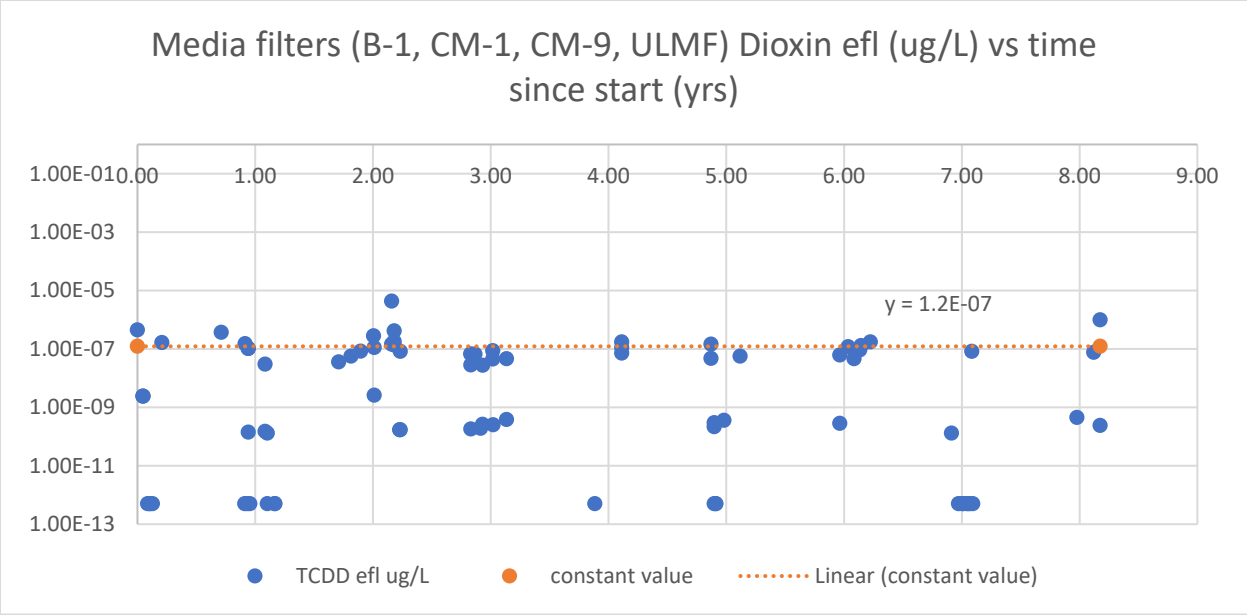

Lower Lot Detention and Biofilter TSS efl (mg/L) vs. time since start (yrs)
120
100
80
60
40
20
0
0.00
1.00
2.00
3.00
4.00
5.00
6.00
y = 25.5
TSS efl mg/L
constant efl value
Linear (constant efl value)

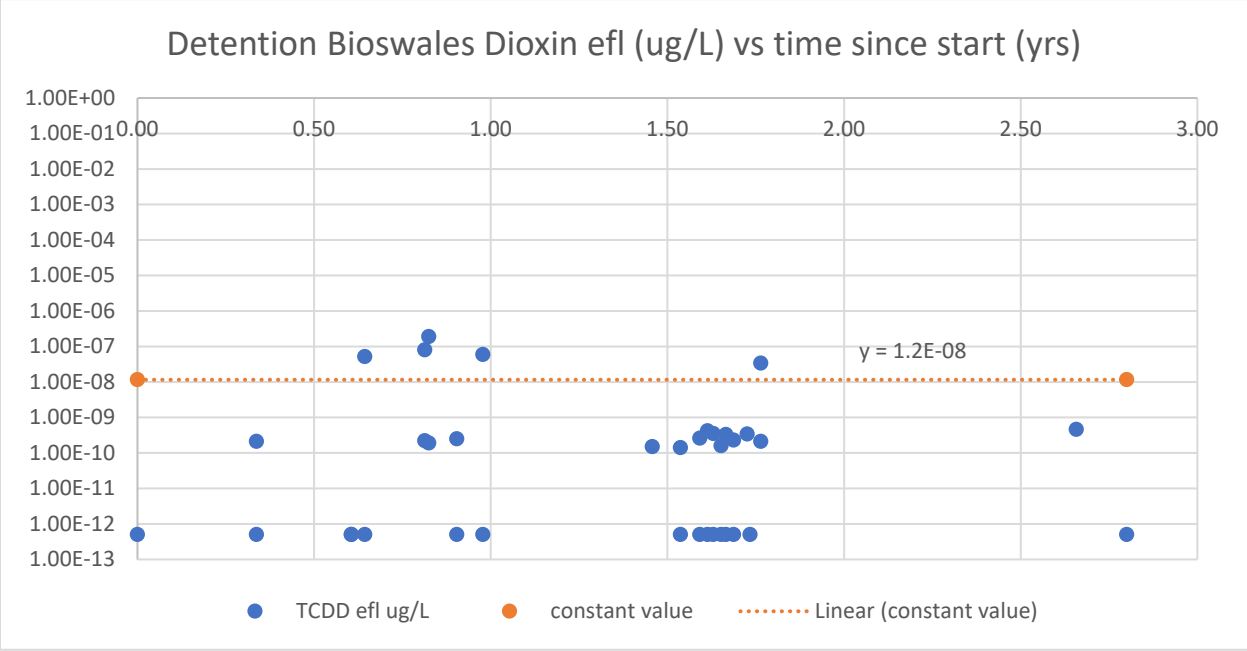


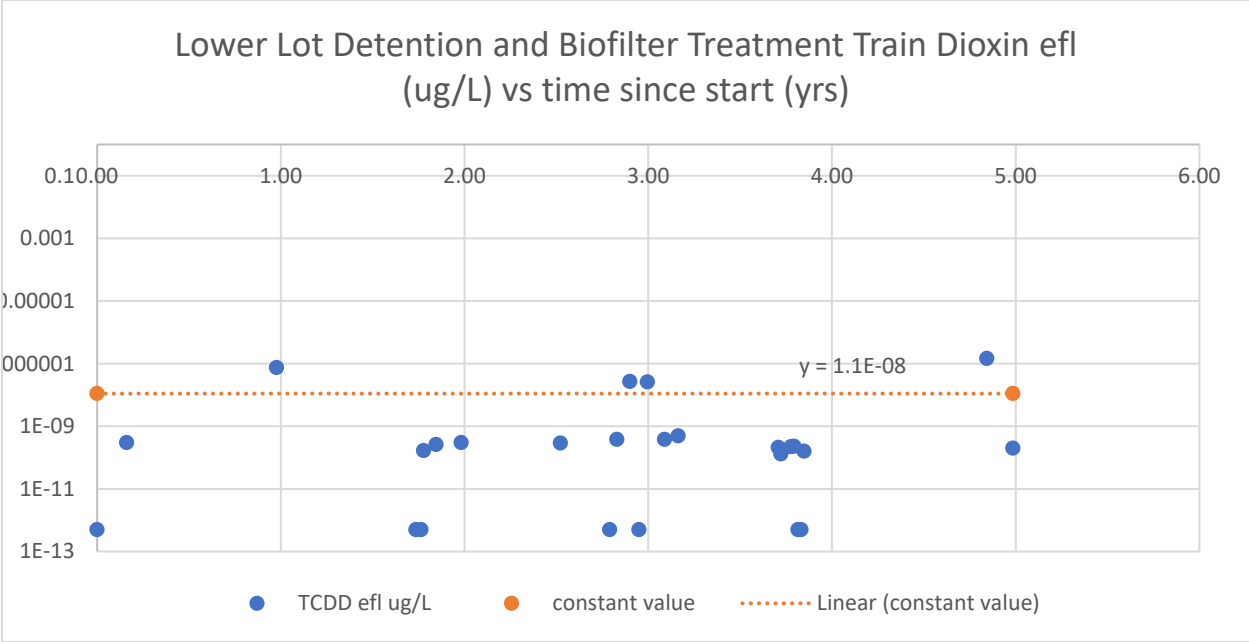
Dioxins - TCDD TEQ NoDNQ Influent Trend

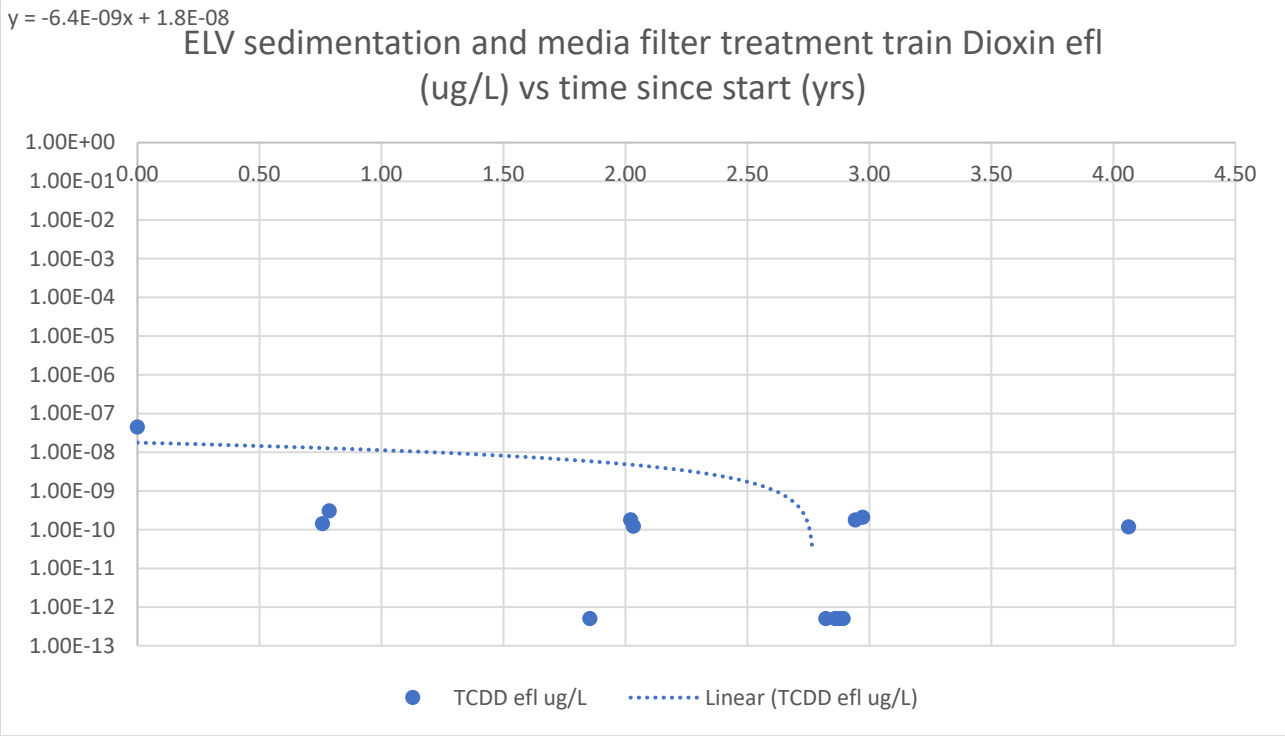


Dioxins - TCDD TEQ NoDNQ Effluent Trends

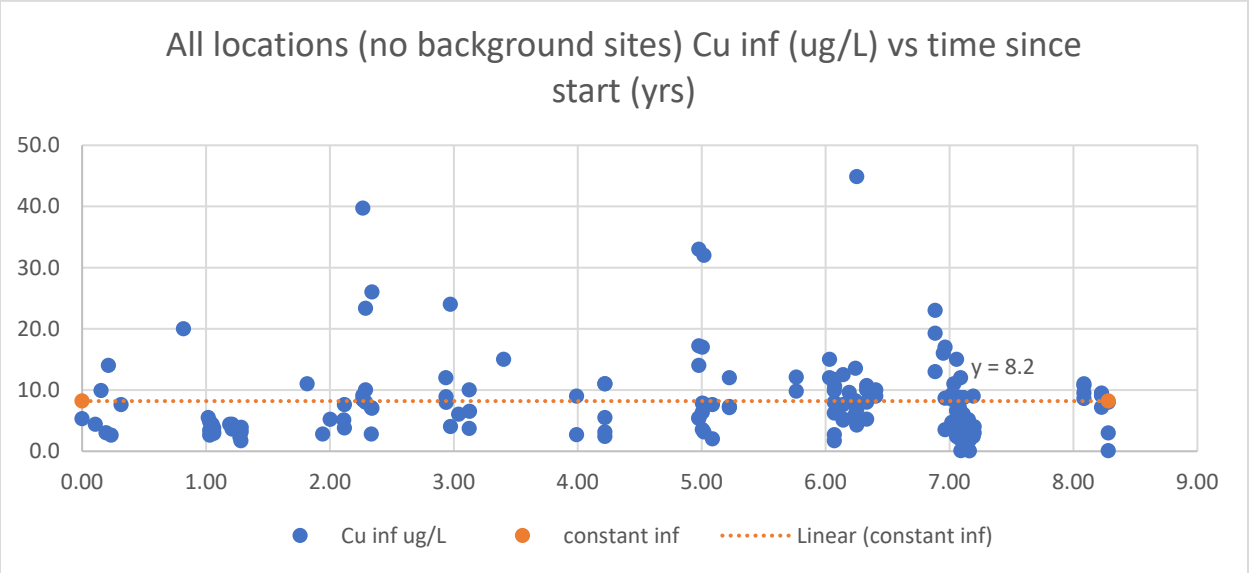

Media filters (B-1, CM-1, CM-9, ULMF) Dioxin efl (ug/L) vs time since start (yrs)
1.00E-01
1.00E-03
1.00E-05
1.00E-07
1.00E-09
1.00E-11
1.00E-13
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
y = 1.2E-07
TCDD efl ug/L
constant value
Linear (constant value)


Detention Bioswales Dioxin efl (ug/L) vs time since start (yrs)
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
1.00E-06
1.00E-07
1.00E-08
1.00E-09
1.00E-10
1.00E-11
1.00E-12
1.00E-13
0.00
0.50
1.00
1.50
2.00
2.50
3.00
y = 1.2E-08
TCDD efl ug/L
constant value
Linear (constant value)

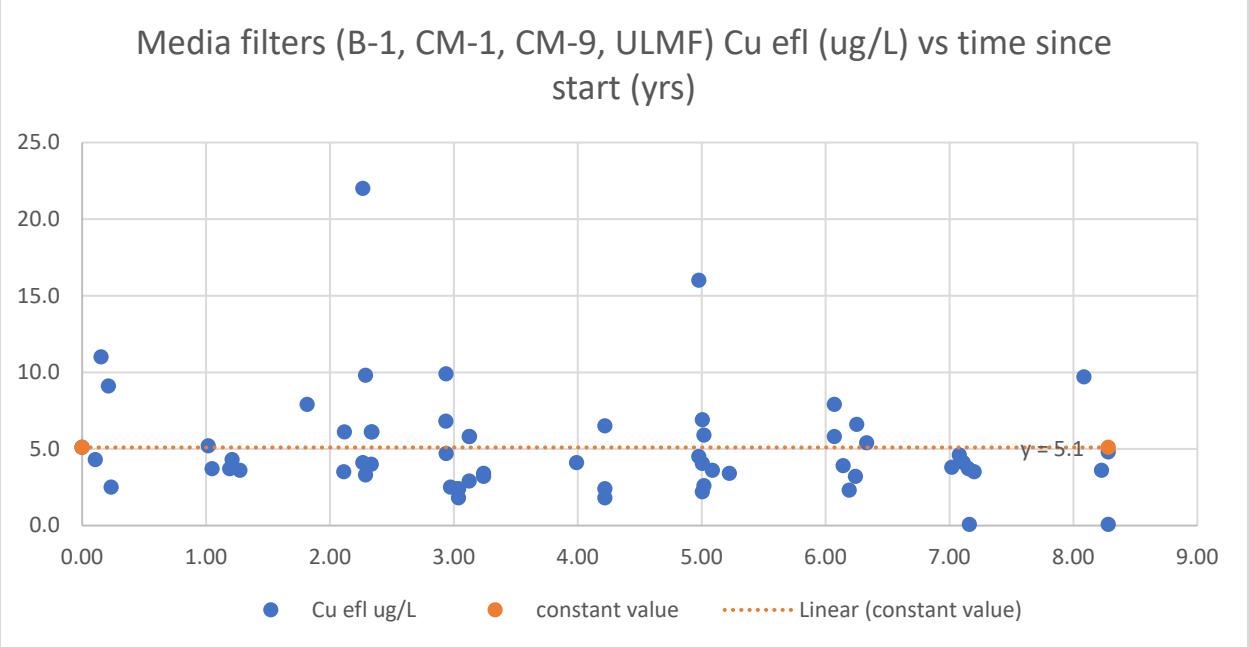

Lower Lot Detention and Biofilter Treatment Train Dioxin efl (ug/L) vs time since start (yrs)
0.10.00
1.00
2.00
3.00
4.00
5.00
6.00
0.001
.00001
000001
1E-09
1E-11
1E-13
y = 1.1E-08
TCDD efl ug/L
constant value
Linear (constant value)

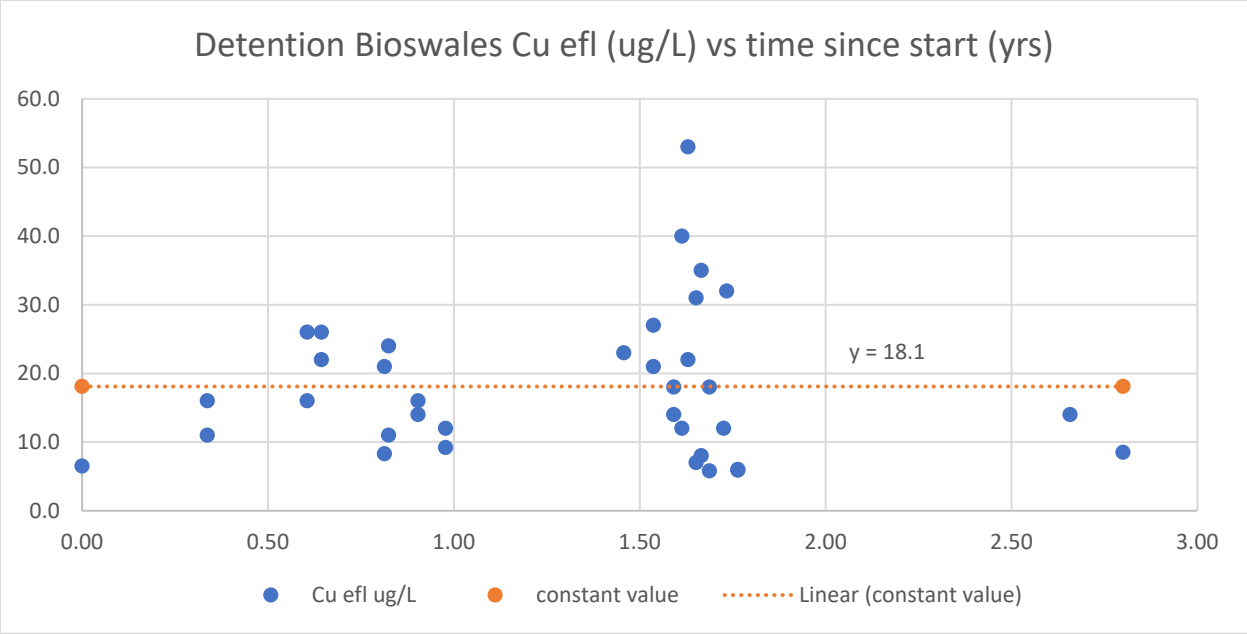

y = -6.4E-09x + 1.8E-08
ELV sedimentation and media filter treatment train Dioxin efl (ug/L) vs time since start (yrs)
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
1.00E-06
1.00E-07
1.00E-08
1.00E-09
1.00E-10
1.00E-11
1.00E-12
1.00E-13
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
TCDD efl ug/L
Linear (TCDD efl ug/L)

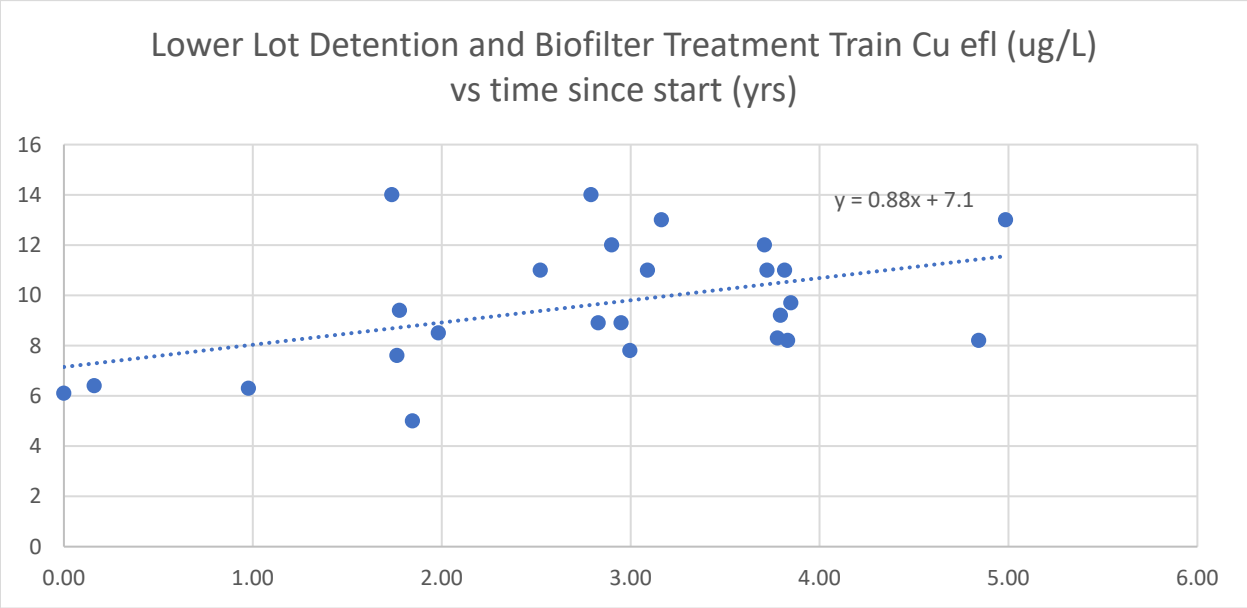
Copper Influent Trend

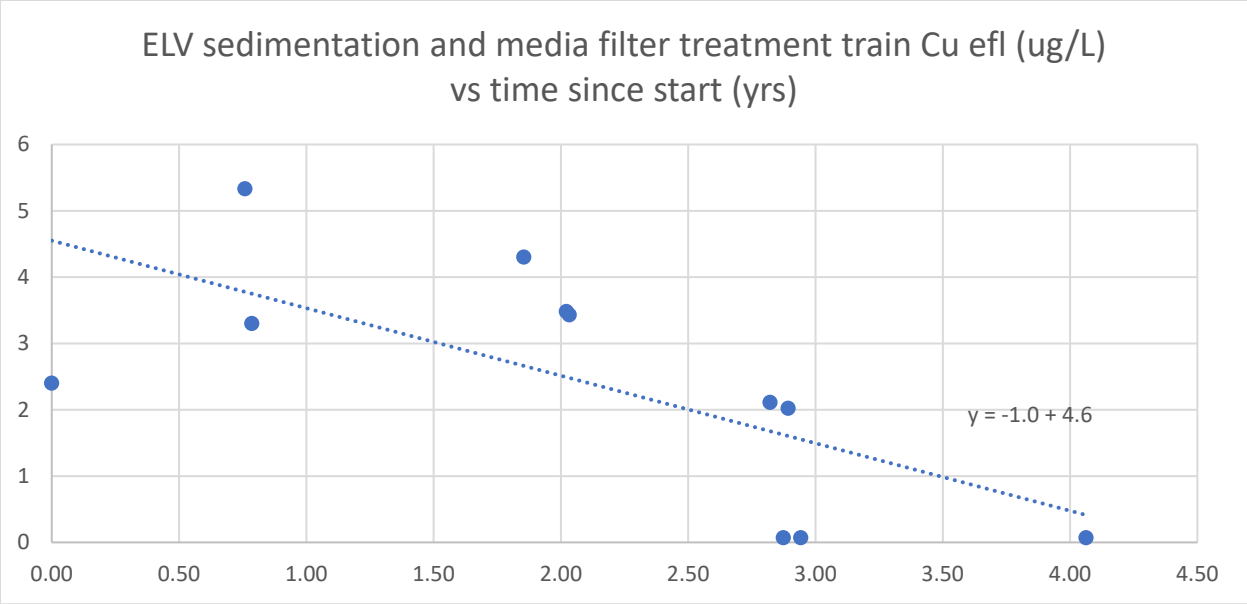


Copper Effluent Trends

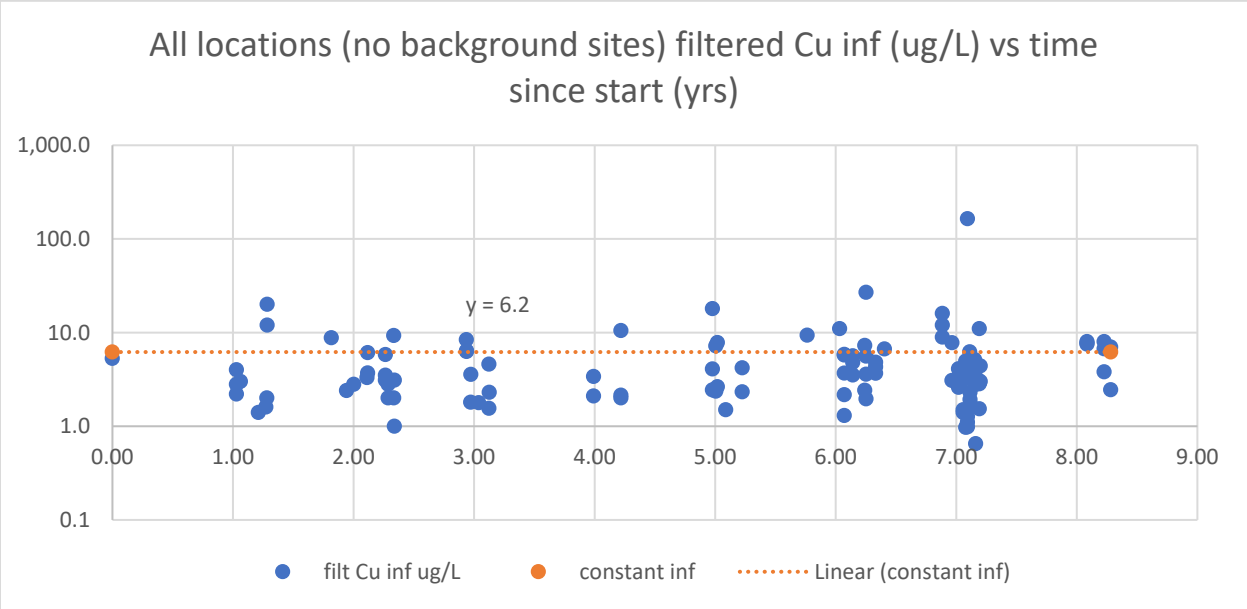



Detention Bioswales Cu efl (ug/L) vs time since start (yrs)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.00
0.50
1.00
1.50
2.00
2.50
3.00
y = 18.1
Cu efl ug/L
constant value
Linear (constant value)

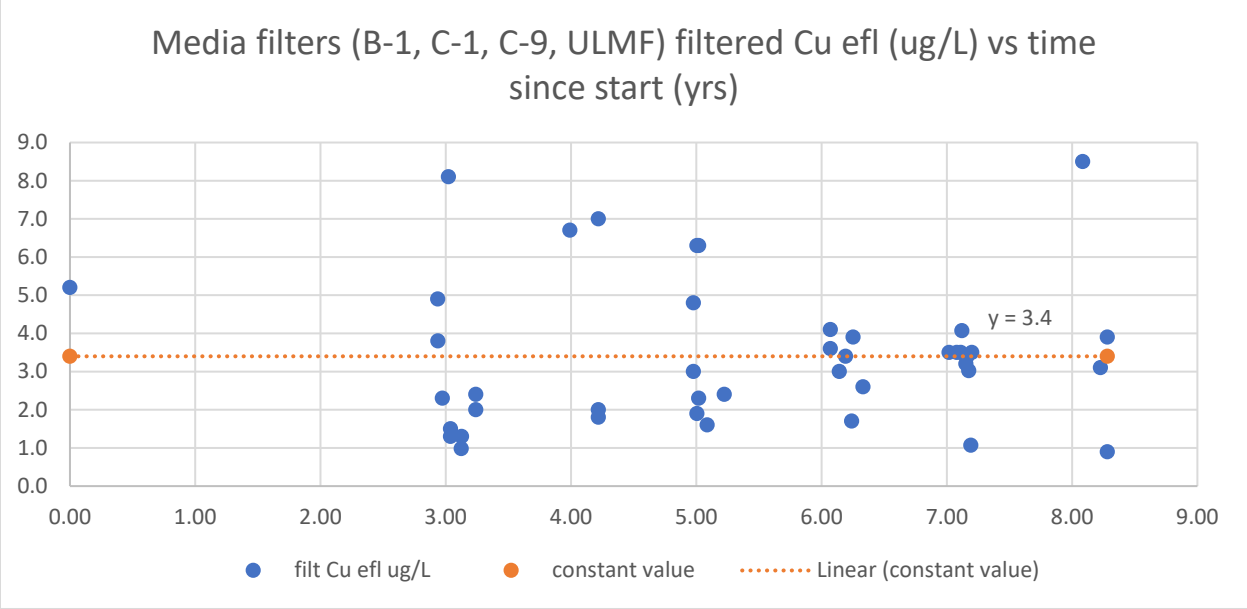

Lower Lot Detention and Biofilter Treatment Train Cu efl (ug/L)
vs time since start (yrs)
16
14
12
10
8
6
4
2
0
0.00
1.00
2.00
3.00
4.00
5.00
6.00
y = 0.88x + 7.1

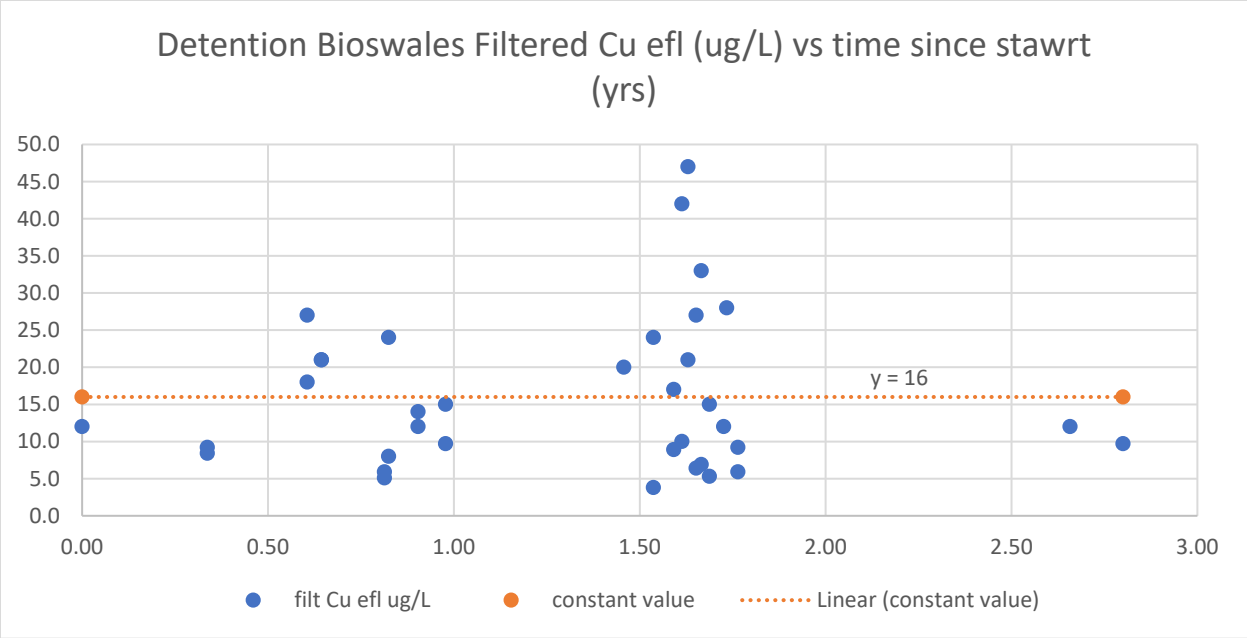

ELV sedimentation and media filter treatment train Cu efl (ug/L) vs time since start (yrs)
6
5
4
3
2
1
0
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
y = -1.0 + 4.6

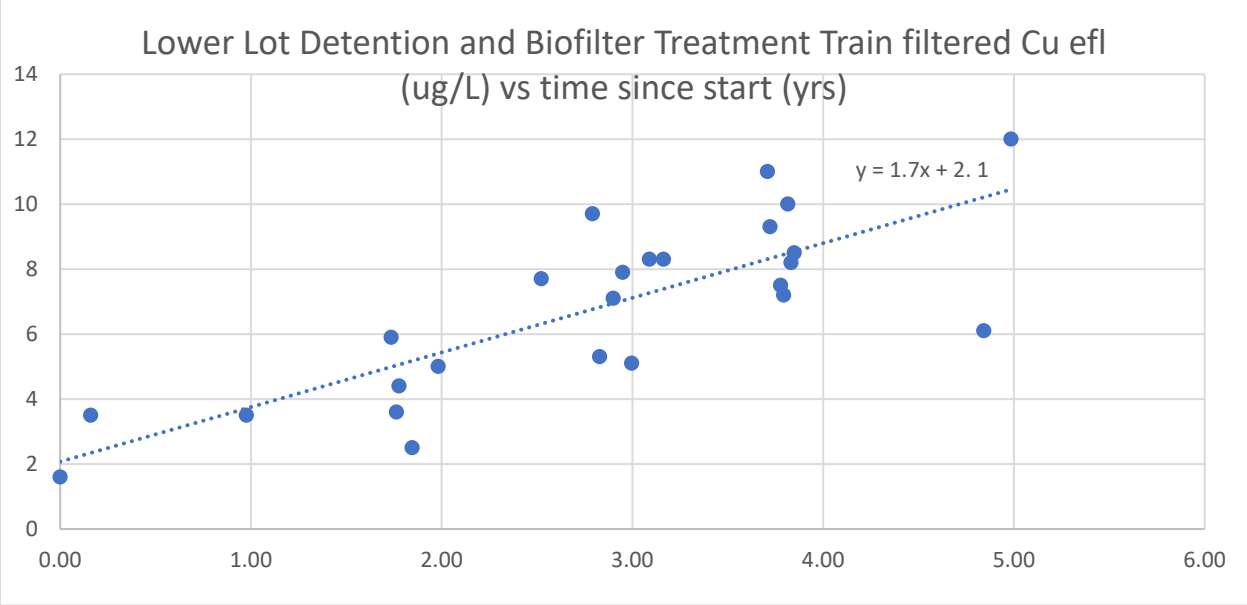
Filtered Copper Influent Trend

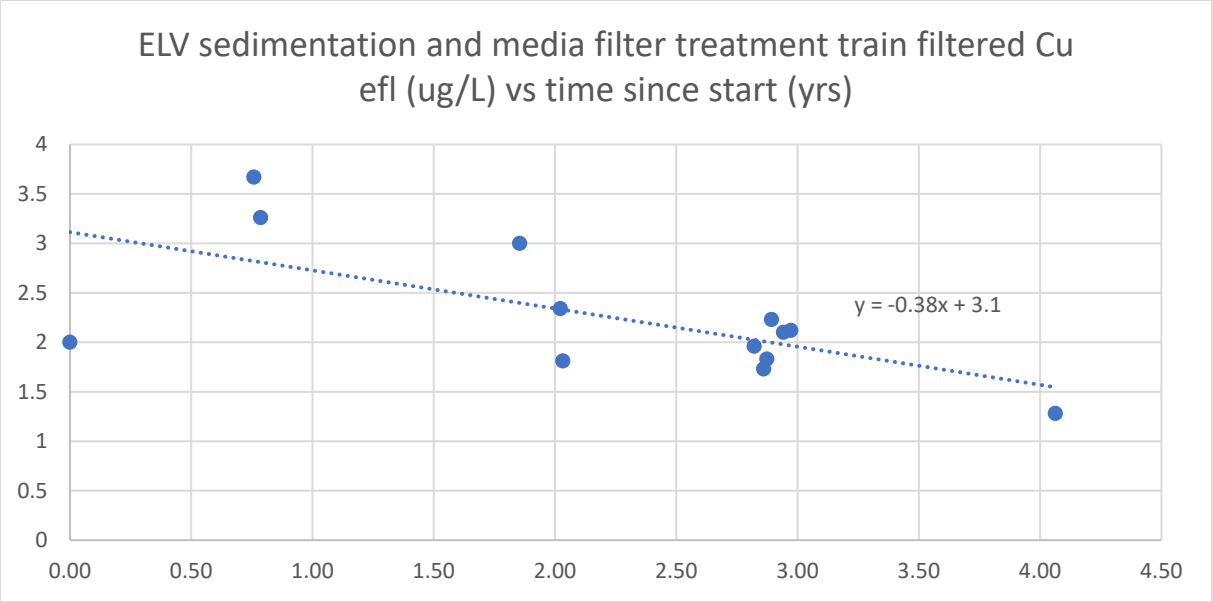


Filtered Copper Effluent Trends

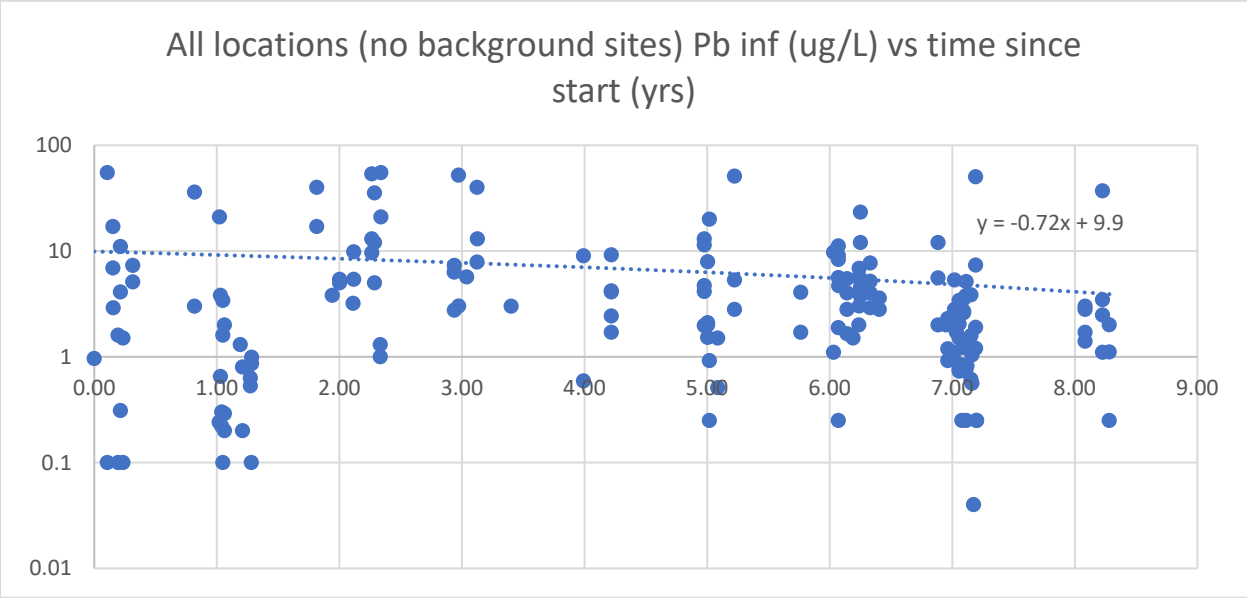



Detention Bioswales Filtered Cu efl (ug/L) vs time since stawrt (yrs)
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0.00
0.50
1.00
1.50
2.00
2.50
3.00
y = 16
filt Cu efl ug/L
constant value
Linear (constant value)

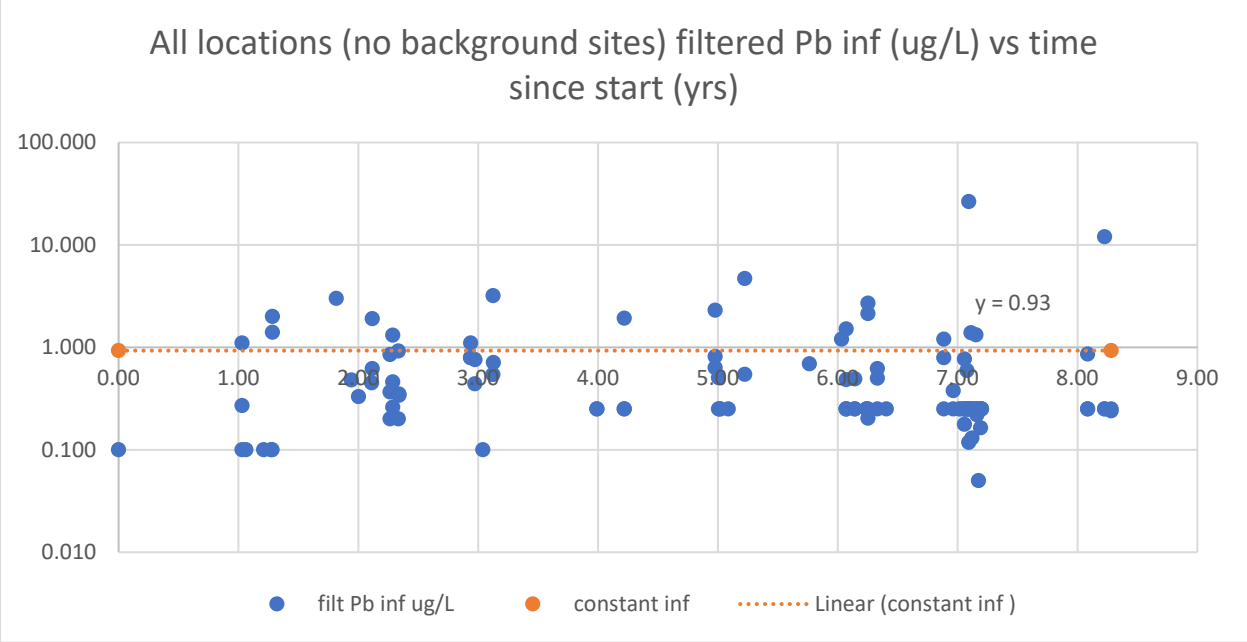

Lower Lot Detention and Biofilter Treatment Train filtered Cu efl (ug/L) vs time since start (yrs)
14
12
10
8
6
4
2
0
0.00
1.00
2.00
3.00
4.00
5.00
6.00
y = 1.7x + 2. 1


ELV sedimentation and media filter treatment train filtered Cu efl (ug/L) vs time since start (yrs)
y = -0.38x + 3.1
4
3.5
3
2.5
2
1.5
1
0.5
0
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50

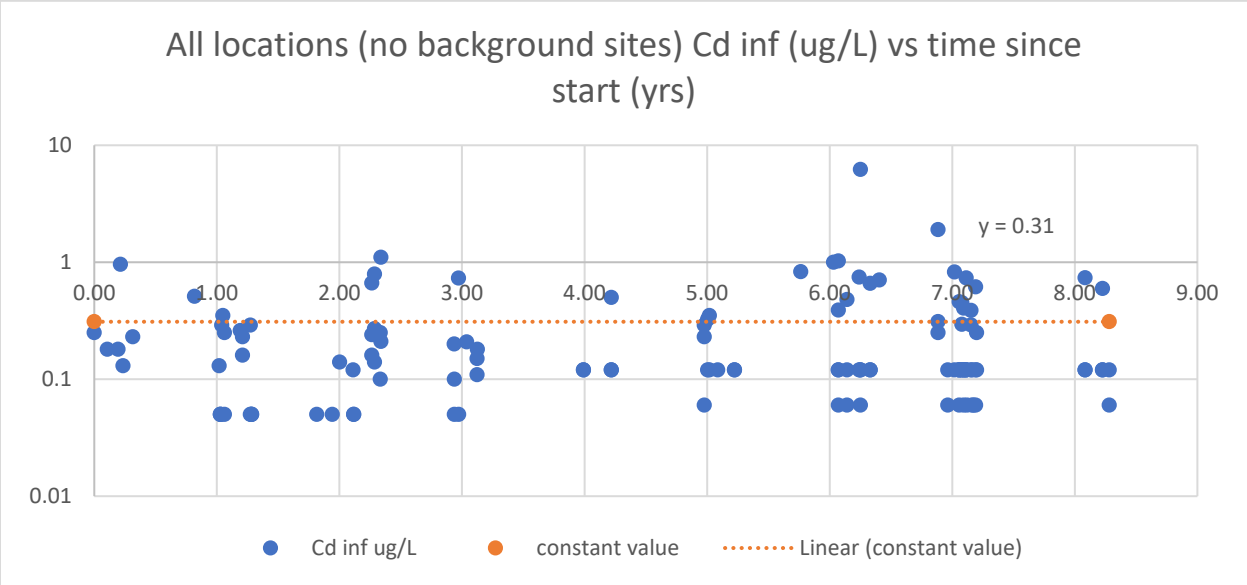
Lead Influent Trend



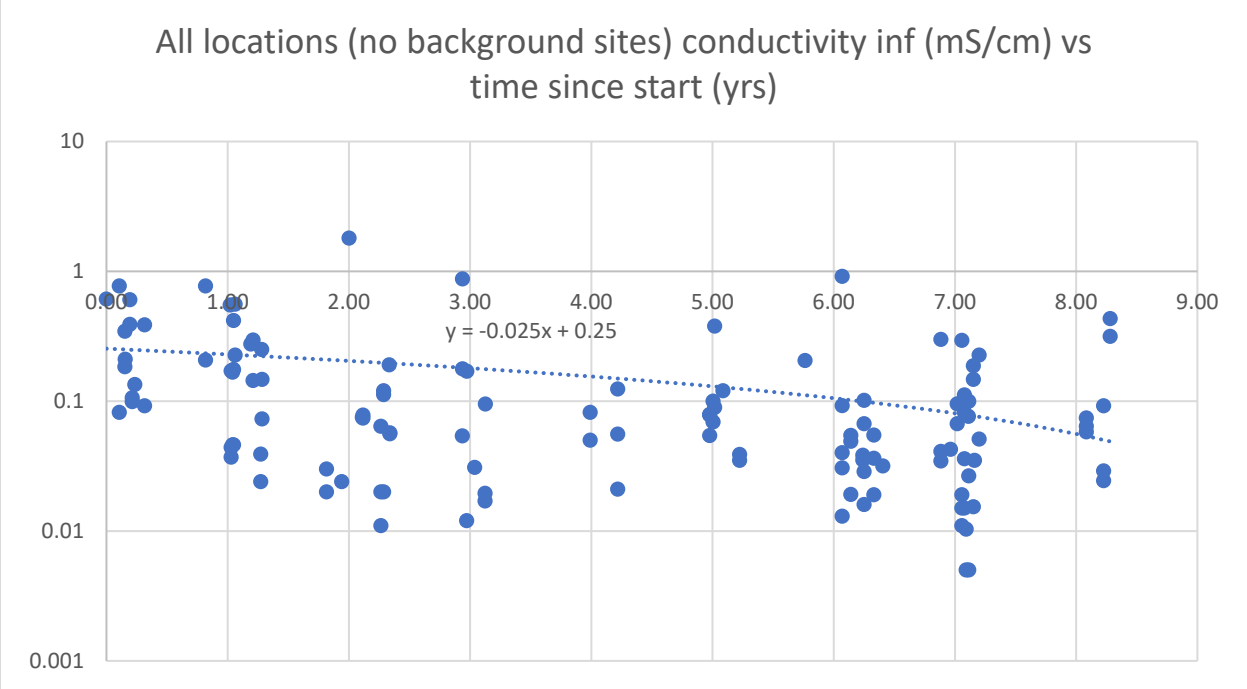
Filtered Lead Influent Trend



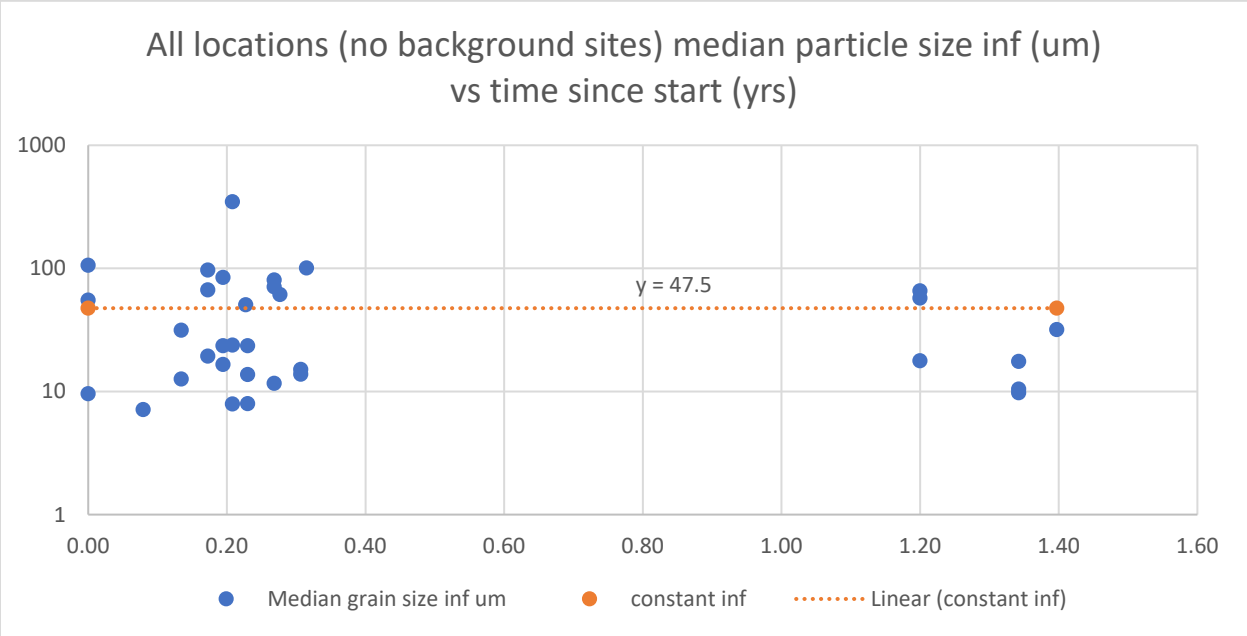
Cadmium Influent Trend



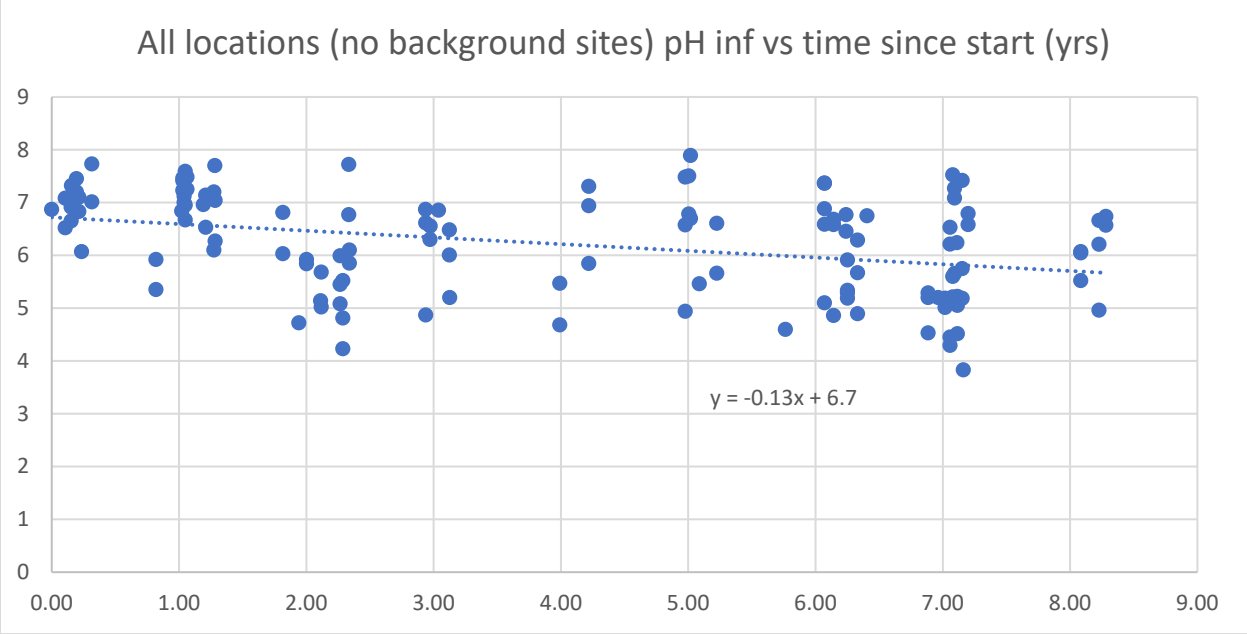
Conductivity Influent Trend



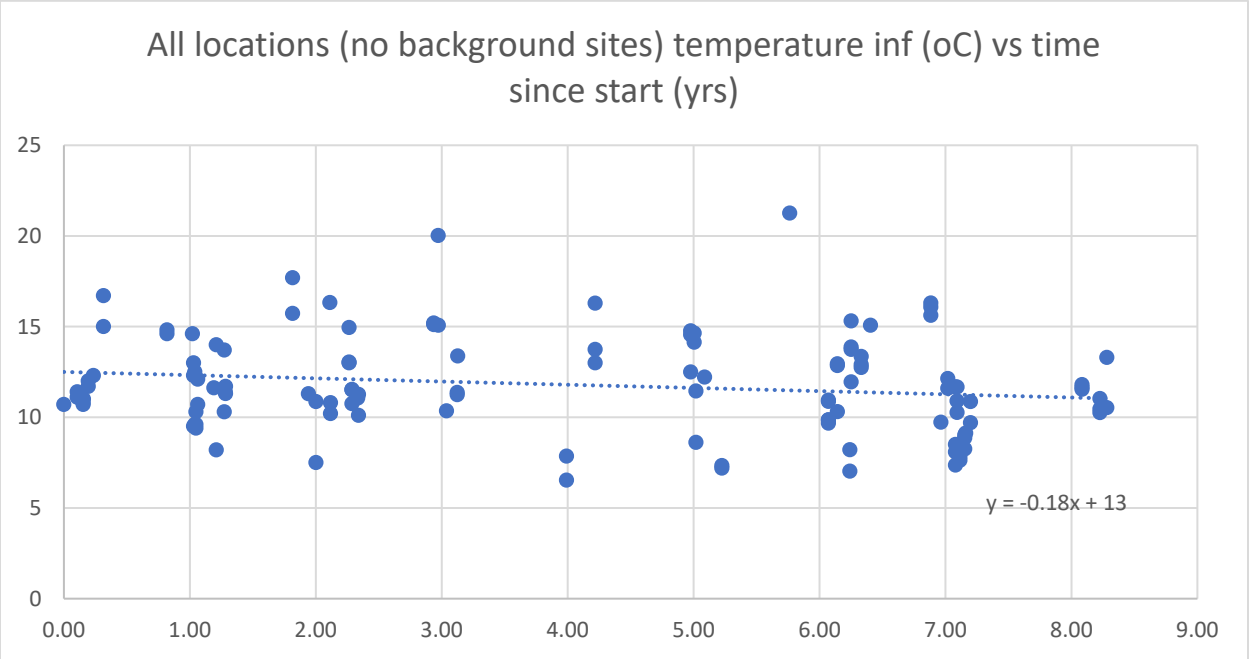
Median Particle Size Influent Trend



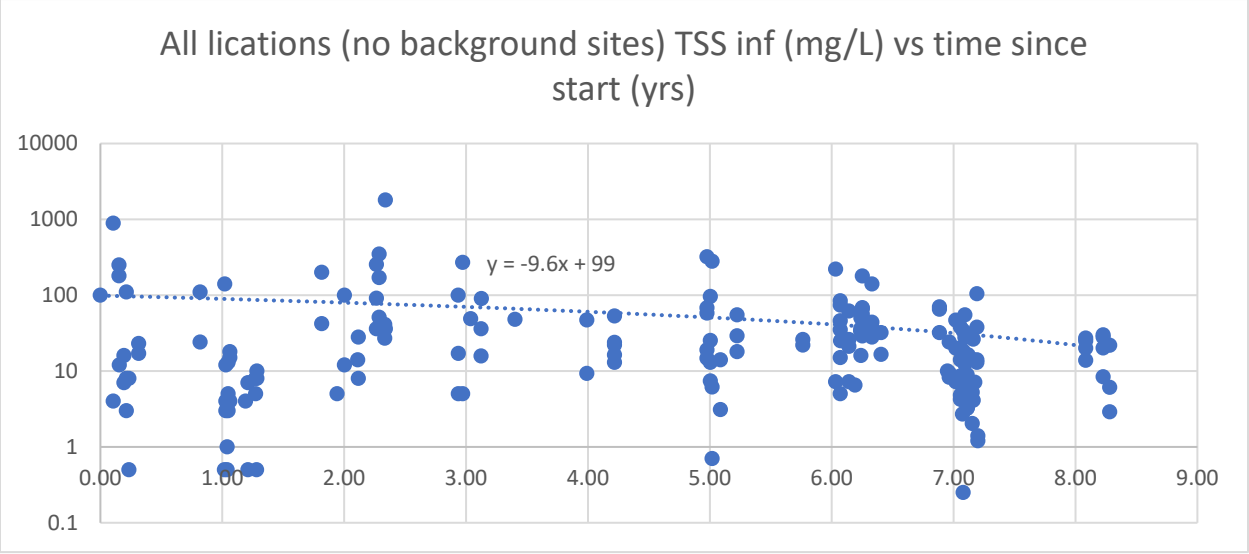
pH Influent Trend



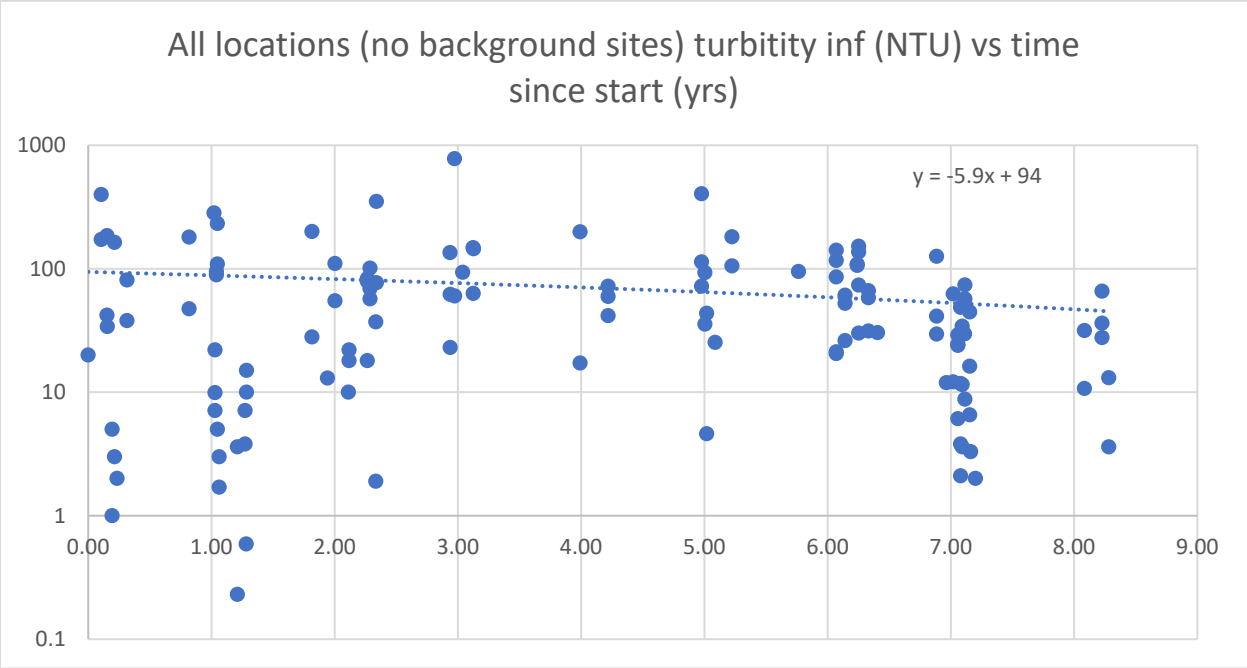
Temperature Influent Trend



Total Suspended Solids Influent Trend



Turbidity Influent Trend



Appendix G: Particulate Strength Trends with Time for Santa Susana Field Lab Stormwater Controls

Influent and effluent particulate strength trends with time since the start of monitoring at the SSFL stormwater control locations were examined. Any evidence for breakthrough was specifically of interest. Breakthrough behavior would be indicated by abrupt changes in the effluent particulate strength values at some time in the time series, especially if the effluent values became similar to the influent values. Therefore, time series plots of particulate strengths were prepared, and both visually examined and statistically evaluated for evidence of breakthrough of particulate bound pollutants. Plots were also prepared for the ratio of the effluent to influent particulate strengths with time since the beginning of the monitoring period. Breakthrough would be indicated as this ratio changed with time, especially if the ratio approaches 1.0.

Time series plots were prepared relating the concentrations of TSS, and particulate strengths of dioxins (TCDD TEQ NoDNQ), copper, lead, cadmium, and mercury with time. It was assumed that all of the dioxin was strongly associated with particulates, so no corrections were made for filtered dioxin concentrations (which were not available). For the metals, the particulate bound forms were determined by calculating the difference between the total and filtered concentrations, which were then divided by the corresponding TSS concentration for the same sample. Unit conversions were then made to result in the particulate strengths with units of mg constituents/kg particulates. These were plotted as a time series since the start of the monitoring period. Excel regression calculations were used to relate the particulate strengths vs. time, with ANOVA to indicate if the trend equations and coefficients were statistically significant ($p \leq 0.05$).

The following pages include the time series plots for 5 to 10 stormwater control locations (depending on available data) for these constituents. If the ANOVA analyses of the regressions indicated significant regression equations and significant equation coefficients, those regression lines and resulting equations are also shown on the plots. In some cases, too few effluent data were available to allow the statistical analyses. Summary tables include the sampling period, the number of samples, the median particulate strengths, and the coefficients of variation (COV) of the particulate strengths. The summary tables also include the significance of the regressions and the coefficients, along with comments.

In many cases, statistically significant particulate strength intercept values were observed, while the trends were not statistically significant. This would result in parallel lines representing the constant (average) particulate strength values with time. No breakthrough would be evident under these conditions. In no cases were abrupt changes in the effluent particulate strengths observed; any minor changes would be masked by the data variations. Some apparent overall visual trends in the particulate strengths occur for both the influent and effluent values (not for just the effluent values alone), so that also does not indicate breakthrough, especially as the regression and ANOVA evaluations result only in very small trends for both influent and effluent values.

Two unusual conditions were observed:

1) Very high effluent particulate strength values were observed for the northern and southern bioswales Cu plots (near the end of the time series for the northern bioswale and near the

middle of the time series for the southern bioswale). These high values are only observed for one or two effluent samples (no influent samples were as high), with much lower values occurring after the very high values. These high values are therefore not consistent.

2) Cadmium particulate strengths for the B-1 media filter is the only condition were relatively large significant increasing PS value slopes were observed for both influent and effluent conditions. However, few data were available for this condition and relatively high values for both influent and effluent cadmium particulate strengths occurred near the end of the observed time series, which resulted in the significant slopes. This is therefore a suspected faulty statistical result as the data are not likely representative.

In conclusion, there is no visual or statistical evidence of breakthrough of particulate-bound pollutants at the SSFL stormwater control locations. As indicated in the laboratory studies, one of the features of the selected treatment media is that silt clogging (resulting in extended surface ponding) would occur well before the pollutant treatment capacity would be exceeded or breakthrough would occur for most pollutants. This provides a factor of safety for the controls as any slit clogging of the controls would be quickly observed before pollutant removal performance is reduced.

TSS

control practice	start of monitoring period	end of monitoring period	monitoring duration (yrs)	influent sample count	effluent sample count	influent median (mg/L)	effluent median (mg/L)	influent COV	effluent COV
B-1 Media Filter	12/12/2011	2/18/2016	4.2	21	23	25	18	1.03	0.79
CM-1	1/19/2010	3/22/2018	8.2	42	34	17	10	2.29	2.79
CM-11	1/20/2010	2/19/2011	1.1	12	12	4	3	0.94	1.19
CM-8	1/20/2010	3/21/2011	1.2	10	10	3	5.5	1.45	1.16
CM-9	12/11/2009	3/22/2018	8.3	45	29	16	13	3.27	2.20
ELV Treatment Train	2/28/2014	3/22/2018	4.1	10	13	15	15	1.02	1.13
Lower Lot Biofilter	3/8/2013	3/2/2018	5.0	24	25	22	17	1.52	1.08
North Detention Bioswale	5/15/2015	2/17/2017	1.8	8	18	5	6	1.08	1.07
South Detention Bioswale	9/15/2015	3/2/2018	2.5	18	19	32	6	1.00	0.84
Upper Lot Media Filter	10/28/2016	3/2/2018	1.3	10	2	8	10	1.31	0.59
Vegetated Channel	11/30/2012	3/7/2016	3.3	2	12	42	31	1.09	0.44

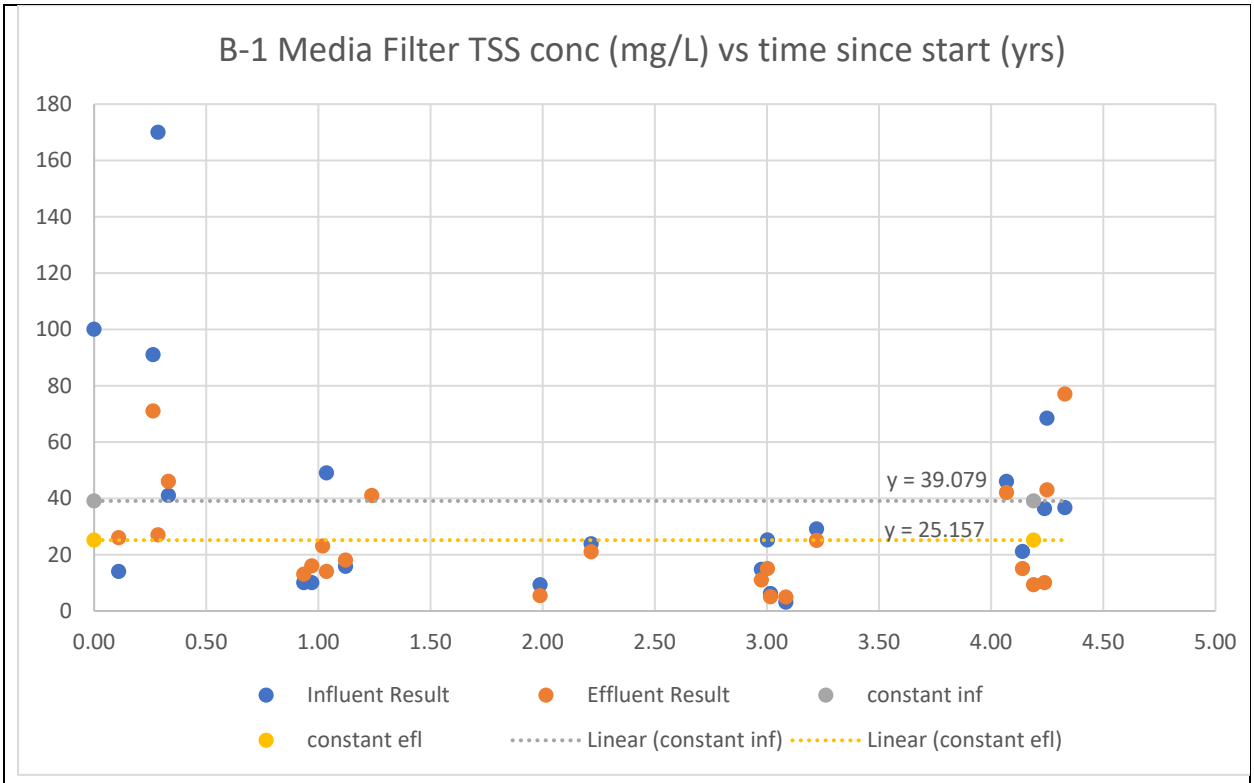
control practice	influent regression F	effluent regression F	influent adjusted R^2	effluent adjusted R^2	influent slope P	effluent slope P	influent slope coefficient*	effluent slope coefficient*
B-1 Media Filter	0.15	0.72	0.06	n/a	0.15	0.72	n/s	n/a
CM-1	0.19	0.59	0.02	n/a	0.19	0.59	n/s	n/s
CM-11	0.003	0.10	0.57	0.17	0.003	0.10	-10.8	n/s
CM-8	0.07	0.15	0.28	0.15	0.07	0.15	n/s	n/s
CM-9	0.20	0.45	0.01	n/a	0.20	0.45	n/s	n/s
ELV Treatment Train	0.22	0.59	0.07	n/a	0.23	0.59	n/s	n/s
Lower Lot Biofilter	0.03	0.16	0.15	0.04	0.03	0.16	-21.4	n/s
North Detention Bioswale	0.04	0.004	0.34	0.37	0.04	0.004	7.6	6.7
South Detention Bioswale	0.09	0.57	0.11	n/a	0.09	0.57	n/s	n/s
Upper Lot Media Filter	0.18	.n/a	0.08	n/a	0.18	n/a	n/s	n/a
Vegetated Channel	n/a	0.08	n/a	0.20	n/a	0.08	n/a	n/s

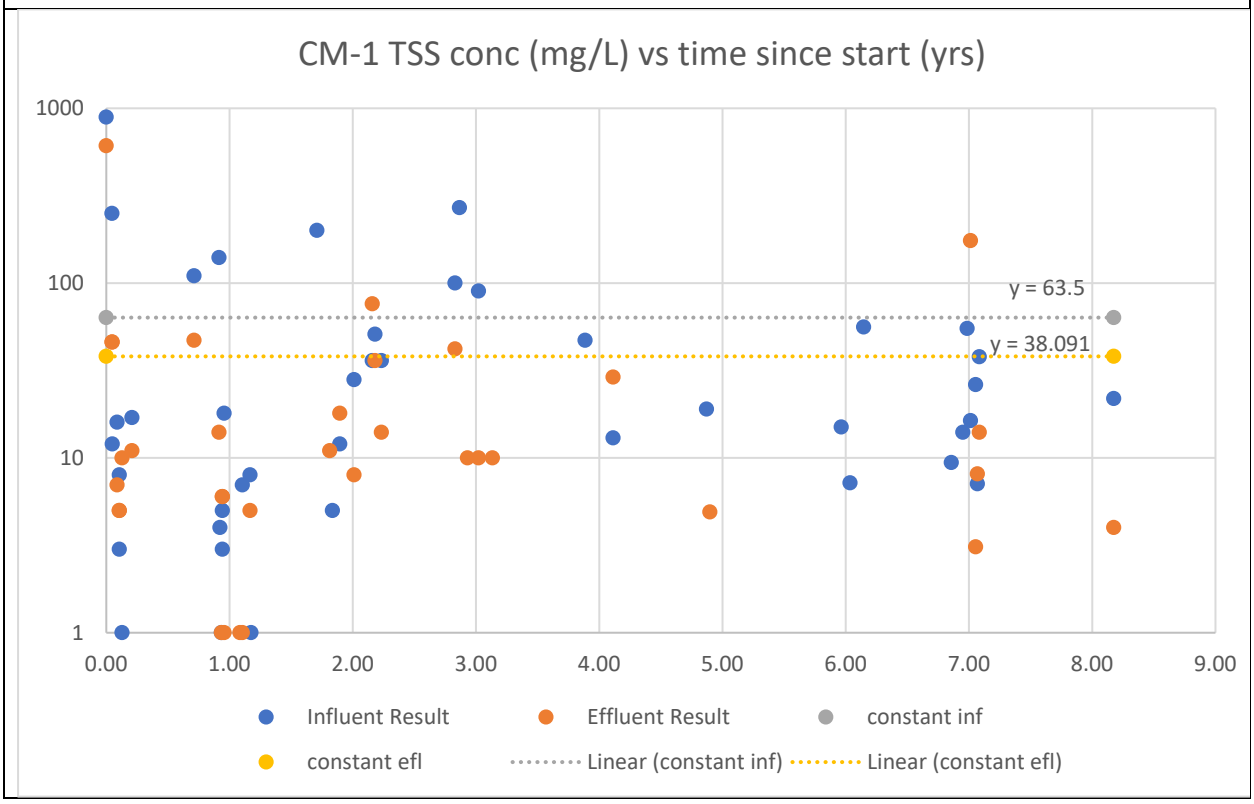
*mg/L/year slope units

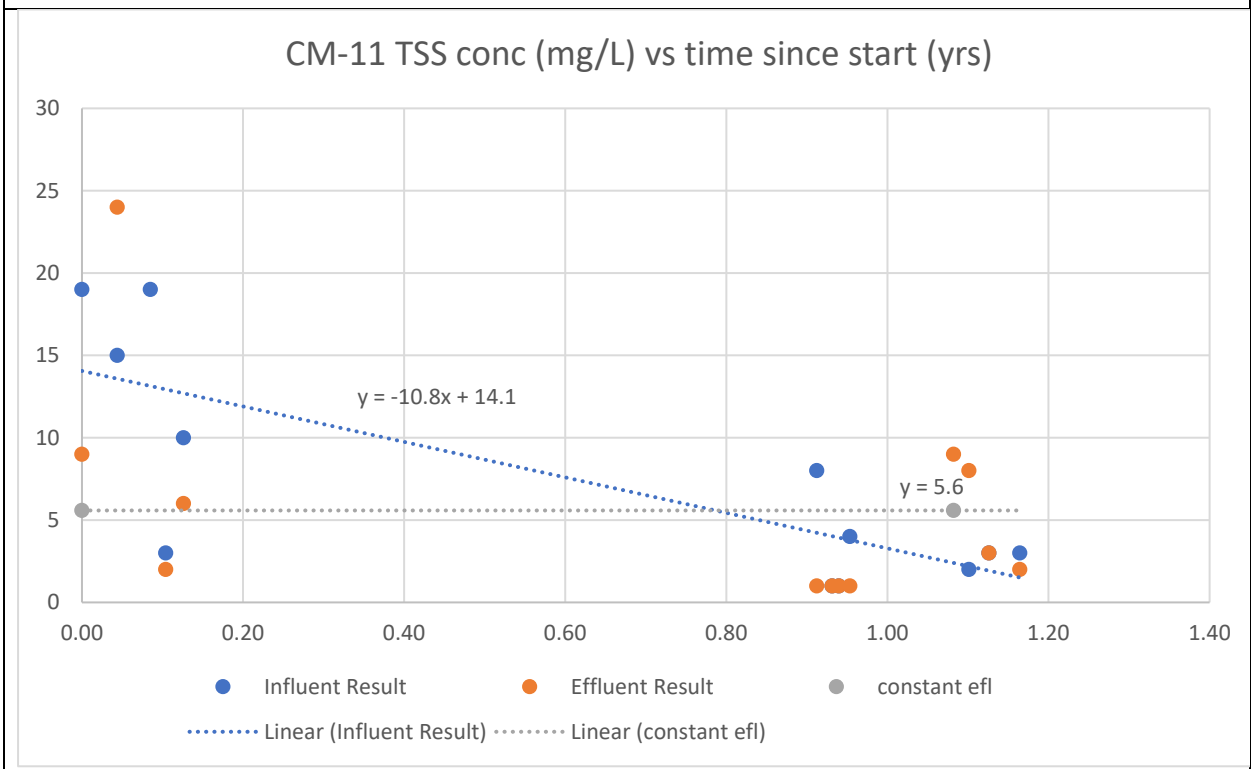
TSS (cont.)

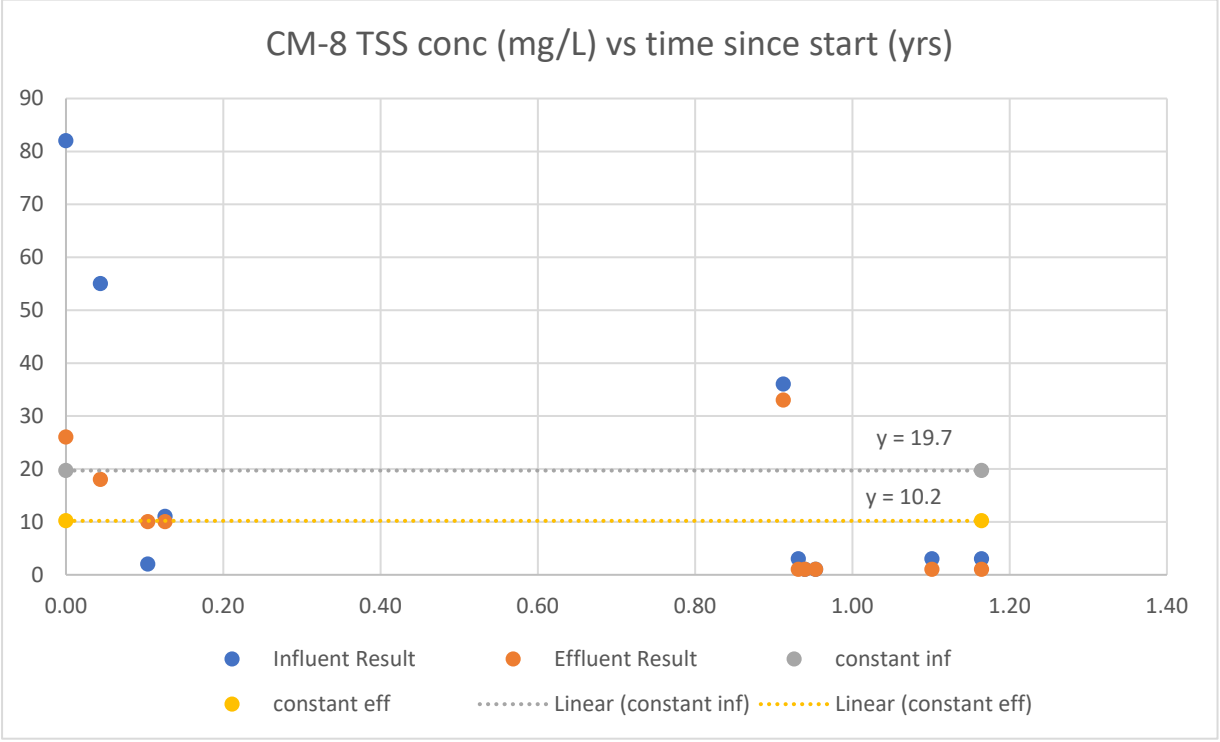
control practice	comments
B-1 Media Filter	no obvious breakthrough, no apparent slopes, and parallel trend lines. Insignificant regression, constant inf and efl values
CM-1	no obvious breakthrough, no apparent slopes, and parallel trend lines. Insignificant regression, constant inf and efl values
CM-11	no obvious breakthrough, no apparent efl slopes (constant value) but sign decreasing inf slope
CM-8	no obvious breakthrough, no apparent slopes, and parallel trend lines. Insignificant regression, constant inf and efl values
CM-9	no obvious breakthrough, no apparent efl slopes (constant value) and inf coefficients not significant
ELV Treatment Train	no obvious breakthrough, no apparent slopes, and parallel trend lines. Insignificant regression, constant inf and efl values
Lower Lot Biofilter	no obvious breakthrough, no apparent efl slopes (constant value) but sign decreasing inf slope
North Detention Bioswale	no obvious breakthrough, very small efl slopes (almost constant value) but sign increasing inf slope
South Detention Bioswale	no obvious breakthrough, no apparent slopes, and parallel trend lines. Insignificant regression, constant inf and efl values
Upper Lot Media Filter	few effluent data and inf not significant regression
Vegetated Channel	few inf data and efl not significant regression but constant value

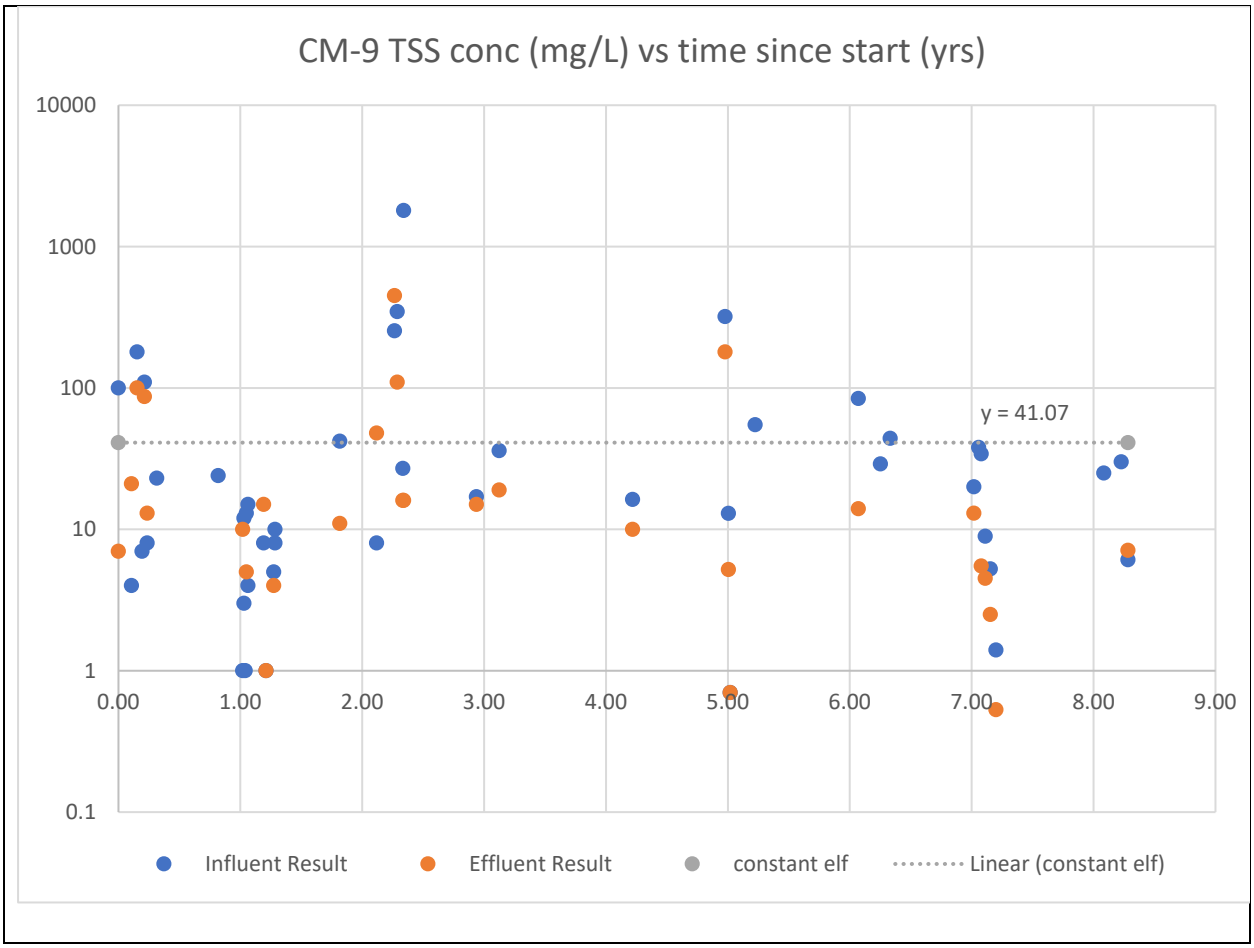
TSS Concentration Trends with Time. Regression equation only shown for significant influent or effluent trends (p<0.05). mg/L/year trend units.

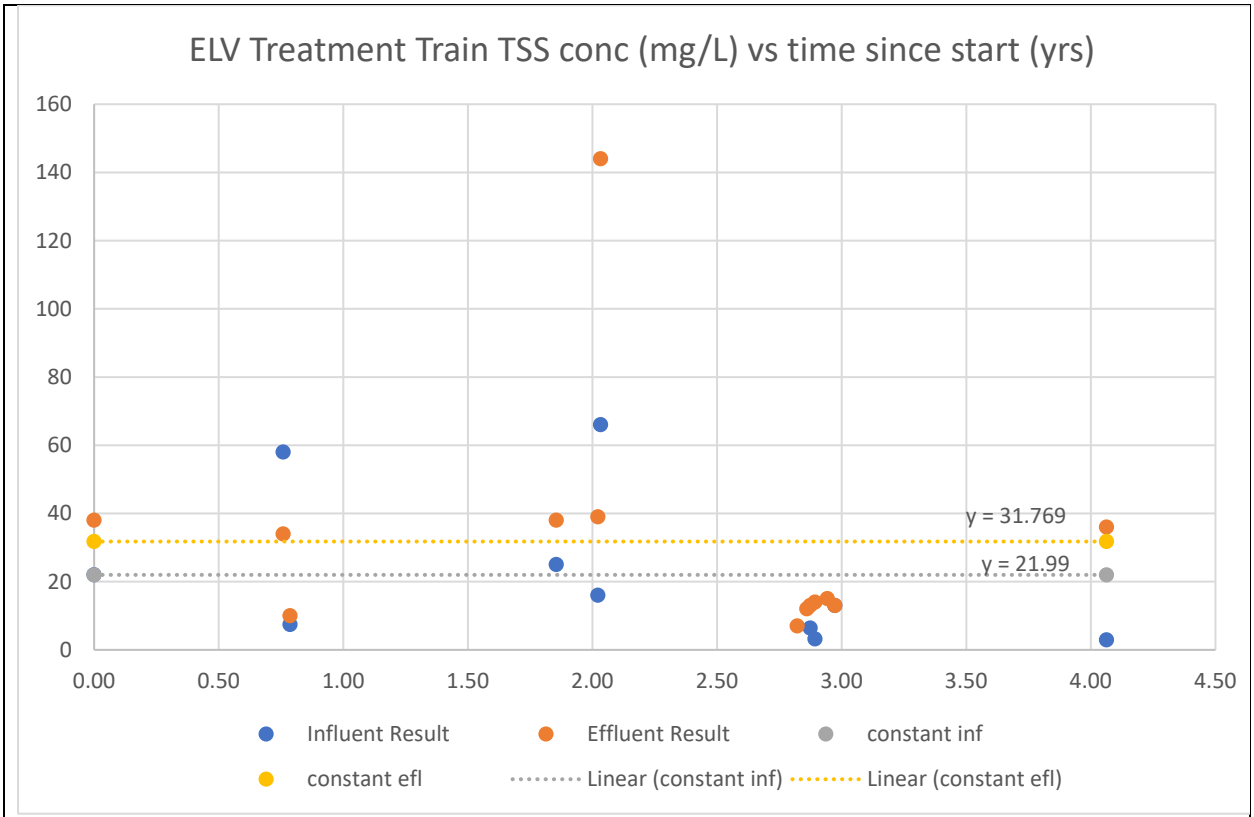


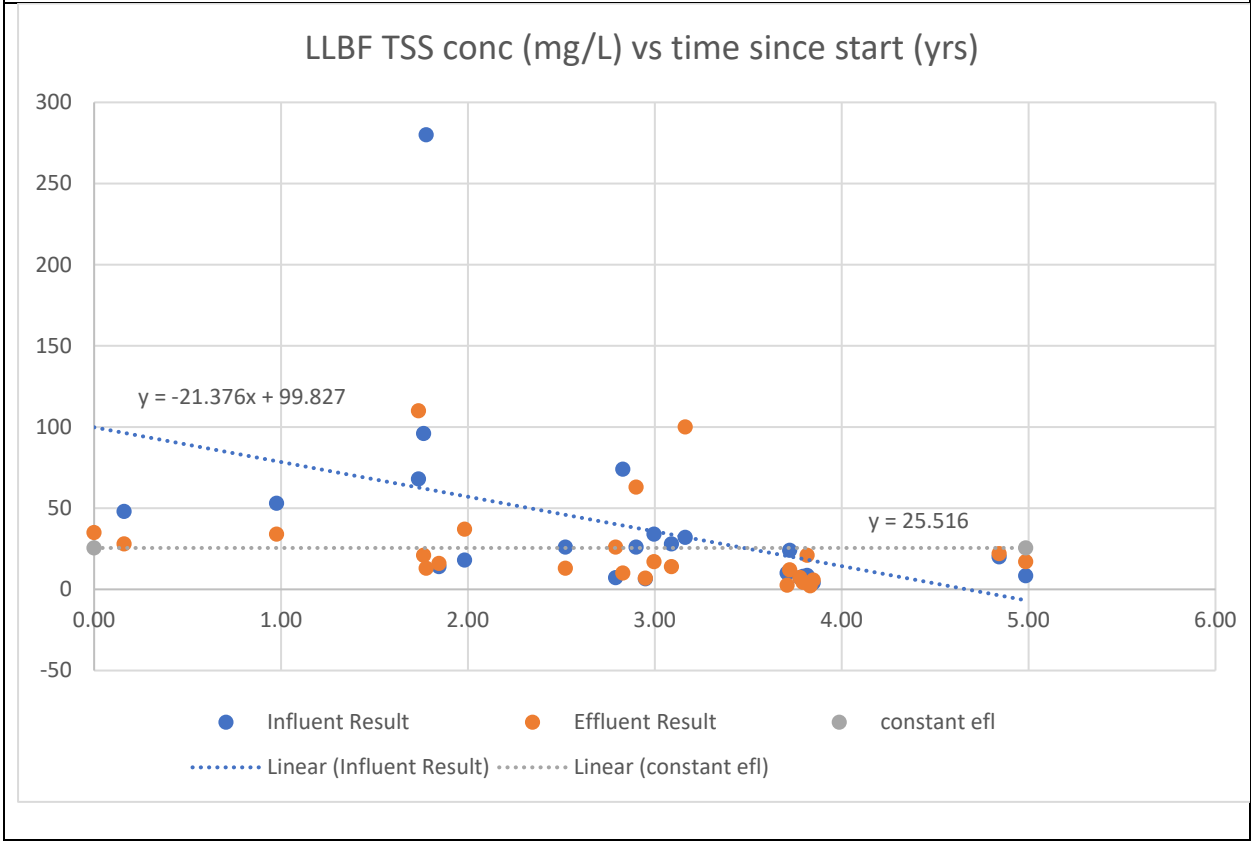


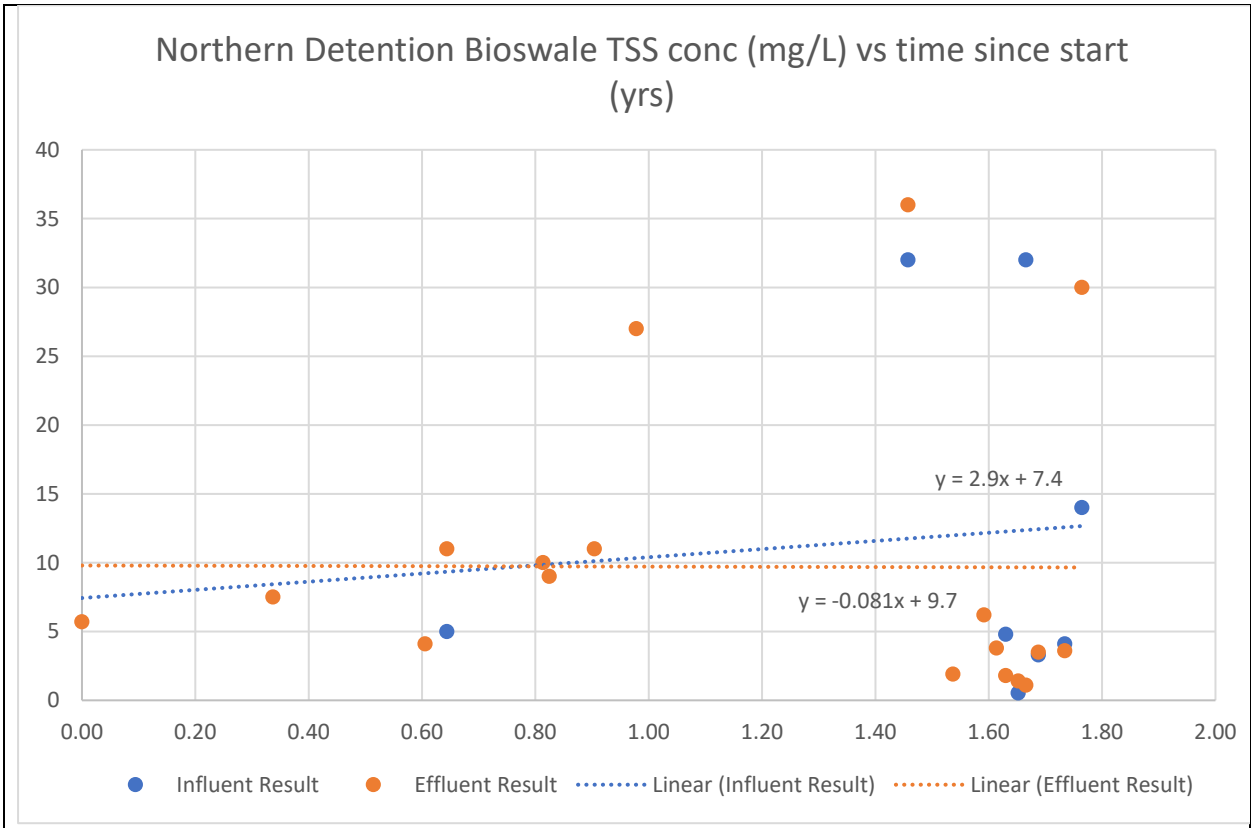

CM-11 TSS conc (mg/L) vs time since start (yrs)
30
25
20
15
10
5
0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
y = -10.8x + 14.1
y = 5.6
Influent Result
Effluent Result
constant efl
Linear (Influent Result)
Linear (constant efl)

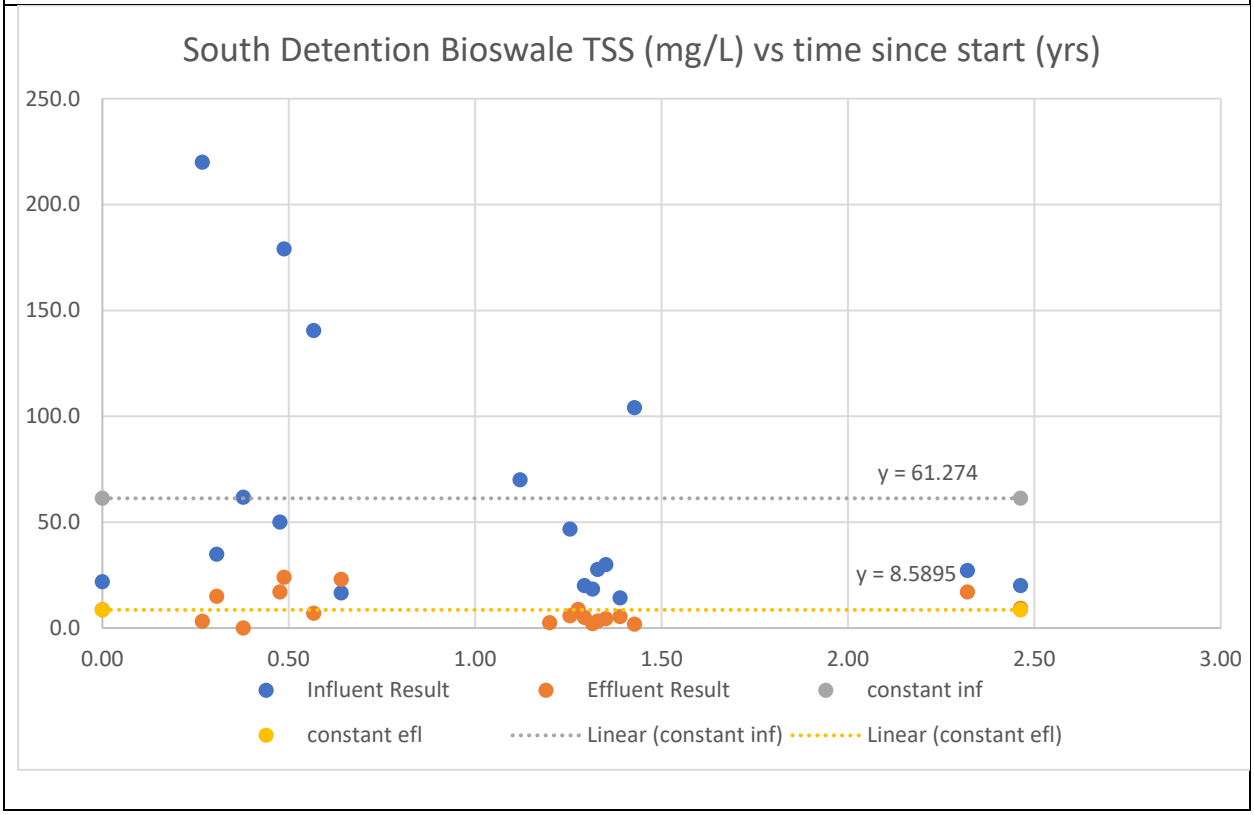

CM-8 TSS conc (mg/L) vs time since start (yrs)
90
80
70
60
50
40
30
20
10
0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
y = 19.7
y = 10.2
Influent Result
Effluent Result
constant inf
constant eff
Linear (constant inf)
Linear (constant eff)

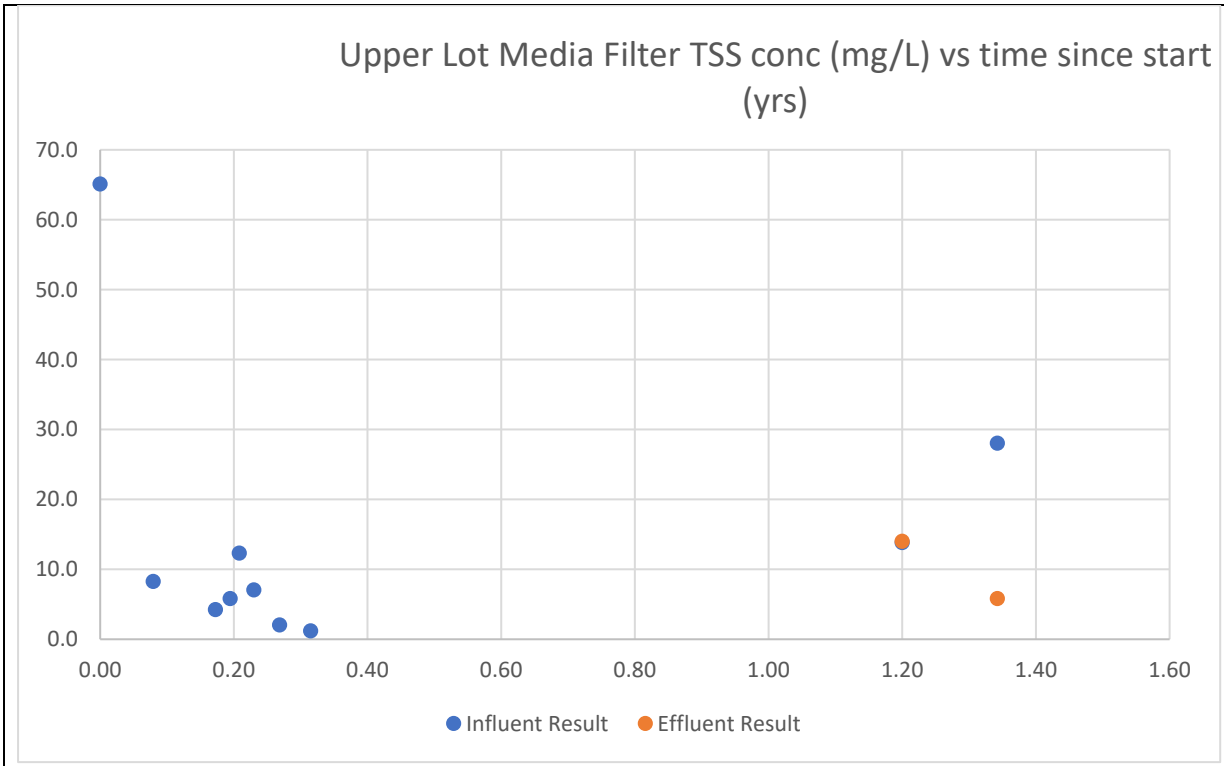

CM-9 TSS conc (mg/L) vs time since start (yrs)
10000
1000
100
10
1
0.1
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
y = 41.07
Influent Result
Effluent Result
constant elf
Linear (constant elf)

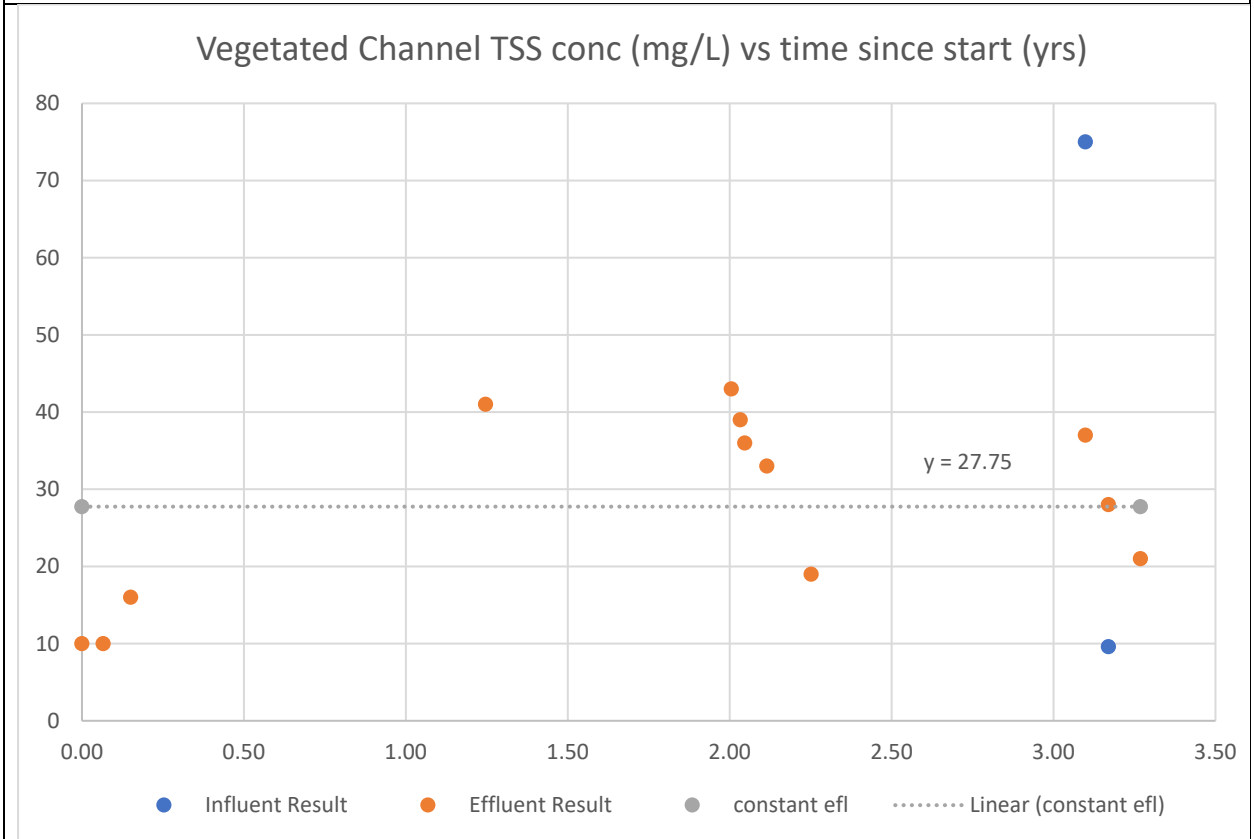

ELV Treatment Train TSS conc (mg/L) vs time since start (yrs)
160
140
120
100
80
60
40
20
0
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
y = 31.769
y = 21.99
Influent Result
Effluent Result
constant inf
constant efl
Linear (constant inf)
Linear (constant efl)


LLBF TSS conc (mg/L) vs time since start (yrs)
300
250
200
150
100
50
0
-50
0.00
1.00
2.00
3.00
4.00
5.00
6.00
y = -21.376x + 99.827
y = 25.516
Influent Result
Effluent Result
constant efl
Linear (Influent Result)
Linear (constant efl)


Northern Detention Bioswale TSS conc (mg/L) vs time since start (yrs)
40
35
30
25
20
15
10
5
0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
1.80
2.00
y = 2.9x + 7.4
y = -0.081x + 9.7
Influent Result
Effluent Result
Linear (Influent Result)
Linear (Effluent Result)


South Detention Bioswale TSS (mg/L) vs time since start (yrs)
250.0
200.0
150.0
100.0
50.0
0.0
0.00
0.50
1.00
1.50
2.00
2.50
3.00
y = 61.274
y = 8.5895
Influent Result
Effluent Result
constant inf
constant efl
Linear (constant inf)
Linear (constant efl)


Upper Lot Media Filter TSS conc (mg/L) vs time since start (yrs)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
Influent Result
Effluent Result


Vegetated Channel TSS conc (mg/L) vs time since start (yrs)
80
70
60
50
40
30
20
10
0
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
y = 27.75
Influent Result
Effluent Result
constant efl
Linear (constant efl)

Dioxins - TCDD TEQ NoDNQ (mg/kg)

Control practice	start of monitoring period	end of monitoring period	monitoring duration (yrs)	Influent sample count	Effluent sample count	influent median (mg/kg)	effluent median (mg/kg)	influent COV	effluent COV
B-1 Media Filter	12/12/2011	2/18/2016	4.2	21	22	7.34E-06	2.25E-06	4.55	0.92
CM-1	1/19/2010	3/22/2018	8.2	42	34	1.02E-06	2.28E-07	2.15	3.28
CM-11	1/20/2010	2/19/2011	1.1	12	12	4.17E-10	1.00E-09	1.70	2.84
CM-9	12/11/2009	3/22/2018	8.3	38	23	4.50E-07	1.06E-08	1.86	2.23
ELV Treatment Train	2/28/2014	3/22/2018	4.1	10	13	2.78E-07	3.26E-09	1.58	3.38
Lower Lot Biofilter	3/8/2013	3/2/2018	5.0	24	25	4.05E-06	1.28E-08	1.06	3.12
North Detention Bioswale	5/15/2015	2/17/2017	1.8	8	18	2.47E-08	2.82E-10	1.87	4.05
South Detention Bioswale	9/15/2015	3/2/2018	2.5	18	18	3.72E-06	5.95E-08	3.09	2.05
Upper Lot Media Filter	10/28/2016	3/2/2018	1.3	10	2	1.41E-05	6.61E-06	1.08	1.41
Vegetated Channel	11/30/2012	3/7/2016	3.3	2	12	7.47E-06	2.66E-06	0.91	0.90

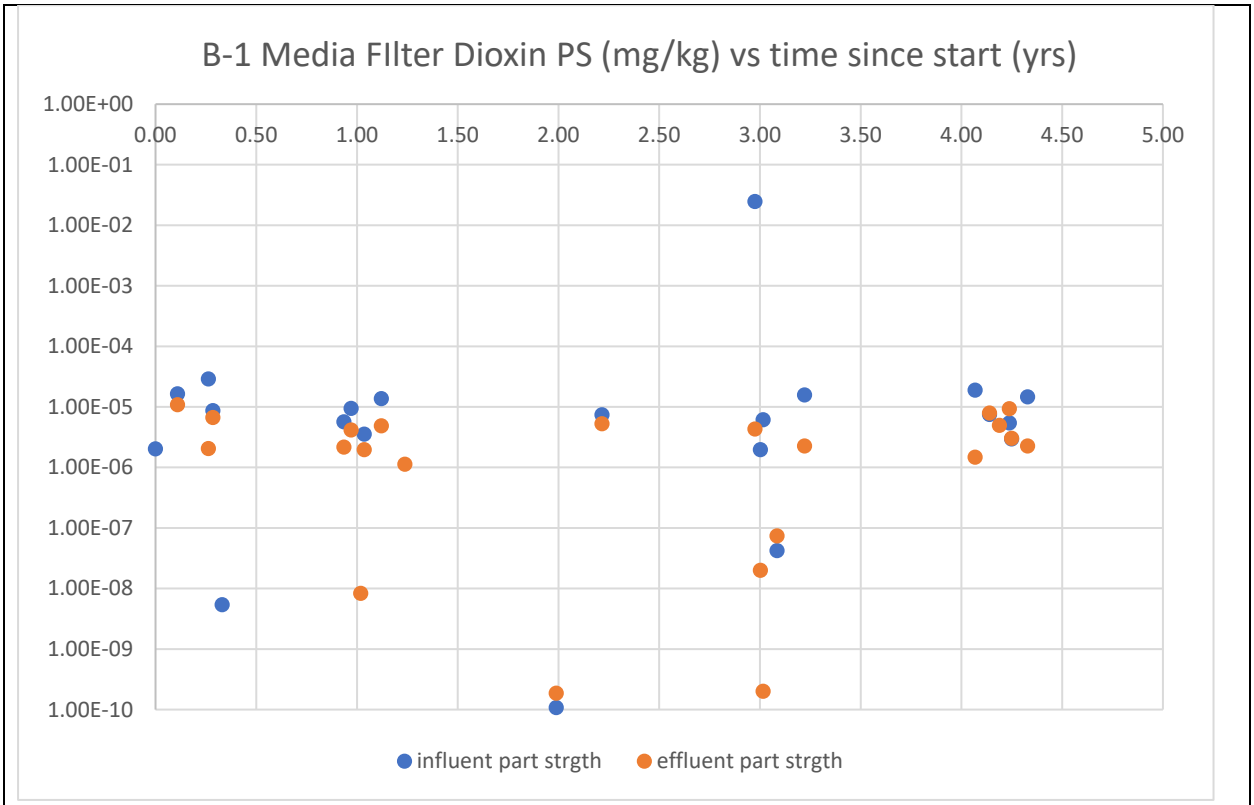
Control practice	influent regression F	effluent regression F	influent adjusted R^2	effluent adjusted R^2	influent slope P	effluent slope P	influent slope coefficient*	effluent slope coefficient*
B-1 Media Filter	0.27	0.88	0.01	n/a	0.27	0.88	n/s	n/s
CM-1	0.46	0.004	n/a	0.19	0.46	0.004	n/s	6.2E-06
CM-11	0.35	0.12	n/a	0.15	0.35	0.12	n/s	n/s
CM-9	0.0055	0.17	0.16	0.04	0.0055	0.17	4.6E-07	n/s
ELV Treatment Train	0.25	0.08	0.034	0.26	0.25	0.08	n/s	n/s
Lower Lot Biofilter	5.6E-05	0.06	0.47	0.10	5E-05	0.06	2.2E-06	n/s
North Detention Bioswale	0.19	0.17	0.09	0.05	0.19	0.17	n/s	n/s
South Detention Bioswale	0.07	0.06	0.14	0.15	0.07	0.06	n/s	n/s
Upper Lot Media Filter	0.50	n/a	n/a	n/a	0.50	n/a	n/s	n/a
Vegetated Channel	n/a	0.00073	n/a	0.59	n/a	0.00056	n/a	1.22E-06

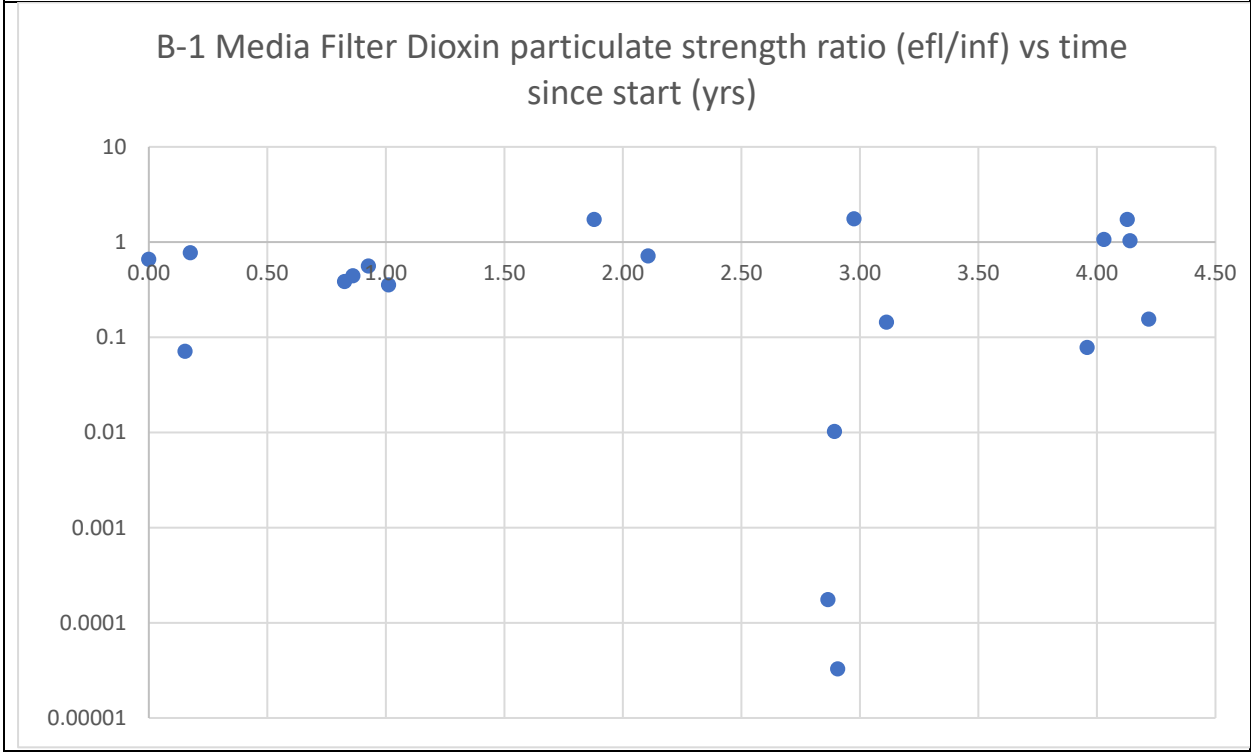
*mg/kg/year slope units

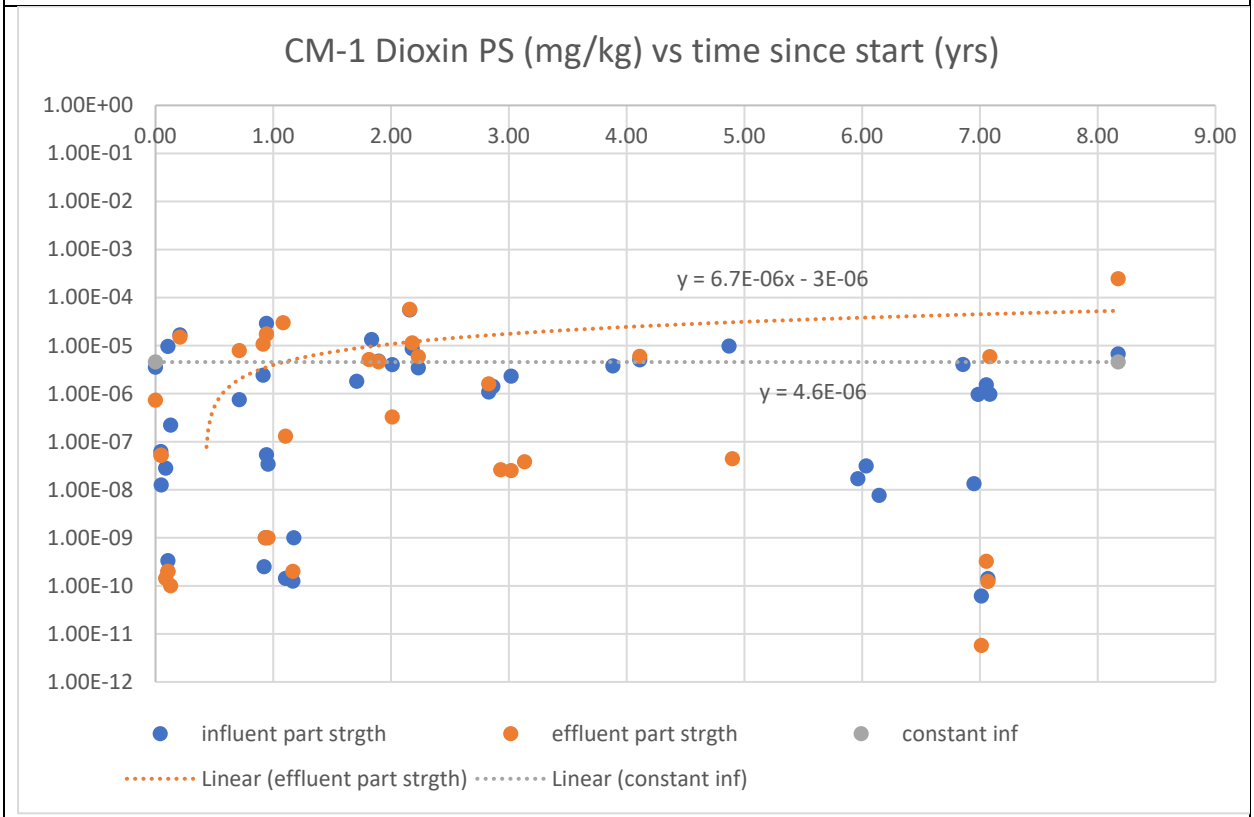
Dioxin (cont.)

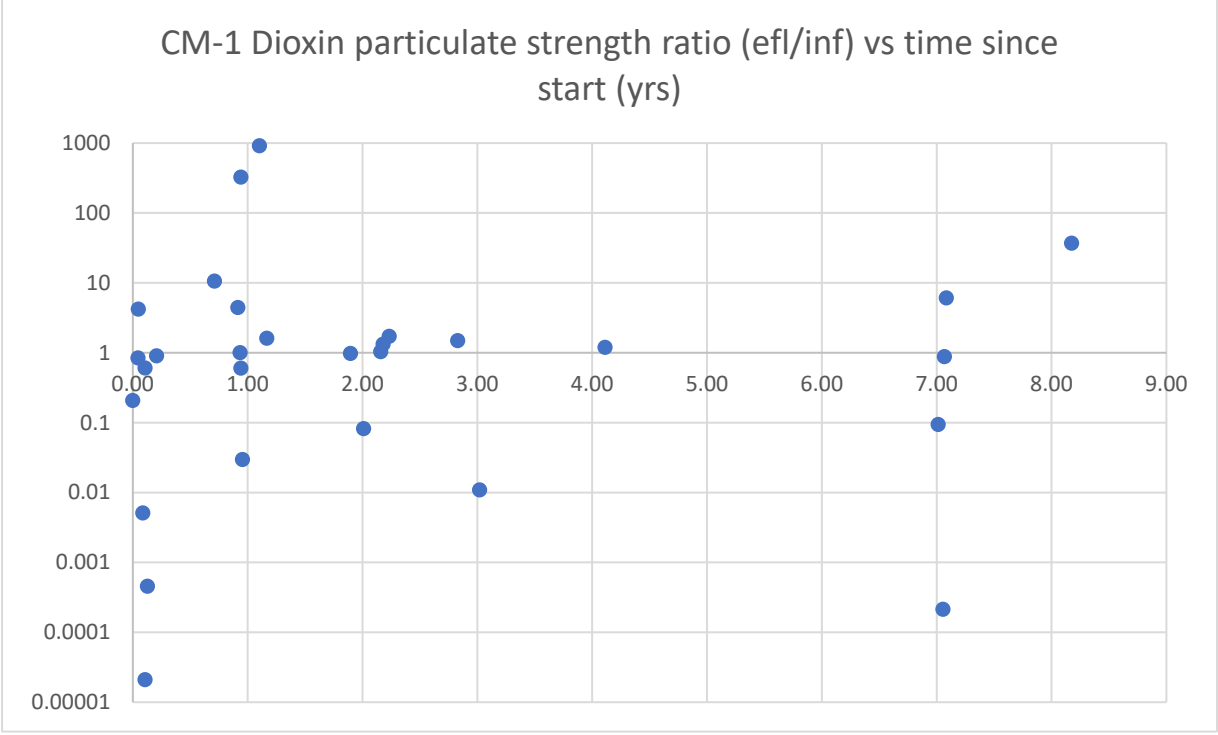
Control practice	comments
B-1 Media Filter	Inf and efl not significant
CM-1	Inf regres not sign with constant value; effluent sign very small slope
CM-11	Inf not sign; efl constant
CM-9	Very small inf slope; efl not sign
ELV Treatment Train	Inf not sign; efl constant
Lower Lot Biofilter	Inf slope sign but very small; efl regres not sign
North Detention Bioswale	Inf and efl not sign
South Detention Bioswale	Constant parallel inf and efl values
Upper Lot Media Filter	Constant inf but not enough efl data to analyze
Vegetated Channel	Inf too few to analyze; efl sign regression

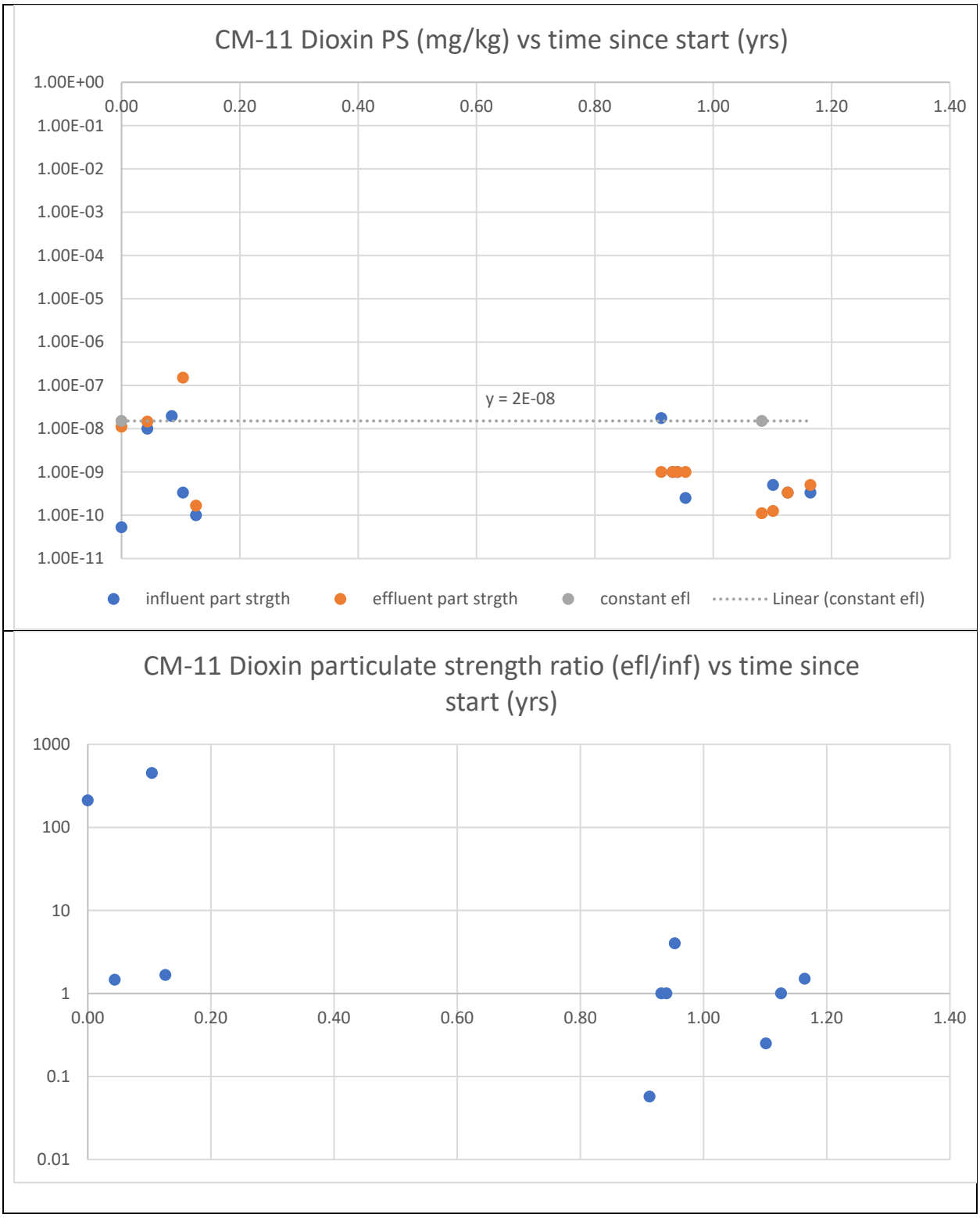
Dioxins (TCDD TEQ NoDNQ) Pollutant Strength Trends with Time. Regression equations only shown for significant influent or effluent trends (p<0.05). mg/kg/year trend units.

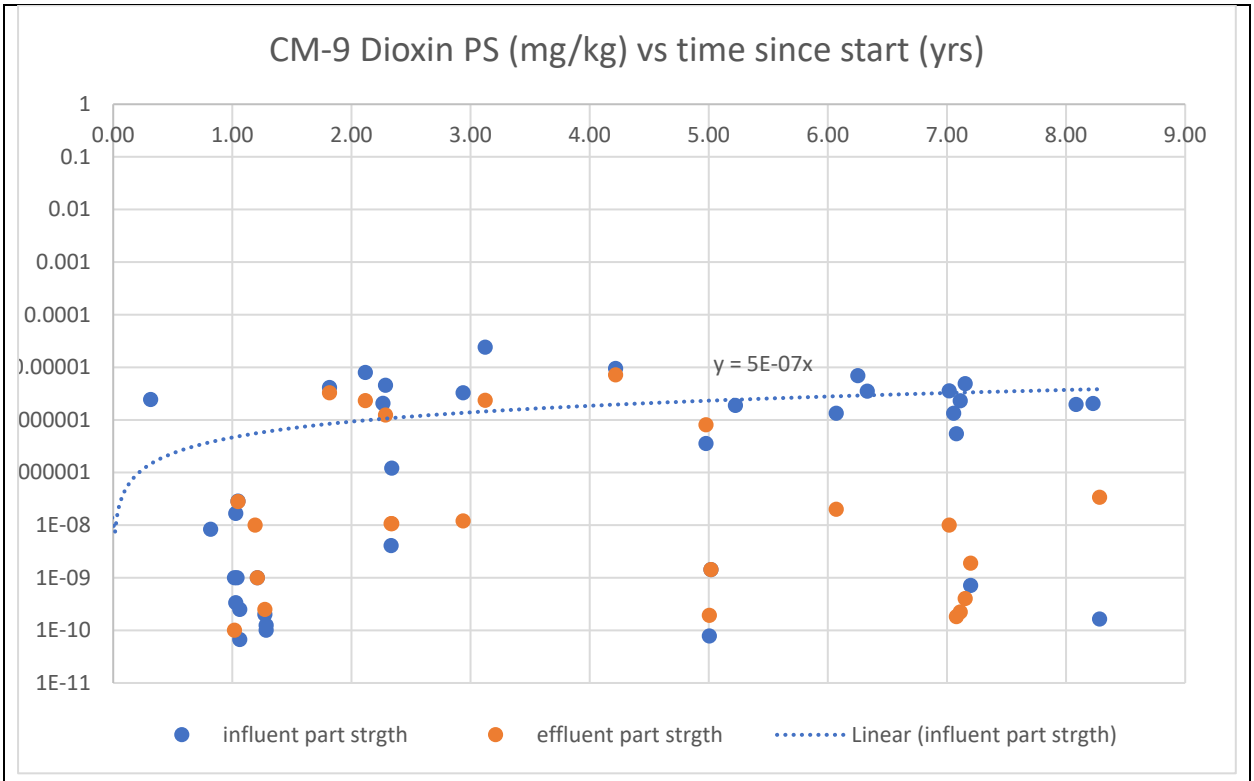


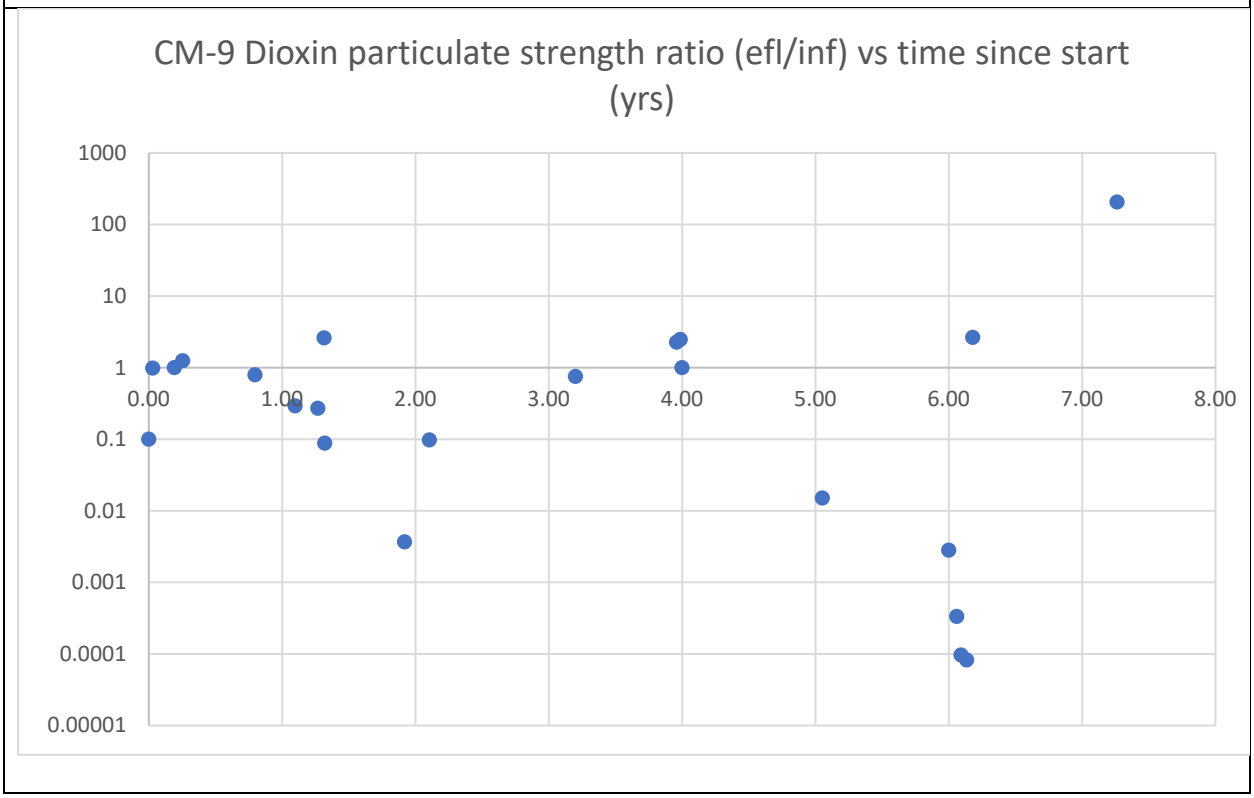


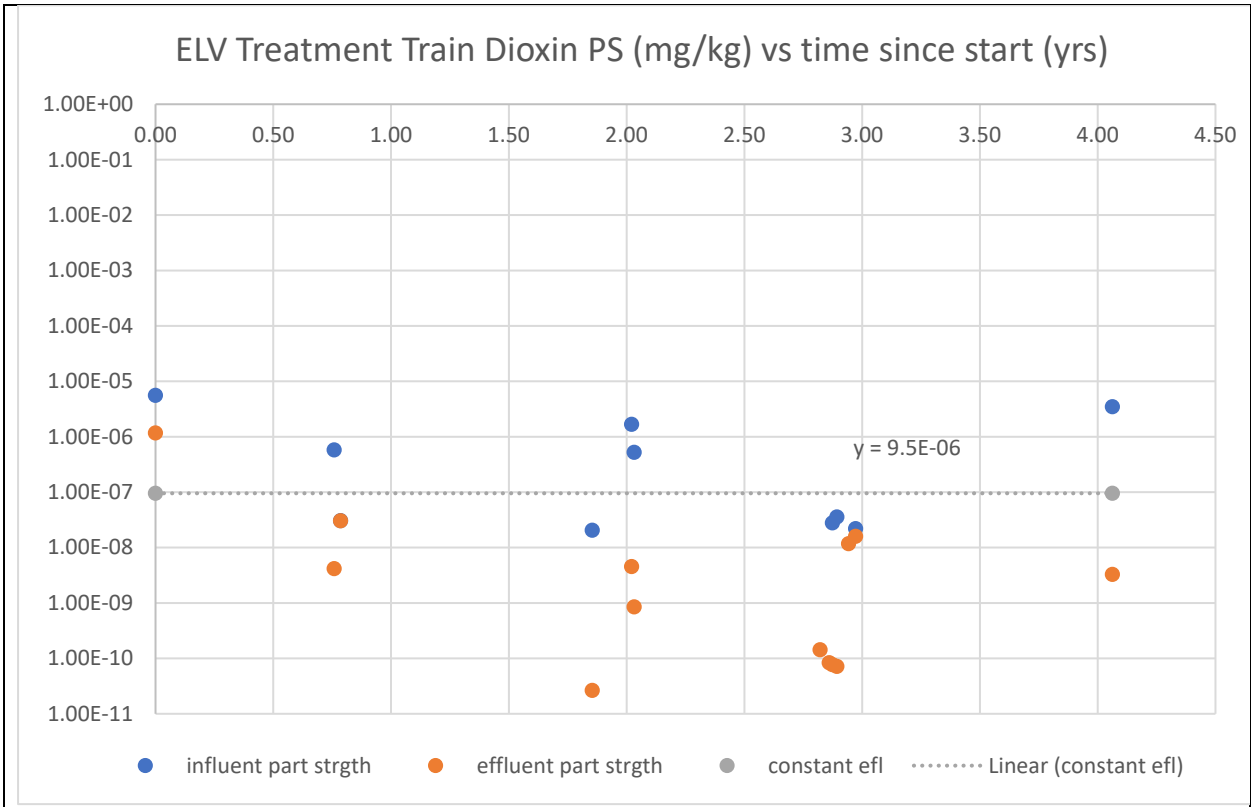

CM-1 Dioxin PS (mg/kg) vs time since start (yrs)
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
1.00E-06
1.00E-07
1.00E-08
1.00E-09
1.00E-10
1.00E-11
1.00E-12
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
y = 6.7E-06x - 3E-06
y = 4.6E-06
influent part strgth
effluent part strgth
constant inf
Linear (effluent part strgth)
Linear (constant inf)

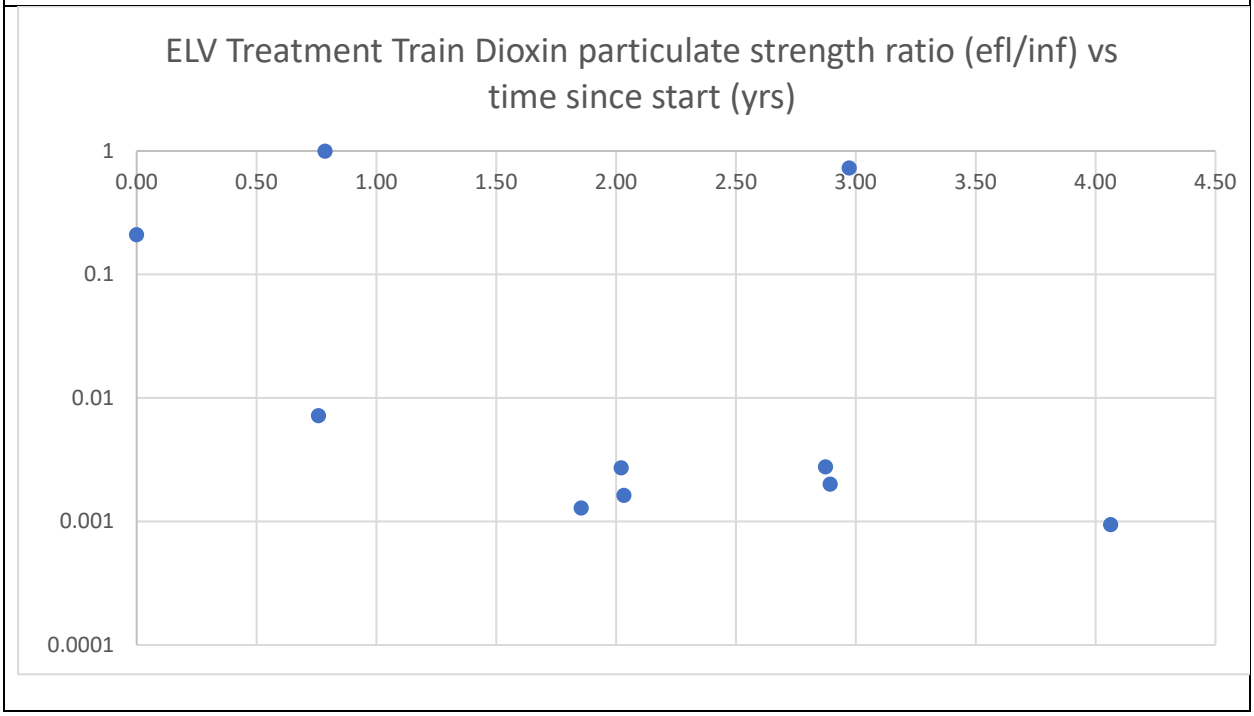

CM-1 Dioxin particulate strength ratio (efl/inf) vs time since start (yrs)
1000
100
10
1
0.1
0.01
0.001
0.0001
0.00001
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00

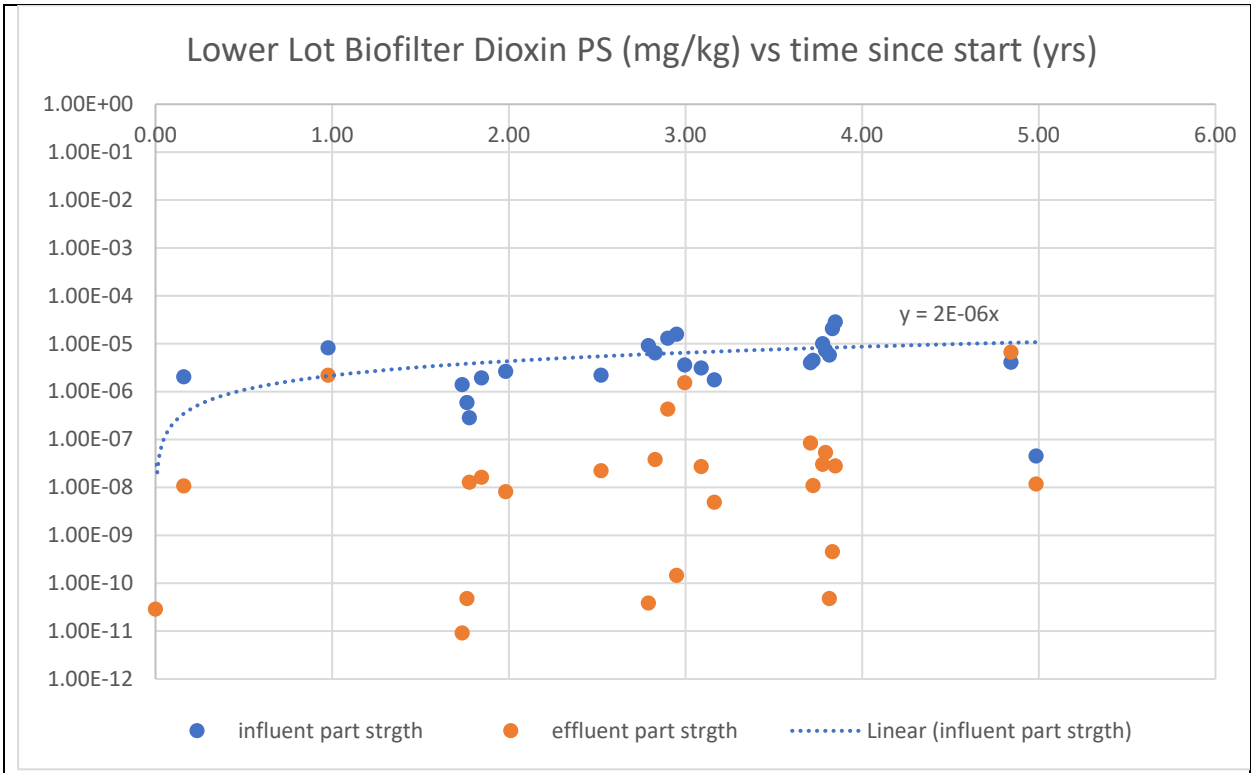

CM-11 Dioxin PS (mg/kg) vs time since start (yrs)
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
1.00E-06
1.00E-07
1.00E-08
1.00E-09
1.00E-10
1.00E-11
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
y = 2E-08
influent part strgth
effluent part strgth
constant efl
Linear (constant efl)
CM-11 Dioxin particulate strength ratio (efl/inf) vs time since start (yrs)
1000
100
10
1
0.1
0.01
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40

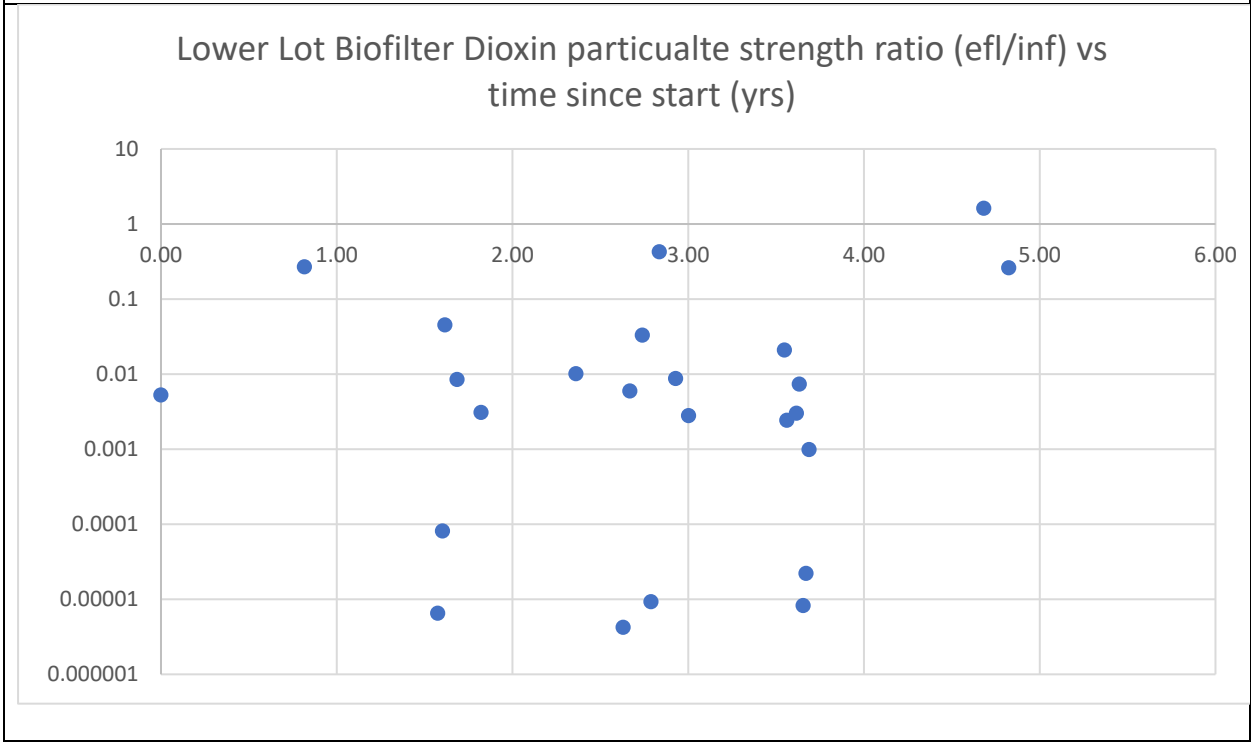

CM-9 Dioxin PS (mg/kg) vs time since start (yrs)
1
0.1
0.01
0.001
0.0001
0.00001
000001
000001
1E-08
1E-09
1E-10
1E-11
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
y = 5E-07x
influent part strgth
effluent part strgth
Linear (influent part strgth)

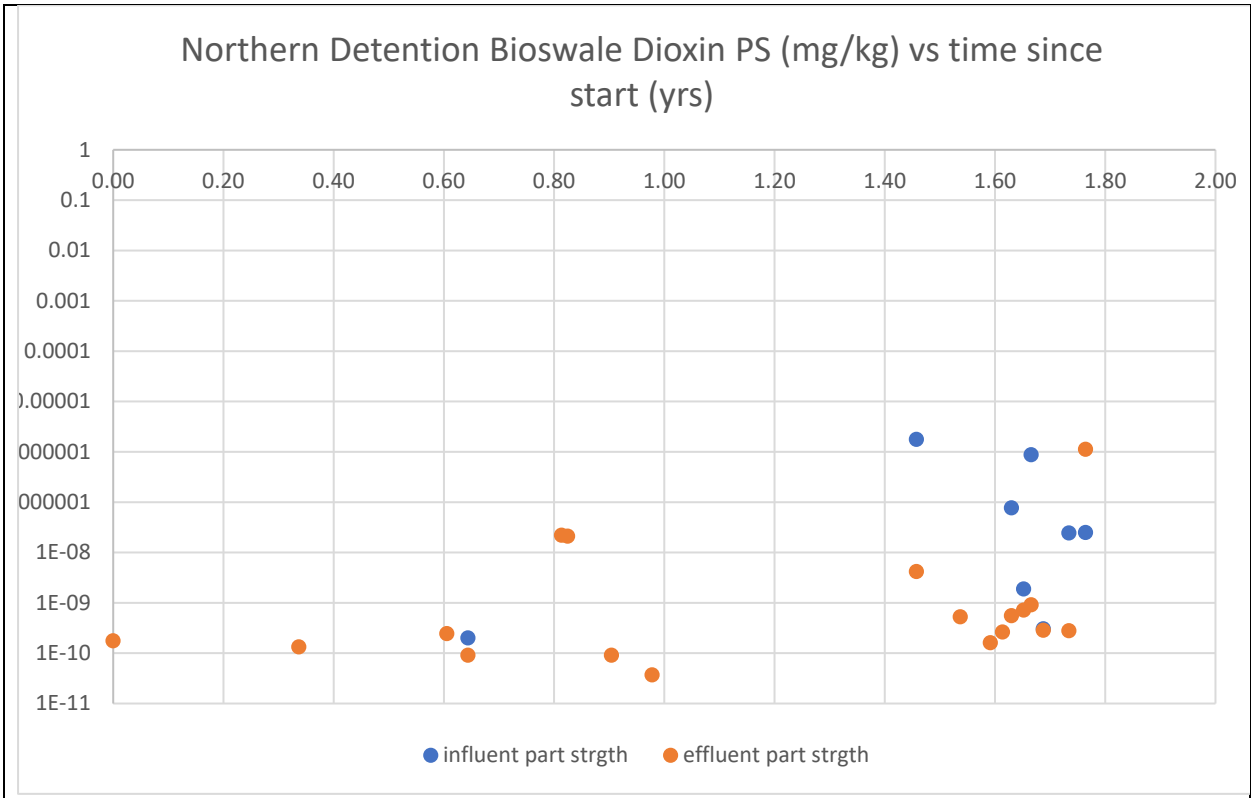

CM-9 Dioxin particulate strength ratio (efl/inf) vs time since start (yrs)
1000
100
10
1
0.1
0.01
0.001
0.0001
0.00001
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00

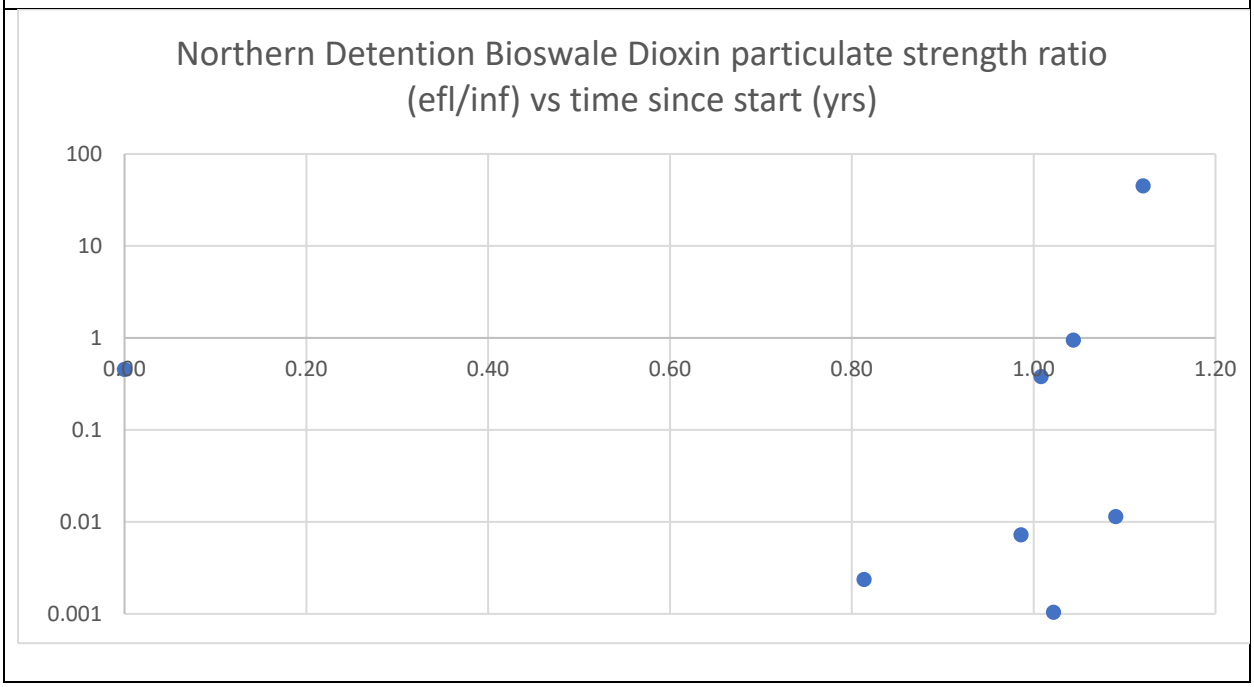

ELV Treatment Train Dioxin PS (mg/kg) vs time since start (yrs)
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
1.00E-06
1.00E-07
1.00E-08
1.00E-09
1.00E-10
1.00E-11
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
y = 9.5E-06
influent part strgth
effluent part strgth
constant efl
Linear (constant efl)

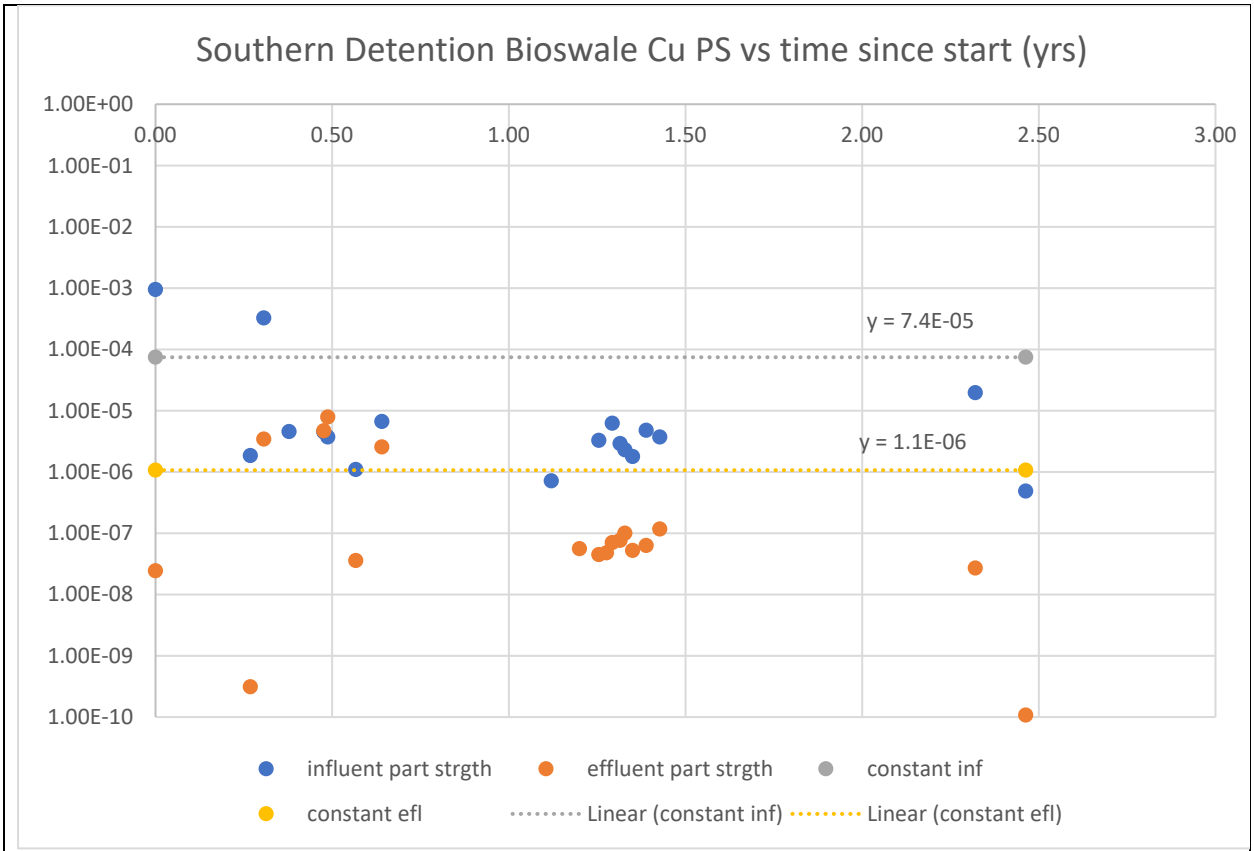

ELV Treatment Train Dioxin particulate strength ratio (efl/inf) vs time since start (yrs)
1
0.1
0.01
0.001
0.0001
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50

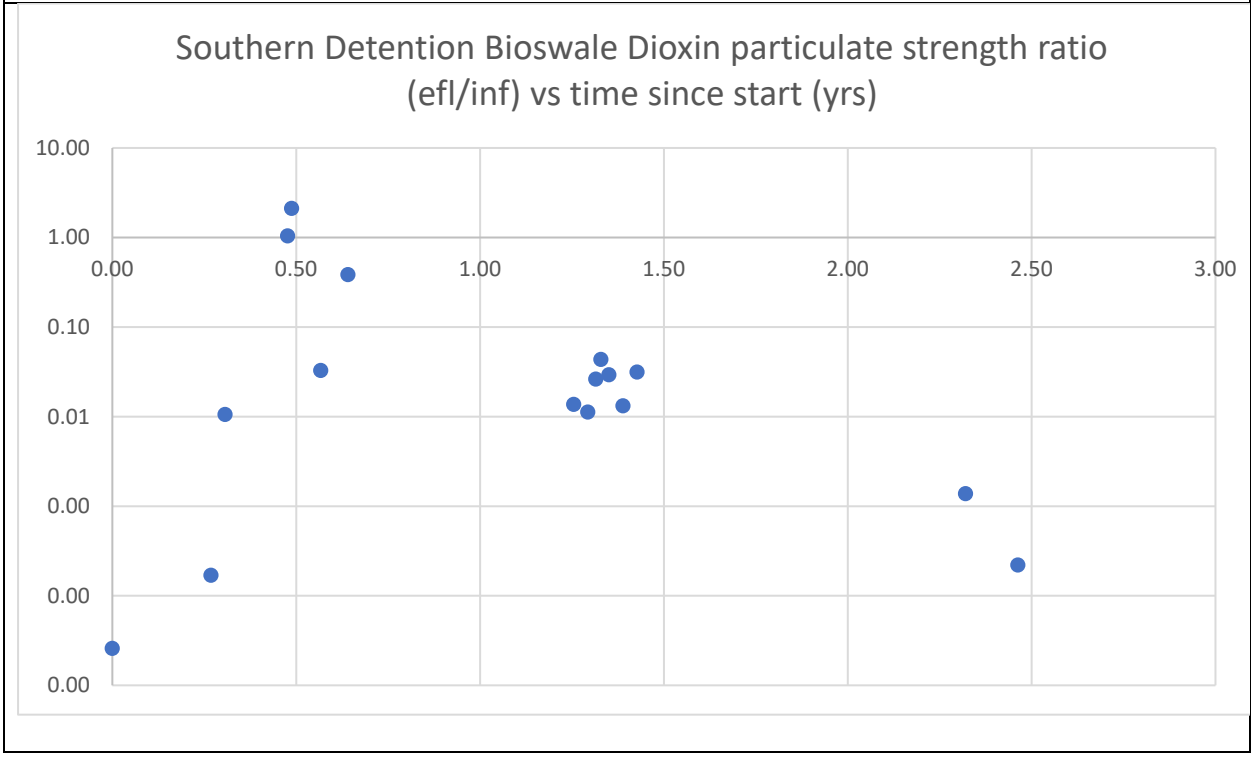

Lower Lot Biofilter Dioxin PS (mg/kg) vs time since start (yrs)
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
1.00E-06
1.00E-07
1.00E-08
1.00E-09
1.00E-10
1.00E-11
1.00E-12
0.00
1.00
2.00
3.00
4.00
5.00
6.00
y = 2E-06x
influent part strgth
effluent part strgth
Linear (influent part strgth)

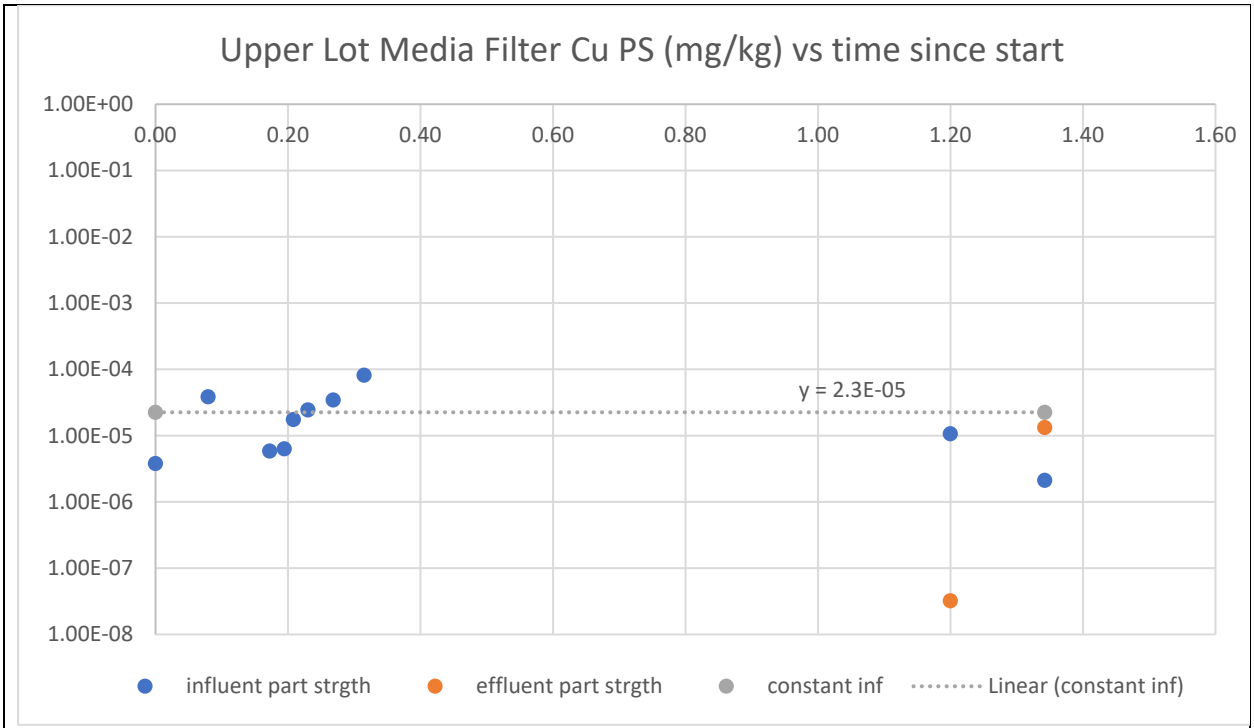

Lower Lot Biofilter Dioxin particualte strength ratio (efl/inf) vs time since start (yrs)
10
1
0.1
0.01
0.001
0.0001
0.00001
0.000001
0.00
1.00
2.00
3.00
4.00
5.00
6.00

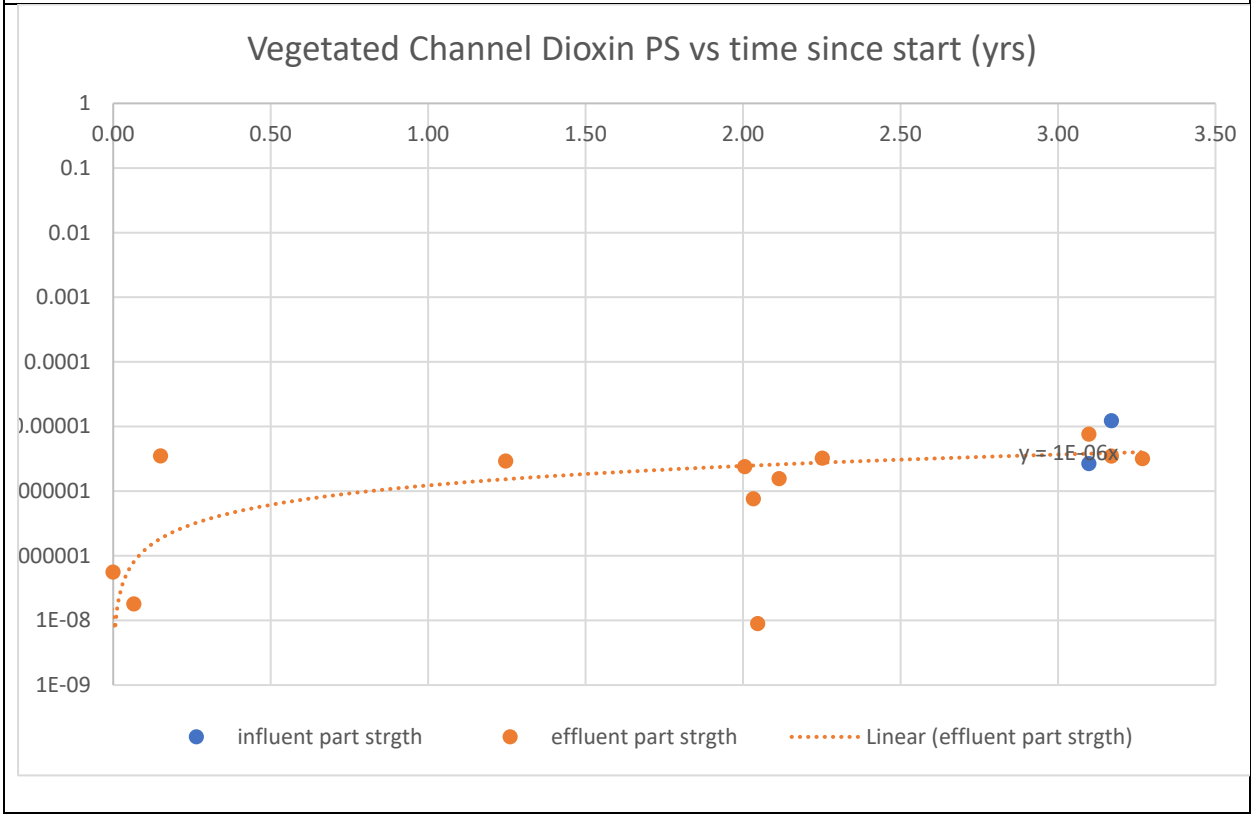

Northern Detention Bioswale Dioxin PS (mg/kg) vs time since start (yrs)
1
0.1
0.01
0.001
0.0001
1E-08
1E-09
1E-10
1E-11
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
1.80
2.00
influent part strgth
effluent part strgth


Northern Detention Bioswale Dioxin particulate strength ratio (efl/inf) vs time since start (yrs)
100
10
1
0.1
0.01
0.001
0.00
0.20
0.40
0.60
0.80
1.00
1.20


Southern Detention Bioswale Cu PS vs time since start (yrs)
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
1.00E-06
1.00E-07
1.00E-08
1.00E-09
1.00E-10
0.00
0.50
1.00
1.50
2.00
2.50
3.00
y = 7.4E-05
y = 1.1E-06
influent part strgth
effluent part strgth
constant inf
constant efl
Linear (constant inf)
Linear (constant efl)


Southern Detention Bioswale Dioxin particulate strength ratio (efl/inf) vs time since start (yrs)
10.00
1.00
0.10
0.01
0.00
0.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00


Upper Lot Media Filter Cu PS (mg/kg) vs time since start
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
1.00E-06
1.00E-07
1.00E-08
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
y = 2.3E-05
influent part strgth
effluent part strgth
constant inf
Linear (constant inf)


Vegetated Channel Dioxin PS vs time since start (yrs)
1
0.1
0.01
0.001
0.0001
.00001
000001
000001
1E-08
1E-09
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
y = 1E-06x
influent part strgth
effluent part strgth
Linear (effluent part strgth)

Copper (mg/kg)

Control practice	start of monitoring period	end of monitoring period	monitoring duration (yrs)	influent sample count	effluent sample count	influent median (mg/kg)	effluent median (mg/kg)	influent COV	effluent COV
B-1 Media Filter	12/12/2011	2/18/2016	4.2	21	20	65	61	0.63	1.00
CM-1	1/19/2010	3/22/2018	8.2	20	5	81	100	0.77	1.16
CM-9	12/11/2009	3/22/2018	8.3	37	25	130	200	2.22	1.88
ELV Treatment Train	2/28/2014	3/22/2018	4.1	6	7	110	21	0.69	0.69
Lower Lot Biofilter	3/8/2013	3/2/2018	5.0	20	24	100	140	0.66	0.69
North Detention Bioswale	5/15/2015	2/17/2017	1.8	6	12	170	1100	1.71	1.32
South Detention Bioswale	9/15/2015	3/2/2018	2.5	17	15	110	200	0.43	1.11
Upper Lot Media Filter	10/28/2016	3/2/2018	1.3	9	2	140	86	0.42	n/a
Vegetated Channel	11/30/2012	3/7/2016	3.3	2	11	190	33	0.84	0.49

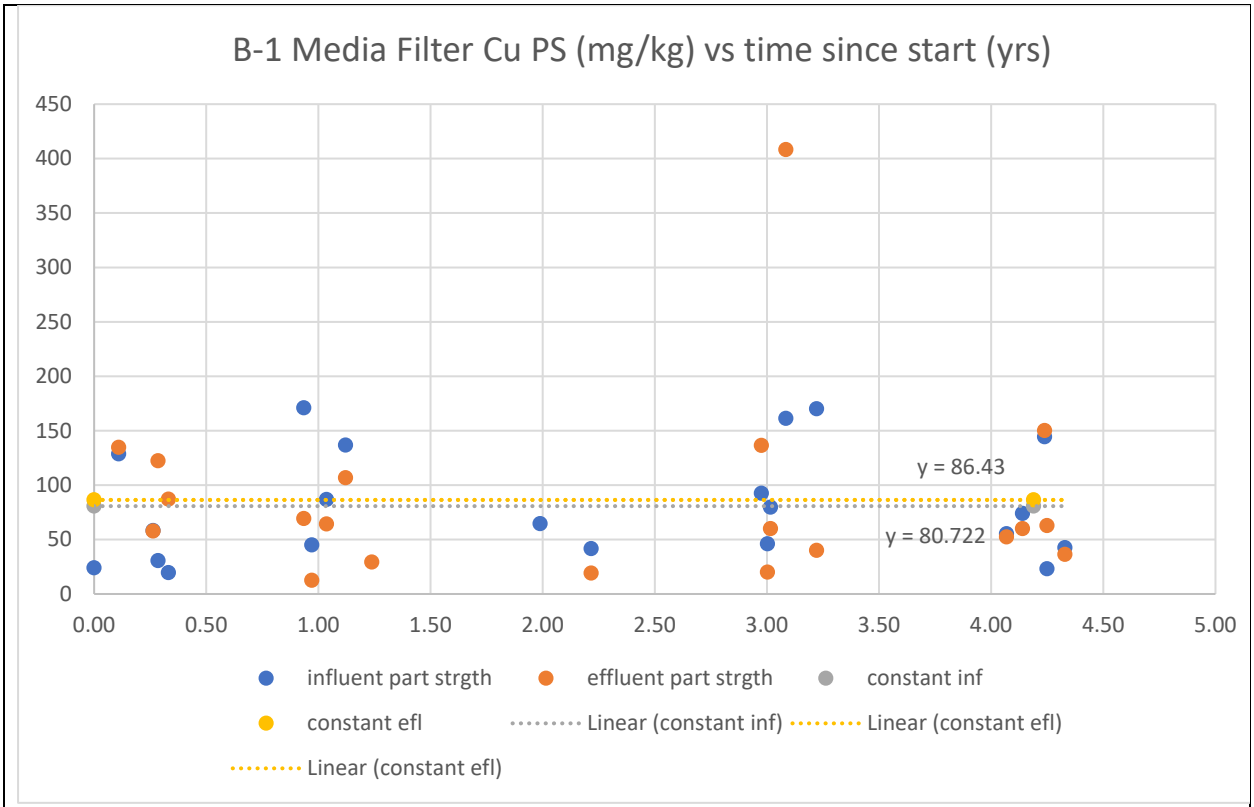
Control practice	influent regression F	effluent regression F	influent adjusted R^2	effluent adjusted R^2	influent slope P	effluent slope P	influent slope coefficient*	effluent slope coefficient*
B-1 Media Filter	0.67	0.85	n/a	n/a	0.67	0.85	n/s	n/s
CM-1	0.045	0.06	0.21	0.42	3.24E-05	0.05	154	n/s
CM-9	0.06	0.24	0.07	0.02	0.06	0.24	n/s	n/s
ELV Treatment Train	0.07	0.04	0.35	0.41	0.06	0.03	n/s	11.8
Lower Lot Biofilter	1.1E-06	0.73	0.68	n/a	7.7E-07	0.73	47	n/s
North Detention Bioswale	0.19	0.02	0.14	0.33	0.17	0.015	n/s	1429
South Detention Bioswale	0.38	0.007	n/a	0.35	0.38	0.007	n/s	235
Upper Lot Media Filter	0.16	n/a	0.16	n/a	0.15	n/a	n/s	n/a
Vegetated Channel	n/a	0.38	n/a	n/a	n/a	0.38	n/a	n/s

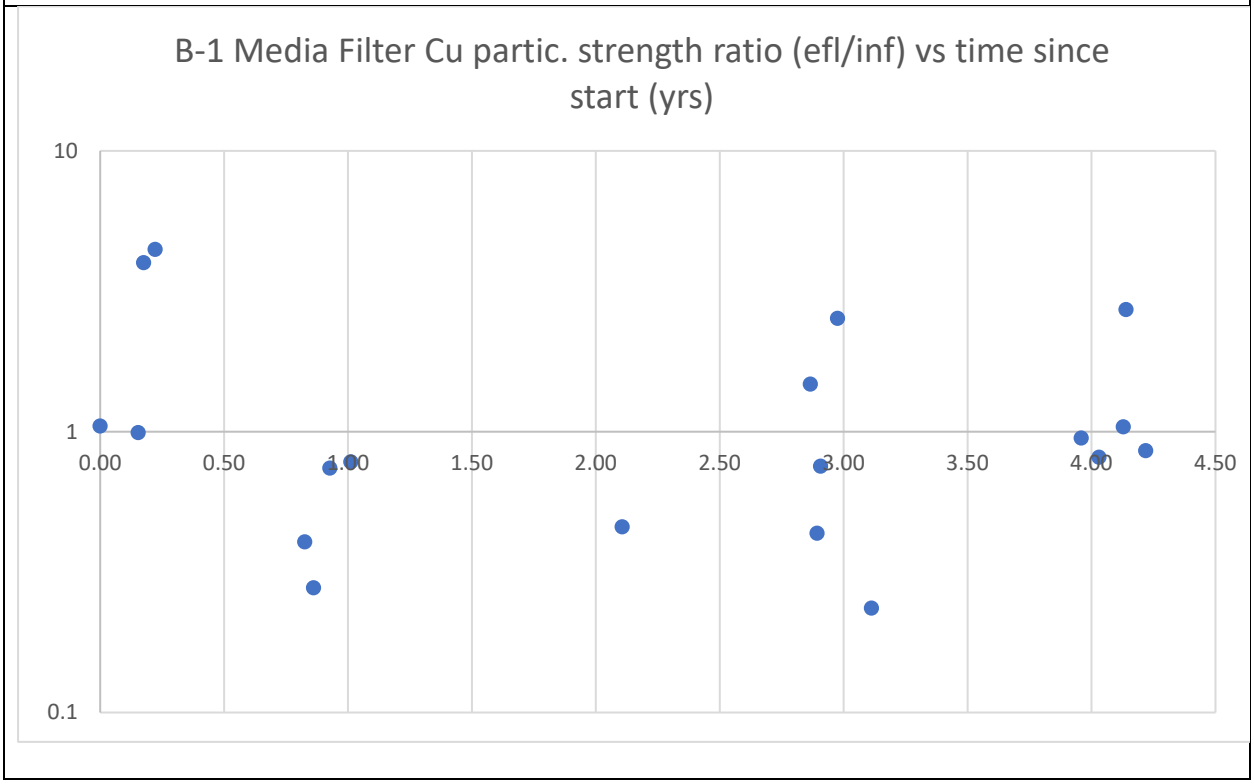
*mg/kg/year slope units

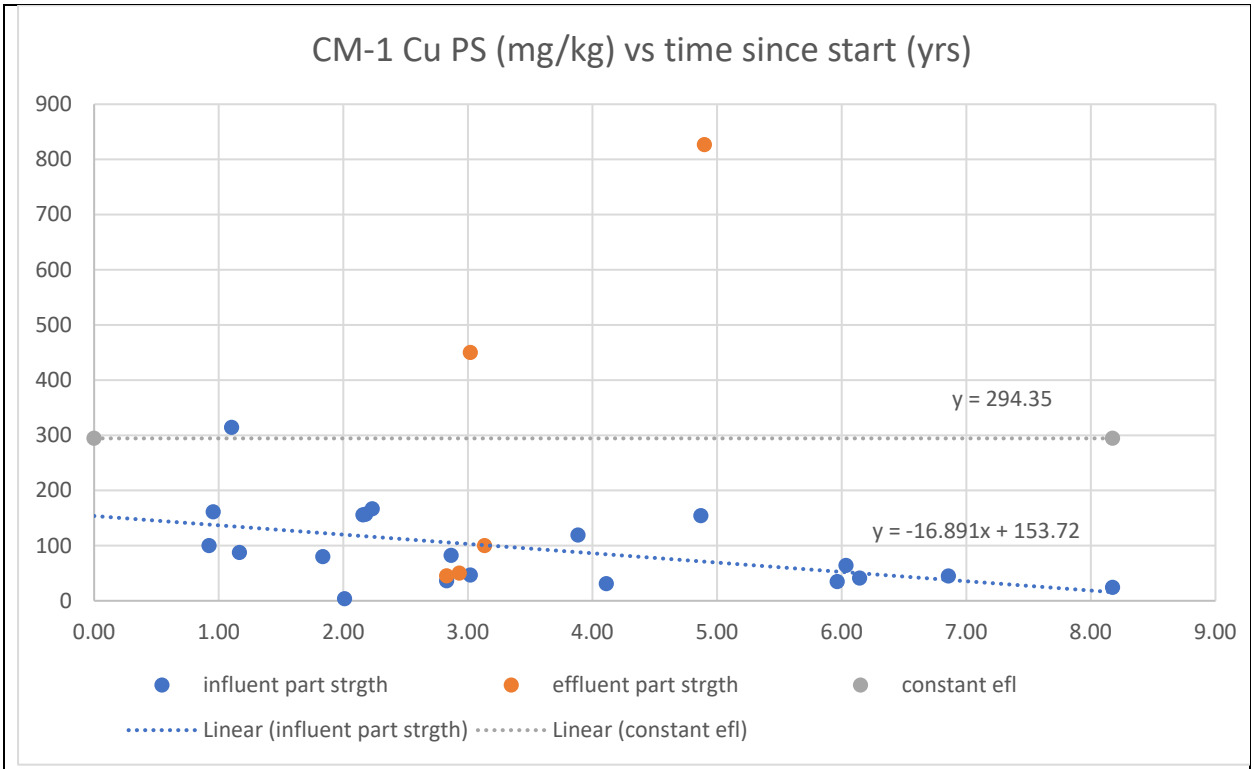
Copper (cont.)

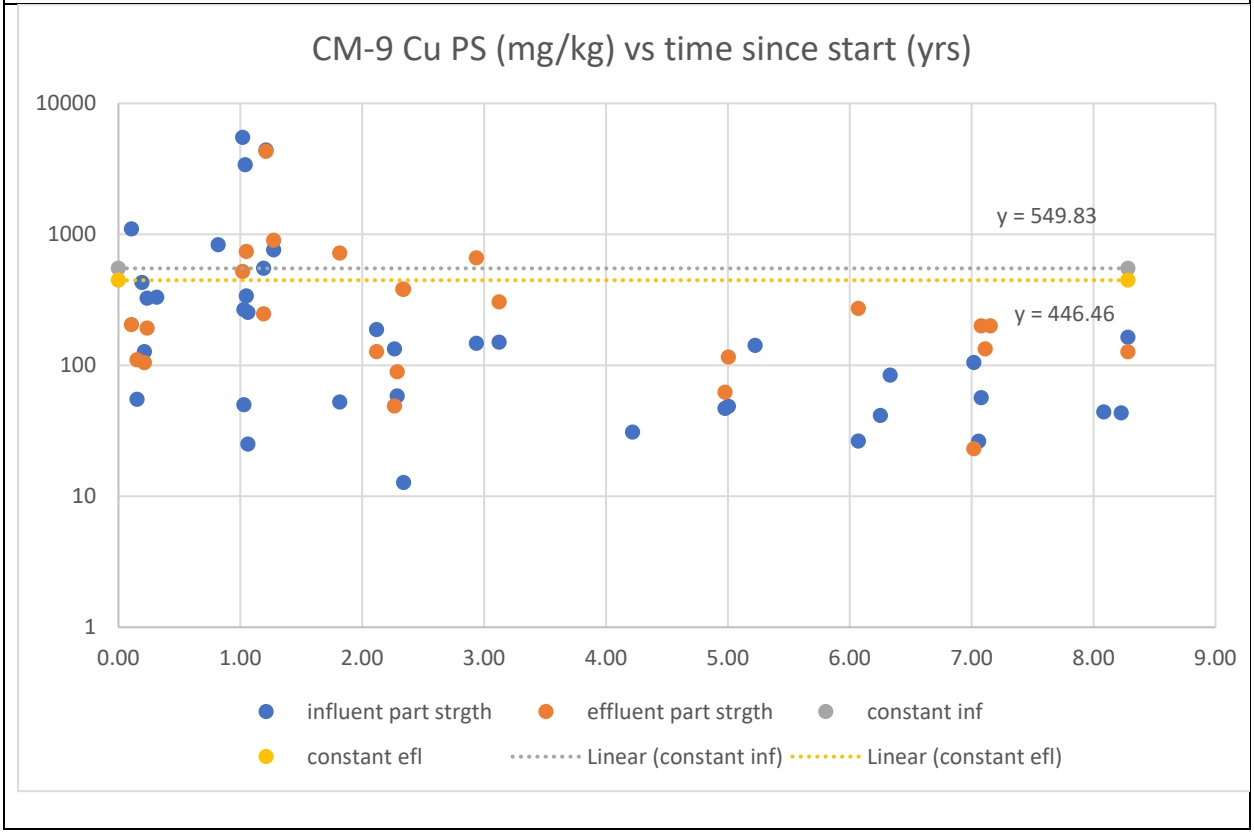
Control practice	comments
B-1 Media Filter	no obvious breakthrough, no significant slopes, and parallel constant and significant trend lines
CM-1	Significant downward inf trend; constant efl value
CM-9	no obvious breakthrough, no significant slopes, and parallel constant and significant trend lines; apparent initial downslope for inf and efl, but not sign
ELV Treatment Train	Inf regres not sign; efl sign increasing slope
Lower Lot Biofilter	Sign inf increasing slope; constant efl value
North Detention Bioswale	Inf regres not sign; efl sign increasing slope
South Detention Bioswale	Constant inf value; efl increasing slope
Upper Lot Media Filter	Constant inf value; not enough efl data for analyses
Vegetated Channel	Not enough inf values for analyses; constant efl values

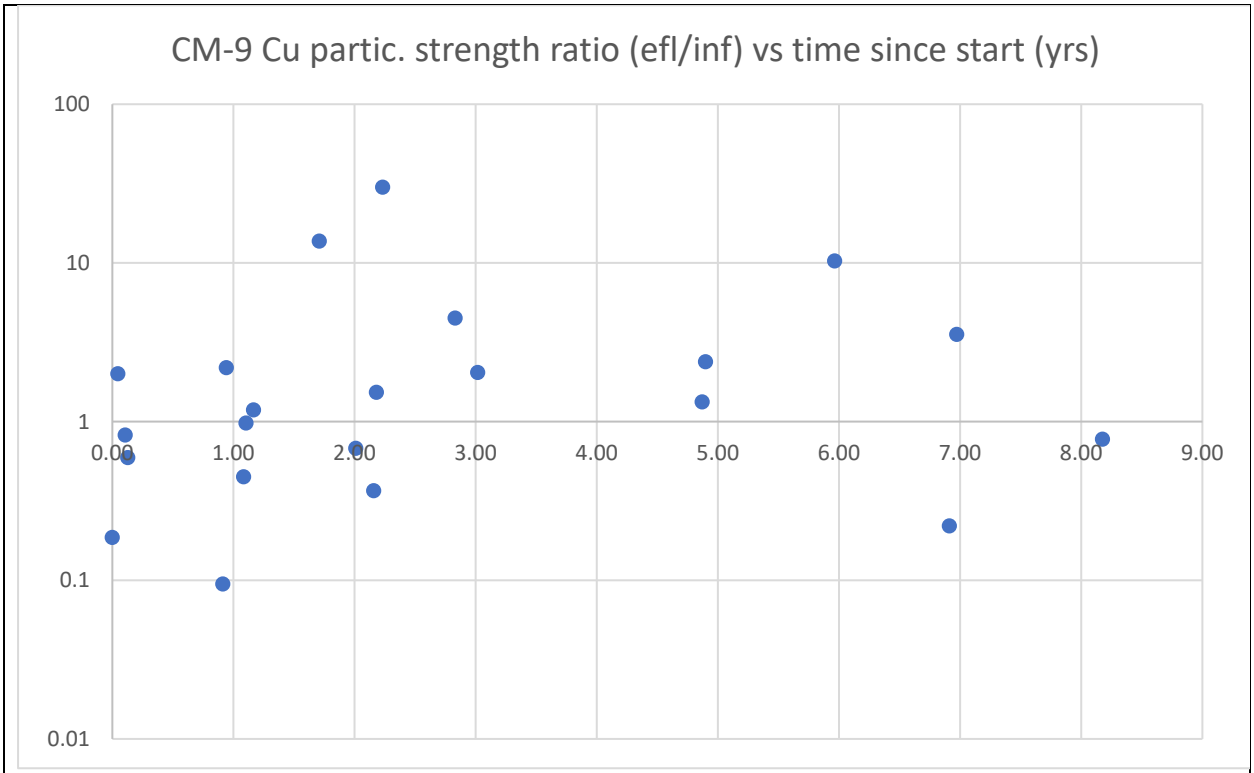
Copper Pollutant Strength Trends with Time. Regression equations only shown for significant influent or effluent trends (p<0.05). mg/kg/year trend units.

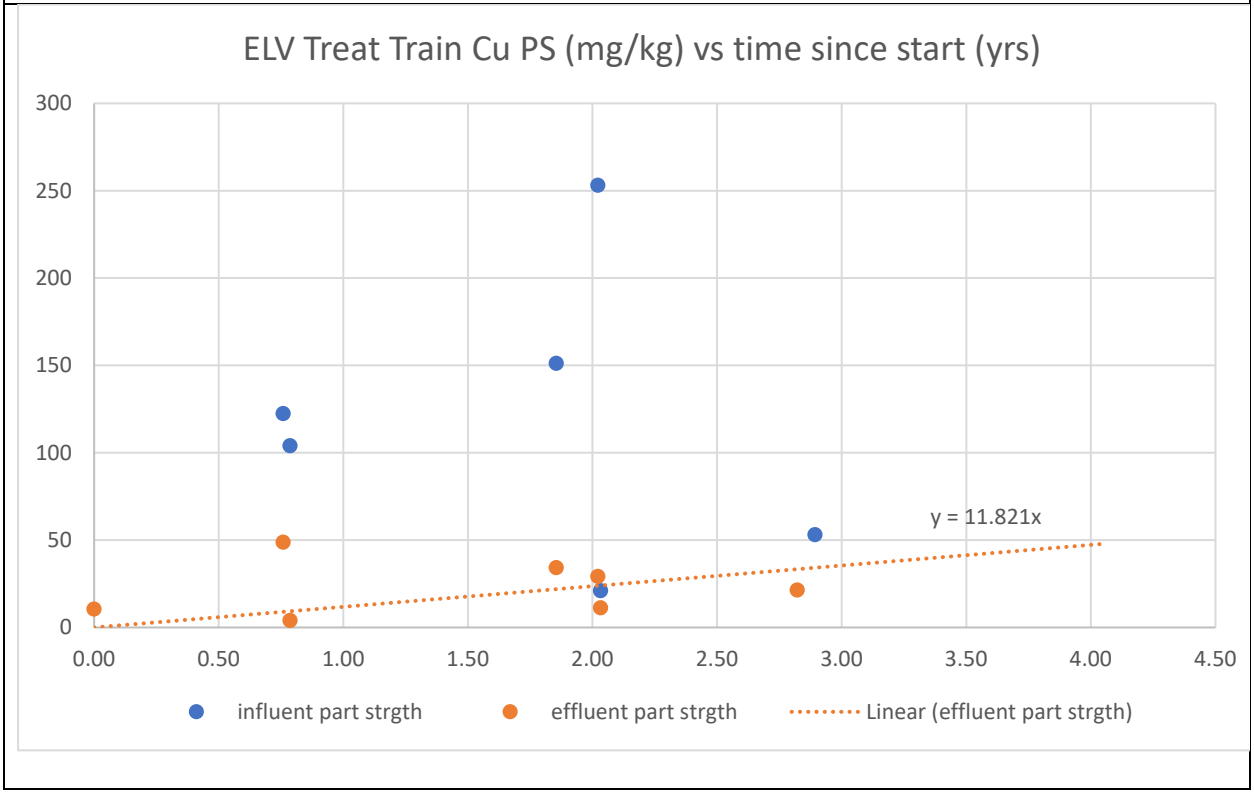


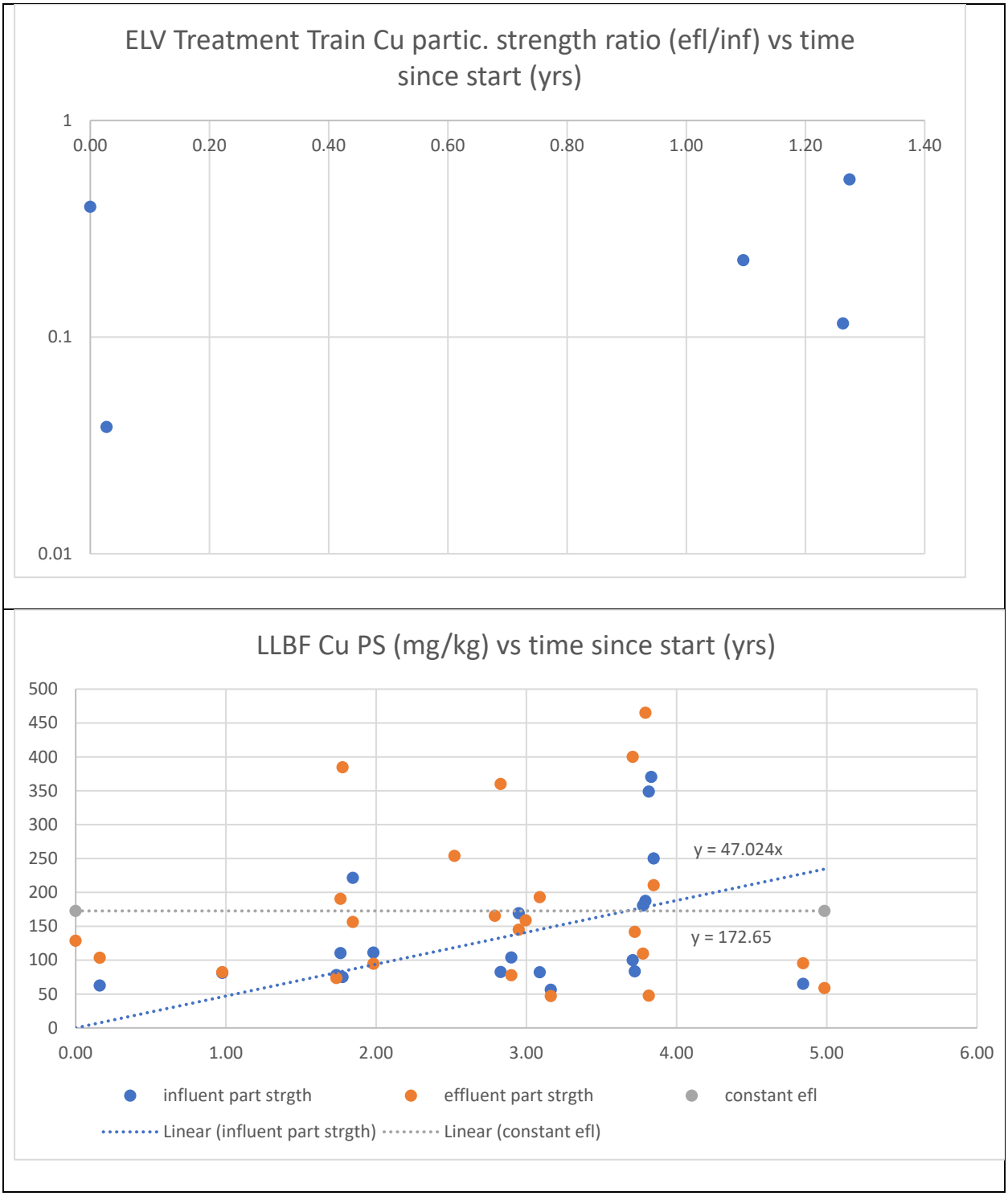


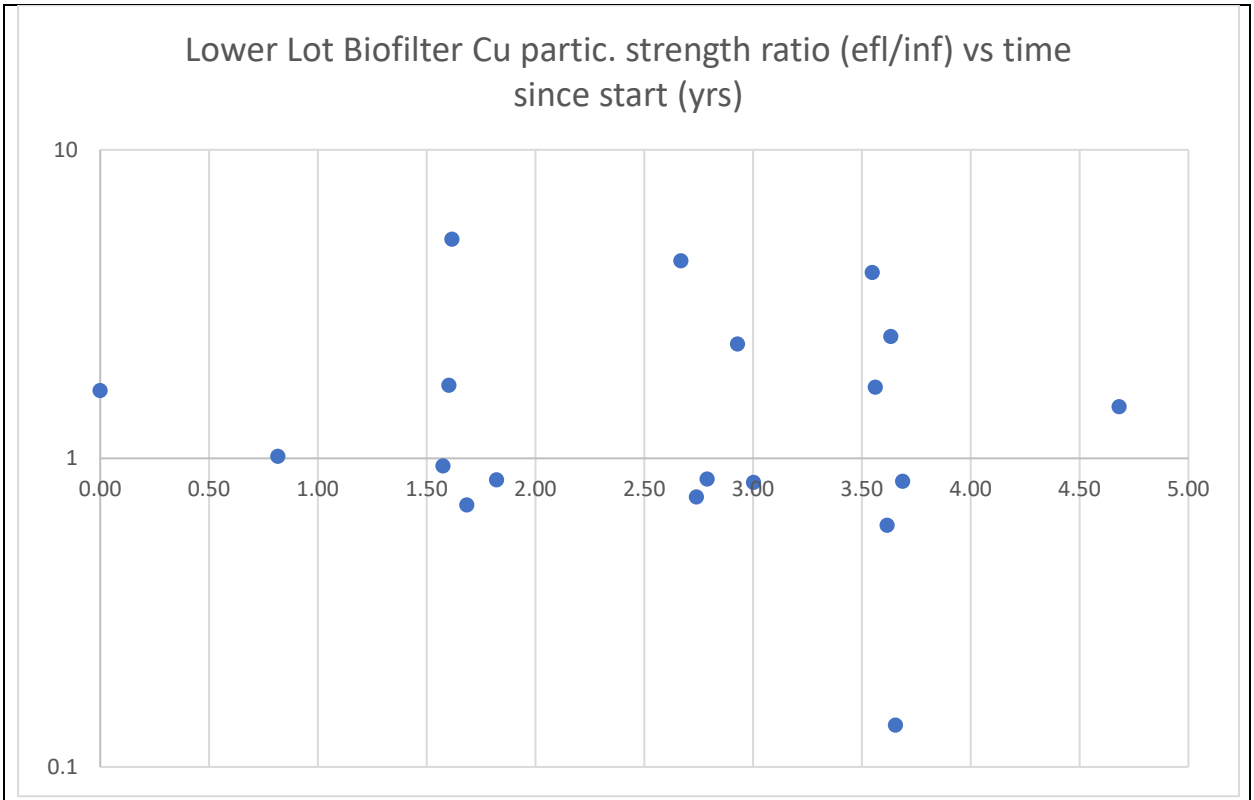

CM-1 Cu PS (mg/kg) vs time since start (yrs)
900
800
700
600
500
400
300
200
100
0
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
y = 294.35
y = -16.891x + 153.72
influent part strgth
effluent part strgth
constant efl
Linear (influent part strgth)
Linear (constant efl)

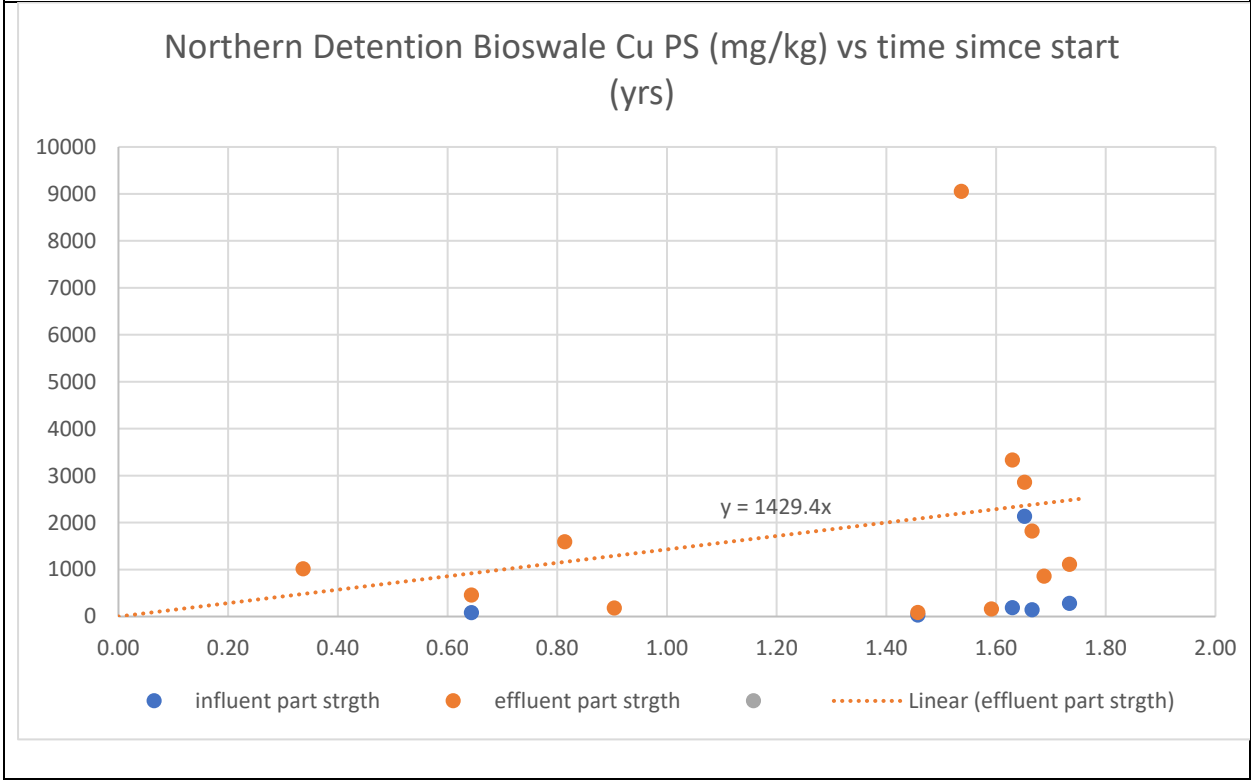

CM-9 Cu PS (mg/kg) vs time since start (yrs)
10000
1000
100
10
1
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
y = 549.83
y = 446.46
influent part strgth
effluent part strgth
constant inf
constant efl
Linear (constant inf)
Linear (constant efl)

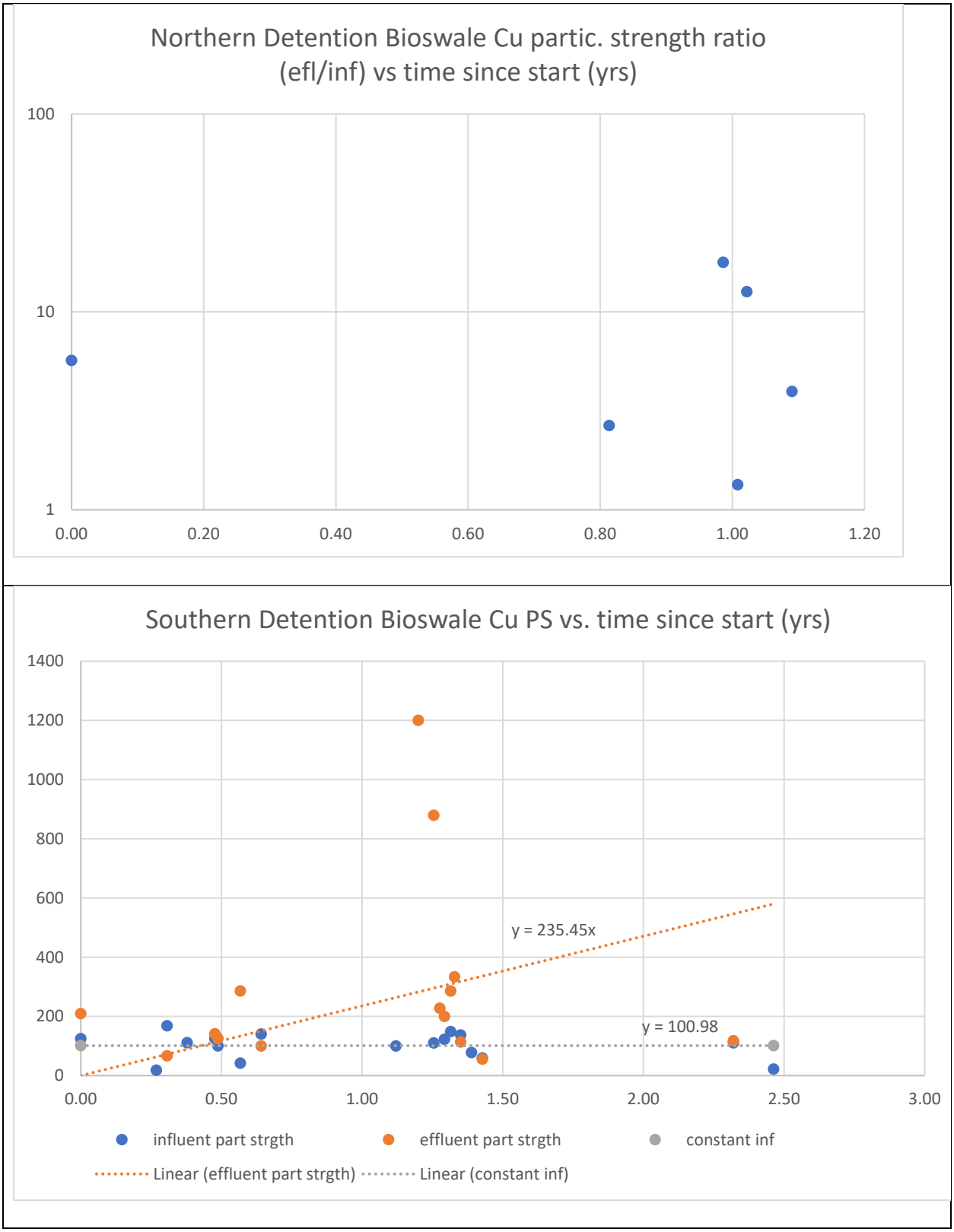

CM-9 Cu partic. strength ratio (efl/inf) vs time since start (yrs)
100
10
1
0.1
0.01
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00

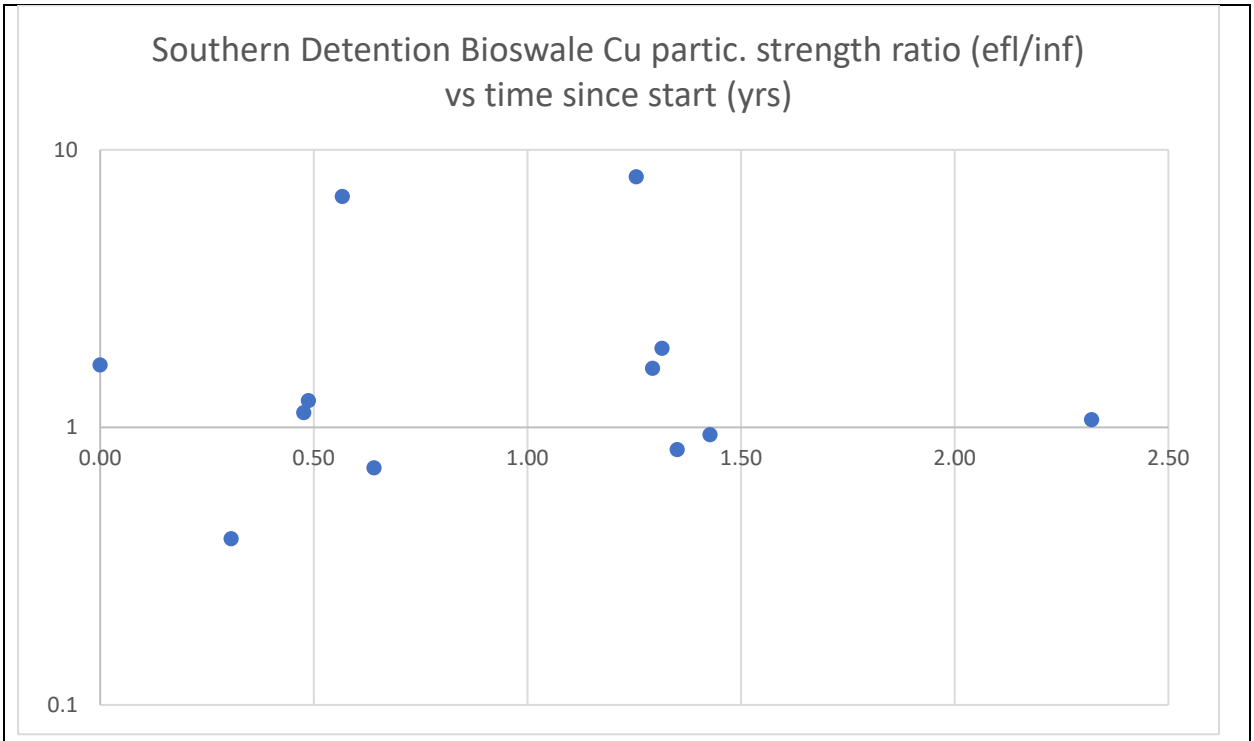

ELV Treat Train Cu PS (mg/kg) vs time since start (yrs)
300
250
200
150
100
50
0
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
y = 11.821x
influent part strgth
effluent part strgth
Linear (effluent part strgth)

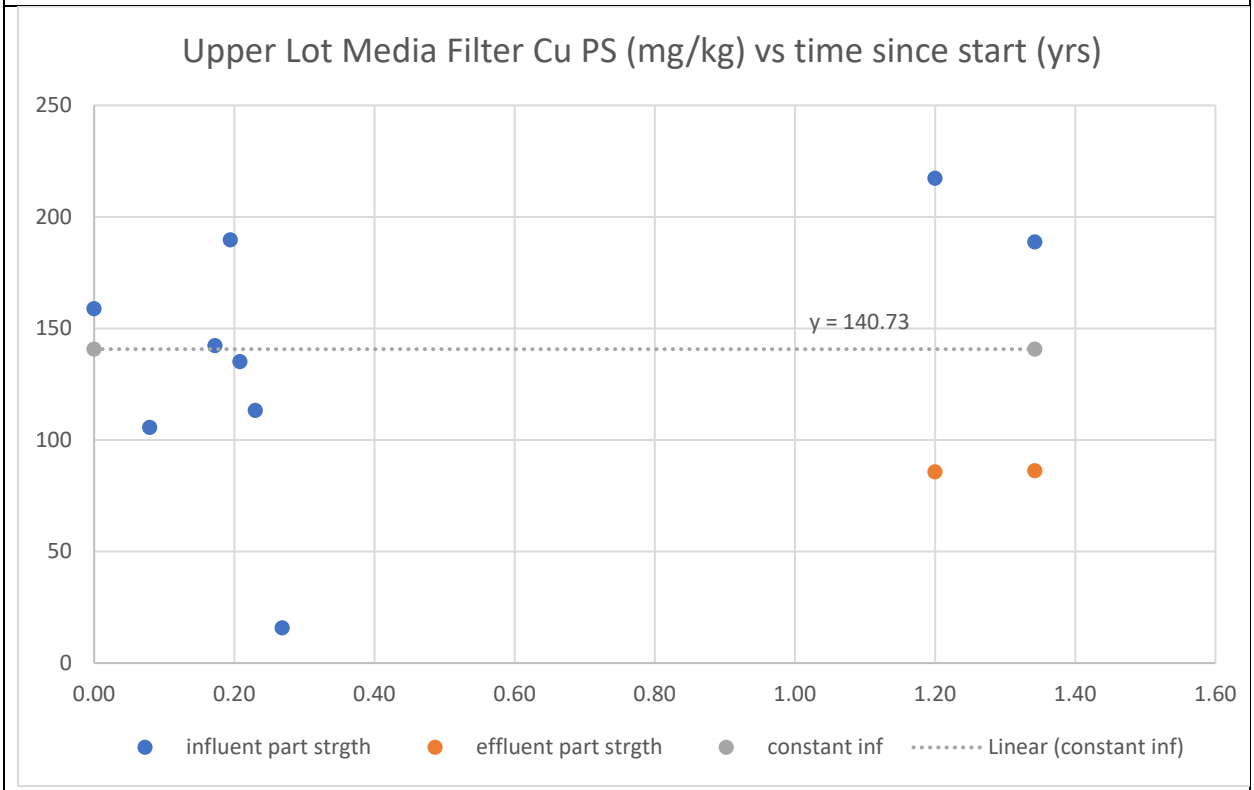

ELV Treatment Train Cu partic. strength ratio (efl/inf) vs time since start (yrs)
1
0.1
0.01
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
LLBF Cu PS (mg/kg) vs time since start (yrs)
500
450
400
350
300
250
200
150
100
50
0
0.00
1.00
2.00
3.00
4.00
5.00
6.00
y = 47.024x
y = 172.65
influent part strgth
effluent part strgth
constant efl
Linear (influent part strgth)
Linear (constant efl)

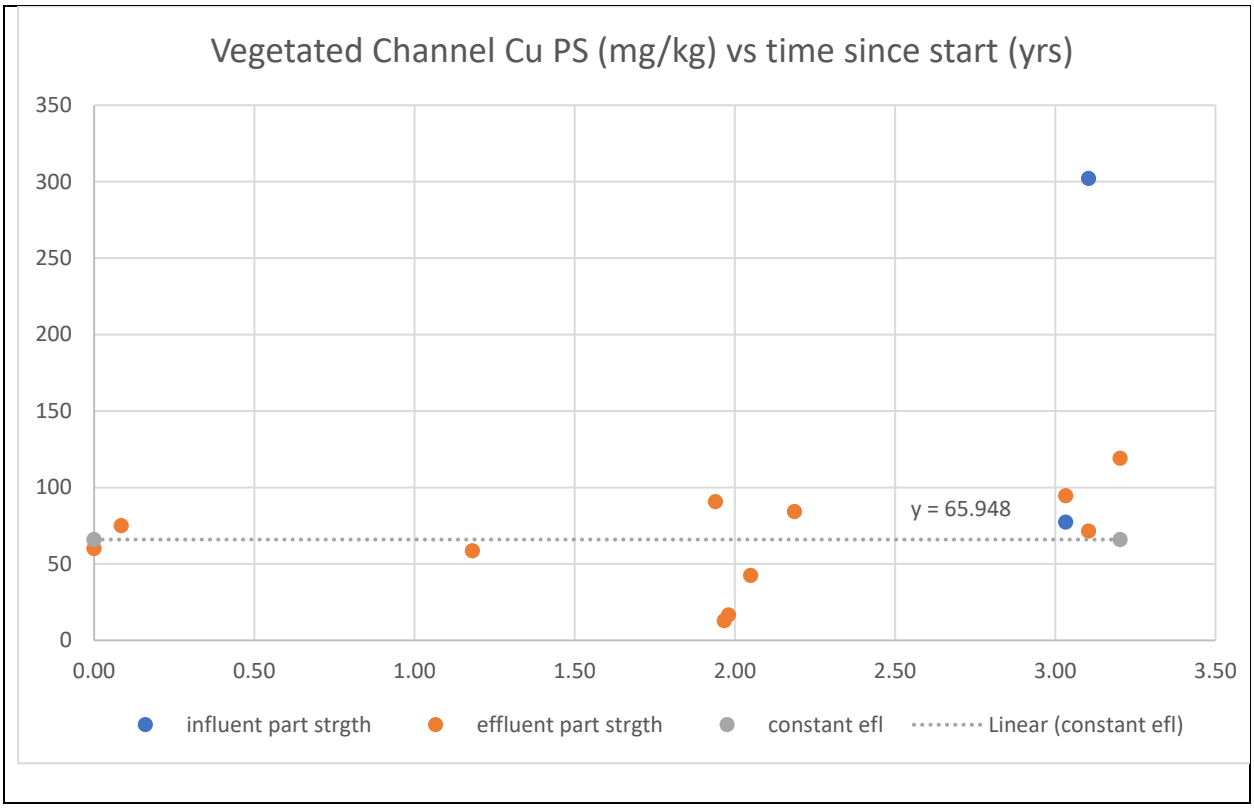

Lower Lot Biofilter Cu partic. strength ratio (efl/inf) vs time since start (yrs)
10
1
0.1
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
5.00


Northern Detention Bioswale Cu PS (mg/kg) vs time simce start (yrs)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
1.80
2.00
y = 1429.4x
influent part strgth
effluent part strgth
Linear (effluent part strgth)


Northern Detention Bioswale Cu partic. strength ratio (efl/inf) vs time since start (yrs)
100
10
1
0.00
0.20
0.40
0.60
0.80
1.00
1.20
Southern Detention Bioswale Cu PS vs. time since start (yrs)
1400
1200
1000
800
600
400
200
0
0.00
0.50
1.00
1.50
2.00
2.50
3.00
y = 235.45x
y = 100.98
influent part strgth
effluent part strgth
constant inf
Linear (effluent part strgth)
Linear (constant inf)


Southern Detention Bioswale Cu partic. strength ratio (efl/inf)
vs time since start (yrs)
10
1
0.1
0.00
0.50
1.00
1.50
2.00
2.50


Upper Lot Media Filter Cu PS (mg/kg) vs time since start (yrs)
250
200
150
100
50
0
y = 140.73
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
influent part strgth
effluent part strgth
constant inf
Linear (constant inf)


Vegetated Channel Cu PS (mg/kg) vs time since start (yrs)
350
300
250
200
150
100
50
0
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
y = 65.948
influent part strgth
effluent part strgth
constant efl
Linear (constant efl)

Lead (mg/kg)

Control practice	start of monitoring period	end of monitoring period	monitoring duration (yrs)	influent sample count	effluent sample count	influent median (mg/kg)	effluent median (mg/kg)	influent COV	effluent COV
B-1 Media Filter	12/12/2011	2/18/2016	4.2	21	22	100	67	0.83	0.61
CM-1	1/19/2010	3/22/2018	8.2	40	33	120	240	1.21	0.95
CM-8	1/20/2010	3/21/2011	1.2	10	10	170	210	0.48	0.47
CM-9	12/11/2009	3/22/2018	8.3	38	27	130	120	1.13	1.19
ELV Treatment Train	2/28/2014	3/22/2018	4.1	10	13	170	47	2.15	0.55
Lower Lot Biofilter	3/8/2013	3/2/2018	5.0	23	25	75	91	0.38	0.83
North Detention Bioswale	5/15/2015	2/17/2017	1.8	5	13	56	90	1.47	1.07
South Detention Bioswale	9/15/2015	3/2/2018	2.5	17	14	100	96	0.48	0.68
Upper Lot Media Filter	10/28/2016	3/2/2018	1.3	8	2	62	27	0.31	0.79
Vegetated Channel	11/30/2012	3/7/2016	3.3	2	12	120	75	0.75	0.52

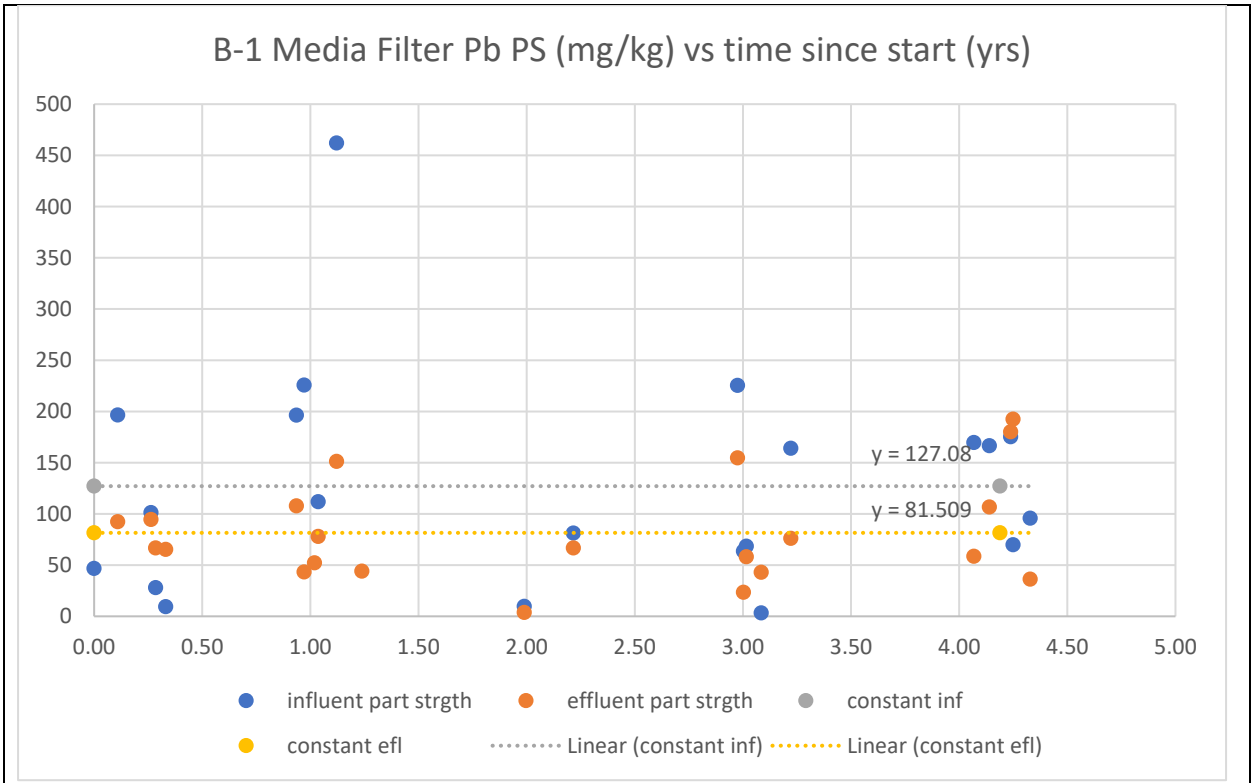
Control practice	influent regression F	effluent regression F	influent adjusted R^2	effluent adjusted R^2	influent slope P	effluent slope P	influent slope coefficient*	effluent slope coefficient*
B-1 Media Filter	0.94	0.35	n/a	n/a	0.94	0.38	n/s	n/s
CM-1	0.021	0.81	0.11	n/a	0.021	0.81	-37.4	n/s
CM-8	0.71	0.09	n/a	0.22	0.71	0.094	n/s	n/s
CM-9	0.16	0.83	0.03	n/a	0.16	0.83	n/s	n/s
ELV Treatment Train	0.11	0.44	0.15	n/a	0.11	0.44	n/s	n/s
Lower Lot Biofilter	0.20	0.76	0.03	n/a	0.20	0.76	n/s	n/s
North Detention Bioswale	0.22	0.007	0.12	0.40	0.20	0.006	n/s	106
South Detention Bioswale	0.22	0.0066	0.12	0.40	0.20	0.006	n/s	106
Upper Lot Media Filter	0.29	n/a	0.05	n/a	0.28	n/a	n/s	n/a
Vegetated Channel	n/a	0.99	n/a	n/a	n/a	0.99	n/a	n/s

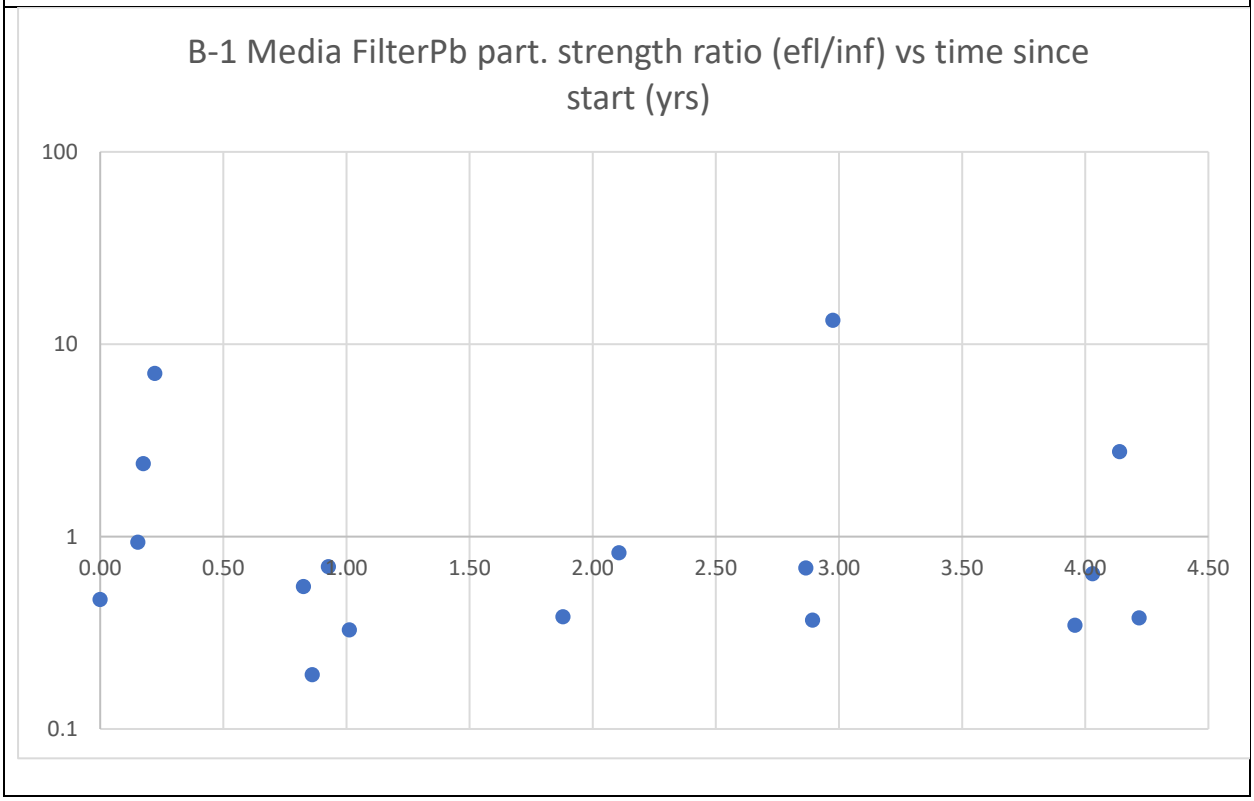
*mg/kg/year slope units

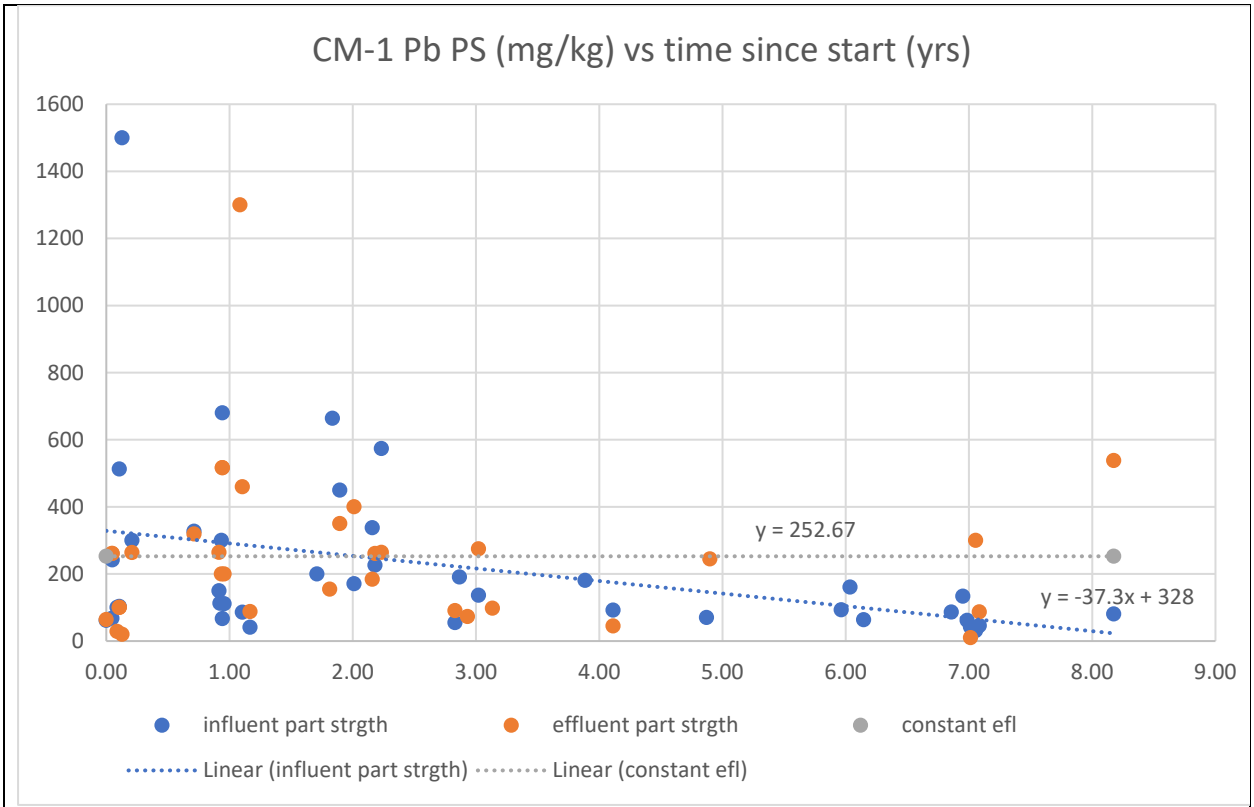
Lead (cont.)

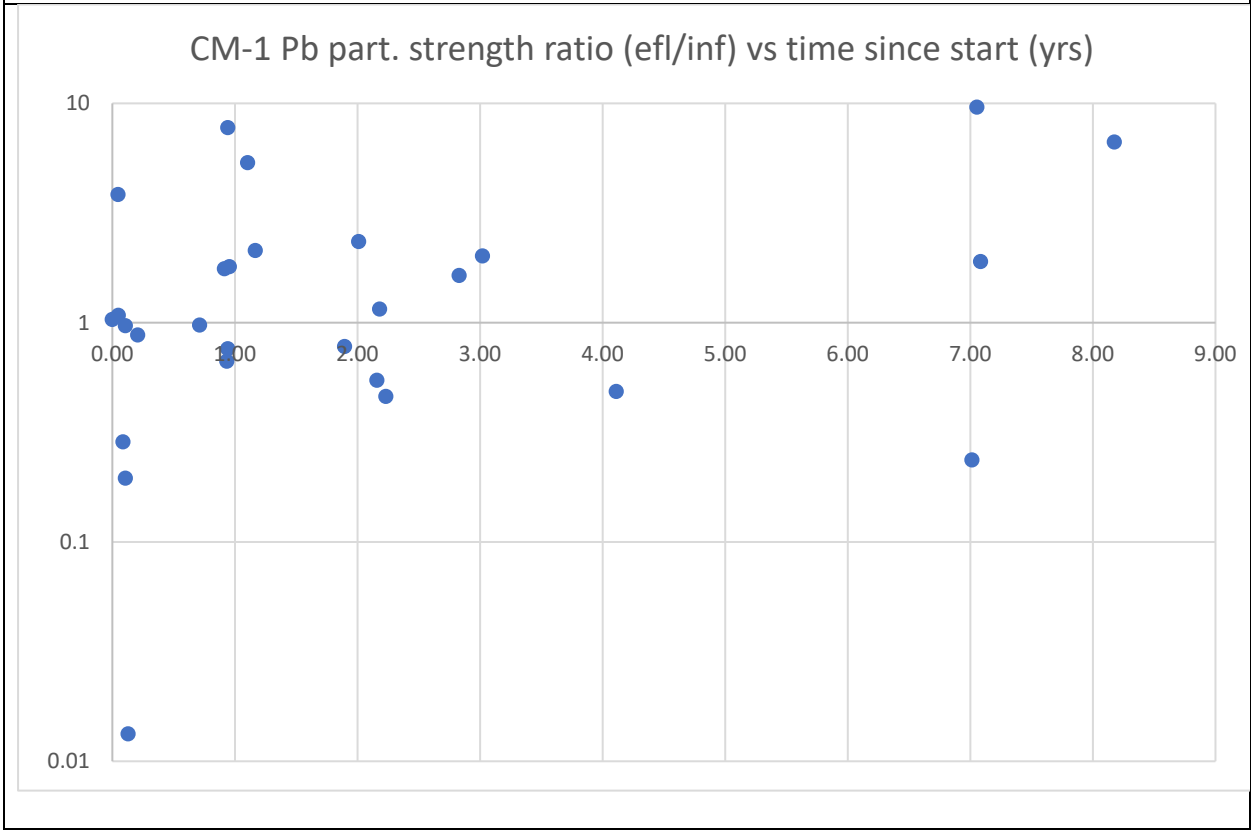
Control practice	comments
B-1 Media Filter	no obvious breakthrough, no apparent slopes, and parallel trend lines (constant values)
CM-1	Sign decreasing inf slope; constant efl value; early values are higher, but not sign trends
CM-8	no obvious breakthrough, no apparent slopes, and parallel trend lines (constant values)
CM-9	no obvious breakthrough, no apparent slopes, and parallel trend lines (constant values)
ELV Treatment Train	Inf regression not sign; efl constant value
Lower Lot Biofilter	no obvious breakthrough, no apparent slopes, and parallel trend lines (constant values)
North Detention Bioswale	Inf regression not sign; efl sign regression with increasing values
South Detention Bioswale	no obvious breakthrough, no apparent slopes, and parallel trend lines (constant values)
Upper Lot Media Filter	Constant inf value; too few efl values for analyses
Vegetated Channel	Too few inf values to analyze; constant efl values

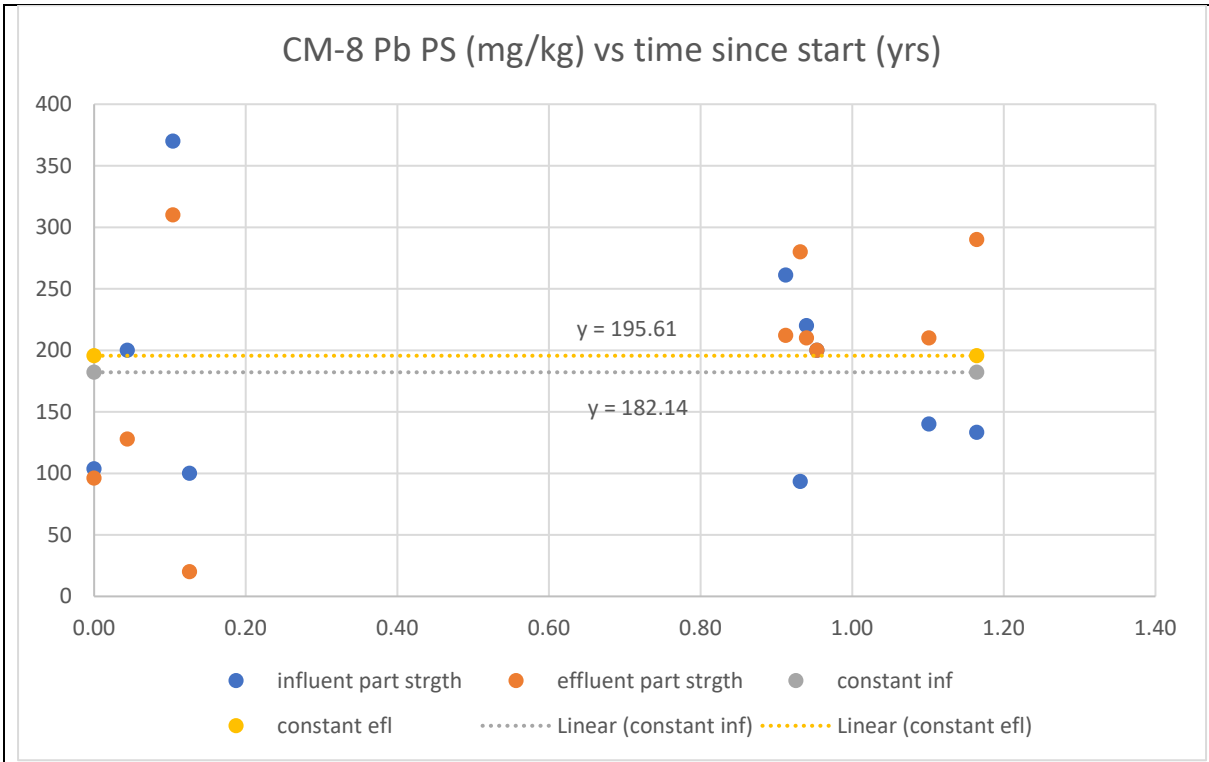
Lead Pollutant Strength Trends with Time. Regression equations only shown for significant influent or effluent trends (p<0.05). mg/kg/year trend units.

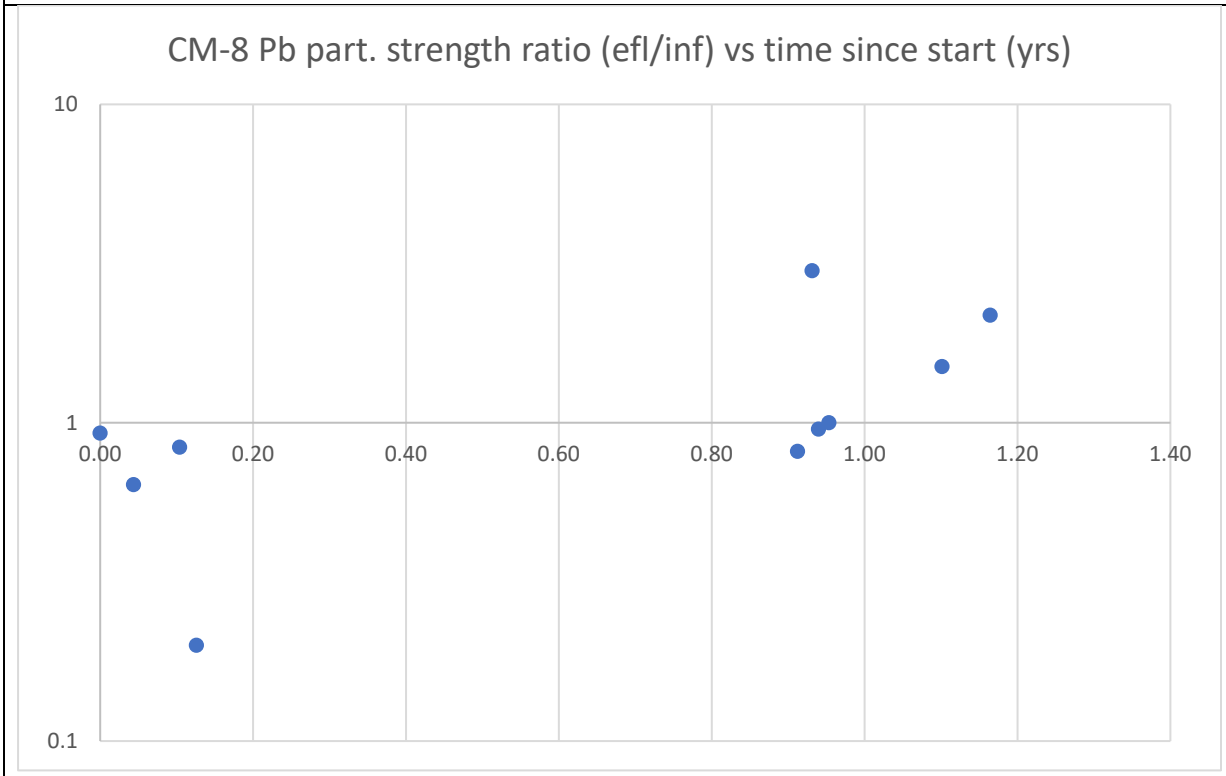


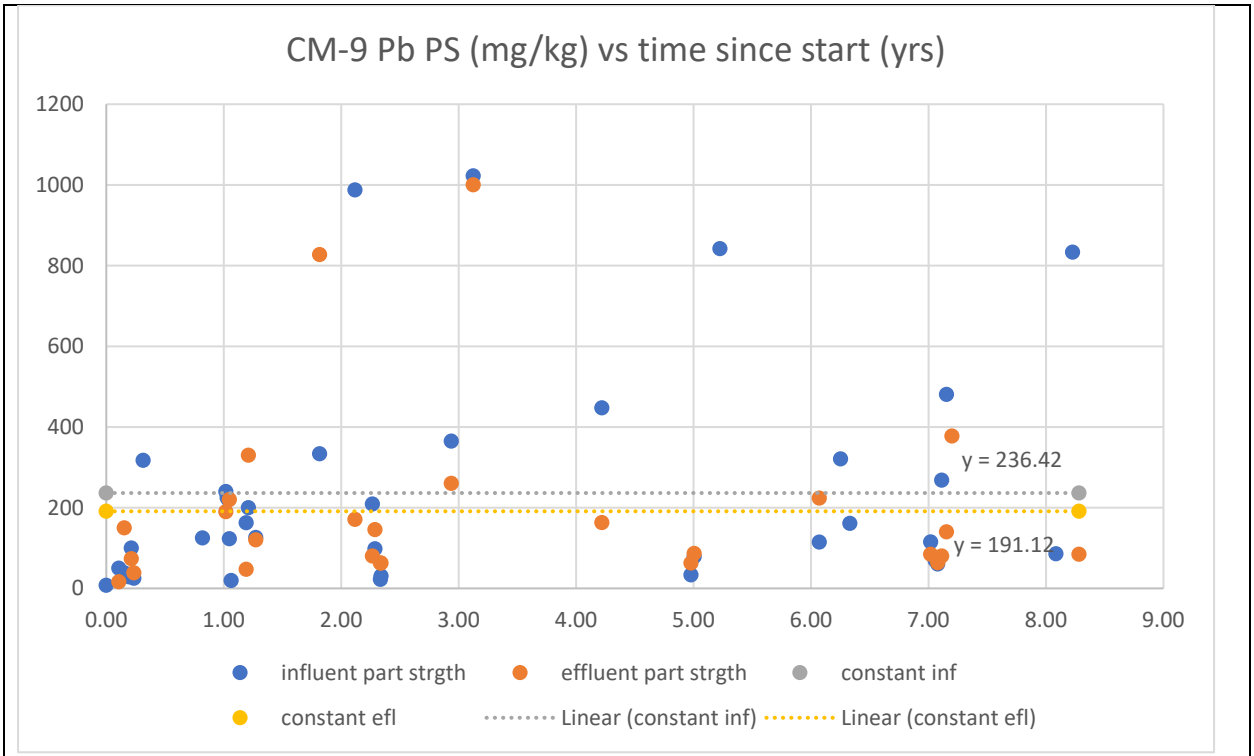


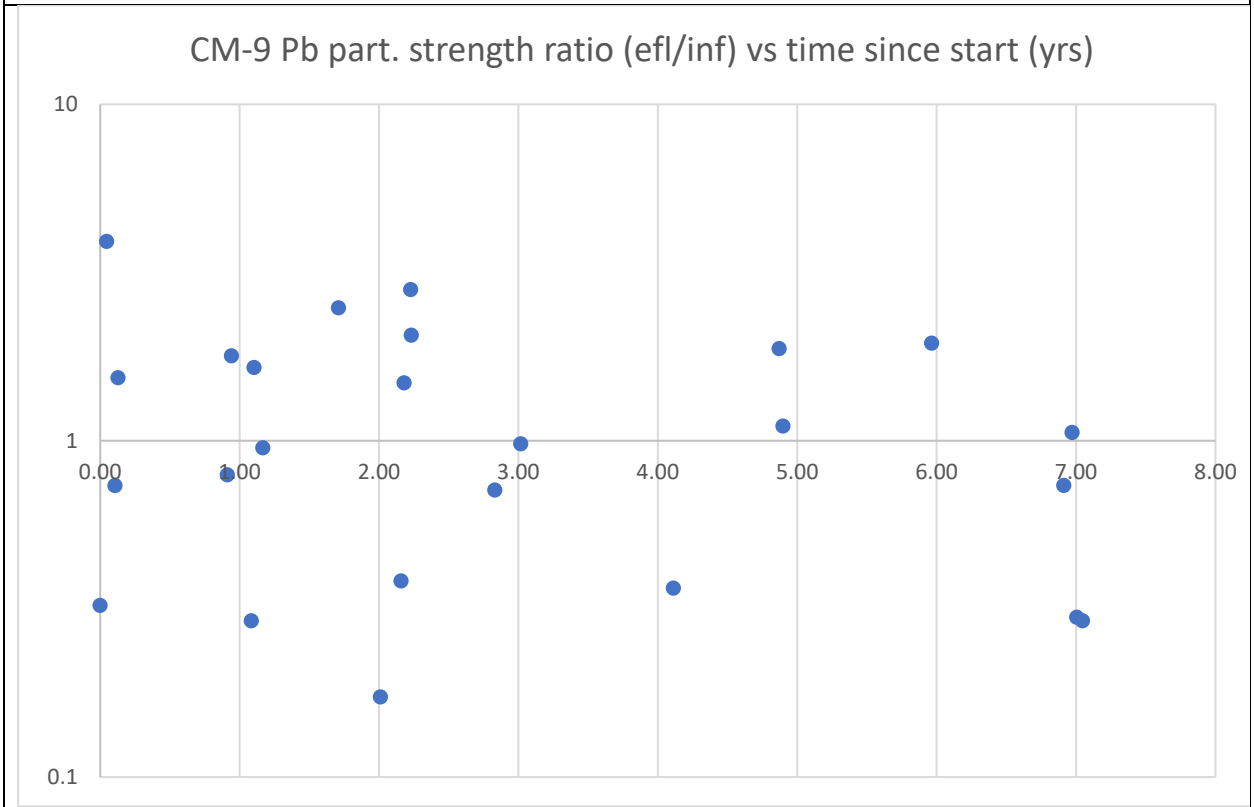

CM-1 Pb PS (mg/kg) vs time since start (yrs)
1600
1400
1200
1000
800
600
400
200
0
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
y = 252.67
y = -37.3x + 328
influent part strgth
effluent part strgth
constant efl
Linear (influent part strgth)
Linear (constant efl)

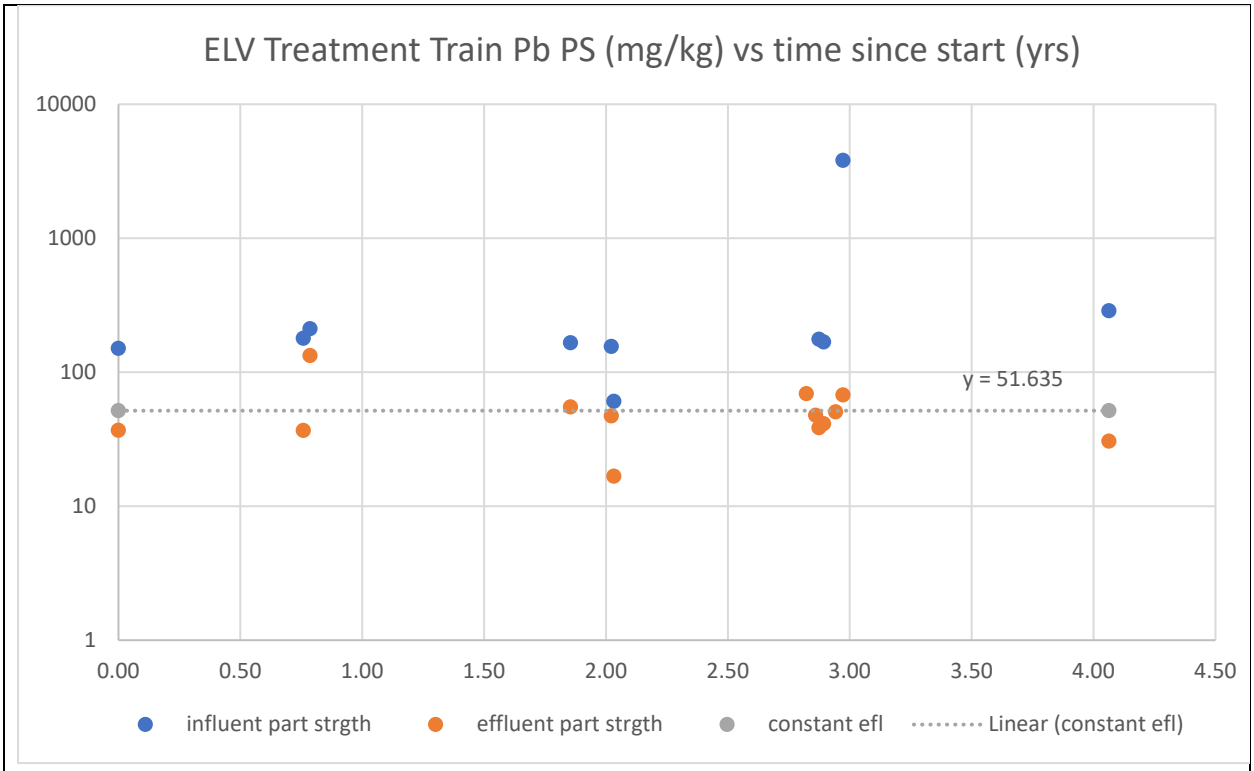

CM-1 Pb part. strength ratio (efl/inf) vs time since start (yrs)
10
1
0.1
0.01
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00

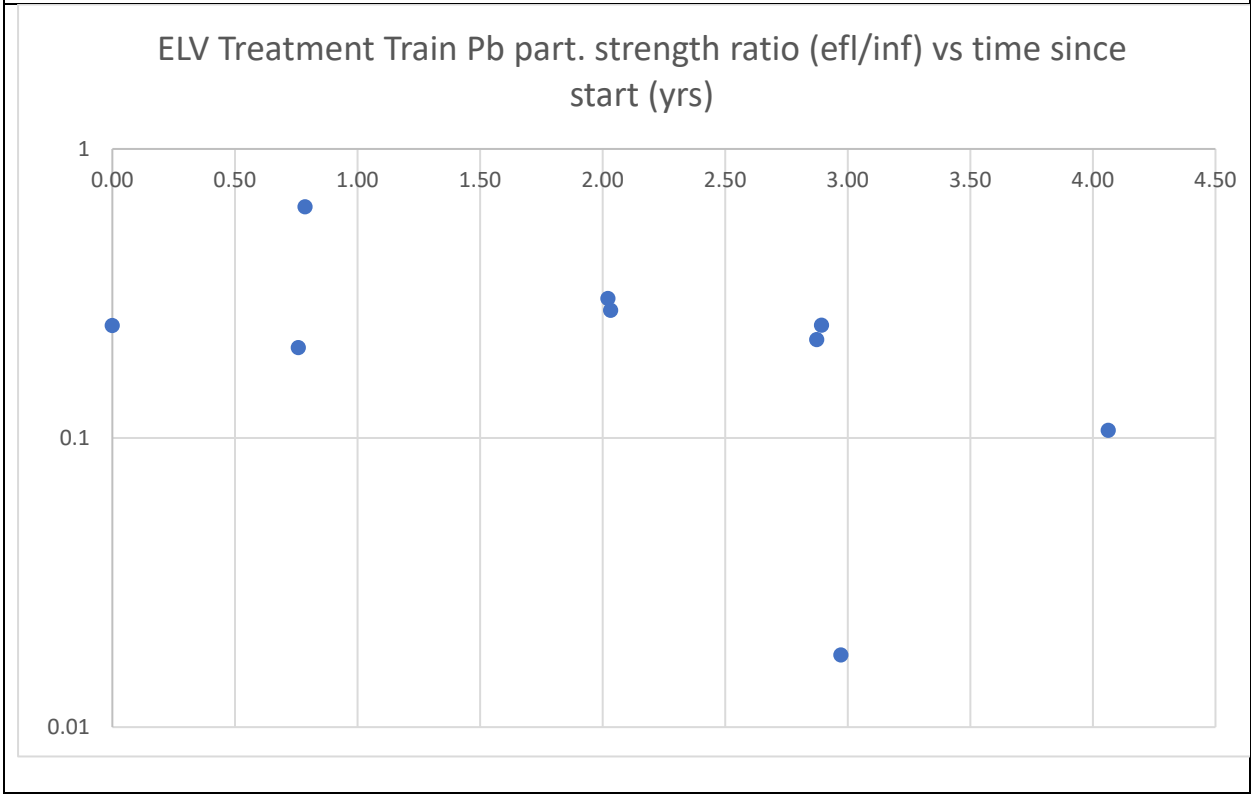

CM-8 Pb PS (mg/kg) vs time since start (yrs)
400
350
300
250
200
150
100
50
0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
y = 195.61
y = 182.14
influent part strgth
effluent part strgth
constant inf
constant efl
Linear (constant inf)
Linear (constant efl)

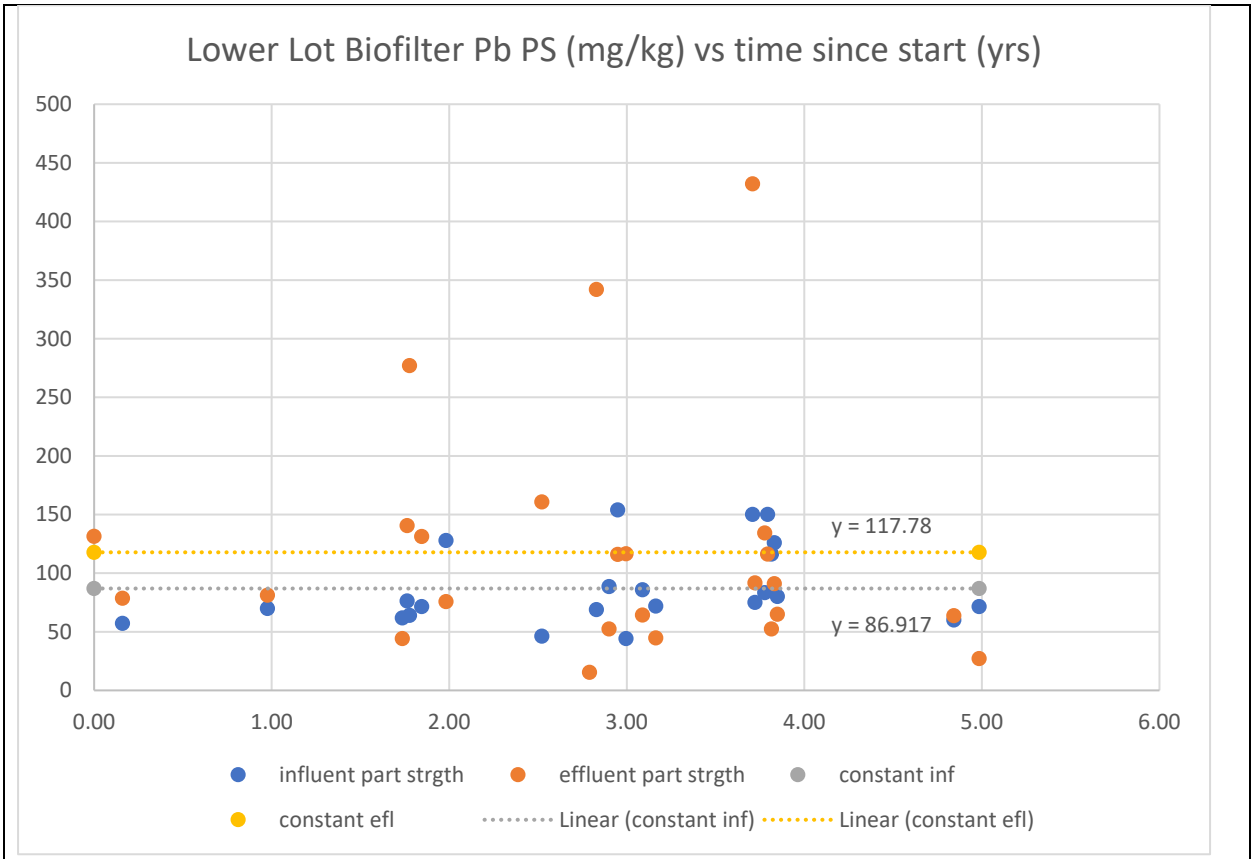

CM-8 Pb part. strength ratio (efl/inf) vs time since start (yrs)
10
1
0.1
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40

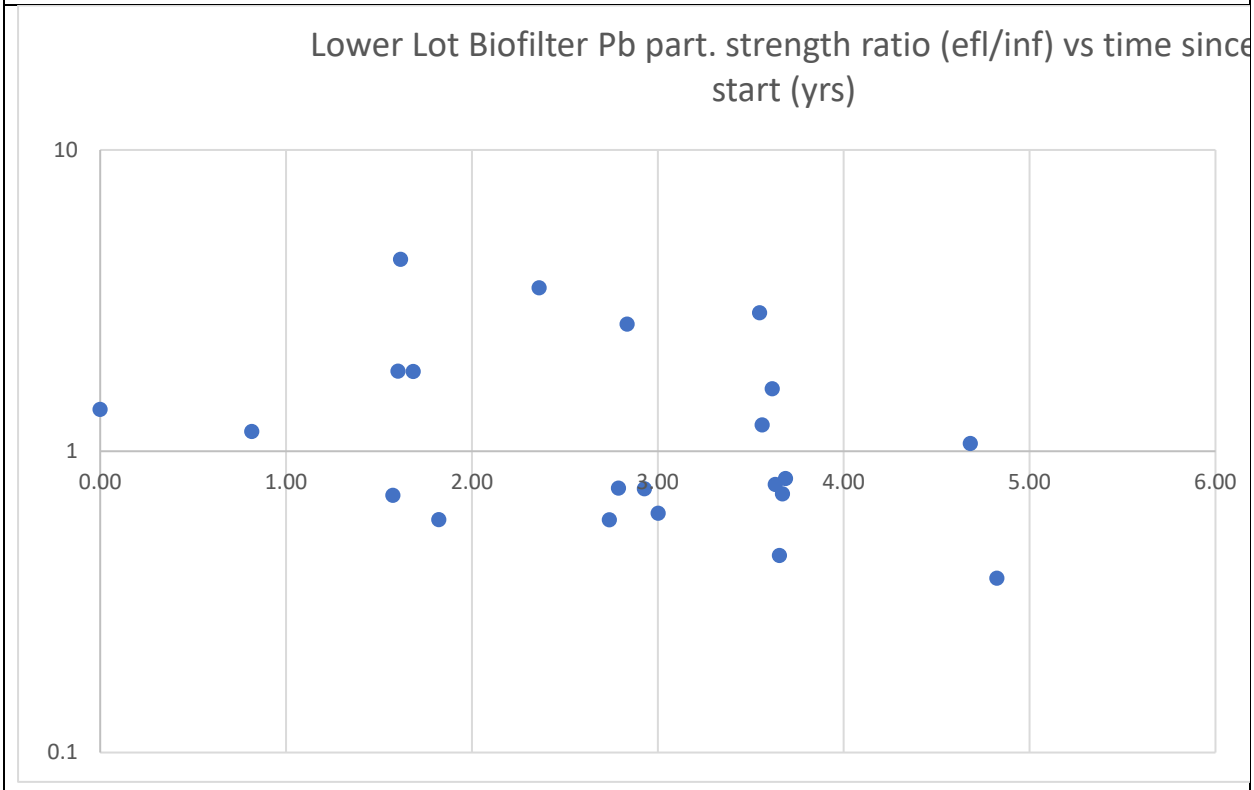

CM-9 Pb PS (mg/kg) vs time since start (yrs)
1200
1000
800
600
400
200
0
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
y = 236.42
y = 191.12
influent part strgth
effluent part strgth
constant inf
constant efl
Linear (constant inf)
Linear (constant efl)

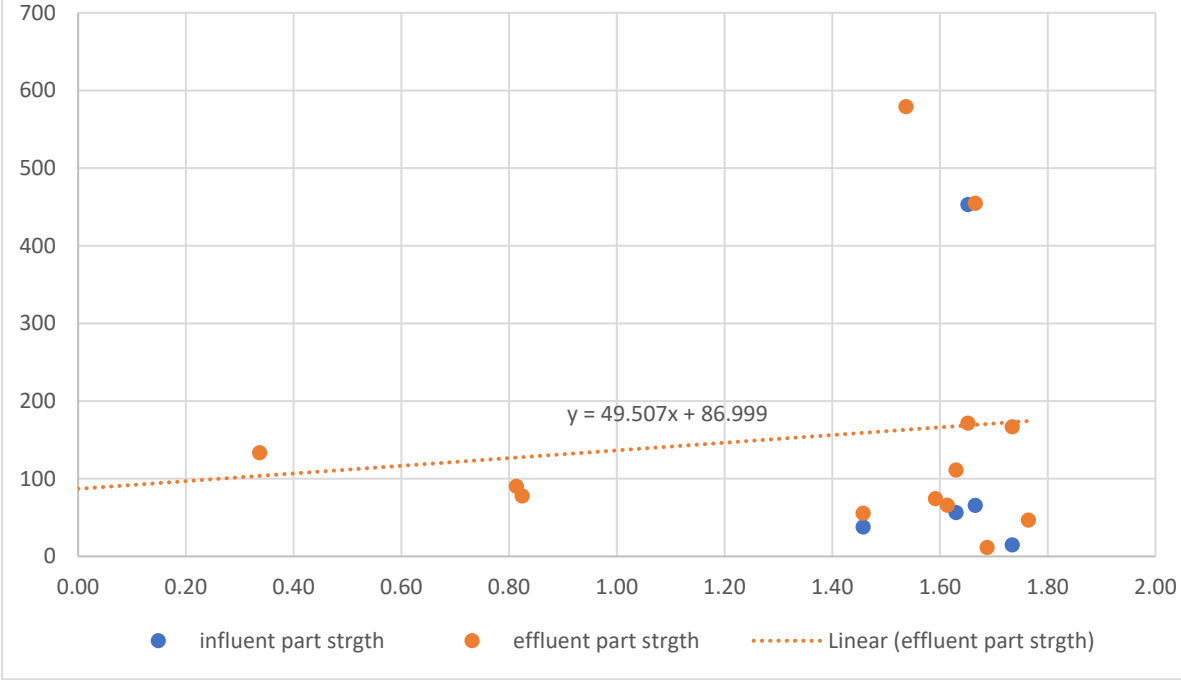

CM-9 Pb part. strength ratio (efl/inf) vs time since start (yrs)
10
1
0.1
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00

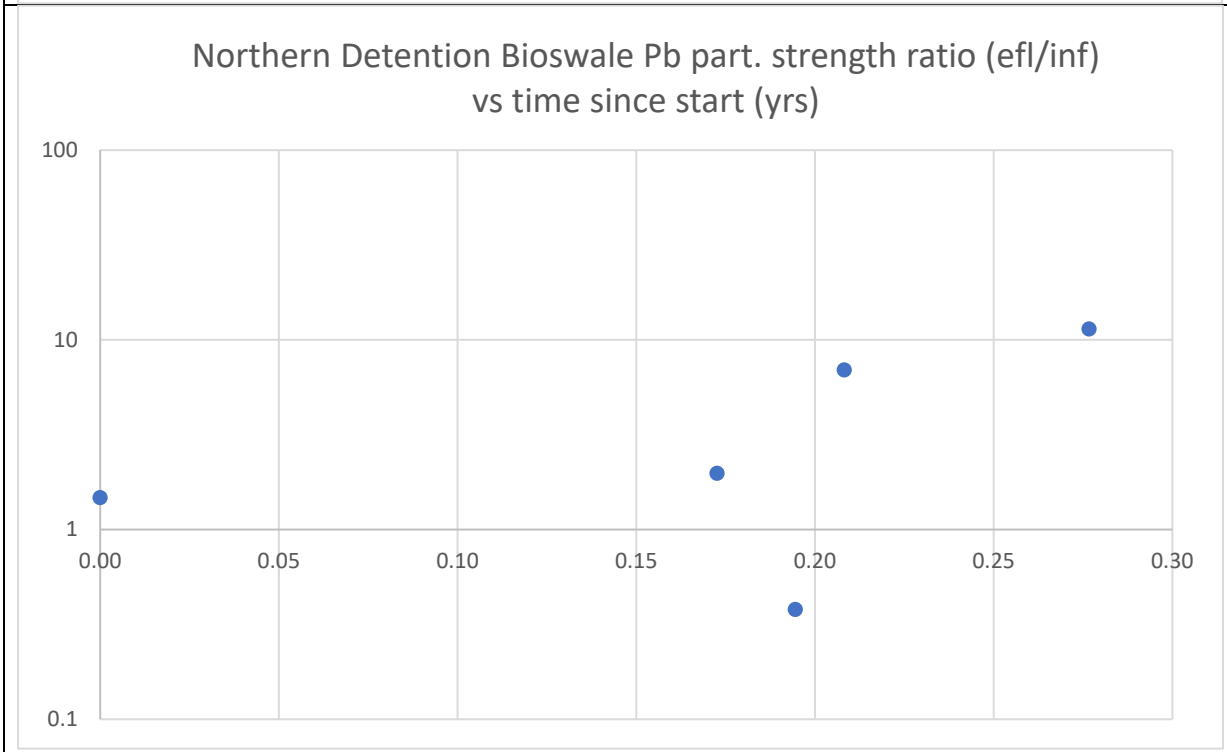

ELV Treatment Train Pb PS (mg/kg) vs time since start (yrs)
10000
1000
100
10
1
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
y = 51.635
influent part strgth
effluent part strgth
constant efl
Linear (constant efl)

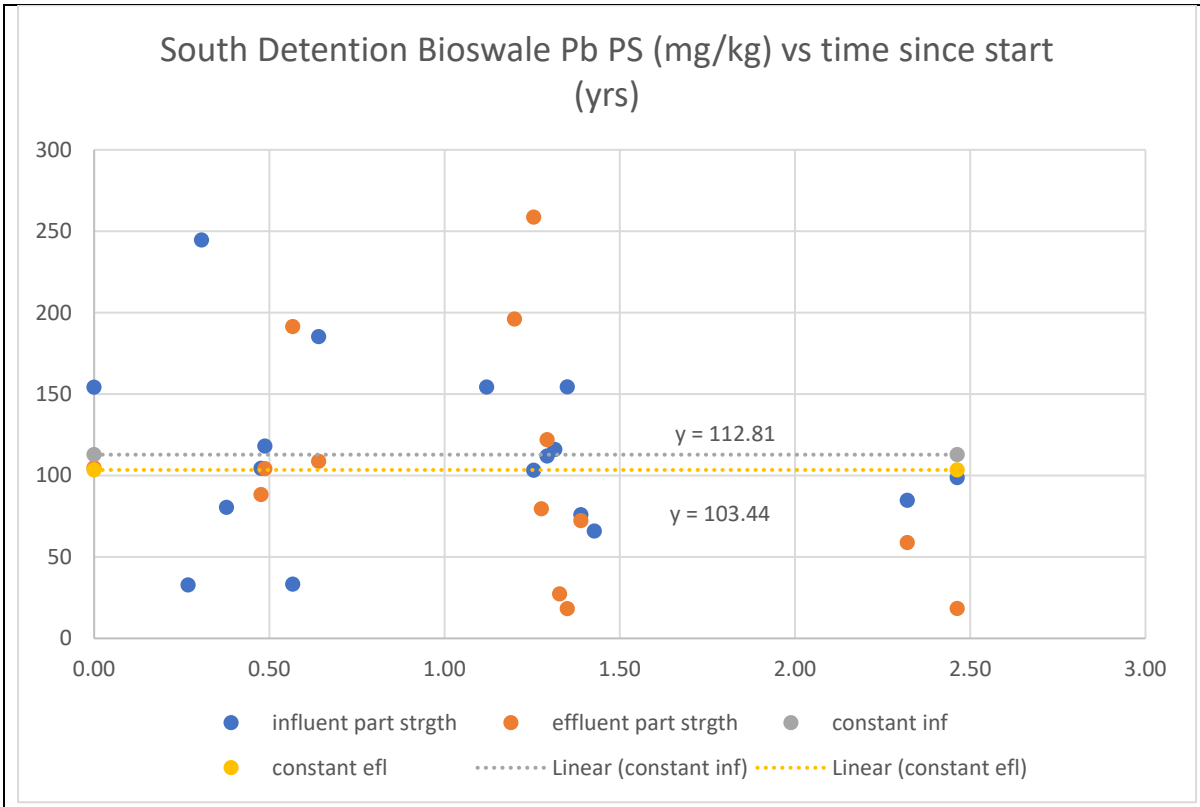

ELV Treatment Train Pb part. strength ratio (efl/inf) vs time since start (yrs)
1
0.1
0.01
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50

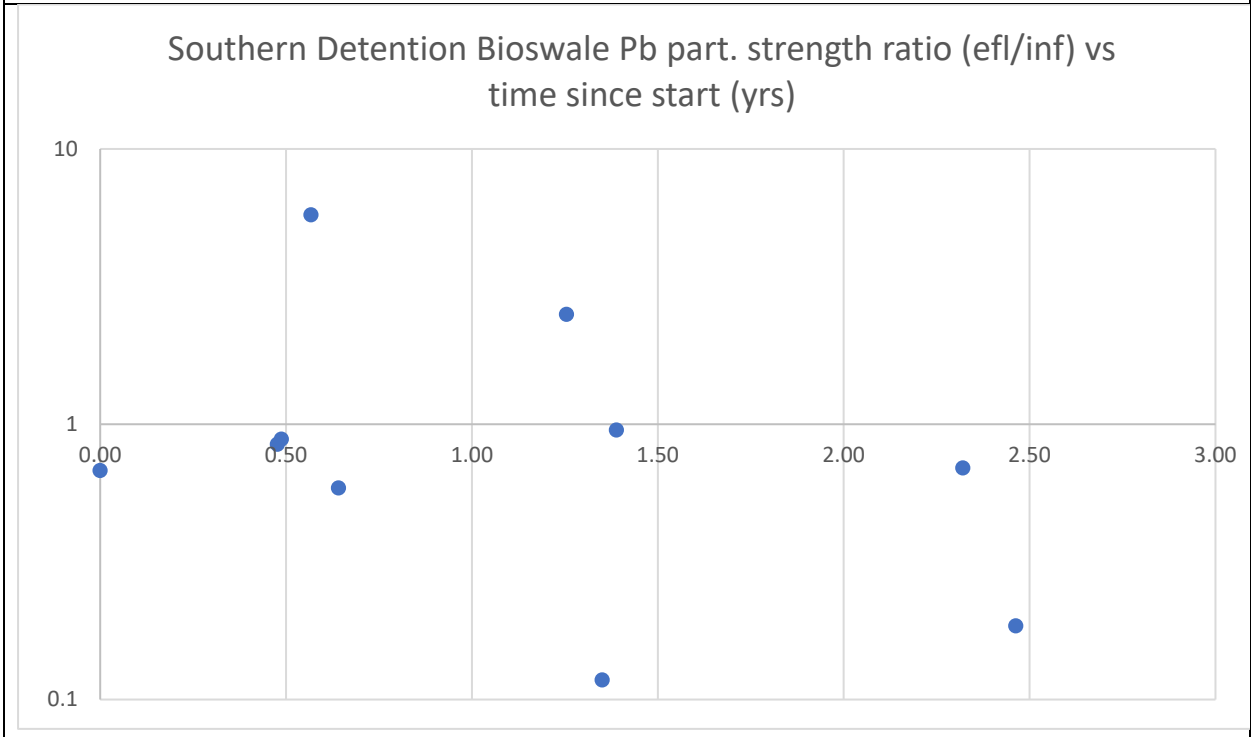

Lower Lot Biofilter Pb PS (mg/kg) vs time since start (yrs)
500
450
400
350
300
250
200
150
100
50
0
0.00
1.00
2.00
3.00
4.00
5.00
6.00
y = 117.78
y = 86.917
influent part strgth
effluent part strgth
constant inf
constant efl
Linear (constant inf)
Linear (constant efl)

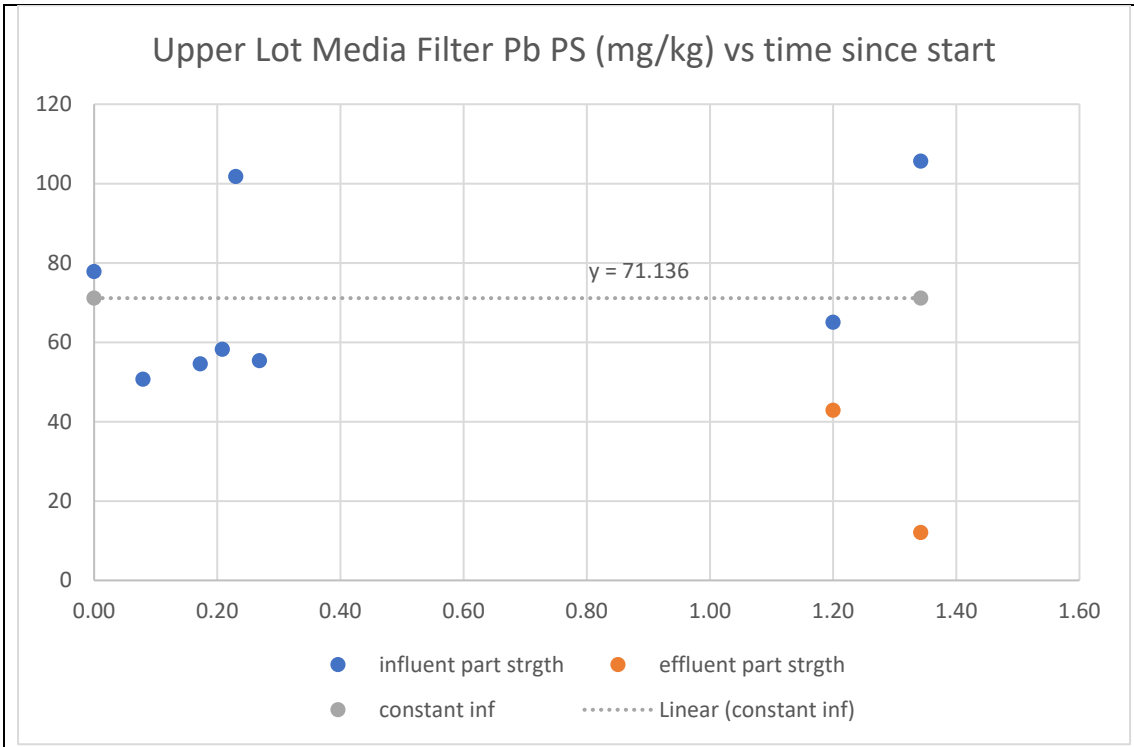

Lower Lot Biofilter Pb part. strength ratio (efl/inf) vs time since start (yrs)
10
1
0.1
0.00
1.00
2.00
3.00
4.00
5.00
6.00

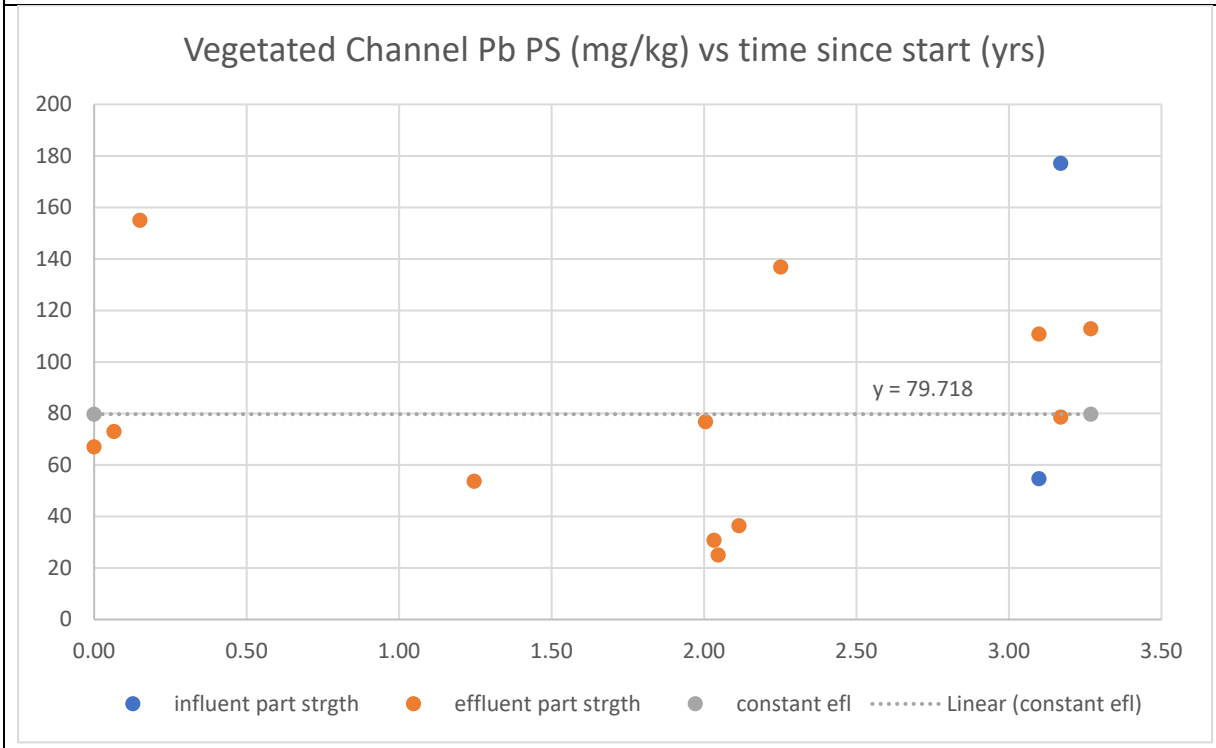

Northern Detention Bioswale Pb PS (mg/kg) vs time since start (yrs)
700
600
500
400
300
200
100
0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
1.80
2.00
y = 49.507x + 86.999
influent part strgth
effluent part strgth
Linear (effluent part strgth)


Northern Detention Bioswale Pb part. strength ratio (efl/inf) vs time since start (yrs)
100
10
1
0.1
0.00
0.05
0.10
0.15
0.20
0.25
0.30


South Detention Bioswale Pb PS (mg/kg) vs time since start (yrs)
300
250
200
150
100
50
0
0.00
0.50
1.00
1.50
2.00
2.50
3.00
y = 112.81
y = 103.44
influent part strgth
effluent part strgth
constant inf
constant efl
Linear (constant inf)
Linear (constant efl)


Southern Detention Bioswale Pb part. strength ratio (efl/inf) vs time since start (yrs)
10
1
0.1
0.00
0.50
1.00
1.50
2.00
2.50
3.00


Upper Lot Media Filter Pb PS (mg/kg) vs time since start
120
100
80
60
40
20
0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
y = 71.136
influent part strgth
effluent part strgth
constant inf
Linear (constant inf)


Vegetated Channel Pb PS (mg/kg) vs time since start (yrs)
200
180
160
140
120
100
80
60
40
20
0
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
y = 79.718
influent part strgth
effluent part strgth
constant efl
Linear (constant efl)

Cadmium (mg/kg)

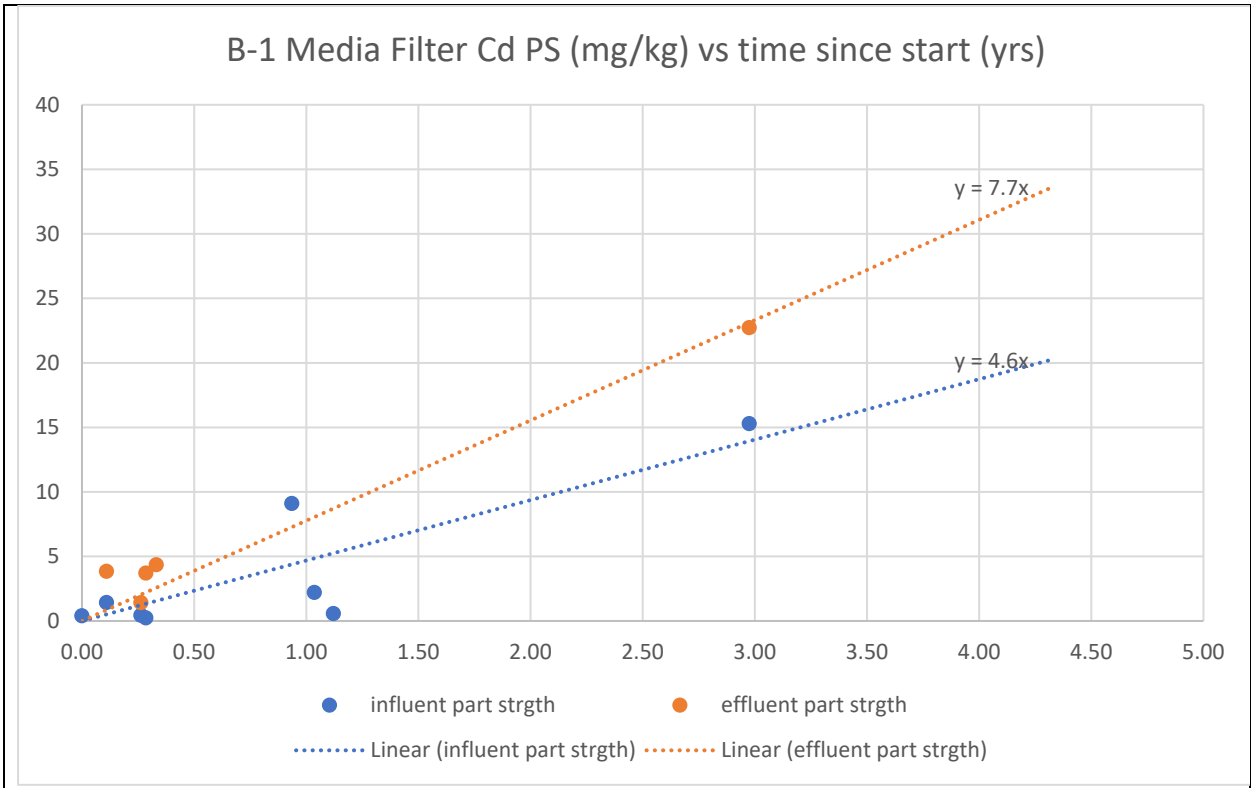
Control practice	start of monitoring period	end of monitoring period	monitoring duration (yrs)	influent sample count	effluent sample count	influent median (mg/kg)	effluent median (mg/kg)	influent COV	effluent COV
B-1 Media Filter	12/12/2011	2/18/2016	4.2	8	5	1.0	3.9	1.49	1.21
CM-1	1/19/2010	3/22/2018	8.2	6	2	2.7	19.1	0.88	0.52
CM-9	12/11/2009	3/22/2018	8.3	24	19	10.6	7.1	1.88	2.13
Lower Lot Biofilter	3/8/2013	3/2/2018	5.0	5	1	2.6	n/a	0.54	n/a
South Detention Bioswale	9/15/2015	3/2/2018	2.5	17	1	10.0	n/a	0.43	n/a

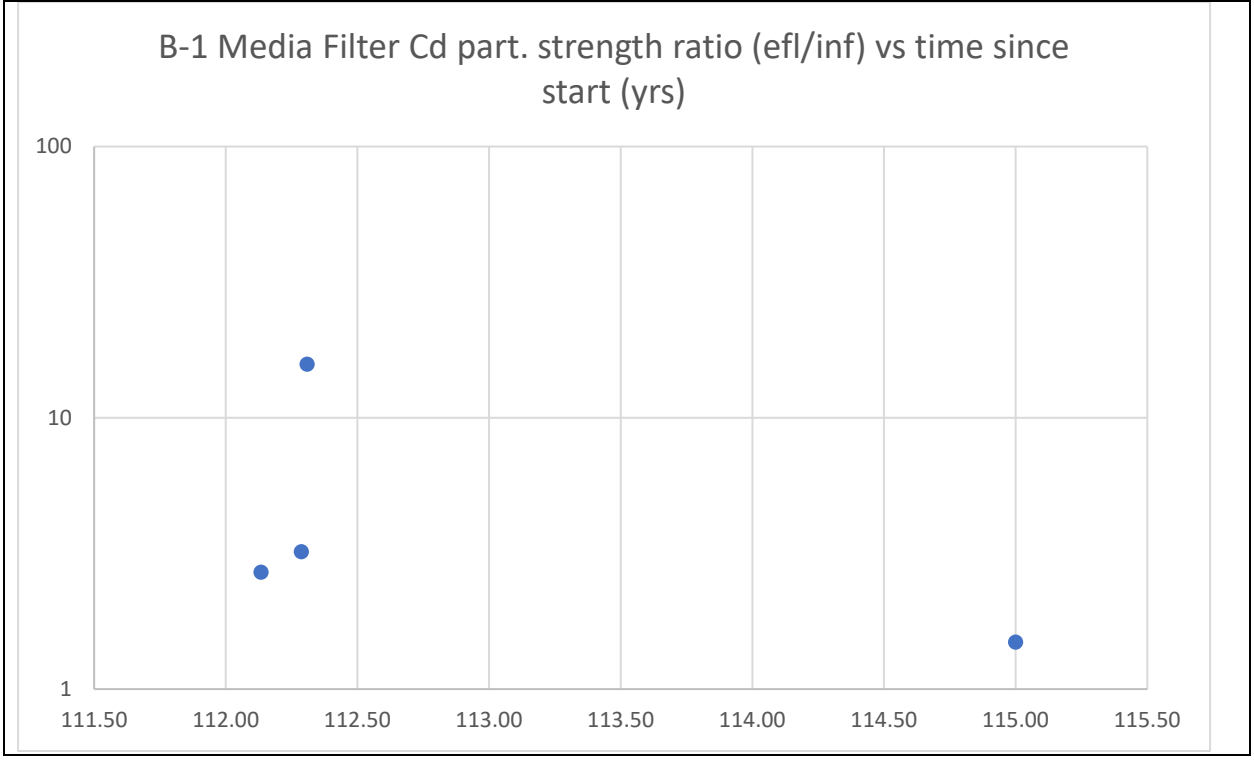
Control practice	influent regression F	effluent regression F	influent adjusted R^2	effluent adjusted R^2	influent slope P	effluent slope P	influent slope coefficient*	effluent slope coefficient*
B-1 Media Filter	0.0012	0.0012	0.68	0.72	0.00067	0.00026	4.7	7.8
CM-1	0.0013	n/a	0.93	n/a	0.0013	n/a	-3.8	n/a
CM-9	0.20	0.22	0.03	0.03	0.20	0.22	n/s	n/s
Lower Lot Biofilter	0.093	n/a	0.35	n/a	0.07	n/a	n/s	n/a
South Detention Bioswale	0.24	n/a	0.03	n/a	0.24	n/a	n/s	n/a

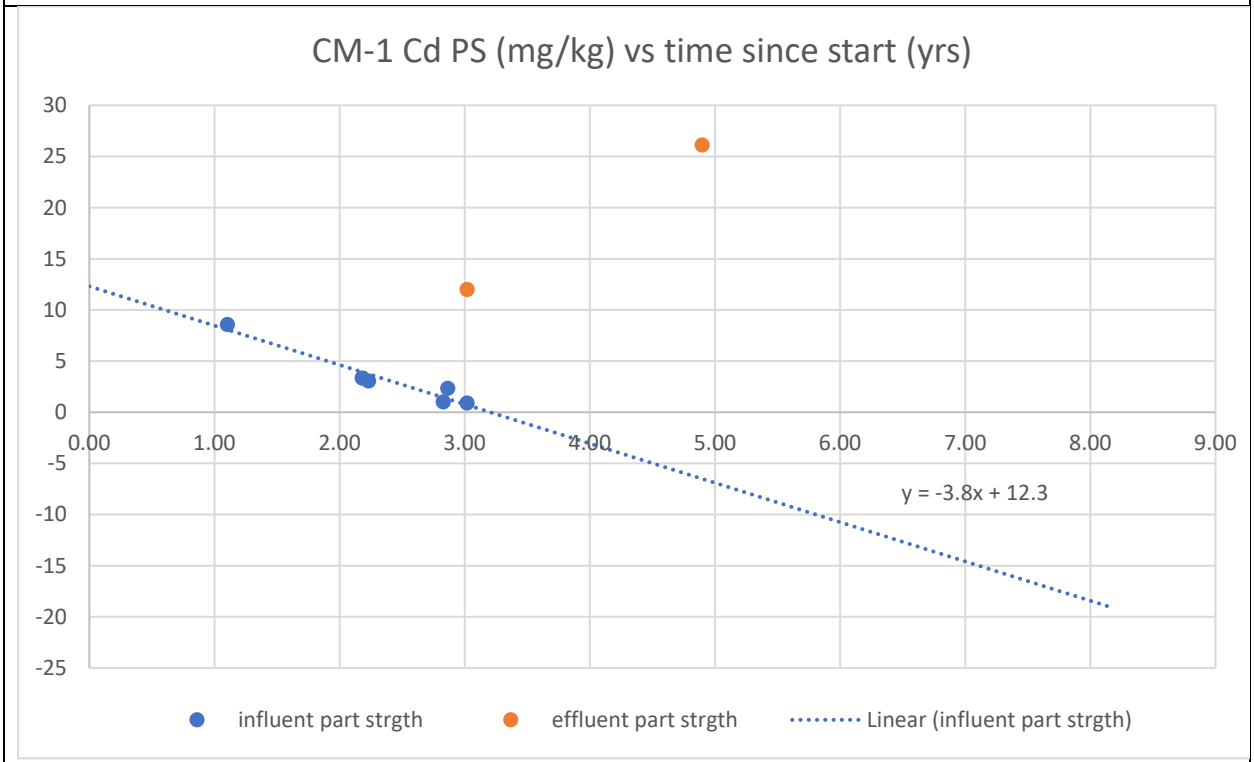
*mg/kg/year slope units

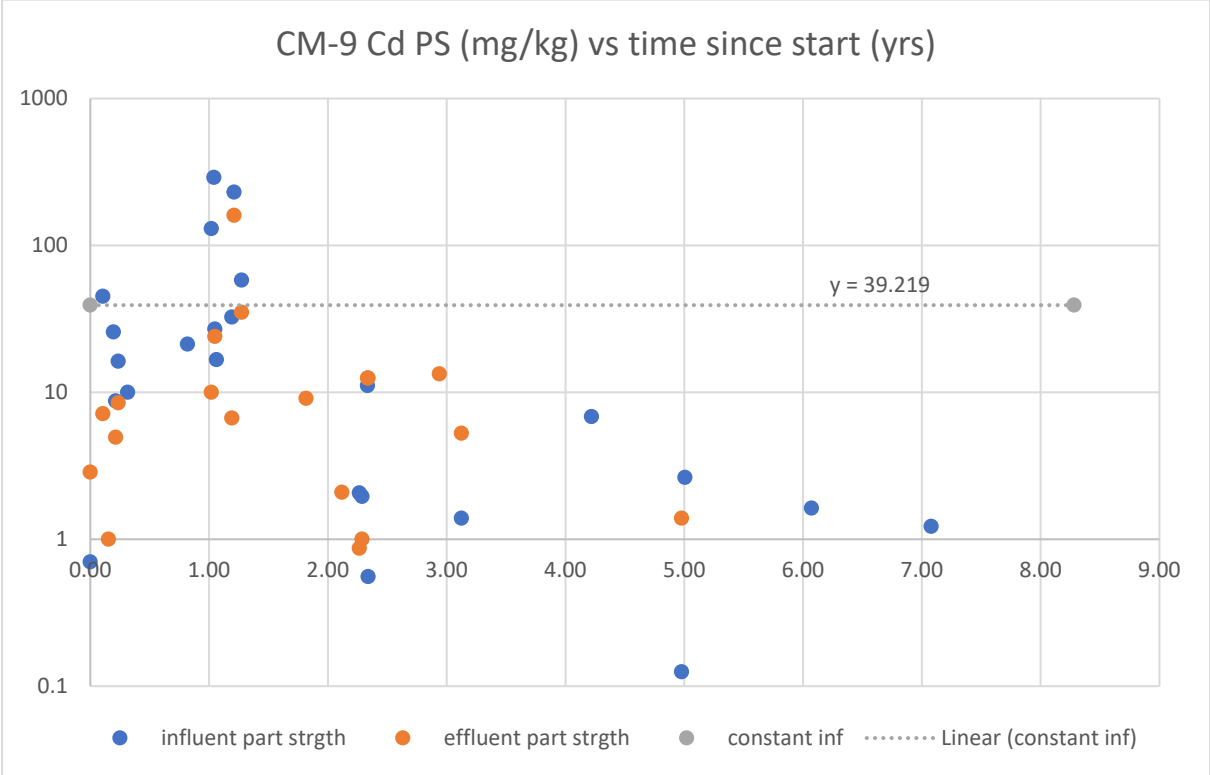
Control practice	comments
B-1 Media Filter	Significant increasing inf and efl trends
CM-1	Significant decreasing inf; too few efl to analyze
CM-9	Constant inf values; no efl regression; apparent decreasing values for both time, but not significant
Lower Lot Biofilter	Inf not sign; too few efl for analyses
South Detention Bioswale	Constant inf values; not enough efl values for analyses

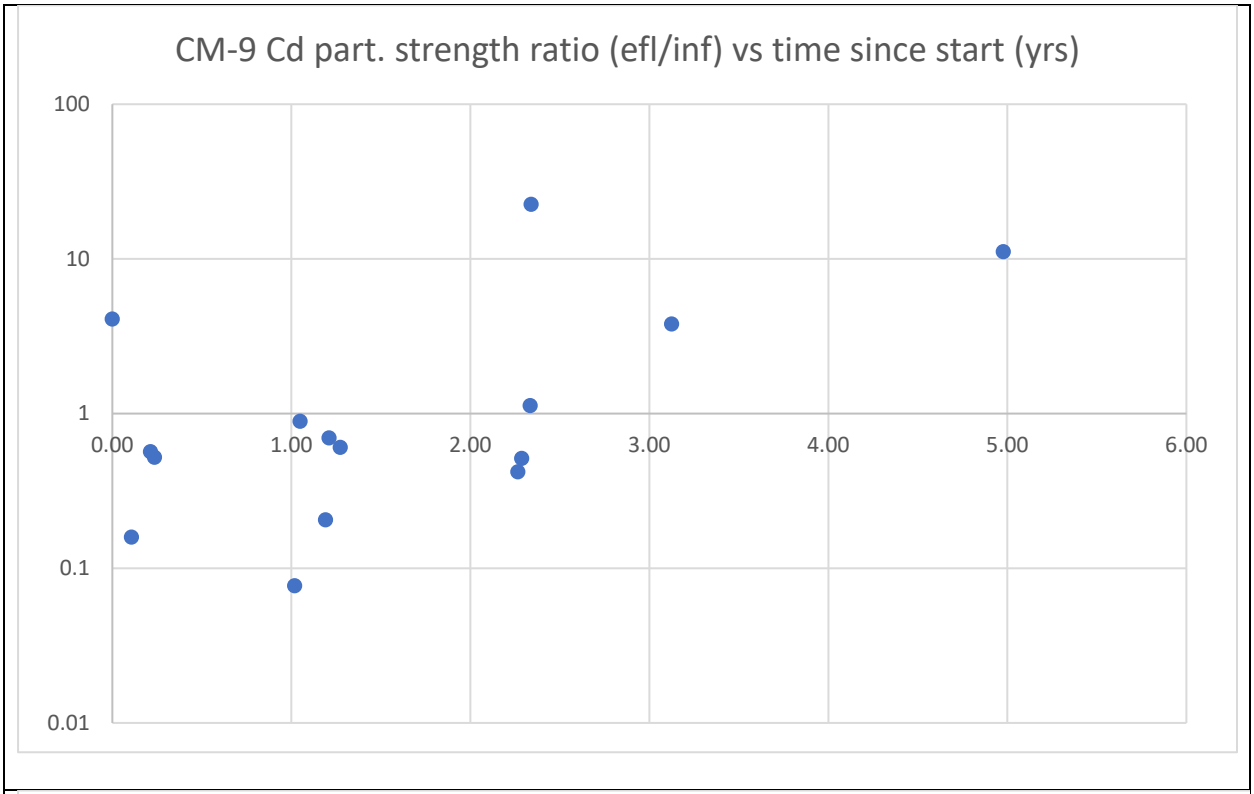
Cadmium Pollutant Strength Trends with Time. Regression equations only shown for significant influent or effluent trends ($p<0.05$). mg/kg/year trend units.

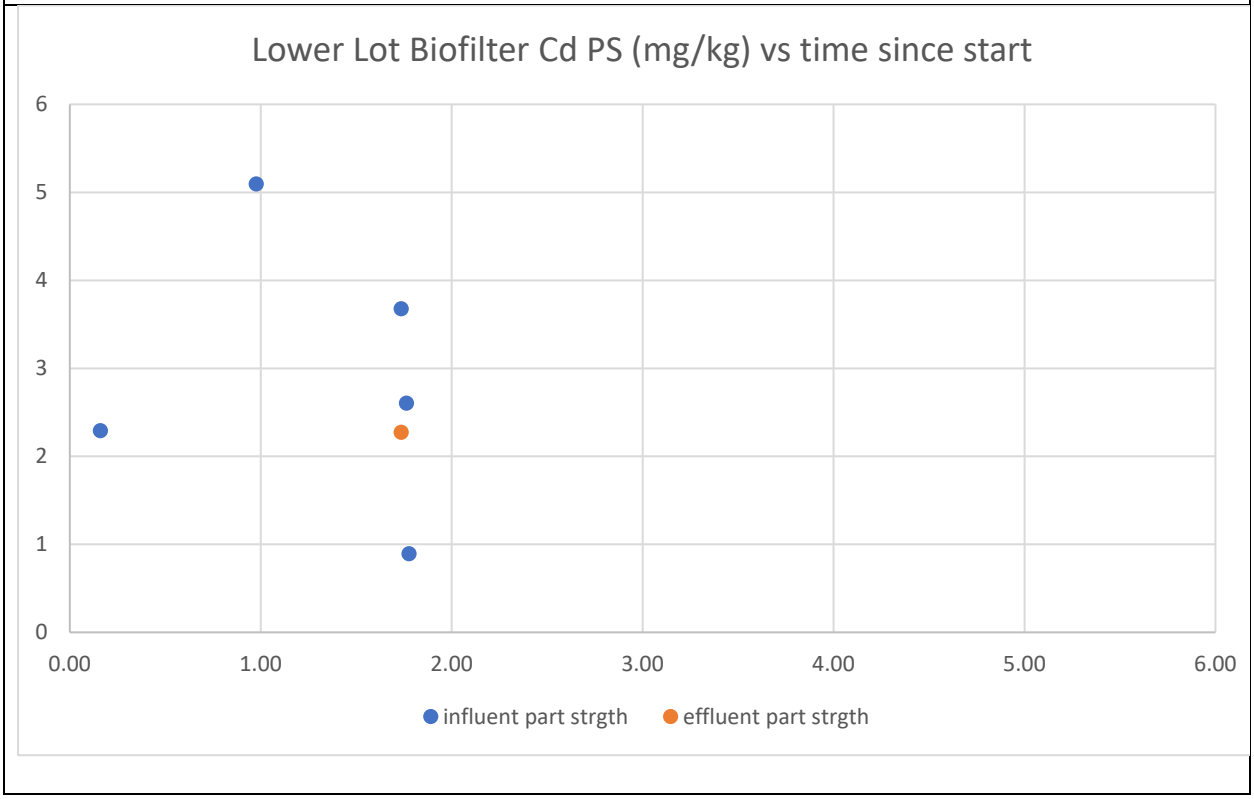


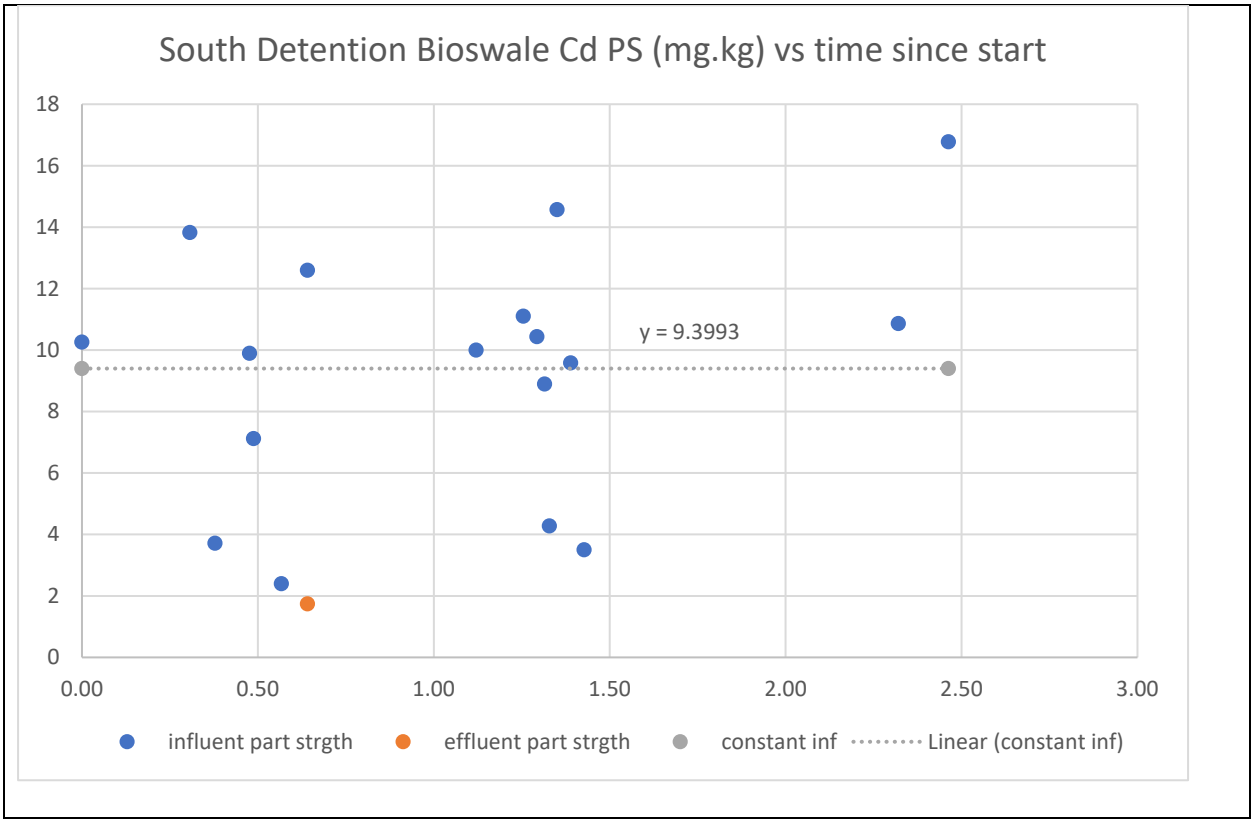



CM-1 Cd PS (mg/kg) vs time since start (yrs)
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
y = -3.8x + 12.3
influent part strgth
effluent part strgth
Linear (influent part strgth)


CM-9 Cd PS (mg/kg) vs time since start (yrs)
1000
100
10
1
0.1
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
y = 39.219
influent part strgth
effluent part strgth
constant inf
Linear (constant inf)


CM-9 Cd part. strength ratio (efl/inf) vs time since start (yrs)
100
10
1
0.1
0.01
0.00
1.00
2.00
3.00
4.00
5.00
6.00


Lower Lot Biofilter Cd PS (mg/kg) vs time since start
6
5
4
3
2
1
0
0.00
1.00
2.00
3.00
4.00
5.00
6.00
influent part strgth
effluent part strgth


South Detention Bioswale Cd PS (mg.kg) vs time since start
18
16
14
12
10
8
6
4
2
0
0.00
0.50
1.00
1.50
2.00
2.50
3.00
y = 9.3993
influent part strgth
effluent part strgth
constant inf
Linear (constant inf)

Mercury (mg/kg)

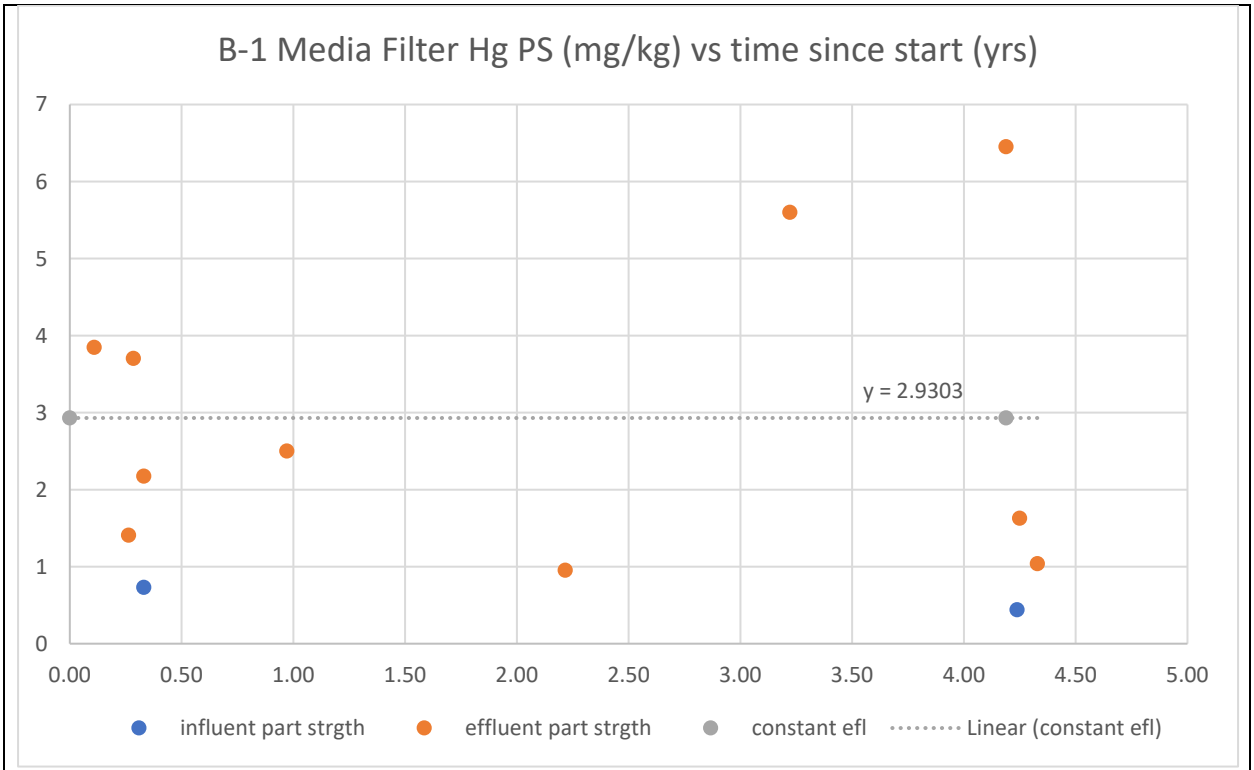
Control practice	start of monitoring period	end of monitoring period	monitoring duration (yrs)	influent sample count	effluent sample count	influent median (mg/kg)	effluent median (mg/kg)	influent COV	effluent COV
B-1 Media Filter	12/12/2011	2/18/2016	4.2	2	10	n/a	2.93	n/a	0.66
CM-9	12/11/2009	3/22/2018	8.3	16	18	10.10	6.25	2.77	2.01

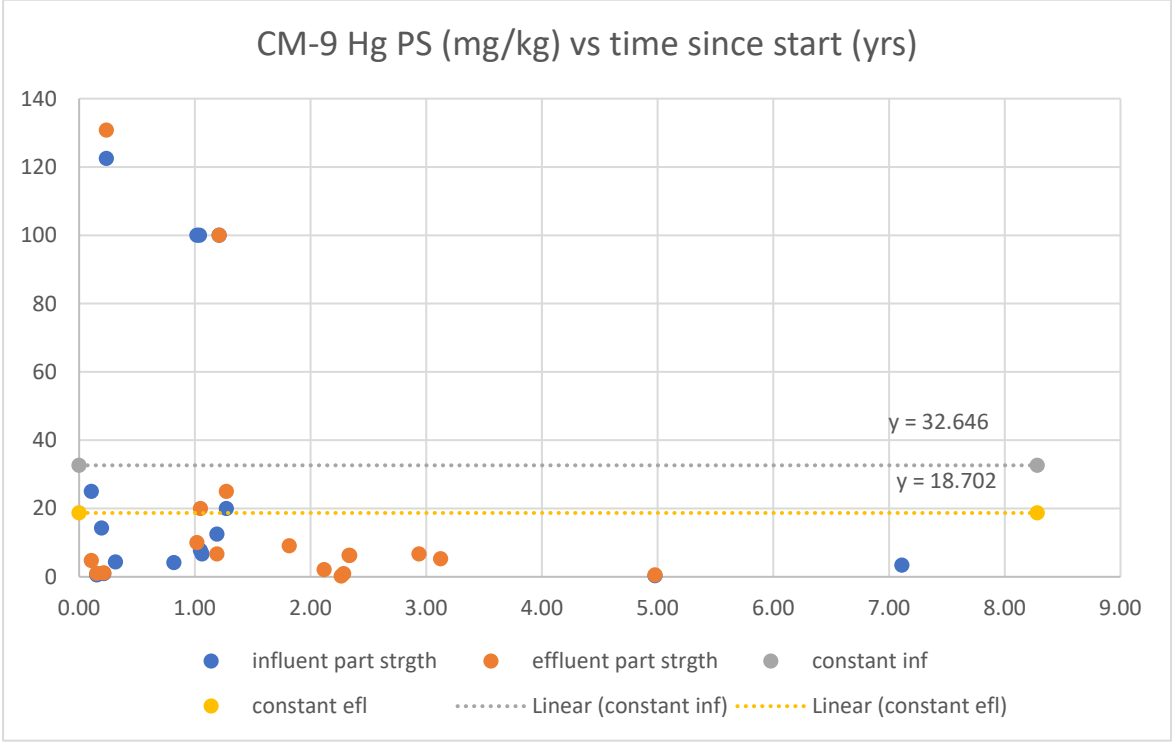
Control practice	influent regression F	effluent regression F	influent adjusted R^2	effluent adjusted R^2	influent slope P	effluent slope P	influent slope coefficient*	effluent slope coefficient*
B-1 Media Filter	n/a	0.70	n/a	n/a	n/a	0.70	n/a	n/a
CM-9	0.43	0.18	n/a	0.06	0.43	0.17	n/s	n/a

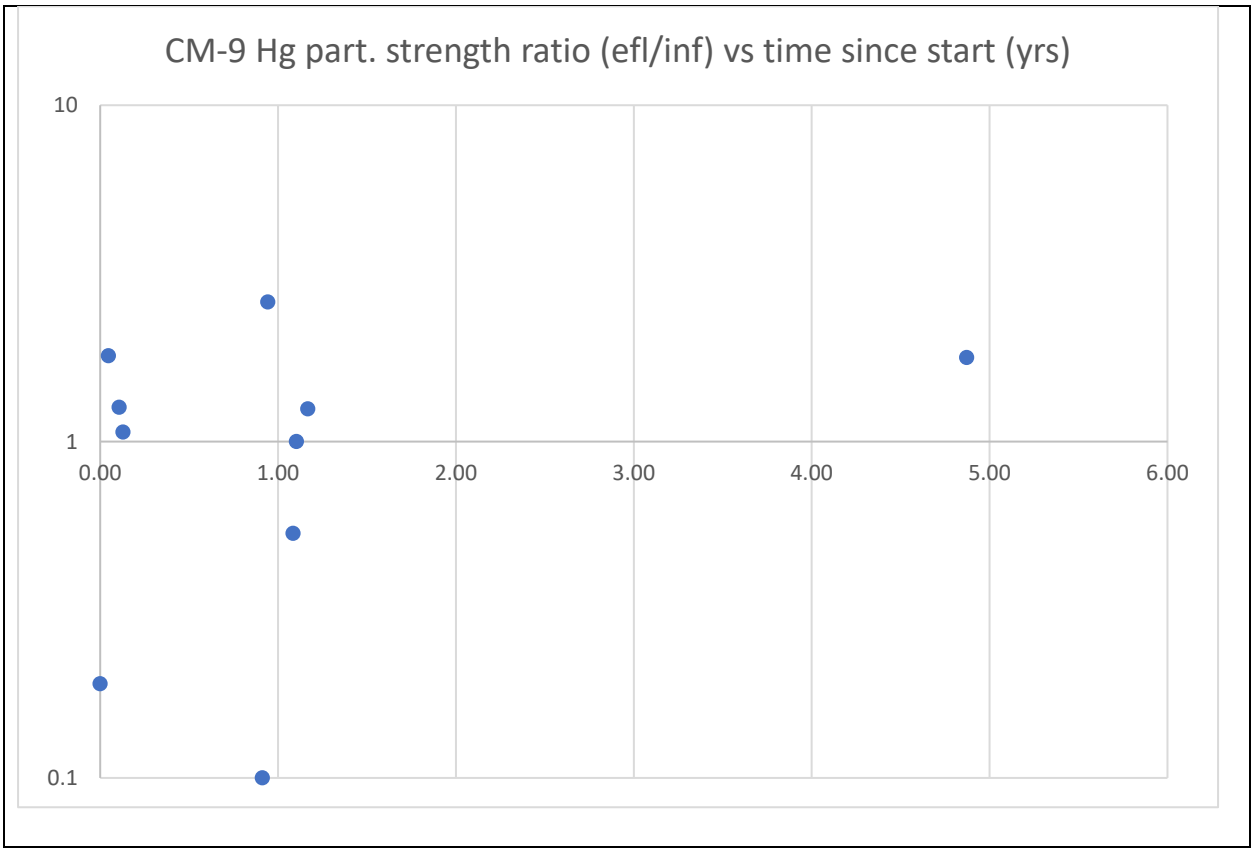
*mg/kg/year slope units

Control practice	comments
B-1 Media Filter	few influent data; constant efl values
CM-9	no obvious breakthrough, no apparent slopes, and parallel trend lines; two large inf and efl early values

Mercury Pollutant Strength Trends with Time. Regression equations only shown for significant influent or effluent trends (p<0.05). mg/kg/year trend units.






CM-9 Hg part. strength ratio (efl/inf) vs time since start (yrs)
10
1
0.1
0.00
1.00
2.00
3.00
4.00
5.00
6.00