APPENDIX H

Background Concentrations for Selected Inorganic Chemicals in Surface Soil

Natural background refers to the concentration of a chemical constituent that occurs naturally in the environment and has not been influenced by localized human activities (Ecology, 1992). For example, inorganic chemicals (metals and metalloids, such as arsenic) occur naturally in bedrock and soils due solely to geological processes that formed these constituents; therefore, the concentrations would be considered natural background. The technical issue is how to characterize the natural background from a sample collection and a statistical perspective.

Available surface soil sample results from various investigations at and near the Poplar Point site have been reviewed to develop an approach for quantifying "natural background" concentrations for selected inorganic chemicals in soil. This was done because the concentrations of several inorganic chemicals measured in soil at the site are above risk-based screening levels in numerous samples. These chemicals include arsenic, cadmium, chromium, lead, nickel and zinc. Because these are naturally-occurring elements, their presence does not necessarily indicate anthropogenic contamination.

In the context of characterizing risk and selecting remedial actions, it is prudent to focus on anthropogenic contamination. It is common practice in this situation to develop remediation goals based on background concentrations, although there are different statistical approaches for comparing site data to background. Two common approaches are to compare site data to the 90th percentile of the background data or to three times the mean concentration of the background data. Both approaches aim to identify remediation goals near the upper end of the range in background concentrations. This reduces the possibility that a significant effort is expended cleaning up areas with chemical concentrations that are slightly above the mean background concentration.

It should be recognized that the approaches used here rely on best professional judgement and statistical reasoning because there is often a gradation between background areas and contaminated areas. Pertinent reference materials, listed at the end of the memo, were reviewed to identify a credible, peer-reviewed approach for determining natural background concentrations. The remainder of this appendix describes the data set used in the evaluation and how these data were divided into "background" and "site" data. Next, statistical procedures for characterizing background are described; and finally, the site data are compared to the background data.

Selection of Sample Locations to Characterize Background

This study focuses on surface soil which, for this evaluation, are those samples any portion of which was collected in the depth range of 0 to 2 feet below ground surface (bgs). Samples used in this evaluation were collected from locations shown on Figure H-1. Samples were collected from several different depth intervals. Many of the samples were collected from 0 to 2 feet bgs, some were 0 to 0.25 feet or 0.25 to 0.5 feet and a few were from 0 to 4 feet bgs. For the Poplar Point site, four areas were selected as background areas: the former U.S. Naval Receiving Station, the former dog training area, the area north of the D.C. Lanham Nursery, and the Howard Road Academy.

Arsenic Discussion

Table H-1 summarizes the 31 background area surface soil samples collected and analyzed for arsenic. Table H-2 summarizes the laboratory results for the surface soil samples collected in non-background or "site" locations. Based on experience at other sites, the range of background concentrations is quite small

and there are no obvious outliers. The mean arsenic concentration of the background samples is 3.1 milligrams per kilogram (mg/kg). A box-and-whiskers plot of the arsenic data is shown in Figure H-2. The left side of Figure H-2 represents the background data and the right side represents the "site" data. The tight vertical grouping on the left side of the plot is an indication of the narrow range of arsenic concentrations in the background samples.

Note that the box-and-whiskers plots for the background and site arsenic data overlap. In other words, many of the site samples have concentrations similar to the background samples. Two approaches that could be used to select an action level based on the evaluation of background samples would be to use the 90^{th} percentile (5.0 mg/kg) or 3 times the mean concentration (9.4 mg/kg). Both approaches are intended to minimize unnecessary clean-ups that might occur if the mean value of the background data were used as a trigger for actions. It should be noted that the 3 times the mean concentration (9.4 mg/kg) exceeds the maximum concentration in the background samples (7.1 mg/kg); therefore, it is probably not a defensible to use the 3 times value from a statistical perspective.

Figure H-1 shows the spatial distribution of arsenic results for the site and background samples. There are elevated arsenic concentrations (exceeding 20 mg/kg, which has been used as an action level for arsenic in D.C.) in the southern and central portions of the AOC area (5 samples) and in the DC Lanham area (12 samples): Wetland 1, near Green Fuel Oil, and near the western and northern road. There is no apparent pattern to the samples with elevated arsenic concentrations that indicates whether the arsenic is associated with a point source or non-point source except that that samples in perimeter areas generally have lower concentrations. The lower concentrations at perimeter locations suggest that arsenic is present in soil because of some site-related activity such as pesticide application or placement of fill materials that contained arsenic.

Cadmium Discussion

Twenty-four surface soil samples were collected from background areas and analyzed for cadmium. Sample results and summary statistics for these samples are shown on Table H-1. The range of cadmium concentrations in the background samples is small and there are three samples defined as outliers or extreme values. The mean cadmium concentration of the background samples is 0.3 mg/kg. Box-and-whiskers plot of the background samples is shown on the left side of Figure H-3. The tight grouping on this plot is an indication of the narrow range of cadmium concentrations in the background samples. The

90th percentile and 3 times mean of the background cadmium samples are 0.4 mg/kg and 0.8 mg/kg, respectively.

The right side of Figure H-3 is a box-and-whiskers plot of the 97 cadmium results for "site" surface soil samples. The mean concentration of the site data is about three times greater than the mean concentration of the background data. Additionally, the inner ranges of the two data sets do not overlap. These characteristics suggest that there is a significant difference between the background and site data.

Figure H-4 shows the spatial distribution of cadmium in surface soil samples. There is one sample that is considered an outlier or extreme value (greater than or equal to the mean plus 1.5 times the standard deviation) in the AOC area and four in the DC Lanham area.

Chromium Discussion

The 27 surface soil samples background areas analyzed for chromium and summary statistics are shown in Table H-1. The chromium concentrations in the background samples are tightly grouped with the exception of one extreme value. The mean chromium concentration of the background samples is 27.3 mg/kg. Box-and-whiskers plots of the chromium samples are shown on Figure H-5, with the background samples on the left side of the figure. The relatively taller inner box on the background samples is associated with the distant outlier, which has a concentration about 5 times greater than the second highest concentration. Excluding the outlier from the background data would make the central portions of the background and site data look quite similar. The 90th percentile and 3 times mean of the background chromium samples are 31.5 mg/kg and 82 mg/kg, respectively.

The right side of Figure H-5 is a box-and-whiskers plot of the 102 chromium results for "site" surface soil samples. Figure H-6 shows the spatial distribution of chromium in surface soil samples. There are seven surface soil samples that are considered outliers or extreme values, including a sample collected at the Howard Road Academy and pooled with the background samples. Two of the samples are in the southern portion of Wetland 1 and two are in the AOC area.

Lead Discussion

Twenty-seven surface soil background samples were collected and analyzed for lead. Summary statistics for these samples are shown in Table H-1. The mean lead concentration of the background samples is 40.1 mg/kg. A box-and-whiskers plot of the lead samples is shown on Figure H-7. The inner range (box) for the background lead samples is relatively tight there is one outlier and one extreme value. The 90th percentile and 3 times mean of the background lead samples are 70.6 mg/kg and 120.4 mg/kg, respectively.

The right side of Figure H-7 is a box-and-whiskers plot of the 108 lead results for "site" surface soil samples. The mean concentration and inner range of the site data is significantly higher than for the background data.

Figure H-8 shows the spatial distribution of lead in surface soil samples. There are eight outliers with concentrations exceeding the upper whisker value of 248 mg/kg. These samples are located near the southern greenhouses and near the garage in the AOC area and in Wetland 1.

Nickel Discussion

Twenty-seven surface soil samples were collected from background areas and analyzed for nickel. Summary statistics for these samples are shown in Table H-1. The mean nickel concentration of the background samples is 14.2 mg/kg. A box-and-whiskers plot of the nickel samples is shown on Figure H-9. The inner range (box) for the background nickel samples is relatively tight there is one extreme value. The 90th percentile and 3 times mean of the background nickel samples are 25 mg/kg and 42.6 mg/kg, respectively.

The right side of Figure H-9 is a box-and-whiskers plot of the 102 nickel results for "site" surface soil samples. The inner range of the site data is similar but slightly elevated compared with the background data and there is some overlap. There are four outliers and three extreme values in the site data. Figure H-10 shows the spatial distribution of nickel in surface soil samples. Eight samples have nickel concentrations exceeding 53 mg/kg, which is the mean plus 1.5 times the standard deviation of the site data. Three of the samples are in the AOC area, four are in Wetland I and one is at the Howard Road Academy.

Zinc Discussion

Twenty-seven surface soil samples were collected from background areas and analyzed for zinc. Summary statistics for these samples are shown in Table H-1. The mean zinc concentration of the background samples is 62.6 mg/kg. A box-and-whiskers plot of the zinc samples is shown on Figure H-11. The inner quartile range (box) for the background zinc samples is very tight there is one extreme value. The 90th percentile and 3 times mean of the background zinc samples are 107 mg/kg and 188 mg/kg, respectively.

The right side of Figure H-11 is a box-and-whiskers plot of the 102 zinc results for "site" surface soil samples. The inner range of the site data is higher than for the background data although there is some overlap. There are four outliers and four extreme values in the site zinc data. Figure H-12 shows the spatial distribution of zinc in surface soil samples. Two of the elevated values are in the AOC area and the others are in Wetland 1 or near Green Fuel.

References

Gilbert, Richard O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. New York: Van Nostrand Reinhold.

U.S. Environmental Protection Agency. 2001. Guidance for Characterizing Background Chemicals in Soil at Superfund Sites (External Review Draft). Office of Emergency and Remedial Response, EPA Publication EPA 540-R-01-003, OSWER 9285.7-41. http://www.epa.gov/superfund/ programs/risk/background.pdf

Washington State Department of Ecology. 1992. Statistical Guidance for Ecology Site Managers. Publication Number 92-54.

Table H-1. Concentrations of Selected Inorganic Chemicals in "background" samples.

Sample ID	Portion of Site	Arsenic	Cadmium [2]		Chromium	Lead	Nickel	Zinc
470E-SS-16d	North of DC Lanham	7.1	0.3	U	24.0	22.0	3.0	23.0
470E-SS-16s	North of DC Lanham	6.1	0.3	U	27.0	63.0	8.0	83.0
SB01	North of DC Lanham	3.3						
SO-1Bs	North of DC Lanham	3.0	0.2		26.0	45.4	28.3	65.5
SO-2Bs	North of DC Lanham	2.5	0.3		14.8	70.5	9.0	56.6
SO-3Bs	North of DC Lanham	2.6	0.9		13.5	54.2	8.0	57.4
470E-SS-01d	Naval Receiving Station	2.6	0.1	U	18.7	11.3	22.0	60.1
470E-SS-01s	Naval Receiving Station	4.4	0.1	U	31.0	25.0	23.0	108.0
470E-SS-02d	Naval Receiving Station	3.4	0.1	U	17.9	11.4	19.0	30.2
470E-SS-02s	Naval Receiving Station	2.4	0.1	U	20.8	11.1	28.0	35.2
470E-SS-03d	Naval Receiving Station	2.7	0.1	U	19.3	16.5	7.0	26.0
470E-SS-03s	Naval Receiving Station	3.0	0.1	U	19.6	14.5	8.0	30.0
470E-SS-04d	Naval Receiving Station	3.2	0.1	U	16.9	12.5	6.0	20.0
470E-SS-04s	Naval Receiving Station	3.4	0.1	U	19.4	15.1	7.0	31.7
470E-SS-05d	Naval Receiving Station	1.5	0.1	U	10.9	5.9	8.0	18.5
470E-SS-05s	Naval Receiving Station	1.7	0.1	U	12.1	7.6	7.0	21.8
470E-SS-06d	Naval Receiving Station	0.7	0.1	U	16.5	8.2	9.0	27.0
470E-SS-06s	Naval Receiving Station	1.8	0.1	U	19.3	12.2	11.0	40.0
470E-SS-26d	Naval Receiving Station	2.0	0.1	U	16.3	31.0	9.0	107.0
470E-SS-26s	Naval Receiving Station	2.5	0.3		22.6	48.0	13.0	108.0
SO-17	Naval Receiving Station	3.2			12.4	20.5	5.8	30.4
SO-18	Naval Receiving Station	3.1			10.8	16.4	5.7	25.0
470E-SS-30	Howard Road Academy	0.6	0.3	U	219.0	19.0	72.0	55.0
470E-SS-31	Howard Road Academy	1.7	0.3	U	45.0	57.0	17.0	81.0
470E-SS-32	Howard Road Academy	3.8	1.9		32.3	220.0	18.0	321.0
HR-DT-01	Dog Kennel Area	3.4						
HR-DT-02	Dog Kennel Area	5.0						
HR-DT-03	Dog Kennel Area	3.1						
SO-11s	Dog Kennel Area	3.8	0.3		26.9	70.7	11.7	88.4
SO-12S	Dog Kennel Area	3.4			9.1	45.4	8.9	41.9
SO-13/SO-13D [1]	Dog Kennel Area	5.7	0.4		15.6	149.5	10.9	99.8
	Count	**31**	**24**		**27**	**27**	**27**	**27**
	Minimum	**0.6**	**0.1**		**9.1**	**5.9**	**3.0**	**18.5**
	Maximum	**7.1**	**1.9**		**219.0**	**220.0**	**72.0**	**321.0**
	Mean	**3.1**	**0.3**		**27.3**	**40.1**	**14.2**	**62.6**
	Median	**3.1**	**0.1**		**19.3**	**20.5**	**9.0**	**41.9**
	Standard deviation	**1.4**	**0.4**		**39.1**	**47.4**	**13.4**	**59.7**
		0.5	**1.4**		**1.4**	**1.2**	**0.9**	**1.0**
	90th percentile	**5.0**	**0.4**		**31.5**	**70.6**	**25.0**	**107.4**
	3 x mean	**9.4**	**0.8**		**82.0**	**120.4**	**42.6**	**187.9**

[1] These are duplicate samples, the average value is shown.

[2] For samples with a "U" qualifier, the listed value is one half of the detection limit that was reported by the laboratory.

Table H-2. Concentrations of Selected Inorganic Chemicals in "site" samples.

Sample ID / Location	Arsenic	Cadmium	Chromium	Lead	Nickel	Zinc
470E-SS-07	63	4.5	70.3	95	70	803
470E-SS-08d	80	1.9	59.4	187	60	510
470E-SS-08s	88	2.4	95	240	83	536
470E-SS-09d	4.9	0.1 U	19.7	56	22	40.6
470E-SS-09s	4.7	0.1 U	32.7	77	40	52.5
470E-SS-10d	5.1	0.4	34.1	82	27	141 J
470E-SS-10s	4.6	0.15 U	25.4	80	18	96.9
470E-SS-11d	8.1	0.5	28.4	103	23	112 J
470E-SS-11s	8.7	0.4	27.8	113	23	122
470E-SS-12d	39	0.8	36.5	133	31	180
470E-SS-12s	37	1	35.8	158	30	211
470E-SS-13d	29	0.8	25.8	260	22	219 J
470E-SS-13s	50	0.9	27.5	300	24	336
470E-SS-14d	6.8	0.3	30.1	96	22	126
470E-SS-14s	7.4	0.4	31	99	23	114
470E-SS-15d	5.2	0.5	24.7	220	23	169 J
470E-SS-15s	5.8	0.8	27.1	220	24	201 J
470E-SS-17d	4.3	0.4	22.7	80	22	89.4
470E-SS-17s	3.2	0.5	22	77	22	101 J
470E-SS-18d	3.2	0.1 U	21.1	58	19	73.3
470E-SS-18s	3.4	0.1 U	21.7	59	19	74.1
470E-SS-19d	6	0.5	24.5	96	24	116 J
470E-SS-19s	6.8	0.5	33.3	79	26	126
470E-SS-20d	46	2.4	23.7	240	22	402
470E-SS-20s	3.2	4.8	47.2	240	33	908
470E-SS-21d	4.9 J	0.4	19.4	113	12	88.4
470E-SS-21s	4.6 J	0.4	20.5	109	13	92.4
470E-SS-22d	41 J	1.1	26	285	22	385 J
470E-SS-22s	33 J	1.1	25	248	23	350 J
470E-SS-23d	6.2 J	0.4	18.3	191	15.3	132
470E-SS-23s	6.5 J	0.6	24.5	329	18	238 J
470E-SS-24d	3.5 J	0.5	42.4	142	49	116
470E-SS-24s	3.9 J	0.7	52.2	124	60	136 J
470E-SS-25	19 J	1.5	40	155	47	1270
470E-SS-27	1.3 J	0.1 U	23.5	34	58	29.9
470E-SS-28d	4.1	0.2 U	12.3	109	16	89
470E-SS-28s	4.3	0.4	14.1	111	12	113
470E-SS-29-01	3	0.4	27	80	28	74
470E-SS-29-02	2.2	0.25 U	13	39	10	38
470E-SS-34	81 J	2.3	91	259	86	565
470E-SS-35	3.3 J	4.7	46	241	33	786
470E-SS-36	37 J	1.2	27.5	278	23	385 J
FD-1	10.1	5.6	61.2	371 L	128	706
HR-TP-01	4.5					

Table H-2. Concentrations of Selected Inorganic Chemicals in "site" samples.

Sample ID / Location	Arsenic	Cadmium	Chromium	Lead	Nickel	Zinc
HR-TP-01	4.5					
HR-TP-03	3.8					
HR-TP-03	3.8					
HR-TP-10	3					
HR-TP-10	3					
MW01	3.2	2.8	12.3	56.4	11.9	49
MW02	4	1.5	14.5	100	20.2	99.4
MW04	3.2	1.9	15.2	84.7	31.6	116
MW05	4.6	2.3	29.7	55.1	12.7	66.5
MW06	4.3	1.9	17.3	81.5	9.3	67.8
OF-1	3.2 K	0.38 B	15.9	61.6	15	156
PA-1	4.5	0.3	18.1	52.2 L	10.8	111
PA-2	1.1 K		12.5	12.2	12.6	18
PA-3	3.5 K	0.37 B	31.4	88.6	46.7	156
PA-4	4.4		16.2	34	6.8	36.1
PA-4D	4.8		16.2	25.1	7	29.8
PA-5	4.8 K	0.36	17.3	153	24.4	114
SB06	56	4	33.5	62.6	29.1	118
SB07	22.8	1.6	16.5	64.8	17.7	59.3
SB08	13.5	0.72	7.4	42.9	15.2	57.3 J
SB09	12.3	1.4	11.8	61.1	8.2	50.9
SB14	44	2.5	21.7	230	16.5	306
SB15	22.4	2.1	22.7	174	20.6	209
SB19	42.7	3	21.3	47	24.8	83.2
SB20	39.9	2.8	41	39.2	10.3	57.3
SB21	22.4	1.6	11.6	41.6	9.4	50.1
SB23	19	1.3	17.1	94.4	7.7	71.5
SB24	37.5	2.4	18	160	13.7	82.6
SB25	15	1.8	13.6	49.6	7.4	43
SB26	2.15 U	1.3	11.2	84.2	9.6	52.9 J
SB27	7.1	1.9	18.8	26.2	8.1	41.2
SB28	6.3	0.89	10.1	25.8	6.4	223
SB30	2.25 U	1.7	27.2	49.6	8.8	58.3
SB31	5.4	2.8	47.3	12.8	6.3	30.8
SB32	2.4 U	1.5	16.7	27.2	7.8	29.8
SB33	10.2	1.2	6.8	158	7.8	132 J
SB36	20.8	1.8	21.6	83	15.3	124
SB37	2.4 U	1.3	8.4	54.5	11	57.6 J
SB-4	11.6	1.6	11	51	8.8	66.4
SB40	17.1	2	13.8	284	14.6	128
SB42	2.35 U	1.2	14.1	64.9	11	49.7 J
SB45	5.6	1.4	13.8	29.3	8.7	36.2
SB-5	16.8	1.4	14.7	52.6	21.4	61.1
SD-1/1s	15.8	1.4	30.2	173	54.2 K	1210
SD-1/2D	14.5	1.4	31.6	198	51.6 K	1170

Table H-2. Concentrations of Selected Inorganic Chemicals in "site" samples.

Sample ID / Location	Arsenic	Cadmium	Chromium	Lead	Nickel	Zinc
SD-1/2d	9.2	0.19	19.9	174	28	175
SD-1/2s	8.7	0.34 B	22.2	121	35.9	350
SD-1/3s	54.3	0.83	28.2	242	54	1000
SD-1/4s	6.2	0.42	18.8	160 L	17.6	173 J
SD-1/5s	49.5	0.32	24.7	109 L	27.3	101
SD-1/6s	9	0.38	14.3	88.1	30.6 K	132
SO-10	3.3	0.32	14.3	89.7 L	13.1	150
SO-4	5.2	0.18 B	24.4	91.5	39.9	92.6
SO-5	3		20.5	41.2	10.8	63.1
SO-5D	3.3		21	43.9	11.2	64.3
SO-7	2.6	0.12	12	68.8 L	7	52.1
SO-8s	3.1	0.26	14.8	105 L	10.4	83.9
SO-9	8.8	0.66	25.3	242 L	24.2	172 J
SU-01	4.6 K	1.1 B	37.7	215	15.3	483
WL01	2.65 U	1.4	20.3	103	42.5	62.1
WL02	2.85 U	1.9	17.4	88.1	24.8	46.7
WL03	2.45 U	2.1	20.6	102	19.3	97.9
WL03	3.55 U	1.6	19	315	26.4	191
WL05	9.2	2.9	21.4	219	22.1	462
Count	**108**	**97**	**102**	**102**	**102**	**102**
minimum	**1.1**	**0.10**	**6.8**	**12.2**	**6.3**	**18**
maximum	**88**	**5.60**	**95**	**371**	**128**	**1270**
mean	**14.3**	**1.28**	**25.3**	**122.8**	**24.6**	**206.7**
median	**5.3**	**1.10**	**21.65**	**95.5**	**21.7**	**113.5**
standard deviation	**18.5**	**1.13**	**15.0**	**83.3**	**19.2**	**262.1**
coefficient of variation	**1.3**	**0.89**	**0.6**	**0.7**	**0.8**	**1.3**
90th percentile	**41.5**	**2.62**	**40.9**	**242.0**	**48.8**	**507.3**
3 x mean	**42.8**	**3.83**	**75.8**	**368.5**	**73.7**	**620.1**

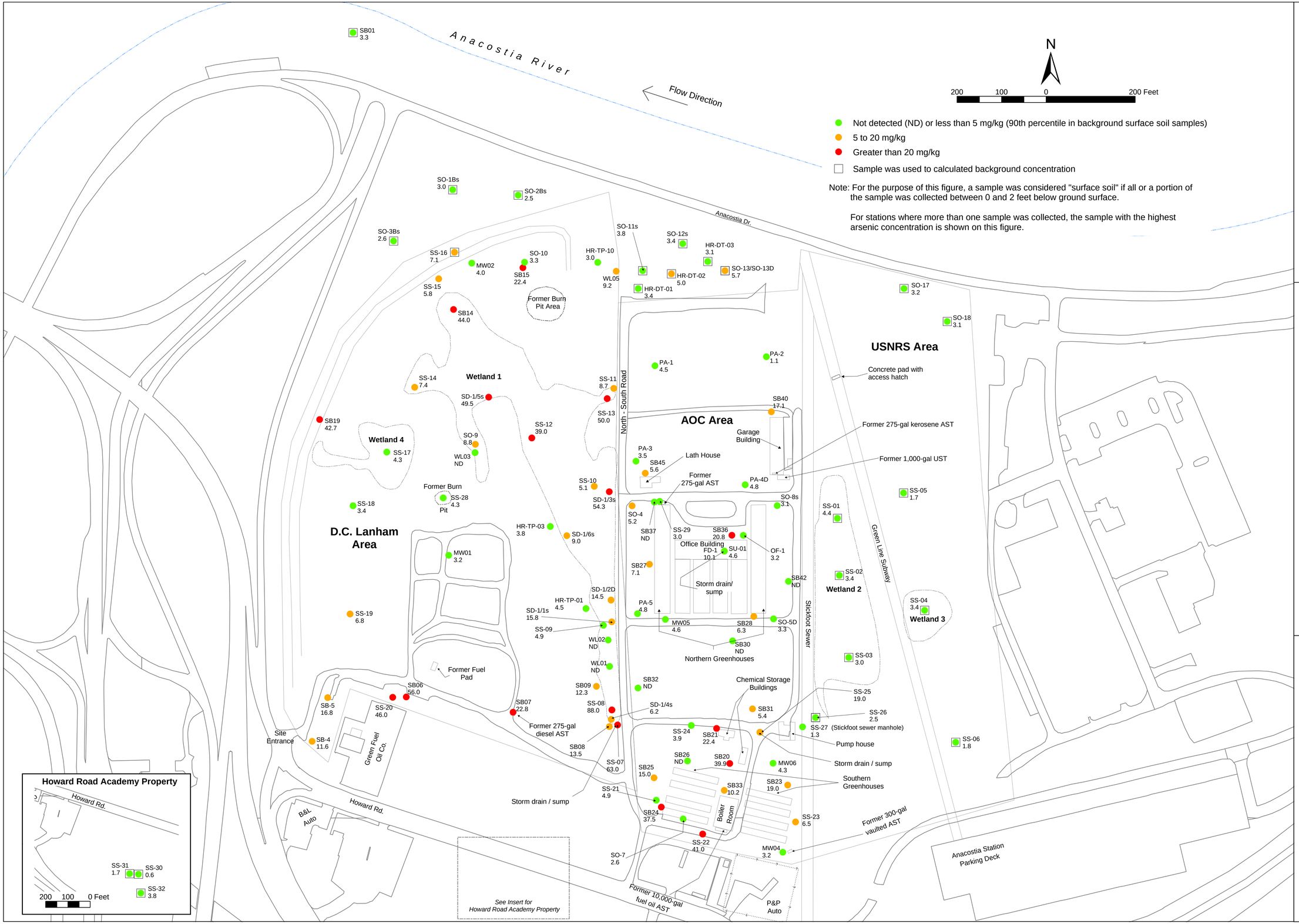


Figure H-1

Arsenic in Surface Soil

Site Characterization Report
Poplar Point
Washington, D.C.

RIDOLFI Inc.

AS_map.mxd

Figure H-2. Box-and-whisker plots for arsenic in surface soil.

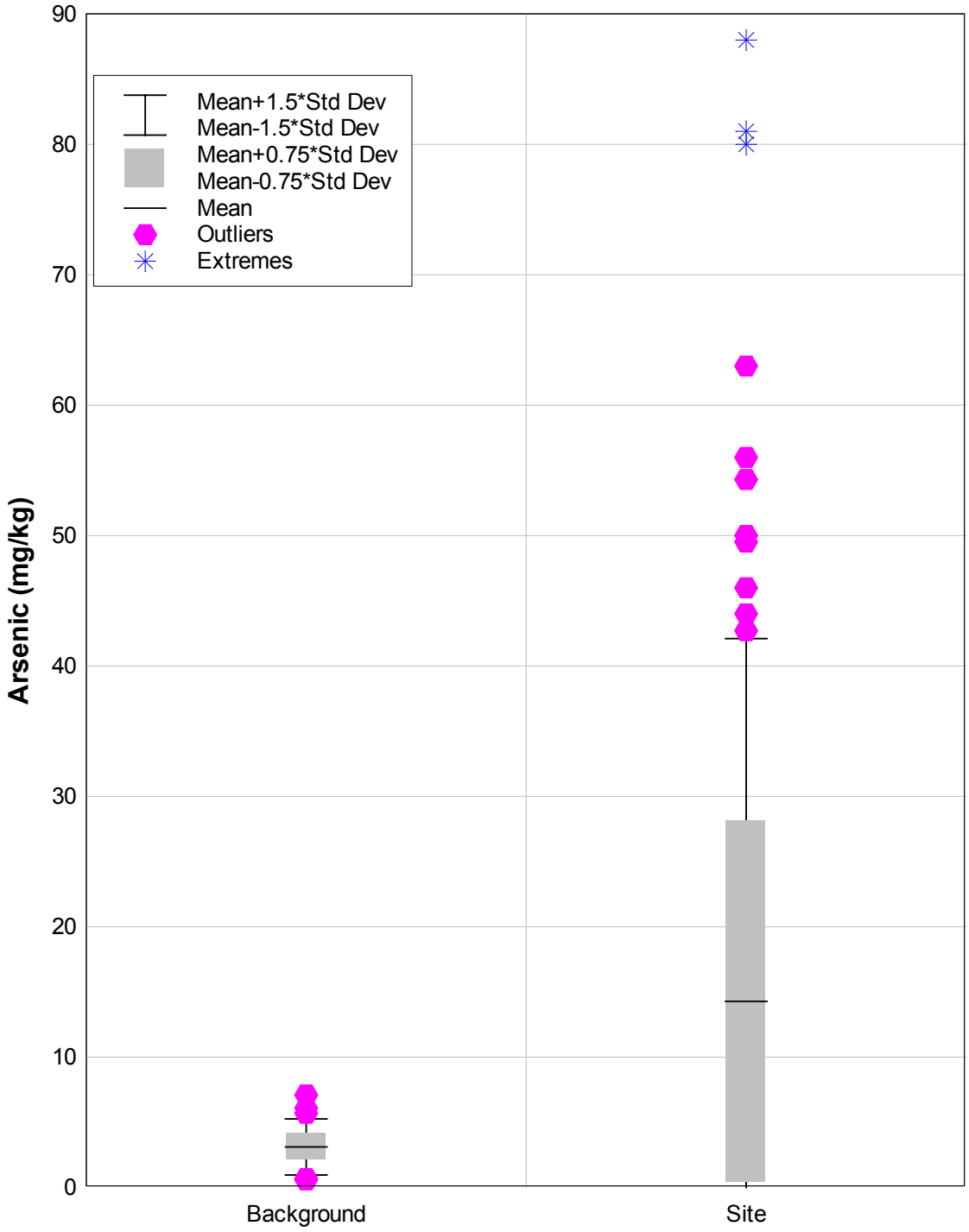
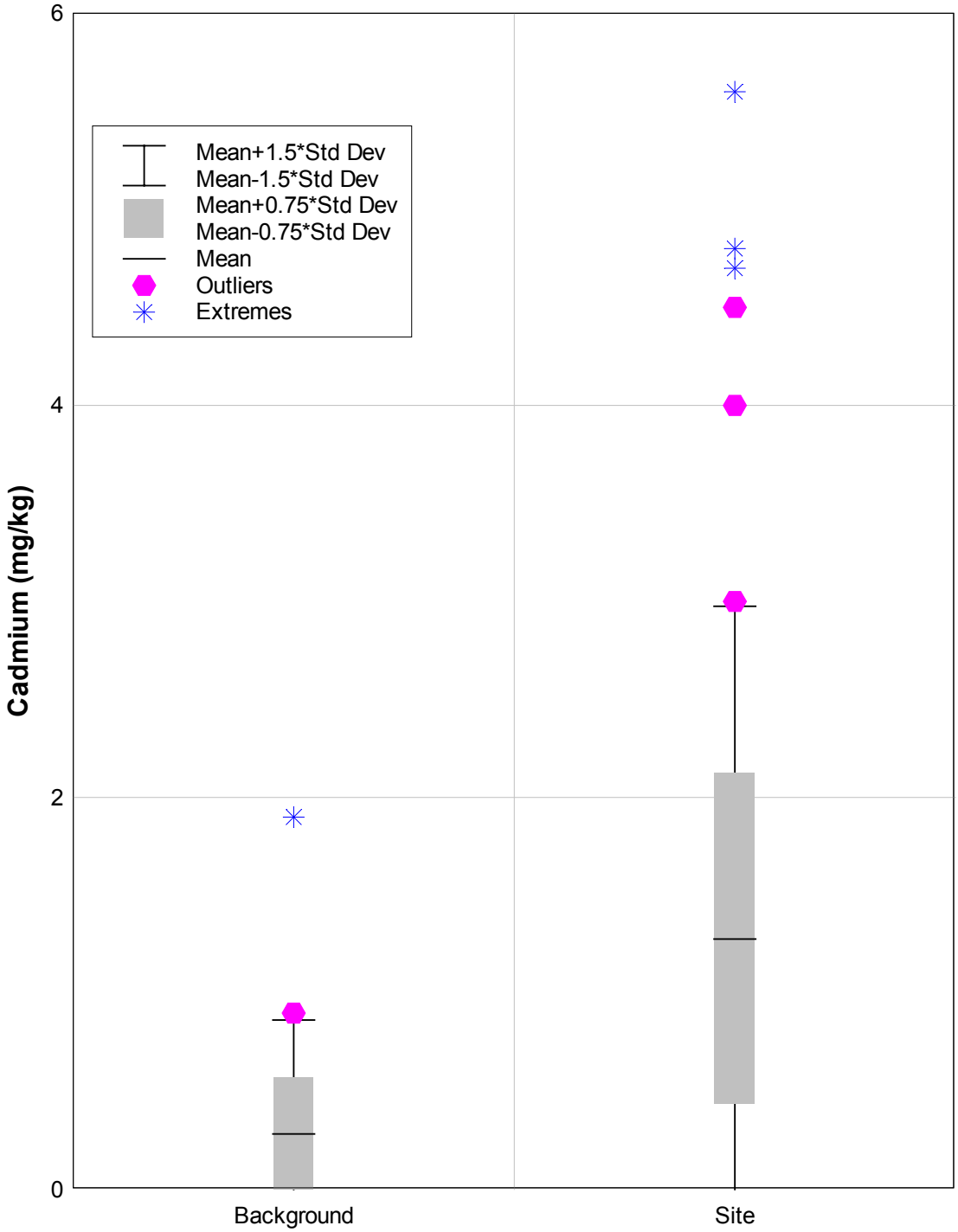


Figure H-3. Box-and-whisker plots for cadmium in surface soil.



Flow Direction

Anacostia River

N

200 100 0 200 Feet

- Not detected (ND) or less than 0.8 mg/kg (3 times the mean background concentration)
- 0.8 to 3.0 mg/kg
- Greater than 3.0 mg/kg
- Sample was used to calculate background

Note: For the purpose of this figure, a sample was considered "surface soil" if all or a portion of the sample was collected between 0 and 2 feet below ground surface.

For stations where more than one sample was collected, the sample with the highest cadmium concentration is shown on this figure.

Anacostia Dr.

SO-1Bs 0.15
SO-2Bs 0.3
SO-3Bs 0.9
SS-16 0.6U
MW02 1.5
SO-10 0.32
SB15 2.1
SS-15 0.8
WL05 2.9
SO-11s 0.29
SO-13 0.44
Former Burn Pit Area
SB14 2.5

USNRS Area

PA-1 0.3
Concrete pad with access hatch
North - South Road
SS-14 0.4
Wetland 1
SD-1/5s 0.32
SS-11 0.5
SS-13 0.9
SB40 2.0
AOC Area
SB19 3.0
Wetland 4
SS-17 0.5
SO-9 0.66
WL03 2.1
SS-12 1.0
Garage Building
Former 275-gal Kerosene AST
Former 1,000-gal UST
PA-3 0.37
Lath House
SB45 1.4
Former 275-gal AST
SS-10 0.4
SD-1/3s 0.83
SS-05 0.2U
Former Burn Pit
SS-28 0.4
SS-18 0.2U
SO-4 0.18
SO-8s 0.26
SS-01 0.2U
D.C. Lanham Area
SD-1/6s 0.38
SB37 1.3
SS-29 0.5
SB36 1.8
Office Building
FD-1 5.6
SU-01 1.1
OF-1 0.38
Green Line Subway
MW01 2.8
SB27 1.9
SB42 1.2
SS-02 0.2U
Wetland 2
SD-1/2D 1.4
SD-1/1s 1.4
PA-5 0.36
SS-04 0.2U
Wetland 3
SS-19 0.5
SS-09 0.2U
MW05 2.3
SB28 0.89
Storm drain/ sump
WL02 1.9
SB30 1.7
Northern Greenhouses
Stickfoot Sewer
SS-03 0.2U
WL01 1.4
Former Fuel Pad
SB32 1.5
Chemical Storage Buildings
SB09 1.4
SB06 4.0
SB-5 1.4
SS-20 4.8
SB07 1.6
SS-08 2.4
SD-1/4s 0.42
SB31 2.8
Storm drain / sump
Stickfoot sewer manhole
Former 275-gal diesel AST
SS-24 0.7
SB21 1.6
SS-27 0.2
SS-26 0.3
SS-06 0.2U
Site Entrance
SB-4 1.6
Green Fuel Oil Co.
SB08 0.72
SS-25 1.5
Pump house
SS-07 4.5
SB26 1.3
SB20 2.8
MW06 1.9
SB25 1.8
Southern Greenhouses
SB23 1.3
SS-21 0.4
SB33 1.2
Storm drain / sump
Boiler Room
SB24 2.4
SS-23 0.6
Howard Rd.
B&L Auto
SO-7 0.12
Former 300-gal vaulted AST
SS-22 1.2
MW04 1.9
Anacostia Station Parking Deck
Former 10,000-gal fuel oil AST
P&P Auto
Howard Road Academy Property
SS-31 0.5U
SS-30 0.5U
SS-32 1.9

Figure H-4

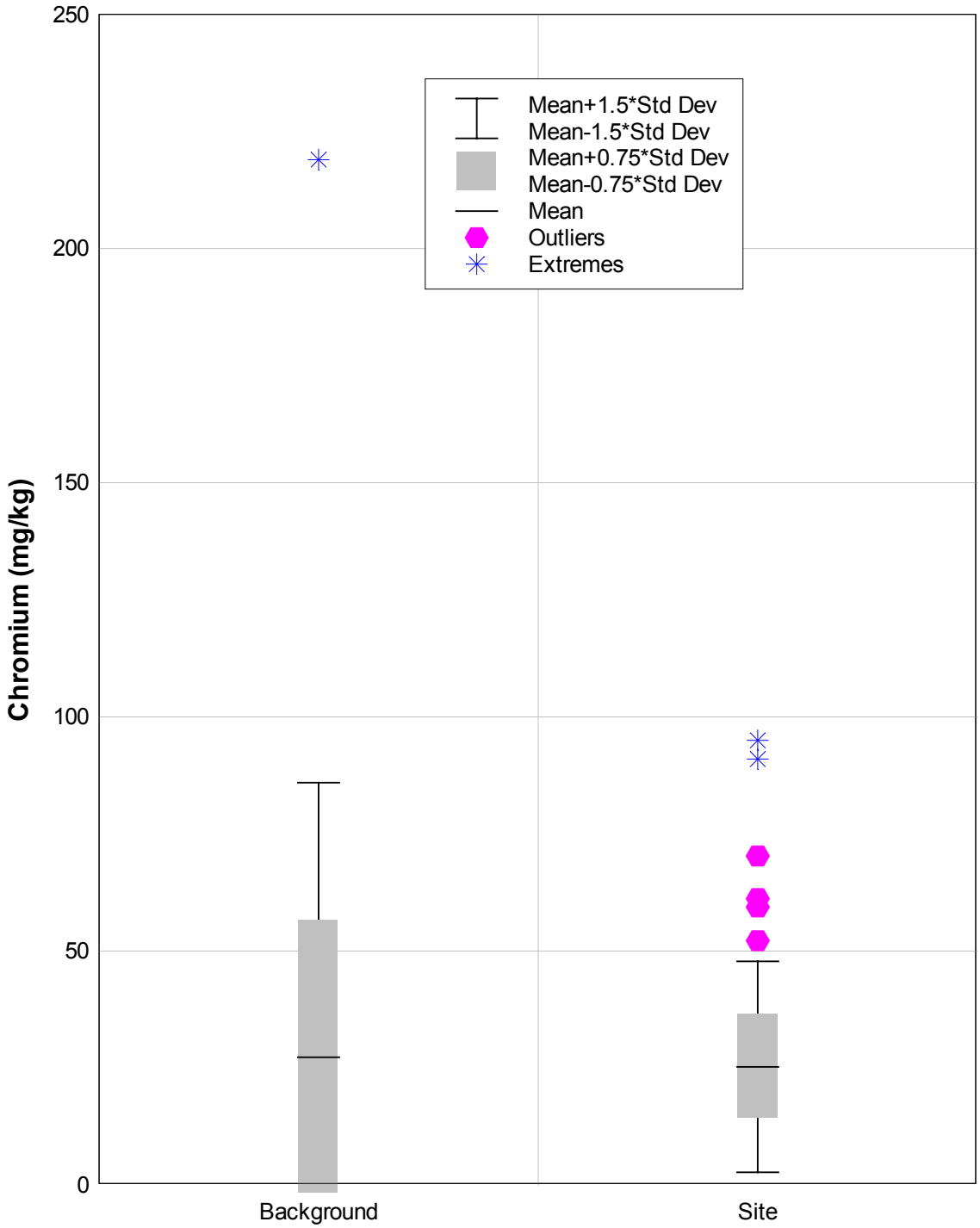
Cadmium in Surface Soil

Site Characterization Report
Poplar Point
Washington, D.C.

RIDOLFI Inc.

Cadmium_map.mxd

Figure H-5. Box-and-whisker plots for chromium in surface soil.



Flow Direction

Anacostia River

Anacostia Dr.

N

200 100 0 200 Feet

- Not detected (ND) or less than 32 mg/kg
- 32 to 48 mg/kg
- Greater than 48 mg/kg
- Sample was used to calculate background

Note: For the purpose of this figure, a sample was considered "surface soil" if all or a portion of the sample was collected between 0 and 2 feet below ground surface.

For stations where more than one sample was collected, the sample with the highest chromium concentration is shown on this figure.

SO-1Bs 26.0
SO-2Bs 14.8
SO-3Bs 13.5
SO-12s 9.1
SO-13D 15.9
SO-17 12.4
SO-18 10.8
SS-16 27.0
MW-02 14.5
SO-10 14.3
SB15 22.7
SS-15 27.1
WL05 21.4
SO-11s 26.9
Former Burn Pit Area
SB14 21.7
USNRS Area
PA-1 18.1
PA-2 12.5
Concrete pad with access hatch
North - South Road
SS-14 31.0
Wetland 1
SD-1/5s 24.7
SS-11 28.4
SS-13 27.5
SB40 13.8
AOC Area
Former 275-gal Kerosene AST
Garage Building
SB19 21.3
Wetland 4
SS-17 22.7
SO-9 25.3
WL03 20.6
SS-12 36.5
PA-3 31.4
SB45 13.8
Lath House
Former 1,000-gal UST
Former 275-gal AST
PA-4D 16.2
SS-05 12.1
Former Burn Pit
SS-28 14.1
SS-10 34.1
SD-1/3s 28.2
SS-18 21.7
SO-4 24.4
SO-8s 14.8
SS-01 31.0
D.C. Lanham Area
SD-1/6s 14.3
SB37 8.4
SS-29 27.0
SB36 21.6
Office Building
FD-1 61.2
SU-01 37.7
OF-1 15.9
Green Line Subway
MW01 12.3
SB27 18.8
SS-02 20.8
Wetland 2
SD-1/2D 31.6
PA-5 17.3
SB42 14.1
SS-04 19.4
Wetland 3
SS-19 33.3
SD-1/1s 30.2
SS-09 32.7
MW05 29.7
SB28 10.1
SO-5D 21.0
Stickfoot Sewer
WL02 17.4
SB30 27.2
Northern Greenhouses
SS-03 19.6
WL01 20.3
Former Fuel Pad
SB32 16.7
Chemical Storage Buildings
SB06 33.5
SB09 11.8
SB07 16.5
SS-08 95.0
SD-1/4s 18.8
SB31 47.3
SS-26 22.6
SB-5 14.7
SS-20 47.2
Former 275-gal diesel AST
SS-24 52.2
SB21 11.6
SS-27 23.5
Site Entrance
SB-4 11.0
Green Fuel Oil Co.
SB08 7.4
SS-25 40.0
Pump house
SS-06 19.3
SS-07 70.3
SB26 11.2
SB20 41.0
MW06 17.3
SB25 13.6
SB33 6.8
SB23 17.1
Southern Greenhouses
SS-21 20.5
Howard Rd.
B&L Auto
SB24 18.0
Boiler Room
SS-23 24.5
Former 300-gal vaulted AST
SQ-7 12.0
SS-22 27.5
MW-04 15.2
Anacostia Station Parking Deck
Former 10,000-gal fuel oil AST
P&P Auto
Howard Road Academy Property
SS-31 45.0
SS-30 219.0
SS-32 32.3

Figure H-6

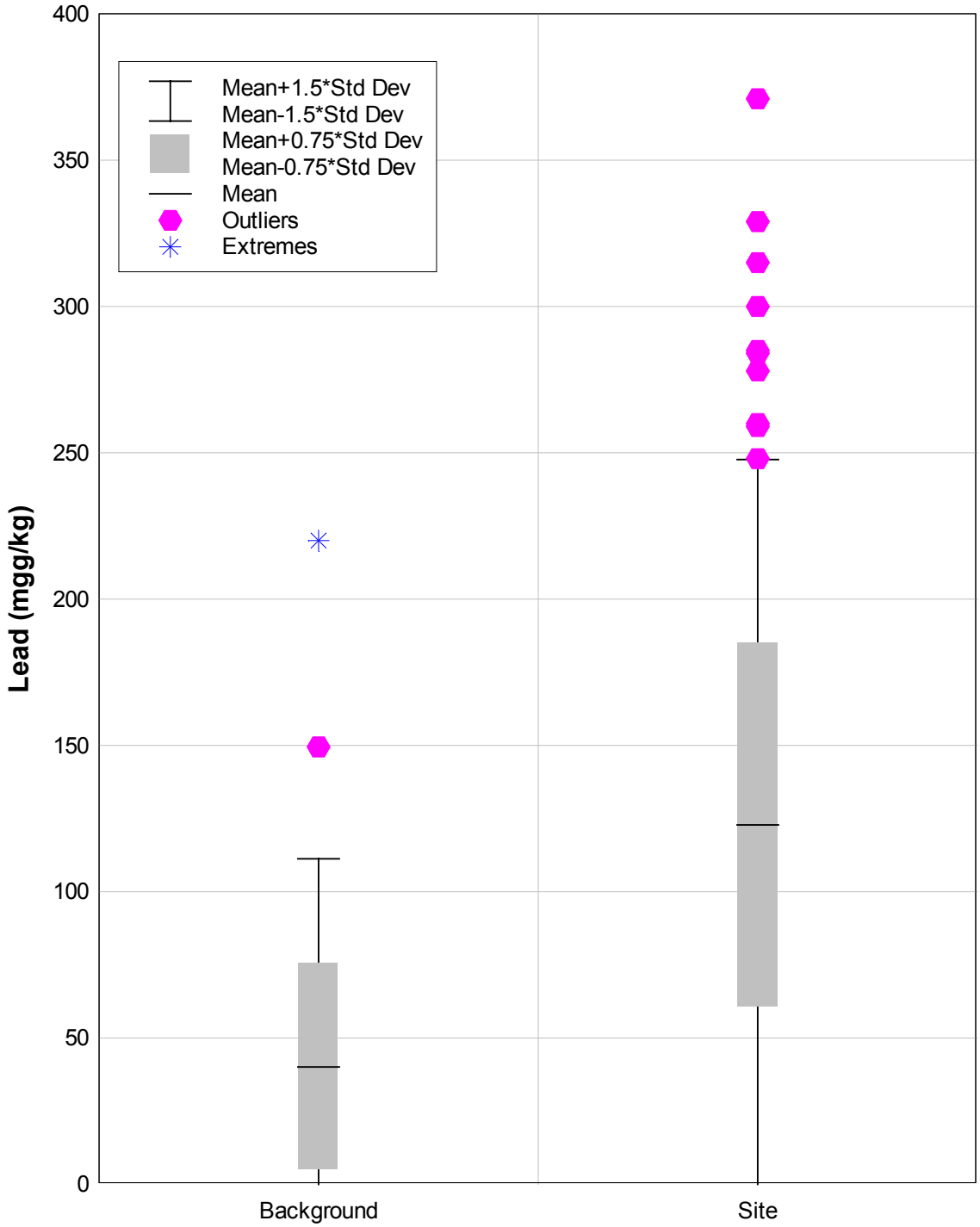
Chromium in Surface Soil

Site Characterization Report
Poplar Point
Washington, D.C.

RIDOLFI Inc.

Chromium_map.mxd

Figure H-7. Box-and-whisker plots for lead in surface soil.



Anacostia River

Flow Direction

Anacostia Dr.

N

200 100 0 200 Feet

- Not detected (ND) or less than 120 mg/kg (3 times mean background)
- 120 to 248 mg/kg
- Greater than 248 mg/kg
- Sample used to calculate background

Note: For the purpose of this figure, a sample was considered "surface soil" if all or a portion of the sample was collected between 0 and 2 feet below ground surface.

For stations where more than one sample was collected, the sample with the highest lead concentration is shown on this figure.

SO-1Bs 45.4
SO-2Bs 70.5
SO-3Bs 54.2
SS-16 63.0
MW02 100.0
SO-10 89.7
SB15 174.0
SS-15 220.0
SB14 230.0
Former Burn Pit Area
WL05 219.0
SO-11s 70.7
SO-12s 45.4
SO-13D 151.0
SO-17 20.5
SO-18 16.4
PA-1 52.2
PA-2 12.2
USNRS Area
Concrete pad with access hatch
SS-14 99.0
Wetland 1
SD-1/5s 109.0
SS-11 113.0
North - South Road
SB40 284.0
SS-13 300.0
AOC Area
Garage Building
Former 275-gal kerosene AST
SB19 47.0
Wetland 4
SS-17 80.0
SO-9 242.0
WL03 315.0
SS-12 158.0
PA-3 88.6
SB45 29.3
Lath House
Former 275-gal AST
Former 1,000-gal UST
PA-4 34.0
SS-05 7.6
SS-10 82.0
SD-1/3s 242.0
Former Burn Pit
SS-28 111.0
SS-18 59.0
SO-4 91.5
SO-8s 105.0
SS-01 25.0
Green Line Subway
D.C. Lanham Area
SD-1/6s 88.1
SB37 54.5
SS-29 80.0
SB36 83.0
Office Building
FD-1 371.0
SU-01 215.0
OF-1 61.6
MW01 56.4
SB27 26.2
Storm drain/ sump
SB42 64.9
SS-02 11.4
Wetland 2
SD-1/2D 198.0
SS-04 15.1
Wetland 3
SS-19 96.0
SD-1/1s 173.0
SS-09 77.0
PA-5 153.0
MW05 55.1
SB28 25.8
SO-5D 43.9
Stickfoot Sewer
WL02 88.1
SB30 49.6
Northern Greenhouses
SS-03 16.5
Former Fuel Pad
WL01 103.0
SB32 27.2
Chemical Storage Buildings
SB09 61.1
SB06 62.6
Storm drain / sump
Stickfoot sewer manhole
SB-5 52.6
SS-20 241.0
SB07 64.8
SS-08 259.0
SD-1/4s 160.0
SB31 12.8
SS-26 48.0
Former 275-gal diesel AST
SS-24 142.0
SB21 41.6
SS-27 34.0
Site Entrance
SB-4 51.0
Green Fuel Oil Co.
SB08 42.9
SS-25 155.0
Pump house
SS-06 12.2
SS-07 95.0
SB26 84.2
SB20 39.2
MW06 81.5
SB25 49.6
Storm drain / sump
Southern Greenhouses
SB23 94.4
SS-21 113.0
SB33 158.0
Howard Rd.
B&L Auto
Boiler Room
SB24 160.0
SS-23 329.0
Former 300-gal vaulted AST
SO-7 68.8
SS-22 285.0
MW-04 84.7
Anacostia Station Parking Deck
Former 10,000-gal fuel oil AST
P&P Auto
Howard Road Academy Property
SS-31 57.0
SS-30 19.0
SS-32 220.0

Figure H-8

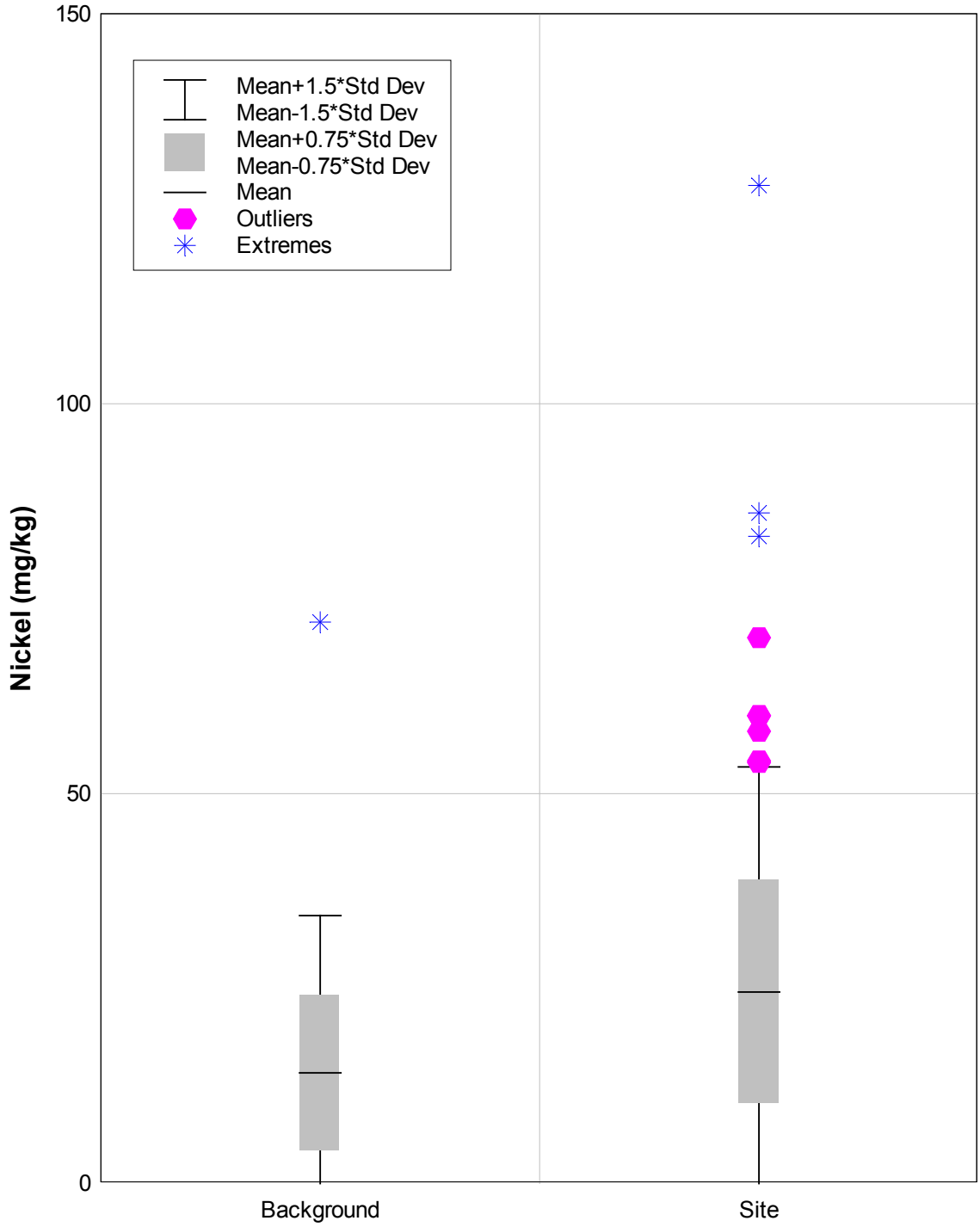
Lead in Surface Soil

Site Characterization Report
Poplar Point
Washington, D.C.

RIDOLFI Inc.

Lead_map.mxd

Figure H-9. Box-and-whisker plots for nickel in surface soil.



Anacostia River

Flow Direction

Anacostia Dr.

N

200 100 0 200 Feet

- Not detected (ND) or less than 25 mg/kg
- 25 to 43 mg/kg
- Greater than 43 mg/kg

Note: For the purpose of this figure, a sample was considered "surface soil" if all or a portion of the sample was collected between 0 and 2 feet below ground surface.

For stations where more than one sample was collected, the sample with the highest nickel concentration is shown on this figure.

SO-1Bs 28.3
SO-2Bs 9.0
SO-3Bs 8.0
SS-16 8.0
MW-02 20.2
SO-10 13.1
SB15 20.6
SS-15 24.0
WL05 22.1
SO-11s 11.7
SO-12s 8.9
SO-13D 11.0
SO-17 5.8
SO-18 5.7
Former Burn Pit Area
SB14 16.5
USNRS Area
PA-1 10.8
PA-2 12.6
Concrete pad with access hatch
SS-14 23.0
Wetland 1
SD-1/5s 27.3
SS-11 23.0
SS-13 24.0
North - South Road
SB40 14.6
SB19 24.8
Wetland 4
SS-17 22.0
SO-9 24.2
WL03 26.4
SS-12 31.0
AOC Area
Garage Building
Former 275-gal Kerosene AST
Former 1,000-gal UST
Lath House
PA-3 46.7
SB45 8.7
Former 275-gal AST
PA-4D 7.0
SS-05 8.0
Former Burn Pit
SS-28 16.0
SS-18 19.0
SS-10 27.0
SD-1/3s 54.0
SO-4 39.9
SO-8s 10.4
SS-01 23.0
GS-1 and GS-5D 14.9 17.2
SB37 11.0
SS-29 28.0
SB36 15.3
Office Building
FD-1 128.0
SU-01 15.3
OF-1 15.0
Green Line Subway
D.C. Lanham Area
SD-1/6s 30.6
MW01 11.9
SB27 8.1
GS-4 9.4
GS-5 3.5
GS-3 1.7
GS-2 24.5
SB42 11.0
SS-02 28.0
Wetland 2
SD-1/1s 54.2
SD-1/2D 51.6
PA-5 24.4
SS-04 7.0
Wetland 3
SS-19 26.0
SS-09 40.0
MW05 12.7
SB28 6.4
SO-5D 11.2
WL02 24.8
SB30 8.8
Northern Greenhouses
Stickfoot Sewer
WL01 42.5
SS-03 8.0
Former Fuel Pad
SB32 7.8
Chemical Storage Buildings
SB09 8.2
SB06 29.1
SB07 17.7
SS-08 86.0
SD-1/4s 17.6
SB31 6.3
SS-26 13.0
SB-5 21.4
SS-20 33.0
Former 275-gal diesel AST
SS-24 60.0
SB21 9.4
SS-27 58.0
Site Entrance
SB-4 8.8
Green Fuel Oil Co.
SB08 15.2
SS-25 47.0
Pump house
SS-06 11.0
SS-07 70.0
SB26 9.6
SB20 10.3
MW06 9.3
SB25 7.4
Southern Greenhouses
SB33 7.8
SB23 7.7
SS-21 13.0
Howard Rd.
B&L Auto
SB24 13.7
SO-7 7.0
Boiler Room
SS-23 18.0
Former 300-gal vaulted AST
SS-22 23.0
MW-04 31.6
Anacostia Station Parking Deck
Former 10,000-gal fuel oil AST
P&P Auto
Howard Road Academy Property
SS-31 17.0
SS-30 72.0
SS-32 18.0

Figure H-10

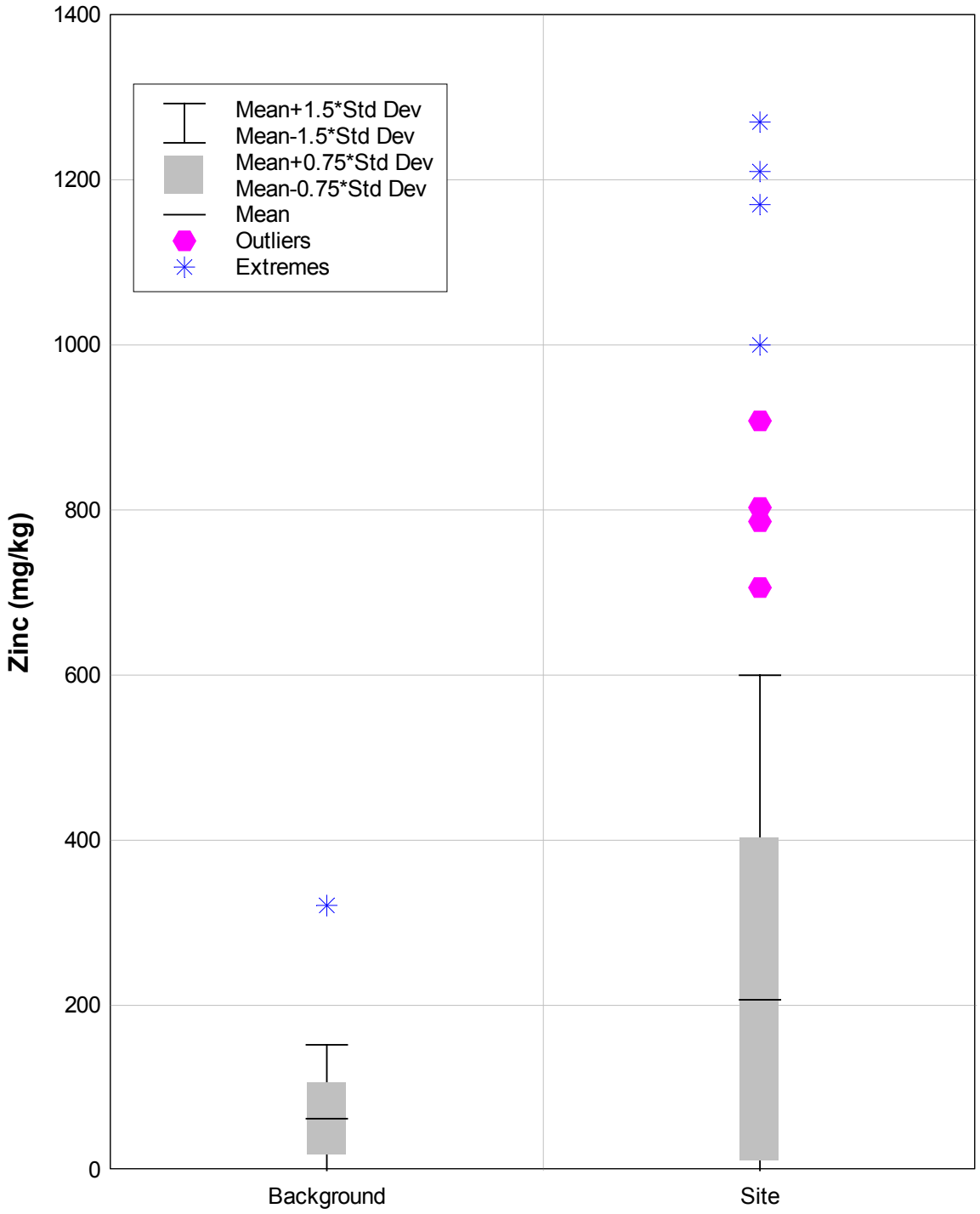
Nickel in Surface Soil

Site Characterization Report
Poplar Point
Washington, D.C.

RIDOLFI Inc.

Nickel_map.mxd

Figure H-11. Box-and-whisker plots for zinc in surface soil.



Anacostia River

Flow Direction

Anacostia Dr.

N

200 100 0 200 Feet

- Not detected (ND) or less than 188 mg/kg
- 188 to 600 mg/kg
- Greater than 600 mg/kg
- Sample was used to calculate background

Note: For the purpose of this figure, a sample was considered "surface soil" if all or a portion of the sample was collected between 0 and 2 feet below ground surface.

For stations where more than one sample was collected, the sample with the highest zinc concentration is shown on this figure.

SO-1Bs 65.5
SO-2Bs 56.6
SO-3Bs 57.4
SS-16 83.0
MW02 99.4
SO-10 150.0
SB15 209.0
SS-15 201.0
SB14 306.0
Former Burn Pit Area
WL05 462.0
SO-11s 88.4
SO-12s 41.9
SO-13D 103.0
SO-17 30.4
SO-18 25.0
USNRS Area
PA-1 111.0
PA-2 18.0
Concrete pad with access hatch
SS-14 126.0
Wetland 1
SD-1/5s 101.0
SS-11 122.0
SS-13 336.0
North - South Road
SB40 128.0
AOC Area
Former 275-gal kerosene AST
Garage Building
Former 1,000-gal UST
SB19 83.2
Wetland 4
SS-17 101.0
SO-9 172.0
WL03 191.0
SS-12 211.0
PA-3 156.0
SB45 36.2
Lath House
Former 275-gal AST
PA-4 36.1
SS-10 141.0
SD-1/3s 1000.0
Former Burn Pit
SS-28 113.0
SS-18 74.1
SS-05 21.8
SS-01 108.0
SO-4 92.6
SO-8s 83.9
SB37 57.6
SS-29 74.0
SB36 124.0
Office Building
FD-1 706.0
SU-01 483.0
OF-1 156.0
Green Line Subway
D.C. Lanham Area
SD-1/6s 132.0
MW01 49.0
SB27 41.2
SS-02 35.2
Wetland 2
SB42 49.7
Storm drain/ sump
SD-1/2D 1170.0
SD-1/1s 1210.0
PA-5 114.0
SS-04 31.7
Wetland 3
Stickfoot Sewer
SS-19 126.0
SS-09 52.5
WL02 46.7
MW05 66.5
SB28 223.0
SO-5D 64.3
SB30 58.3
Northern Greenhouses
SS-03 30.0
Former Fuel Pad
WL01 62.1
SB32 29.8
Chemical Storage Buildings
SB06 118.0
SB09 50.9
Storm drain /sump
Stickfoot sewer manhole
SB07 59.3
SS-08 565.0
SD-1/4s 173.0
SB31 30.8
SS-26 108.0
SB-5 61.1
SS-20 908.0
Former 275-gal diesel AST
SS-24 136.0
SB21 50.1
SS-27 29.9
SS-06 40.0
Site Entrance
SB-4 66.4
Green Fuel Oil Co.
SB08 57.3
SS-07 803.0
SS-25 1270.0
Pump house
SB26 52.9
SB20 57.3
MW06 67.8
SB25 43.0
Southern Greenhouses
SB23 71.5
SB33 132.0
Storm drain / sump
SS-21 92.4
Howard Rd.
B&L Auto
SB24 82.6
Boiler Room
SS-23 238.0
Former 300-gal vaulted AST
SO-7 52.1
SS-22 385.0
MW04 116.0
Anacostia Station Parking Deck
Former 10,000-gal fuel oil AST
P&P Auto
Howard Road Academy Property
SS-31 81.0
SS-30 55.0
SS-32 321.0

Figure H-12

Zinc in Surface Soil

Site Characterization Report
Poplar Point
Washington, D.C.

RIDOLFI Inc.

Zinc_map.mxd