Appendix I

Compliance Averaging Evaluations

Appendix I-1	**IRM #1 Compliance Averaging Evaluations**
Appendix I-2	**Phase 1B Compliance Averaging Evaluation**
Appendix I-3A	**Phase 1C Compliance Averaging Evaluations**
Appendix I-3B	**Phase 1C Compliance Averaging Evaluations Supplemental Information**
Appendix I-4	**Phase 2B-1 Compliance Averaging Evaluations**
Appendix I-5	**Phase 2B-3 Compliance Averaging Evaluations**
Appendix I-6	**Phase 2B-4 Compliance Averaging Evaluations**

Notes:

The Compliance Averaging Memoranda presented in this appendix are as approved by NJDEP by email as follows:

- IRM #1 on July 3, 2018
- Phase 1B on July 16, 2018
- Phase 1C on July 13, 2018
- Phase 2B-1 on July 13, 2018 (note that the delineation and compliance averaging sections have been modified from the approved version as requested by NJDEP)
- Phase 2B-3 on March 23, 2018
- Phase 2B-4 on March 26, 2018

Note that the property lines shown on the figures in this appendix are not updated to reflect the most recent survey which are included on the figures in Appendix D.

Notes (continued):

The Remedial Action Report Tables and Figures from Site 114 referenced in these memoranda are included in Appendix D of this *Remedial Action Report, Site 114 (AOC 114-1A, AOC 114-2, AOC 114-3, AOC 114-4A, AOC 114-4B, and AOC 114-5) Soil.*

The laboratory analytical reports and data validation reports from Site 114 referenced in these memoranda are included in Appendices F and G, respectively, of this *Remedial Action Report, Site 114 (AOC 114-1A, AOC 114-2, AOC 114-3, AOC 114-4A, AOC 114-4B, and AOC 114-5) Soil.*

I-1 IRM #1 Compliance Averaging Evaluations

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Memorandum

To	Wayne Howitz, NJDEP David Doyle, NJDEP Prabal Amin, WESTON Solutions Laura Amend Babcock, WESTON Solutions David Spader, ERFS Bhavini Doshi, City of Jersey City James D. Ray, MDMC-Law Nancy Colson, MDMC-Law	Page 1
CC	Jody Overmyer, PPG Mark Terril, PPG Rich Feinberg, PPG Joseph Lagrotteria, LeClairRyan Dorothy Laguzza, LeClairRyan Carolyn Scott, AECOM Aimee Ruiter, AECOM Kit Williams, AECOM	
Subject	PPG Site 114, IRM #1 Compliance Averaging for Antimony in Soil (Revision 1)	
From	Claire Hunt	
Date	June 11, 2018	

This memorandum provides documentation of attainment of compliance for antimony in soil with the 31 milligram per kilogram (mg/kg) residential direct contact site remediation standard (RDCSRS) for a site-specific soil sample set from Site 114, IRM #1 in accordance with the *New Jersey Department of Environmental Protection's (NJDEP) Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria (September 24, 2012, Version 1.0)*.

Introduction

Based on investigation and remediation, the following antimony concentration remains in place in excess of RDCSRS of 31 mg/kg at Site 114, IRM #1 when using single point compliance and for which applied compliance averaging was applied for the attainment of compliance:

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Antimony (mg/kg)
J4B	X20	114-X20F-16.5-17	16.5 - 17.0	-0.5 - -1.0	101

bgs below ground surface
ft foot or feet
mg/kg milligram per kilogram
NAVD88 North American Vertical Datum of 1988

This sample was collected from the top of the meadow mat (MM). **Figure 1** shows borings with antimony remaining in place, the phase boundary, and the location of the sample exceeding the antimony RDCSRS. Figure 1 also shows a sample in Site 114, Phase 2B-1 and a sample that is in Site 114, Phase 1A that are used for delineation The remaining-in-place results for antimony in IRM #1 are provided in Table 5-2 of the *Site 114, IRM #1 Remedial Action Report (RAR) Tables and Figures (Revision 3)* submittal, June 11, 2018. The antimony result for the sample located in Phase 1A was included in Table 5-2 of the *Site 114, Phase 1A Remedial Action Report (RAR) Tables and Figures (Revision 0)* submittal, October 5, 2017. The antimony result for the sample located in Phase 2B-1 was included in Table 5-2 of the *Site 114, Phase 2B-1 Remedial Action Report (RAR) Tables and Figures (Revision 1)* submittal, March 14, 2018.

Delineation

The antimony concentration in excess of the RDCSRS at one location at Site 114, IRM #1 is delineated as indicated in the table below by samples within the functional area to the east, west and vertically.

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	Antimony Result (mg/kg)	SDG	Direction
H2B	114-H2B	18.3 - 18.8	-2.5 - -3.0	4/8/2011	<0.21 UJ	JA72776	West
J4B	X20	17.5 - 18.0	-1.5 - -2.0	11/1/2005	<1.4 U	R2629753	Vertical
J5B	114-J5B	17.5 - 18.0	-1.5 - -2.0	3/23/2011	<0.36 U	JA71285	East

bgs below ground surface
ft foot or feet
mg/kg milligrams per kilogram
NAVD88 North American Vertical Datum of 1988
SDG sample delivery group
U The analyte was not detected above the sample reporting limit shown.
UJ The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

The antimony concentration in excess of the RDCSRS at one location at Site 114, IRM #1 is delineated as indicated in the table below by samples outside of the functional area to the north and south.

Grid ID	Location ID	Site 114 Phase of Work	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	Antimony Result (mg/kg)	SDG	Direction
E9B	114-E9B-IRM1	IRM #1	17.8 - 18.3	-2.2 - -2.7	1/11/2011	<0.59 UJ	JA65990	North
M1B	114-MN01B-PB	Phase 2B-1	13.4 - 13.9	-1.0 - -1.5	11/6/2013	0.51 J	JB52280	South

bgs	below ground surface
ft	foot or feet
mg/kg	milligrams per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group
U	The analyte was not detected above the sample reporting limit shown.
UJ	The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

Each of the samples used for horizontal delineation was collected at the MM or native material/historic fill interface. Laboratory reports and data validation reports for the delineation samples in Grids E9B, H2B, J4B, and J5B were included with the *Site 114, IRM #1 RAR Tables and Figures (Revision 1)* submittal, July 26, 2017. Laboratory reports and data validation reports for the delineation sample in Grid M1B was provided with the *Site 114, Phase 2B-1 RAR Tables and Figures (Revision 0)* submittal, November 8, 2017.

Functional Area

The antimony RDCSRS is based on the ingestion-dermal pathway (**Attachment 1**). The functional area for the ingestion-dermal pathway is limited to 0.25 acres for residential use. The extent of the functional area is the Site 114 boundary shown in **Figure 1**. The functional area is square. The functional area was centered on the exceedance, and then the location was adjusted to capture the western and eastern delineation samples and samples from boring E7 to the east. Remaining samples within the functional area extents were collected from deeper than 2 feet below ground surface and are considered a part of the functional area for the calculations.

Compliance Averaging

Compliance with the antimony RDCSRS can be attained through the arithmetic average because there are less than ten samples. The sample size is small within the functional area because most samples within the functional area were removed by excavation. The arithmetic mean method is more representative of the post-remedial conditions than the spatial averaging method due to the limited number of samples that remain in place. The selected samples are listed below. The sample selection process is as follows:

1. All of the samples for antimony with a sample status of remaining that fall within the functional area horizontally and vertically are identified (backfill samples are excluded).
2. All remaining samples are used in the arithmetic average. Zero is substituted for the method detection limit / reporting limit (MDL/RL) for non-detects.

For duplicate sample results, the higher of the sample or duplicate result is selected. Laboratory reports and data validation reports for the samples are included with the *Site 114, IRM #1 RAR Tables and Figures* (Revision 1) submittal, July 26, 2017. Laboratory reports and data validation reports for the samples located in Phase 1A were included in the *Site 114, Phase 1A Remedial Action Report (RAR) Tables and Figures (Revision 0)* submittal, October 5, 2017.

Grid ID	Location ID	Site 114 Phase of Work	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	SDG	Date Collected	Maximum Antimony Result (mg/kg)	Antimony Result Used in the Average (mg/kg)
H2B	114-H2B	IRM #1	18.3 - 18.8	-2.5 - -3	JA72776	4/8/2011	< 0.21 UJ	0
J4B	X20	IRM #1	16.5 - 17.0	-0.5 - -1.0	R2528632	11/1/2005	101	101
J4B	X20	IRM #1	17.5 - 18.0	-1.5 - -2.0	R2629753	11/1/2005	< 1.4 U	0
J5B	114-J5B	IRM #1	17.5 - 18.0	-1.5 - -2.0	JA71285	3/23/2011	< 0.36 U	0
K5B	E7	Phase 1A	28.0 - 28.5	-12.4 - -12.9	R2318307	9/4/2003	1.6 B	1.6
							Sum	102.6

bgs	below ground surface
ft	foot or feet
mg/kg	milligrams per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group
sf	square feet
U	The analyte was not detected above the sample reporting limit shown.
UJ	The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

Arithmetic Average Concentration = 102.6 mg/kg / 5 samples = 21 mg/kg

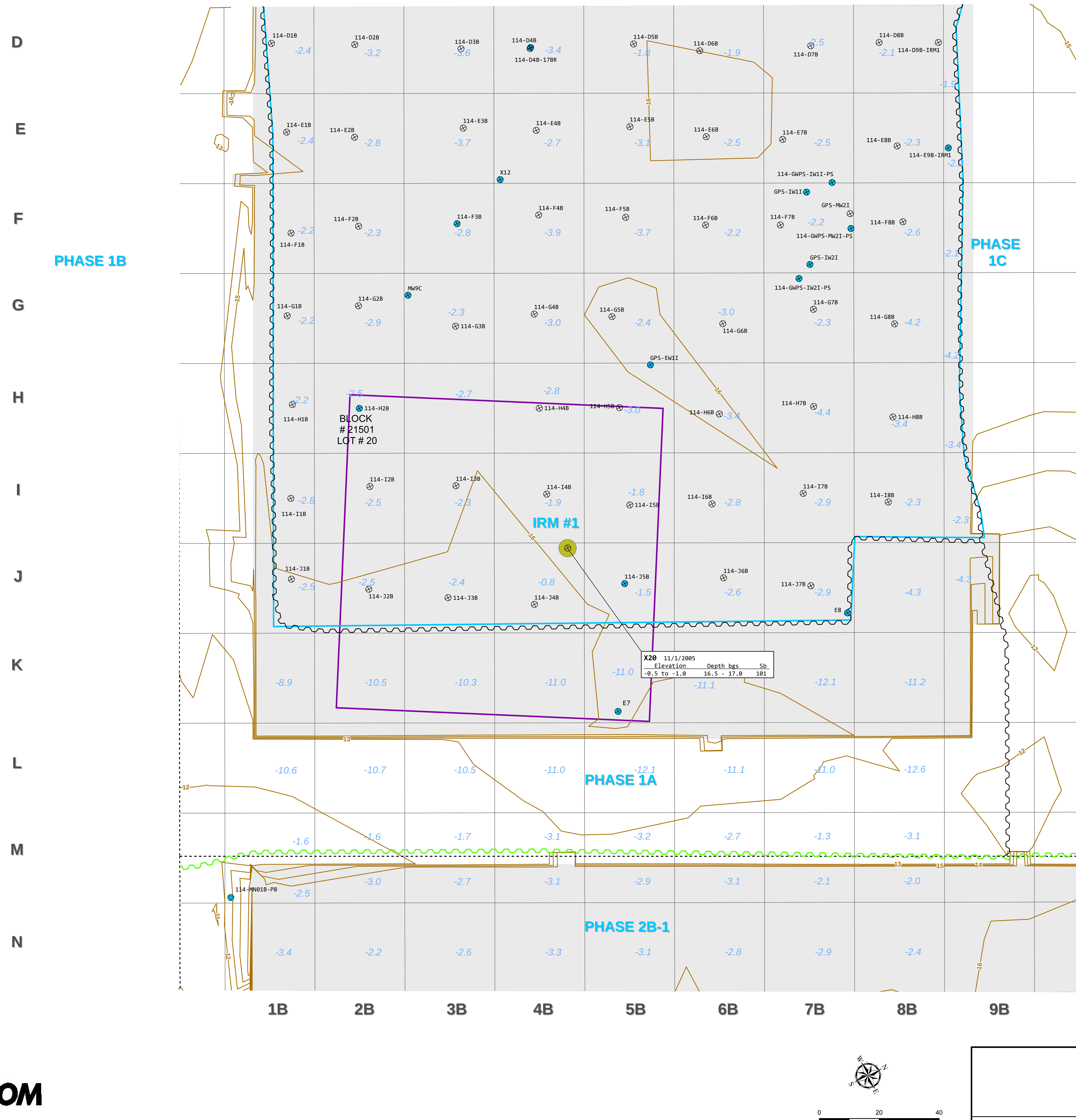
Conclusion

Based on the residential exposure scenario, the arithmetic average antimony concentration within the study area at sample 114-X20F-16.5-17 is 21 mg/kg, which is compliant with the 31 mg/kg RDCSRS.

Attachments:

Figure 1 Sample Map for Antimony Compared to Soil Remediation Standards and Functional Area

Attachment 1 NJDEP Environmental Criteria for Antimony



ABBREVIATIONS:

bgs - below ground surface

ft - feet

IRM - Interim Remedial Measure

mg/kg - milligrams per kilogram

N/A - not applicable

NAVD88 - North American Vertical Datum of 1988

NJDEP - New Jersey Department of Environmental Protection

NRDCSRS - New Jersey Department of Environmental Protection Non-Residential Direct Contact Soil Remediation Standard

RDCSRS - New Jersey Department of Environmental Protection Residential Direct Contact Soil Remediation Standard

RDCSRS-GAG - Residential Direct Contact Soil Remediation Standard - Garfield Avenue Group (alternative remediation standard approved by the New Jersey Department of Environmental Protection on December 28, 2016)

Sb - antimony

GENERAL NOTES:

G1. The antimony data associated with the sample locations shown on this figure are provided in Table 5-2. Data presented in call out boxes on this figure are outliers (i.e., data points that require further explanation). Specific notes for each outlier sample are provided in the Specific Notes in Table 5-2.

G2. “Elevation” refers to the sample elevation based on the pre-remediation surface elevation for samples collected from the pit bottom, and the surface elevation of the sample location when the sample was collected via boring or test pit.

G3. Elevation vertical datum is NAVD88, in U.S. survey ft.

G4. Results are reported in mg/kg.

G5. Source of block/lot information is Jersey City Parcel Data from New Jersey Geographic Information Network (NJGIN), last updated 10/6/2015 (available at: http://data.jerseycitynj.gov/dataset/jersey-city-parcel-polygon).

G6. This figure presents data for locations within the Phase boundary that have samples remaining in place. This figure also shows remaining locations in Site 114, Phase 1A that are located within the functional area and locations in Phase 2-B1 that are used for delineation.

SPECIFIC NOTES:

S1. Property lines and pre-construction topographical contours are sourced from the “Catch Basin-Receptor Evaluation Survey, PPG Site 114, City of Jersey City, Hudson County, New Jersey” prepared by Borbas Surveying and Mapping, LLC, dated April 19, 2011.

S2. As-built terminal excavation elevations were taken from the “Post Excavation Elevations Plan for ENTACT, LLC; PPG Site IRM1” produced by Maser Consulting P.A., dated 05/23/2017 with revisions.

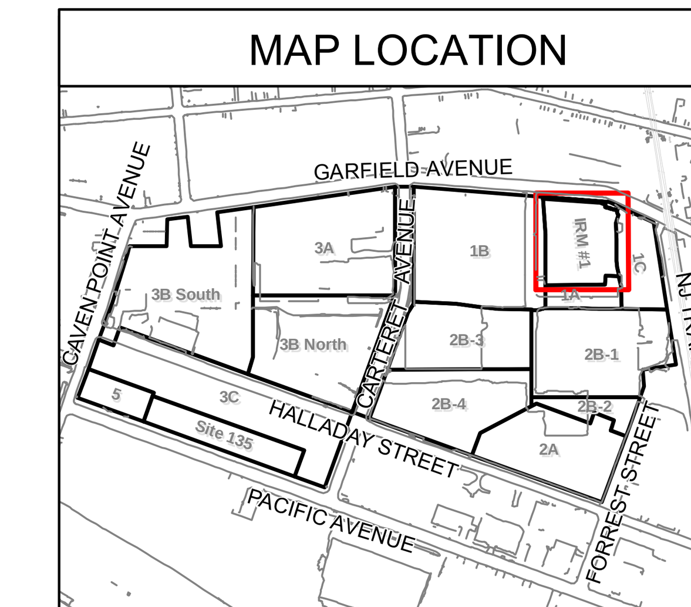
LEGEND

- REMAINING SAMPLES NOT ANALYZED FOR ANTIMONY
- SAMPLING LOCATION (REMAINING SAMPLES)
- SAMPLING LOCATION (REMOVED CONFIRMATION SAMPLES)
- RESULT IS BELOW THE MOST STRINGENT STANDARD
- RESULTS EXCEED THE MOST STRINGENT STANDARD, BUT ARE IN COMPLIANCE WITH REMEDIATION OBJECTIVES
- ANTIMONY (Sb)
- IN PLACE SHEET PILE (AS OF MAY 2018)
- REMOVED SHEET PILE
- PRE-REMEDIATION ELEVATION CONTOUR (1-FOOT INTERVAL IN FT NAVD88)
- PROPERTY LINE
- PHASE BOUNDARY
- 0.5 GRID LAYOUT WITH AS-BUILT TERMINAL EXCAVATION ELEVATIONS (FT NAVD88)
- FUNCTIONAL AREA
- FORMER BUILDING SLAB (AVERAGE ELEVATION 16.0 FT NAVD88)

Soil Remediation Standards (mg/kg)

Analyte	RDCSRS	RDCSRS-GAG	NRDCSRS
ANTIMONY	31	N/A	450

MAP LOCATION



AECOM

PPG
SITE 114
GARFIELD AVENUE GROUP
JERSEY CITY, NEW JERSEY

DATE: 05/14/2018

IRM #1
SAMPLE MAP FOR ANTIMONY COMPARED TO SOIL REMEDIATION STANDARDS AND FUNCTIONAL AREA

FIGURE 1

ATTACHMENT 1

NJDEP Environmental Criteria for Antimony

New Jersey Department of Environmental Protection

Standards for Drinking Water, Ground Water, Soil and Surface Water

Antimony (Total)

CAS #: 7440-36-0

Drinking Water Standards (µ g/l or ppb)

Standard: 6 **Type:** Primary FEDERAL MCL

Ground Water Quality Standards (µ g/l or ppb)

Standard: 6 **Type:** Specific

GW-Quality Criterion: 6

PQL: 3

Surface Water Quality Standards (µ g/l or ppb)

Fresh Water-

Human Health: 5.6(h)(T) **Aquatic-Acute:** **Aquatic-Chronic:**

Saline Water-

Human Health: 640(h)(T) **Aquatic-Acute:** **Aquatic-Chronic:**

Soil Standards (mg/kg)

Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 31 **Effective:** 6/2/2008 **Interim:** ☐

Ingestion Dermal: 31

Inhalation: 360,000

Soil PQL: 6

Non-Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 450 **Effective:** 6/2/2008 **Interim:** ☐

Ingestion Dermal: 450

Inhalation: 23,000

Soil PQL: 6

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Memorandum

To	Wayne Howitz, NJDEP David Doyle, NJDEP Prabal Amin, WESTON Solutions Laura Amend Babcock, WESTON Solutions David Spader, ERFS Bhavini Doshi, City of Jersey City James D. Ray, MDMC-Law Nancy Colson, MDMC-Law	Page 1
CC	Jody Overmyer, PPG Mark Terril, PPG Rich Feinberg, PPG Joseph Lagrotteria, LeClairRyan Dorothy Laguzza, LeClairRyan Carolyn Scott, AECOM Aimee Ruiter, AECOM Kit Williams, AECOM	
Subject	PPG Site 114, IRM #1 Compliance Averaging for Arsenic in Soil (Revision 1)	
From	Claire Hunt	
Date	June 11, 2018	

This memorandum provides the documentation of attainment of compliance for arsenic in soil with the 19 milligram per kilogram (mg/kg) Residential Direct Contact Soil Remediation Standard (RDCSRS) for a site-specific soil sample set from Site 114, Interim Remedial Measure (IRM) #1 in accordance with the New Jersey Department of Environmental Protection's (NJDEP) *Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria* (Attainment Guidance) (September 24, 2012, Version 1.0).

Introduction

Based on investigation and remediation, the following arsenic concentration remains in place in excess of the RDCSRS of 19 mg/kg at Site 114, IRM #1 when using single point compliance and for which compliance averaging was applied for the attainment of compliance:

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Arsenic (mg/kg)
J5B	114-J5B	114-J5B_18B	17.5 - 18.0	-1.5 - -2.0	19.3

bgs below ground surface
ft foot or feet
mg/kg milligrams per kilogram
NAVD88 North American Vertical Datum of 1988

Figure 1 shows borings with arsenic remaining in place within IRM #1, the phase boundary, and the location of the sample exceeding the arsenic RDCSRS. **Figure 1** also shows remaining locations in Site 114, Phase 1A that are located within the functional area or used for delineation and in Phase 2B-1 that are used for delineation. The remaining-in-place results for arsenic in IRM #1 are provided in Table 5-3 of the *Site 114, IRM #1 Remedial Action Report (RAR) Tables and Figures (Revision 3)* submittal, June 11, 2018. The remaining-in-place arsenic results for the samples located in Phase 1A were included in Table 5-3 of the *Site 114, Phase 1A Remedial Action Report (RAR) Tables and Figures (Revision 0)* submittal, October 5, 2017. The remaining-in-place arsenic results for the samples located in Phase 2B-1 were included in Table 5-3 of the *Site 114, Phase 2B-1 Remedial Action Report (RAR) Tables and Figures (Revision 1)* submittal, March 14, 2018.

Delineation

The arsenic concentration in excess of the RDCSRS at one location at Site 114, IRM #1 is horizontally delineated by samples in polygons intersecting the functional area as indicated in the table below.

Grid ID	Location ID	Site 114 Phase of Work	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	SDG	Date Collected	Arsenic Result (mg/kg)	Direction
H5B	GPS-EW1I	IRM #1	22.0 - 24.0	-8.2 - -10.2	JB47629A	9/17/2013	3.5	West
J4B	X20	IRM #1	16.5 - 17.0	-0.5 - -1.0	R2528632	11/1/2005	14.2	South
J7B	E8	IRM #1	20.0 - 20.5	-4.1 - -4.6	R2318189	8/27/2003	6.6 J	North
K5B	E7	Phase 1A	30.5 - 31.0	-14.9 - -15.4	R2318307	9/4/2003	0.59 J	East

bgs below ground surface
ft foot or feet
J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg milligrams per kilogram
NAVD88 North American Vertical Datum of 1988
SDG sample delivery group

In addition, outside of the functional area, there are samples to the northwest and east that are at the meadow mat (MM)/native material interface that are closer to the elevation of the exceedance. These samples are listed below.

Grid ID	Location ID	Site 114 Phase of Work	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Arsenic Result (mg/kg)	Direc-tion
E9B	114-E9B-IRM1	IRM #1	17.8 - 18.3	-2.2 - -2.7	1/11/2011	JA65990	7.7	North
N7B	114-MN6B7B-PB	Phase 2B-1	13.9 - 14.4	-2.9 - -3.4	10/28/2013	JB51379	5.4 J	East

bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligrams per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group

Laboratory reports and data validation reports for the delineation samples from IRM #1 were included with the *Site 114, IRM #1 Remedial Action Report (RAR) Tables and Figures (Revision 1)* submittal, July 26, 2017. The laboratory and data validation reports for the delineation sample located in Phase 1A were included in the *Site 114, Phase 1A Remedial Action Report (RAR) Tables and Figures (Revision 0)* submittal, October 5, 2017. The laboratory and data validation reports for the delineation sample located in Phase 2B-1 were provided with the *Site 114, Phase 2B-1 Remedial Action Report (RAR) Tables and Figures (Revision 0)* submittal, November 8, 2017.

With respect to vertical delineation, arsenic was not analyzed for in soil deeper than sample 114-J5B_18B, which was collected at the pit bottom. Vertical delineation has deviated from guidance since single-point compliance was not achievable. Vertical delineation is based on the lines of evidence presented below:

- The deepest remaining arsenic exceedance in soil in IRM #1 is from the sample of interest, 114-J5B_18B (Elevation [El.] -1.5 to -2.0 ft NAVD88).
- The arsenic concentration in soil was not detected or was less than the RDCSRS in 42 samples collected from 14 unique locations at elevations deeper than El. -2.0 ft NAVD88 in IRM #1 (see Table 5-3 of the *Site 114, IRM #1 Remedial Action Report (RAR) Tables and Figures (Revision 3)* submittal, June 11, 2018).
- As described in the *2012 Remedial Investigation Report – Soil, Garfield Avenue Group Non-Residential Chromate Chemical Production Waste Sites 114, 132, 133, 135, 137, 143 and 186*, Jersey City, New Jersey, (AECOM, 2012), arsenic exceedances throughout the Garfield Avenue Group were generally limited to fill material above MM or undisturbed native deposits (UND). The sample of interest (114-J5B_18B) was collected in the first instance of MM below historic fill and was likely impacted by historic fill. Excavation throughout IRM #1 was conducted to native material. Based on the historical results, there is no evidence that arsenic exceedances extend deeper than the native material/fill interface.

Functional Area

The arsenic RDCSRS is based on natural background (**Attachment 1**). The Attainment Guidance does not define a functional area size for criteria based on natural background. For compliance averaging compared to the RDCSRS, an area based on 0.25 acre is assumed. This area is smaller than the size defined for the inhalation pathway (0.5 acre) and more limiting for compliance area sample selection. The extent of the functional area is within the Site 114 boundary shown in

Figure 1. The functional area is square. The remaining samples within the functional area extents were collected from deeper than 2 feet below ground surface and are considered a part of the functional area for the calculation.

Compliance Averaging

Compliance with the arsenic RDCSRS is demonstrated through spatial averaging. Thiessen polygons were created within Site 114, IRM #1 and Phase 1A from all sample locations with remaining in place arsenic sample results. The functional area was intersected with the Thiessen polygons to capture as many representative locations with arsenic data as possible, as shown in **Figure 1**. The maximum concentration is selected at each sample location associated with a Thiessen polygon within the functional area for use in the weighted average. The maximum of the concentration for detections or the Method Detection Limit (MDL)/Reporting Limit (RL) for non-detects is selected.

Laboratory reports and data validation reports for the samples located in IRM #1 were included with the *Site 114, IRM #1 Remedial Action Report (RAR) Tables and Figures (Revision 1)* submittal, July 26, 2017. Laboratory reports and data validation reports for the samples located in Phase 1A were included in the *Site 114, Phase 1A Remedial Action Report (RAR) Tables and Figures (Revision 0)* submittal, October 5, 2017.

Grid ID	Location ID	Site 114 Phase of Work	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	SDG	Date Collected	Maximum Arsenic Result (mg/kg)	Area (sf)	Area x Maximum Arsenic Result (sf*mg/kg)
H2B	114-H2B	IRM#1	18.3 - 18.8	-2.5 - -3.0	JA72776	4/8/2011	16.3	76	1,239
H5B	GPS-EW1I	IRM#1	22.0 - 24.0	-8.2 - -10.2	JB47629A	9/17/2013	3.5	1,066	3,731
J4B	X20	IRM#1	16.5 - 17.0	-0.5 - -1.0	R2528632	11/1/2005	14.2	3,202	45,468
J5B	114-J5B	IRM#1	17.5 - 18.0	-1.5 - -2.0	JA71285	3/23/2011	19.3	2,666	51,454
J7B	E8	IRM#1	20.0 - 20.5	-4.1 - -4.6	R2318189	8/27/2003	6.6 J	927	6,118
K5B	E7	Phase 1A	30.5 - 31.0	-14.9 - -15.4	R2318307	9/4/2003	0.59 J	2,612	1,541
L7B	MW6B	Phase 1A	28.0 - 30.0	-15.0 - -17.0	R2319208	11/20/2003	3.1 UJ	372	1,153
							Total	10,921	110,704

bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligrams per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group
sf	square feet
UJ	The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

Weighted Average Concentration = 110,704 sf x mg/kg / 10,921 sf = 10 mg/kg

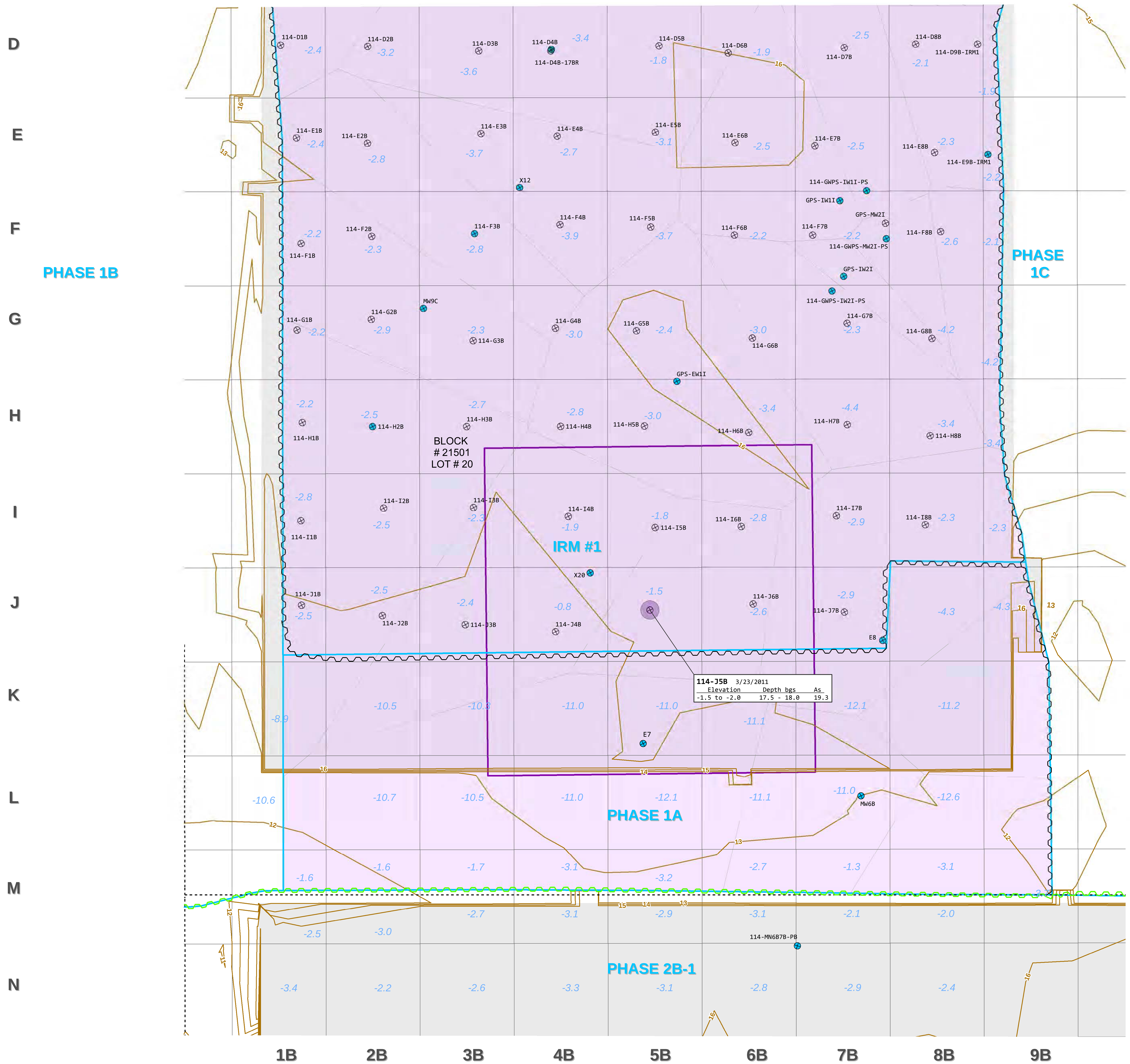
Conclusion

Based on the residential exposure scenario, the spatially weighted average arsenic concentration within the study area at sample 114-J5B_18B is 10 mg/kg, which is compliant with the 19 mg/kg RDCSRS.

Attachments:

Figure 1 Sample Map for Arsenic Compared to Soil Remediation Standards and Thiessen Polygons (RDCSRS)

Attachment 1 NJDEP Environmental Criteria for Arsenic



ABBREVIATIONS:

As - arsenic

bgs - below ground surface

ft - feet

IRM - Interim Remedial Measure

mg/kg - milligrams per kilogram

NAVD88 - North American Vertical Datum of 1988

NRDCSRS - New Jersey Department of Environmental Protection Non-Residential Direct Contact Soil Remediation Standard

RDCSRS - New Jersey Department of Environmental Protection Residential Direct Contact Soil Remediation Standard

GENERAL NOTES:

G1. The arsenic data associated with the sample locations shown on this figure are provided in Table 5-3. Data presented in call out boxes on this figure are outliers (i.e., data points that require further explanation). Specific notes for each outlier sample are provided in the Specific Notes in Table 5-3.

G2. "Elevation" refers to the sample elevation based on the pre-remediation surface elevation for samples collected from the pit bottom, and the surface elevation of the sample location when the sample was collected via boring or test pit.

G3. Elevation vertical datum is NAVD88, in U.S. survey ft.

G4. Results are reported in mg/kg.

G5. Source of block/lot information is Jersey City Parcel Data from New Jersey Geographic Information Network (NJGIN), last updated 10/6/2015 (available at: http://data.jerseycitynj.gov/dataset/jersey-city-parcel-polygon).

G6. This figure presents data for locations within the Phase boundary that have samples remaining in place. This figure also shows remaining locations in Site 114, Phase 1A that are located within the functional area and locations in Phase 2-B1 that are used for delineation.

SPECIFIC NOTES:

S1. Property lines and pre-construction topographical contours are sourced from the "Catch Basin-Receptor Evaluation Survey, PPG Site 114, City of Jersey City, Hudson County, New Jersey" prepared by Borbas Surveying and Mapping, LLC, dated April 19, 2011.

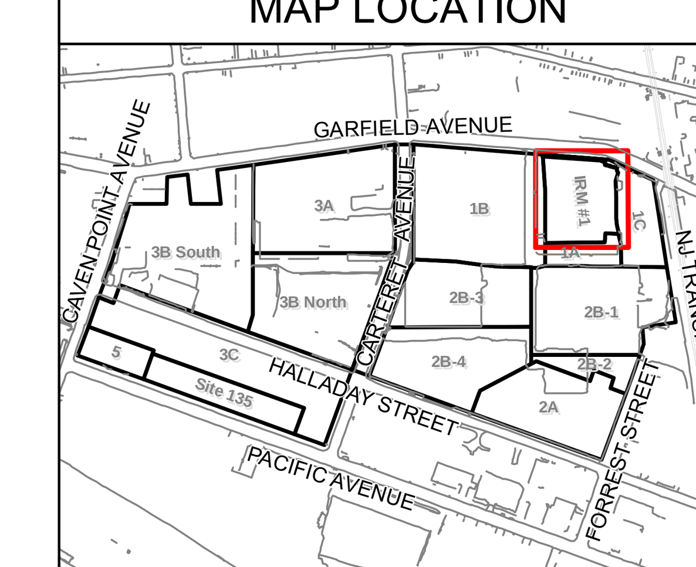
S2. As-built terminal excavation elevations were taken from the "Post Excavation Elevations Plan for ENTACT, LLC; PPG Site IRM1" produced by Maser Consulting P.A., dated 05/23/2017 with revisions.

LEGEND

- REMAINING SAMPLES NOT ANALYZED FOR ARSENIC
- SAMPLING LOCATION (REMAINING SAMPLES)
- RESULT IS BELOW THE MOST STRINGENT STANDARD
- RESULTS EXCEED THE MOST STRINGENT STANDARD, BUT ARE IN COMPLIANCE WITH REMEDIATION OBJECTIVES
- ARSENIC (As)
- IN PLACE SHEET PILE (AS OF MAY 2018)
- REMOVED SHEET PILE
- PROPERTY LINE
- PRE-REMEDIATION ELEVATION CONTOUR (1-FOOT INTERVAL IN FT NAVD88)
- PHASE BOUNDARY
- 0.5 GRID LAYOUT WITH AS-BUILT TERMINAL EXCAVATION ELEVATIONS (FT NAVD88)
- FUNCTIONAL AREA
- THIESSEN POLYGONS
- FORMER BUILDING SLAB (AVERAGE ELEVATION 16.0 FT NAVD88)

Soil Remediation Standards (mg/kg)		
Analyte	RDCSRS	NRDCSRS
ARSENIC	19	19

MAP LOCATION



0 20 40 Feet

AECOM

PPG
SITE 114
GARFIELD AVENUE GROUP
JERSEY CITY, NEW JERSEY

IRM #1
SAMPLE MAP FOR ARSENIC COMPARED TO SOIL REMEDIATION STANDARDS AND THIESSEN POLYGONS (RDCSRS)

DATE: 05/14/2018

FIGURE 1

ATTACHMENT 1

NJDEP Environmental Criteria for Arsenic

New Jersey Department of Environmental Protection

Standards for Drinking Water, Ground Water, Soil and Surface Water

Arsenic (Total)

CAS #: 7440-38-2

Drinking Water Standards (µ g/l or ppb)

Standard: 5 **Type:** Primary STATE MCL

Ground Water Quality Standards (µ g/l or ppb)

Standard: 3 **Type:** Specific

GW-Quality Criterion: 0.02

PQL: 3

Surface Water Quality Standards (µ g/l or ppb)

Fresh Water-

Human Health: 0.017(hc)(T) **Aquatic-Acute:** 340(d)(s) **Aquatic-Chronic:** 150(d)(s)

Saline Water-

Human Health: 0.061(hc)(T) **Aquatic-Acute:** 69(d)(s) **Aquatic-Chronic:** 36(d)(s)

Soil Standards (mg/kg)

Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 19* **Effective:** 6/2/2008 **Interim:** ☐

The direct contact standard for arsenic is based on natural background

Ingestion Dermal: 0.4

Inhalation: 980

Soil PQL: 1

Non-Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 19* **Effective:** 6/2/2008 **Interim:** ☐

The direct contact standard for arsenic is based on natural background

Ingestion Dermal: 2

Inhalation: 76

Soil PQL: 1

I-2 Phase 1B Compliance Averaging Evaluation

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Memorandum

To	Wayne Howitz, NJDEP	Page 1
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	Aimee Ruiter, AECOM	
	Kit Williams, AECOM	
Subject	PPG Site 114, Phase 1B	
	Compliance Averaging for Antimony in Soil (Revision 1 Supplemental)	
From	Claire Hunt	
Date	June 28, 2018	

This memorandum provides documentation of attainment of compliance for antimony in soil with the 31 milligram per kilogram (mg/kg) Residential Direct Contact Site Remediation Standard (RDCSRS) for a site-specific soil sample set from Site 114, Phase 1B in accordance with the New Jersey Department of Environmental Protection's (NJDEP) Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria (September 24, 2012, Version 1.0).

Introduction

This memorandum provides documentation of attainment of compliance for antimony with the 31 mg/kg RDCSRS for a site-specific soil sample set that includes one antimony exceedance in samples collected at Site 114, Phase 1B:

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Antimony (mg/kg)
D8A	114-RD2-D8A	114-RD2-D8A-12.6-13.1	12.6 - 13.1	1.1 - 0.6	86.2

bgs below ground surface
ft foot or feet
mg/kg milligram per kilogram
NAVD88 North American Vertical Datum of 1988

Figure 1 shows borings with remaining antimony data, the phase boundary, and the location of the samples exceeding the antimony RDCSRS. The remaining-in-place sample antimony results are provided in Table 5-2 of the *Site 114, Phase 1B Remedial Action Report (RAR) Tables and Figures (Revision 1 Supplemental)* submittal, June 28, 2018.

Delineation within the Functional Area

Within the functional area (as described below), the antimony sample exceedance of the RDCSRS is delineated. The nearby remaining delineation samples are listed below.

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	Antimony Result (mg/kg)	Direction
B8A	B-8A	114-B-8A-12.0	12.0 - 12.5	1.7 - 1.2	9/23/2011	0.46 U	Northwest
C9A	X1	114-X1E-13.2-13.7	13.2 - 13.7	0.3 - -0.2	10/3/2005	1.5 UJ	West
D8A	114-RD2-D8A	114-RD2-D8A-15.2-15.7	15.2 - 15.7	-1.5 - -2.0	9/26/2012	0.15 U	Vertical
E9A	B5S	B5S12.5-13	12.5 - 13.0	1.0 - 0.5	12/2/2003	0.43 U	South
E6A*	114-RD2-E6A	114-RD2-E6A-16.5-17.0	16.5 - 17.0	-3.0 - -3.5	9/28/2012	0.15 U	Northeast

bgs below ground surface
ft foot or feet
mg/kg milligram per kilogram
NAVD88 North American Vertical Datum of 1988
U The analyte was not detected above the sample reporting limit shown.
UJ The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate

*In addition, there is a removed sample in Grid E6A (114-RD2-E6A-12.0-12.5, El. 1.5 - 1.0 ft NAVD88), Sample Delivery Group [SDG] JB17722T) closer to the elevation of the antimony exceedance, with an antimony concentration of 30.1 mg/kg, which also serves as a delineation sample.

Functional Area

The size and shape of the functional area established to compare antimony RDCSRS are based on the ingestion-dermal pathway (**Attachment 1**). The functional area for the ingestion-dermal pathway is limited to 0.25 acres for residential exposure. The extent of the functional area is shown in **Figure 1**. Remaining samples within the functional area extents were collected from deeper than 2 feet below ground surface and are considered a part of the functional area for the calculations. The functional area is square. The functional area was positioned to capture surrounding sample locations and sample results approaching the RDCSRS.

Compliance Averaging

Compliance with the antimony RDCSRS is demonstrated through spatial averaging. Thiessen polygons were created within Site 114, Phase 1B from all sample locations with remaining-in-place antimony sample results. The functional area was intersected with the Thiessen polygons as shown in **Figure 1**. The maximum concentration is selected at each sample location associated with a Thiessen polygon within the functional area for use in the weighted average. The maximum of the concentration for detections or the Method Detection Limit (MDL)/Reporting Limit (RL) for non-detects is selected.

Laboratory reports and data validation reports for the samples are included with the *Site 114, Phase 1B RAR Tables and Figures (Revision 0)* submittal, January 18, 2018.

Grid ID	Location ID	Sample Depth (ft bgs)	Sample Elevation (ft NAVD88)	Lab SDG	Date Collected	Maximum Antimony Result (mg/kg)	Area (sf)	Area x Maximum Antimony Result (sf*mg/kg)
E5A	114-F6A	16.3 - 16.8	-3.0 - -3.5	JB4032U	4/12/2012	23.6	130	3,068
D8A	114-RD2-D8A	12.6 - 13.1	1.1 - 0.6	JB17455T	9/26/2012	86.2	1,648	142,058
E6A	114-RD2-E6A	16.5 - 17.0	-3 .0- -3.5	JB17722U	9/28/2012	0.15 U	404	61
D8A	114-SW-D8A	10.0 - 10.5	3.6 - 3.1	JB25559	1/4/2013	0.17 U	949	161
E6A	114-SW-E6A	16.5 - 17.0	-3.1 - -3.6	JB26057	1/10/2013	0.31 UJ	2,978	923
E9A	B5S	18.5 - 19.0	-5.0 - -5.5	R2319364	12/2/2003	1.1 UJ	784	862
B8A	B-8A	12.0 - 12.5	1.7 - 1.2	460315591	9/23/2011	0.46 U	2,389	1,099
A6A	MW1B	25.0 - 27.0	-13.0 - -15.0	R2319419	12/3/2003	0.35 U	601	210
C9A	X1	13.2 - 13.7	0.3 - -0.2	J11476	10/3/2005	1.5 UJ	1,038	1,557
						Total	10,921	149,999

bgs	below ground surface
ft	foot or feet
mg/kg	milligram per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group
sf	square feet
U	The analyte was not detected above the sample reporting limit shown.
UJ	The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

Weighted Average Concentration = 149,999 sf x mg/kg / 10,921 sf = 14 mg/kg

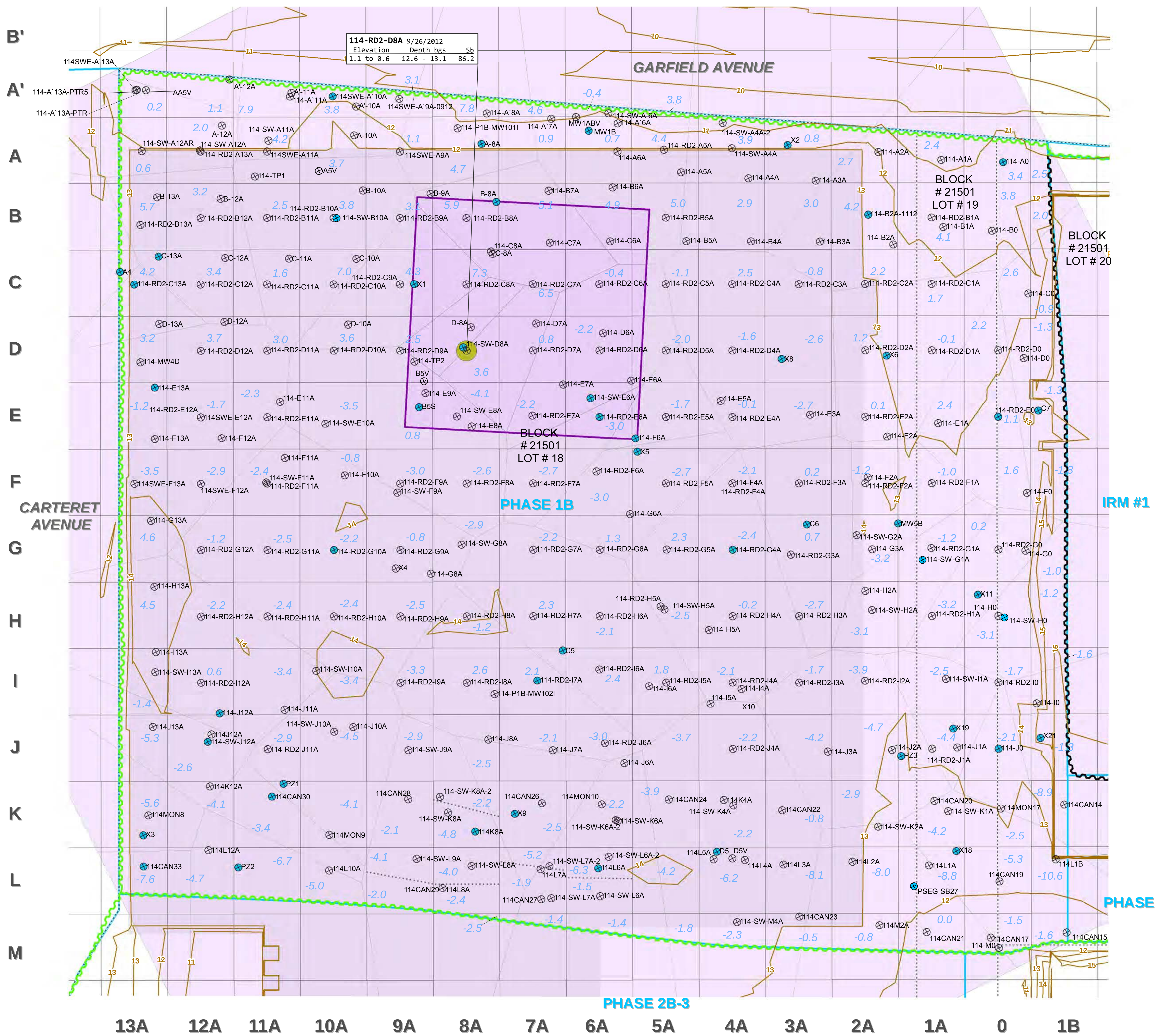
Conclusion

Based on the residential exposure scenario, the spatially weighted average antimony concentration within the study area at sample 114-RD2-D8A-12.6-13.1 is 14 mg/kg, which is compliant with the 31 mg/kg RDCSRS.

Attachments:

Figure 1 Sample Map for Antimony Compared to Soil Remediation Standards and Thiessen Polygons

Attachment 1 NJDEP Environmental Criteria for Antimony



ABBREVIATIONS:

bgs - below ground surface

ft - feet

mg/kg - milligrams per kilogram

N/A - not applicable

NAVD88 - North American Vertical Datum of 1988

NJDEP - New Jersey Department of Environmental Protection

NRDCSRS - New Jersey Department of Environmental Protection Non-Residential Direct Contact Soil Remediation Standard

RDCSRS - New Jersey Department of Environmental Protection Residential Direct Contact Soil Remediation Standard

RDCSRS-GAG - Residential Direct Contact Soil Remediation Standard - Garfield Avenue Group (alternative remediation standard approved by the New Jersey Department of Environmental Protection on December 28, 2016)

Sb - antimony

GENERAL NOTES:

G1. The antimony metals data associated with the sample locations shown on this figure are provided in Table 5-2. Data presented in call out boxes on this figure are outliers (i.e., data points that require further explanation). Specific notes for each outlier sample are provided in the Specific Notes in Table 5-2.

G2. “Elevation” refers to the sample elevation based on the pre-remediation surface elevation for samples collected from the pit bottom, and the surface elevation of the sample location when the sample was collected via boring or test pit.

G3. Elevation vertical datum is NAVD88, in U.S. survey ft.

G4. Results are reported in mg/kg.

G5. Source of block/lot information is Jersey City Parcel Data from New Jersey Geographic Information Network (NJGIN), last updated 10/6/2015 (available at: http://data.jerseycitynj.gov/dataset/jersey-city-parcel-polygon).

G6. This figure presents data for locations within the Site boundary that have samples remaining in place.

SPECIFIC NOTES:

S1. Property lines and pre-construction topographical contours are sourced from the “Catch Basin-Receptor Evaluation Survey, PPG Site 114, City of Jersey City, Hudson County, New Jersey” prepared by Borbas Surveying and Mapping, LLC, dated April 19, 2011.

S2. As-built terminal excavation elevations were taken from the “Post Excavation Elevations Plan for ENTACT, LLC; PPG Site 114, Phase 1B,” produced by Maser Consulting P.A., dated 04/27/2017 with revisions.

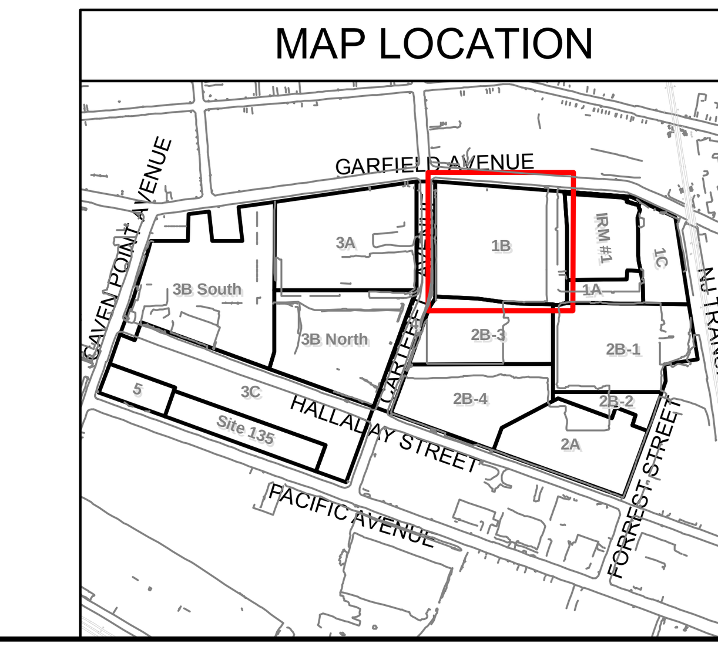
S3. In Grids A'11A, A'13A, A12A, B10A, C8A, D8A, E12A, F2A, F4A, F11A, H0, H5A, and K6A two or more sample locations are located adjacent; therefore, the sampling location symbols overlap on the figure.

LEGEND

- REMAINING SAMPLES NOT ANALYZED FOR ANTIMONY
- SAMPLING LOCATION (REMAINING SAMPLES)
- RESULT IS BELOW THE MOST STRINGENT STANDARD
- RESULTS EXCEED THE MOST STRINGENT STANDARD, BUT ARE IN COMPLIANCE WITH REMEDIATION OBJECTIVES
- ANTIMONY (Sb)
- IN PLACE SHEET PILE (AS OF JUNE 2018)
- REMOVED SHEET PILE
- PRE-REMEDIATION ELEVATION CONTOUR (1-FOOT INTERVAL IN FT NAVD88)
- PROPERTY LINE
- APPROXIMATE LOCATION OF GRID SPLIT
- PHASE BOUNDARY
- 0.5 GRID LAYOUT WITH AS-BUILT TERMINAL EXCAVATION ELEVATIONS (FT NAVD88)
- FORMER BUILDING SLAB (AVERAGE ELEVATION 13.5 FT NAVD88)
- FUNCTIONAL AREA
- THIESSEN POLYGONS

Soil Remediation Standards (mg/kg)			
Analyte	RDCSRS	RDCSRS-GAG	NRDCSRS
ANTIMONY	31	N/A	450

MAP LOCATION



0 20 40 60 Feet

AECOM

PPG
SITE 114
GARFIELD AVENUE GROUP
JERSEY CITY, NEW JERSEY

DATE: 06/14/2018

FIGURE 1
SAMPLE MAP FOR ANTIMONY
COMPARED TO SOIL REMEDIATION STANDARDS
AND THIESSEN POLYGONS

FIGURE 1

ATTACHMENT 1

NJDEP Environmental Criteria for Antimony

New Jersey Department of Environmental Protection

Standards for Drinking Water, Ground Water, Soil and Surface Water

Antimony (Total)

CAS #: 7440-36-0

Drinking Water Standards (µ g/l or ppb)

Standard: 6 **Type:** Primary FEDERAL MCL

Ground Water Quality Standards (µ g/l or ppb)

Standard: 6 **Type:** Specific

GW-Quality Criterion: 6

PQL: 3

Surface Water Quality Standards (µ g/l or ppb)

Fresh Water-

Human Health: 5.6(h)(T) **Aquatic-Acute:** **Aquatic-Chronic:**

Saline Water-

Human Health: 640(h)(T) **Aquatic-Acute:** **Aquatic-Chronic:**

Soil Standards (mg/kg)

Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 31 **Effective:** 6/2/2008 **Interim:** ☐

Ingestion Dermal: 31

Inhalation: 360,000

Soil PQL: 6

Non-Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 450 **Effective:** 6/2/2008 **Interim:** ☐

Ingestion Dermal: 450

Inhalation: 23,000

Soil PQL: 6

I-3-A Phase 1C Compliance Averaging Evaluations

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Memorandum

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	Jennifer Atkins, AECOM	
Subject	PPG Site 114, Phase 1C	
	Compliance Averaging for Antimony in Soil (Revision 1 Supplemental)	
From	Claire Hunt	
Date	June 20, 2018	

This memorandum provides documentation of attainment of compliance for antimony in soil with the 450 milligram per kilogram (mg/kg) non-residential direct contact site remediation standard (NRDCSRS) for a site-specific soil sample set from Site 114, Phase 1C in accordance with the New Jersey Department of Environmental Protection's (NJDEP) *Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria* (Attainment Guidance) (September 24, 2012, Version 1.0). Antimony in soil also exceeds the residential direct contact site remediation standard (RDCSRS), but this standard can only be partially attained by compliance averaging, using the iterative approach to spatial averaging in accordance with Appendix A, Section A3.0 of the *Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria*, as discussed later in the section on Compliance Averaging.

Introduction

This memorandum documents the use of compliance averaging to evaluate compliance for antimony with the 31 mg/kg RDCSRS and the 450 mg/kg NRDCSRS for a site-specific soil sample set that includes two antimony exceedances in samples collected at Site 114, Phase 1C:

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Antimony (mg/kg)
C9B	X14	114-X14F-17.3-17.8	17.3 - 17.8	-1.9 - -2.4	1,130
E12B	X22	114-X22F-16.6-17.1	16.6 - 17.1	-1.6 - -2.1	1,090

bgs below ground surface
ft foot or feet
mg/kg milligram per kilogram
NAVD88 North American Vertical Datum of 1988

Figure 1 shows borings with remaining antimony data, the phase boundary, and the location of the samples exceeding the antimony NRDCSRS. The remaining-in-place sample results for antimony are provided in Table 5-2 of the *Site 114, Phase 1C Remedial Action Report (RAR) Tables and Figures (Revision 1 Supplemental)* submittal, June 20, 2018.

Delineation

The delineation of antimony was implemented during the Remedial Investigation (RI) activities by PPG as documented in the *Remedial Investigation Report – Soil, Garfield Avenue Group Non-Residential Chromate Chemical Production Waste Sites 114, 132, 133, 135, 137, 143 and 186, Jersey City, New Jersey*, AECOM, February 2012 and conditionally approved by NJDEP on March 12, 2012.

Horizontal delineation was further refined during remedial action by the samples listed below and shown on **Figure 1**.

Sample 114-X14F-17.3-17.8

The antimony concentration in excess of the RDCSRS at location 114-X14F-17.3-17.8 within the functional area is delineated as follows.

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Antimony (mg/kg)	Direction
C9B	X14	114-X14G-21.8-22.3	21.8 - 22.3	-6.4 - -6.9	< 1.1 UJ	Vertical
C11B	114-C11B-PB	114-C11B-PB-13.5-14.0	13.5 - 14.0	-0.8 - -1.3	< 0.41 UJ	North
D9B	114-D9B-PB	114-D9B-PB-17.3-17.8	17.3 - 17.8	-2.4 - -2.9	< 0.44 UJ	East

bgs below ground surface
ft foot or feet

mg/kg	milligram per kilogram
NAVD88	North American Vertical Datum of 1988
UJ	The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

Sample 114-X14F-17.3-17.8 was collected in the top 0.5 feet (ft) of meadow mat (MM) encountered below historic fill. Each of the samples used for horizontal delineation was collected in the first interval of MM below historic fill. In the event that multiple samples were collected at a single location, the greater of the two results is shown. Laboratory reports and data validation reports for these samples are included with the *Site 114, Phase 1C RAR Tables and Figures (Revision 0)* submittal (AECOM, December 13, 2017).

There are no samples within the functional area to the south and west of sample 114-X14F-17.3-17.8. Delineation to the south is demonstrated by the following samples collected from Interim Remedial Measure (IRM) #1, as shown on **Figure 1**.

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Lab SDG	Antimony (mg/kg)	Sample Source
C5B	PZ12	114-PZ-12A-15-15.5	15.0 - 15.5	0.8 - 0.3	R2528367	29.6 J	Fill 2 ft above MM
C5B	PZ12	114-PZ-12B-19-19.5	19.0 - 19.5	-3.2 - -3.7	R2629753	21.5	2 ft below top of MM

bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligram per kilogram
MM	meadow mat
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group

In boring PZ12, although a sample was not collected from the top 0.5 ft of MM, the closest samples above and below the top of MM had antimony results below the RDCSRS, as shown in the table above. Therefore, it is reasonably inferred that antimony would not be present in the top 0.5 ft of MM at a concentration greater than the RDCSRS. Laboratory reports, data validation reports, and boring logs for these samples are included with the in the *IRM #1 RAR Tables and Figures (Revision 1)* submittal (AECOM, July 26, 2017).

Delineation to the west is demonstrated by the following borings in Garfield Avenue, as shown on **Figure 1**. Laboratory reports and data validation reports for these samples and their boring logs were included as Attachments 2 and 3 of *PPG Site 114, Phase 1C Compliance Averaging for Antimony in Soil (Revision 1)*, dated May 4, 2018.

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Lab SDG	Antimony (mg/kg)
A10B	GAR-PDI-A10B	GAR-PDI-A10B-8.0-8.5	8.0 - 8.5	3.8 - 3.3	JC37505A	< 0.39 U
A10B	GAR-PDI-A10B	GAR-PDI-A10B-10.0-10.5	10.0 - 10.5	1.8 - 1.3	JC37505A	< 0.40 U
A10B	GAR-PDI-A10B	GAR-PDI-A10B-10.0-10.5X	10.0 - 10.5	1.8 - 1.3	JC37505A	< 0.43 U
A10B	GAR-PDI-A10B	GAR-PDI-A10B-12.0-12.5	12.0 - 12.5	-0.2 - -0.7	JC37505A	< 0.37 U
A10B	GAR-PDI-A10B	GAR-PDI-A10B-14.0-14.5	14.0 - 14.5	-2.2 - -2.7	JC37505A	< 0.34 U
A'9B	EF-42	EF-B42-16.0	16.0 - 16.5	-4.5 - -5.0	460259551	< 0.92 UJ

bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligram per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group
U	The analyte was not detected above the sample reporting limit shown.
UJ	The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

In boring EF-42, MM was not observed and sample EF-B42-16.0 was collected from 0.5 ft below the top of undisturbed native deposits (UND); therefore, this sample provides delineation to the west. In addition in boring GAR-PDI-A10B, MM was not observed and the top of UND was shallower than in boring EF-42. Therefore, samples from this boring that span the interval from the top of UND to the elevation corresponding to the exceeding sample (El. -1.9 to -2.4 ft NAVD88) are included to provide supporting evidence of delineation to the west.

Sample 114-X22F-16.6-17.1

The antimony concentration in excess of the RDCSRS and NRDCSRS at o114-X22F-16.6-17.1 is delineated as indicated in the table below.

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Antimony (mg/kg)	Direction
C11B	114-C11B-PB	114-C11B-PB-13.5-14.0	13.5 - 14.0	-0.8 - -1.3	< 0.41 UJ	West
E12B	X22	114-X22G-20-20.5	20.0 - 20.5	-5.0 - -5.5	< 1.2 UJ	Vertical
F11B	114-F11B-PB	114-F11B-PB-17.2-17.7	17.2 - 17.7	-2.0 - -2.5	0.27 J	East
D9B	114-D9B-PB	114-D9B-PB-17.3-17.8	17.3 - 17.8	-2.4 - -2.9	<0.44 UJ	South

bgs	below ground surface
ft	foot or feet

J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligram per kilogram
NAVD88	North American Vertical Datum of 1988
UJ	The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

Sample 114-X22F-16.6-17.1 was collected in the top 0.5 ft of MM encountered below historic fill. Each of the samples used for horizontal delineation was collected in the first interval of MM below historic fill. In the event that multiple samples were collected at a single location, the greater of the two results is shown. Laboratory reports and data validation reports for these samples are included with the *Site 114, Phase 1C RAR Tables and Figures (Revision 0)* submittal, December 13, 2017.

As discussed in the Remedial Investigation Report – Soil, Garfield Avenue Group Non-Residential Chromate Chemical Production Waste Sites 114, 132, 133, 135, 137, 143 and 186, Jersey City, New Jersey, AECOM, February 2012 and conditionally approved by NJDEP on March 12, 2012, to the north Site 114, Phase 1C borders a New Jersey Transit Hudson-Bergen Light Rail right-of-way (Light Rail) that is being addressed by other parties. The area to the north of the Light Rail property (Berry Lane Park area) is being investigated and remediated under a separate effort. Therefore, a point by point delineation to the north is not applicable.

Functional Area

The size and shape of the functional areas established to compare antimony RDCSRS and NRDCSRS are based on the ingestion-dermal pathway (**Attachment 1**). The functional area for the ingestion-dermal pathway is limited to 0.25 acres for residential exposure and 2 acres for non-residential exposure. The entire Phase 1C area is less than 1 acre. The extent of the residential functional area is shown on **Figure 1**. For the non-residential exposure scenario, the extent of the functional area is the phase boundary shown in **Figure 2**. Remaining samples within the functional area extents were collected from deeper than 2 feet below ground surface and are considered a part of the functional area for the calculations.

Compliance Averaging

Compliance with the Antimony RDCSRS

Compliance with the antimony RDCSRS was attempted through spatial averaging. Thiessen polygons were created from sample locations with remaining-in-place antimony sample results in Site 114, Phase 1C, Interim Remedial Measure (IRM) #1, and Garfield Avenue along the Site 114, Phase 1C border. The functional area intersected with the Thiessen polygons to capture as many representative locations with antimony data as possible, as shown in **Figure 1**. The maximum concentration is selected at each sample location associated with a Thiessen polygon within the functional area for use in the weighted average. The maximum of the concentration for detections or the Method Detection Limit (MDL)/Reporting Limit (RL) for non-detects is selected.

Laboratory reports and data validation reports for the samples are included with the *Site 114, Phase 1C RAR Tables and Figures (Revision 0)* submittal, December 13, 2017 and the *IRM #1 RAR Tables and Figures (Revision 1)* submittal (AECOM, July 26, 2017).

Grid ID	Location ID	Sample Depth (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Maximum Antimony Result (mg/kg)	Area (sf)	Area x Maximum Antimony Result (sf*mg/kg)
C9B	114-C9B	22.0 - 22.5	-6.6 - -7.1	4/26/2012	JB5074R	2.1 J	761	1,598
C9B	X14	17.3 - 17.8	-1.9 - -2.4	10/6/2005	R2528199	1,130	551	622,630
C11B	114-C11B-PB	13.5 - 14.0	-0.8 - -1.3	10/17/2013	JB50487	0.41 UJ	2,271	931
D9B	114-D9B-PB	17.3 - 17.8	-2.4 - -2.9	10/17/2013	JB50487	0.44 UJ	1,766	777
E9B	D9	18.6 - 19.1	-2.9 - -3.4	12/8/2003	R2319419	0.38 U	1,747	664
E9B [a]	114-E9B-IRM1	17.8 - 18.3	-2.2 - -2.7	1/11/2011	JA65990	0.59 UJ	853	503
E12B	X22	16.6 - 17.1	-1.6 - -2.1	10/7/2005	R2528199	1,090	1,722	1,876,980
F11B	114-F11B-PB	17.2 - 17.7	-2.0 - -2.5	10/21/2013	JB50771A	0.27 J	956	258
						Total	10,627	2,504,342

bgs	below ground surface
ft	foot or feet
IRM	Interim Remedial Measure
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligram per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group
sf	square feet
U	The analyte was not detected above the sample reporting limit shown.
UJ	The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.
[a]	Location is from IRM #1

Weighted Average Concentration = 2,504,342 sf x mg/kg / 10,627 sf = 236 mg/kg

The weighted average concentration of 236 mg/kg exceeds the 31 mg/kg antimony RDCSRS.

Because the initial attempt at spatial averaging was not able to demonstrate compliance with the RDCSRS, an iterative approach to compliance averaging was used, as described in Appendix A, Section A3.0 of the *Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria*. The first step in the iteration process is to replace the most highly contaminated polygon with a fill or background concentration, and then recalculate the spatial average concentration. If the first iteration does not result in a spatially weighted average concentration less than the RDCSRS, then a second iteration of the calculations is performed by replacing the second highest concentration with a fill or background concentration. This iterative process of replacing the next highest concentration and recalculating the average is continued until the spatially weighted average concentration is less than the RDCSRS.

Antimony analytical data for backfill that was placed into Phase 1C in the functional area was evaluated, and the highest antimony backfill result reported (which included non-detect results with varying MDL/RL values) was chosen to use in the compliance averaging iteration process. Possible backfill sample antimony results were non-detect with MDL/RL ranging from 2.0 U mg/kg to 20 U mg/kg. Using the highest value will result in the most conservative average. The backfill result used is 20 U mg/kg from sample 114-BACKFILL-4-20131114A collected on 11/14/2013 (SDG JB53133A). A copy of this laboratory report was included in Attachment 2 of *PPG Site 114, Phase 1C Compliance Averaging for Antimony in Soil (Revision 1)*, dated May 4, 2018.

Iteration 1

For the first iteration, the highest concentration exceeding the RDCSRS (from location X14 in Grid C9B) was replaced using an estimated antimony concentration in backfill of 20 U mg/kg as discussed above. The weighted average antimony concentration is calculated below.

Grid ID	Location ID	Sample Depth (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Maximum Antimony Result (mg/kg)	Area (sf)	Area x Maximum Antimony Result (sf*mg/kg)
C9B	114-C9B	22.0 - 22.5	-6.6 - -7.1	4/26/2012	JB5074R	2.1 J	761	1,599
C9B [a]	114-BACKFILL-4-20131114A	N/A	N/A	11/14/2013	JB53133	20 U	551	11,022
C11B	114-C11B-PB	13.5 - 14.0	-0.8 - -1.3	10/17/2013	JB50487	0.41 UJ	2,271	931
D9B	114-D9B-PB	17.3 - 17.8	-2.4 - -2.9	10/17/2013	JB50487	0.44 UJ	1,766	777
E9B	D9	18.6 - 19.1	-2.9 - -3.4	12/8/2003	R2319419	0.38 U	1,747	664
E9B [b]	114-E9B-IRM1	17.8 - 18.3	-2.2 - -2.7	1/11/2011	JA65990	0.59 UJ	853	503
E12B	X22	16.6 - 17.1	-1.6 - -2.1	10/7/2005	R2528199	1,090	1,722	1,877,372
F11B	114-F11B-PB	17.2 - 17.7	-2.0 - -2.5	10/21/2013	JB50771A	0.27 J	956	258
						Total	10,627	1,893,126

bgs	below ground surface
ft	foot or feet
IRM	Interim Remedial Measure
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligram per kilogram
N/A	not applicable
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group
sf	square feet
U	The analyte was not detected above the sample reporting limit shown.
UJ	The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

[a] The backfill sample result from 114-BACKFILL-4-20131114A collected on 11/14/2013 was substituted for the antimony exceedance at location X14 in Grid C9B in this iteration of the compliance averaging calculations.
[b] Location is from IRM #1

Weighted Average Concentration = 1,893,126 sf x mg/kg / 10,627 sf = 178 mg/kg

The weighted average concentration of 178 mg/kg exceeds the 31 mg/kg antimony RDCSRS.

Iteration 2

A second iteration of the calculations was performed, substituting the backfill concentration for the antimony concentrations at sample location X14, El. -1.9 to -2.4 ft NAVD88 in Grid C9B and location X22, El. -1.6 to -2.1 ft NAVD88 in Grid E12B, as provided below.

Grid ID	Location ID	Sample Depth (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Maximum Antimony Result (mg/kg)	Area (sf)	Area x Maximum Antimony Result (sf*mg/kg)
C9B	114-C9B	22.0 - 22.5	-6.6 - -7.1	4/26/2012	JB5074R	2.1 J	761	1,599
C9BA [a]	114-BACKFILL-4-20131114A	N/A	N/A	11/14/2013	JB53133	20 U	551	11,022
C11B	114-C11B-PB	13.5 - 14.0	-0.8 - -1.3	10/17/2013	JB50487	0.41 UJ	2,271	931
D9B	114-D9B-PB	17.3 - 17.8	-2.4 - -2.9	10/17/2013	JB50487	0.44 UJ	1,766	777
E9B	D9	18.6 - 19.1	-2.9 - -3.4	12/8/2003	R2319419	0.38 U	1,747	664
E9B [b]	114-E9B-IRM1	17.8 - 18.3	-2.2 - -2.7	1/11/2011	JA65990	0.59 UJ	853	503
E12B [a]	114-BACKFILL-4-20131114A	N/A	N/A	11/14/2013	JB53133	20 U	1,722	34,447
F11B	114-F11B-PB	17.2 - 17.7	-2.0 - -2.5	10/21/2013	JB50771A	0.27 J	956	258
						Total	10,627	50,201

bgs below ground surface
ft foot or feet
IRM Interim Remedial Measure
J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg milligram per kilogram
NAVD88 North American Vertical Datum of 1988
N/A not applicable
SDG sample delivery group
sf square feet
U The analyte was not detected above the sample reporting limit shown.
UJ The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

[a] The backfill sample result from 114-BACKFILL-4-20131114A collected on 11/14/2013 was substituted for the antimony exceedances at locations X14 in Grid C9B and X22 in Grid E12B in this iteration of the compliance averaging calculations.
[b] Location is from IRM #1

Weighted Average Concentration = 50,201 sf x mg/kg / 10,627 sf = 4.7 mg/kg

The weighted average concentration of 4.7 mg/kg is below the 31 mg/kg antimony RDCSRS. Per the Attainment Guidance, for unrestricted use, the "removed" polygons would be remediated to the fill or background concentration used in the calculation of the area weighted mean concentration, in this case 20 mg/kg for antimony. However, the fill concentration used in this case is less than the RDCSRS (31 mg/kg), therefore, remediation would only be required to the RDCSRS. For limited restricted and restricted use, the "removed" polygons would be subject to institutional and possibly engineering controls, as well as a remedial action permit for soil. The outlines of these polygons are shown on **Figure 1**.

Compliance with the Antimony NRDCSRS

Compliance with the antimony NRDCSRS is demonstrated through spatial averaging. Thiessen polygons were created within the functional area as shown in **Figure 2**. The selected samples and associated Thiessen polygon areas are listed below. The sample selection process is as follows:

1. All of the samples for antimony with a sample status of remaining that fall within the functional area horizontally and vertically are identified (backfill samples are excluded).
2. The maximum concentration is selected at each sample location for use in the weighted average. The maximum of the concentration for detections or the MDL/RL for non-detects is selected.

Laboratory reports and data validation reports for the samples are included with the *Site 114, Phase 1C RAR Tables and Figures (Revision 0)* submittal, December 13, 2017.

Grid ID	Location ID	Sample Depth (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Maximum Antimony Result (mg/kg)	Area (sf)	Area x Maximum Antimony Result (sf*mg/kg)
C9B	114-C9B	22.0 - 22.5	-6.6 - -7.1	4/26/2012	JB5074R	2.1 J	594	1,247
C9B	X14	17.3 - 17.8	-1.9 - -2.4	10/6/2005	R2528199	1,130	621	701,730
C11B	114-C11B-PB	13.5 - 14.0	-0.8 - -1.3	10/17/2013	JB50487	0.41 UJ	2,314	949
D9B	114-D9B-PB	17.3 - 17.8	-2.4 - -2.9	10/17/2013	JB50487	0.44 UJ	1,521	669
E9B	D9	18.6 - 19.1	-2.9 - -3.4	12/8/2003	R2319419	0.38 U	2,985	1,134
E12B	X22	16.6 - 17.1	-1.6 - -2.1	10/7/2005	R2528199	1,090	3,705	4,038,450
F11B	114-F11B-PB	17.2 - 17.7	-2.0 - -2.5	10/21/2013	JB50771A	0.27 J	3,351	905
H9B	114-H9B-PB2	22.0 - 22.5	-8.0 - -8.5	11/6/2013	JB52296A	0.33 J	3,251	1,073

Grid ID	Location ID	Sample Depth (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Maximum Antimony Result (mg/kg)	Area (sf)	Area x Maximum Antimony Result (sf*mg/kg)
H11B	E9	27.5 - 28.0	-12.5 - -13.0	12/5/2003	R2319419	4.3 B	3,101	13,334
H13B	114-P1C-H13B	18.0 - 18.5	-3.0 - -3.5	8/20/2013	JB45233A	0.6 UJ	2,751	1,651
J10B	114-J10B-PB	16.2 - 16.7	-4.4 - -4.9	11/14/2013	JB53160A	0.35 J	2,055	719
J11B	114-J11B-PB	17.0 - 17.5	-4.3 - -4.8	11/14/2013	JB53160A	0.23 U	2,175	500
J13B	114-J13B-PB	16.5 - 17.0	-1.5 - -2.0	5/30/2014	JB68102A	0.51 U	2,364	1,206
K10B	X27	20.0 - 20.5	-7.5 - -8.0	10/7/2005	J18128	1.6 J	4,060	6,496
K12B	F9	27.5 - 28.0	-12.9 - -13.4	8/29/2003	R2318235	3.4 B	4,480	15,232
M14B	CHEM-5	15.0 - 17.0	0.5 - -1.5	5/3/2011	JA74890	0.31 J	1,081	335
M14B	EF-02	27.0 - 27.5	-11.7 - -12.2	4/28/2011	460258991	1.1 UJ	738	812
						Total	41,147	4,786,442

B	Indicates that the analyte was detected at a concentration less than the Practical Quantitation Limit but greater than or equal to the Instrument Detection Limit.
bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligram per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group
sf	square feet
U	The analyte was not detected above the sample reporting limit shown.
UJ	The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

Weighted Average Concentration = 4,786,442 sf x mg/kg / 41,147 sf = 116 mg/kg

The weighted average concentration of 116 mg/kg is below the 450 mg/kg antimony NRDCSRS.

Conclusion

Based on the non-residential exposure scenario, the spatially weighted average antimony concentration within the study area at samples 114-X22F-16.6-17.1 and 114-X14F-17.3-17.8 is 116 mg/kg, which is compliant with the 450 mg/kg NRDCSRS.

However, for the residential exposure scenario, initial calculation of the spatially weighted average antimony concentration within the study area at samples 114-X22F-16.6-17.1 and 114-X14F-17.3-17.8 is 236 mg/kg, which is not compliant with the 31 mg/kg RDCSRS. An iterative approach to the compliance averaging was used to remove both samples exceeding the RDCSRS and substitute a backfill concentration from Phase 1C backfill sample results, resulting in a spatially weighted

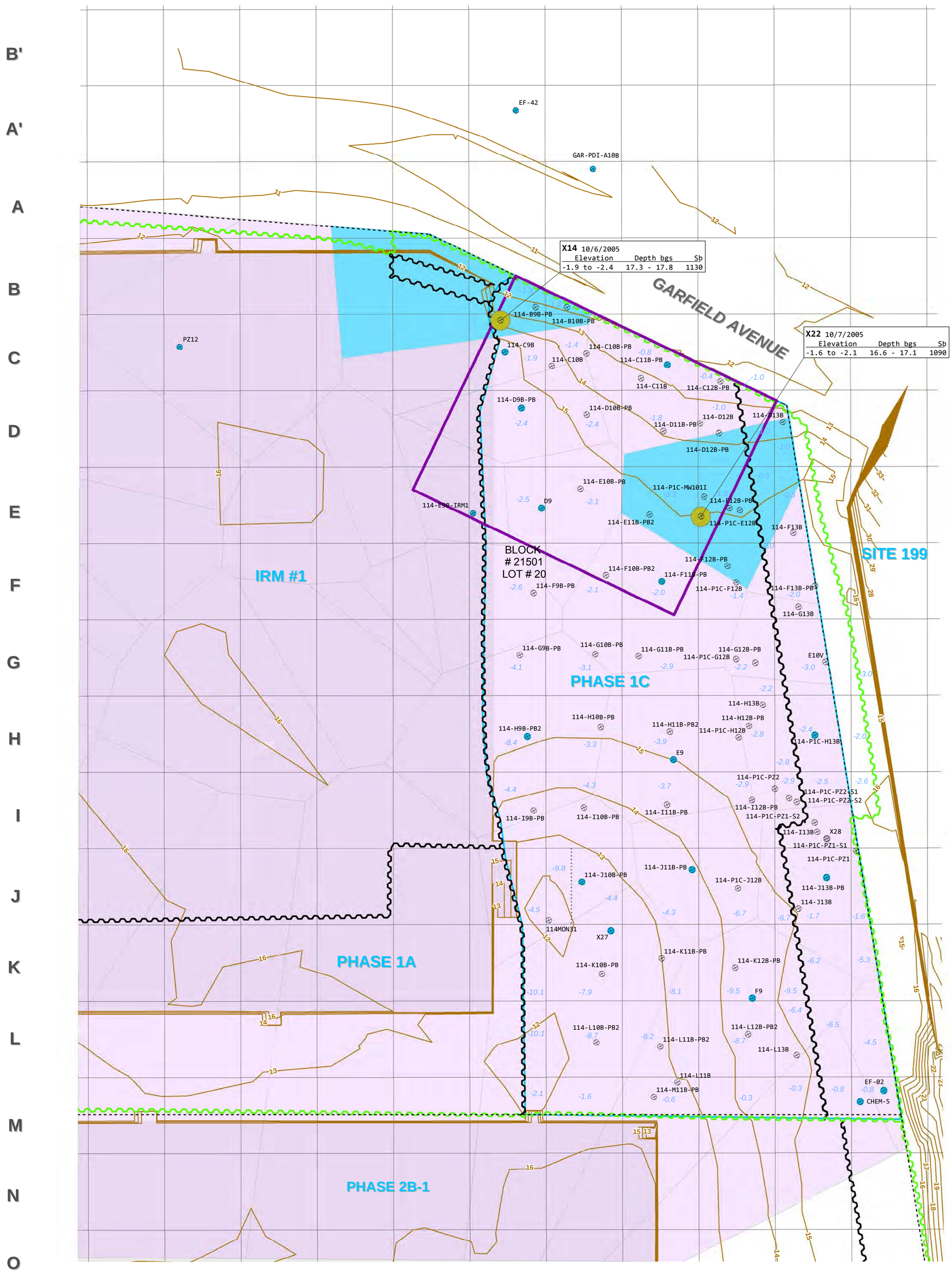
average concentration of 4.7 mg/kg, which is compliant with the 31 mg/kg antimony RDCSRS. Per the Attainment Guidance, for unrestricted use, the “removed” polygons would be remediated to the fill or background concentration used in the calculation of the area weighted mean concentration, in this case 20 mg/kg for antimony. However, the fill concentration used in this case is less than the RDCSRS (31 mg/kg), therefore, remediation would only be required to the RDCSRS. The outlines of these polygons are shown on **Figure 1**. Because the area will be zoned residential for future use, restricted use will apply to the “removed” polygon areas and they will be subject to engineering controls and institutional controls as well as a remedial action permit for soil.

Attachments:

Figure 1 Sample Map for Antimony Compared to Soil Remediation Standards and Functional Area (RDCSRS)

Figure 2 Sample Map for Antimony Compared to Soil Remediation Standards and Functional Area (NRDCSRS)

Attachment 1 NJDEP Environmental Criteria for Antimony



ABBREVIATIONS:

bgs - below ground surface

ft - feet

IRM - Interim Remedial Measure

mg/kg - milligrams per kilogram

N/A - not applicable

NAVD88 - North American Vertical Datum of 1988

NRDCSRS - New Jersey Department of Environmental Protection Non-Residential Direct Contact Soil Remediation Standard

RDCSRS - New Jersey Department of Environmental Protection Residential Direct Contact Soil Remediation Standard

RDCSRS-GAG - Residential Direct Contact Soil Remediation Standard - Garfield Avenue Group (alternative remediation standard approved by the New Jersey Department of Environmental Protection on December 28, 2016)

Sb - antimony

GENERAL NOTES:

G1. The antimony data associated with the sample locations shown on this figure are provided in Table 5-2. Data presented in call out boxes on this figure are outliers (i.e., data points that require further explanation). Specific notes for each outlier sample are provided in the Specific Notes in Table 5-2.

G2. "Elevation" refers to the sample elevation based on the pre-remediation surface elevation for samples collected from the pit bottom, and the surface elevation of the sample location when the sample was collected via boring or test pit.

G3. Elevation vertical datum is NAVD88, in U.S. survey ft.

G4. Results are reported in mg/kg.

G5. Source of block/lot information is Jersey City Parcel Data from New Jersey Geographic Information Network (NJGIN), last updated 10/6/2015 (available at: http://data.jerseycitynj.gov/dataset/jersey-city-parcel-polygon).

G6. This figure presents data for locations within the phase boundary that have samples remaining in place. In addition, this figure includes only the off-site locations in IRM #1 and the Garfield Avenue right-of-way that are within the functional area or are used to demonstrate delineation.

SPECIFIC NOTES:

S1. Property lines and pre-construction topographical contours are sourced from the "Catch Basin-Receptor Evaluation Survey, PPG Site 114, City of Jersey City, Hudson County, New Jersey" prepared by Borbas Surveying And Mapping, LLC, dated April 19, 2011.

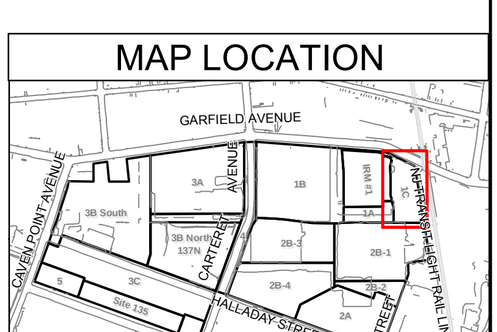
S2. As-built terminal excavation elevations were taken from the "PPG - Jersey City Phase 1C Excavation Status," produced by ENTACT, dated 07/09/2014 with revisions.

S3. In Grid I13B, two sample locations are located adjacent; therefore, the sampling location symbols overlap on the figure.

S4. During the Phase 1C work, excavation was conducted to the northernmost sheet pile, part of which was located beyond the Site 114, Phase 1C boundary, as shown on this figure. However, data from beyond the Phase 1C boundary is not included on this figure.

S5. In Grids C12B, D12B, E12B, F12B, G13B, H13B, I13B, J13B, K13B, L13B, and M13B, temporary sheet pile was used to facilitate excavation. The as-built terminal excavation elevation for each side of the temporary sheet pile is shown in these grids.

MAP LOCATION



AECOM

PPG
SITE 114
GARFIELD AVENUE GROUP
JERSEY CITY, NEW JERSEY

Date: 6/18/2018

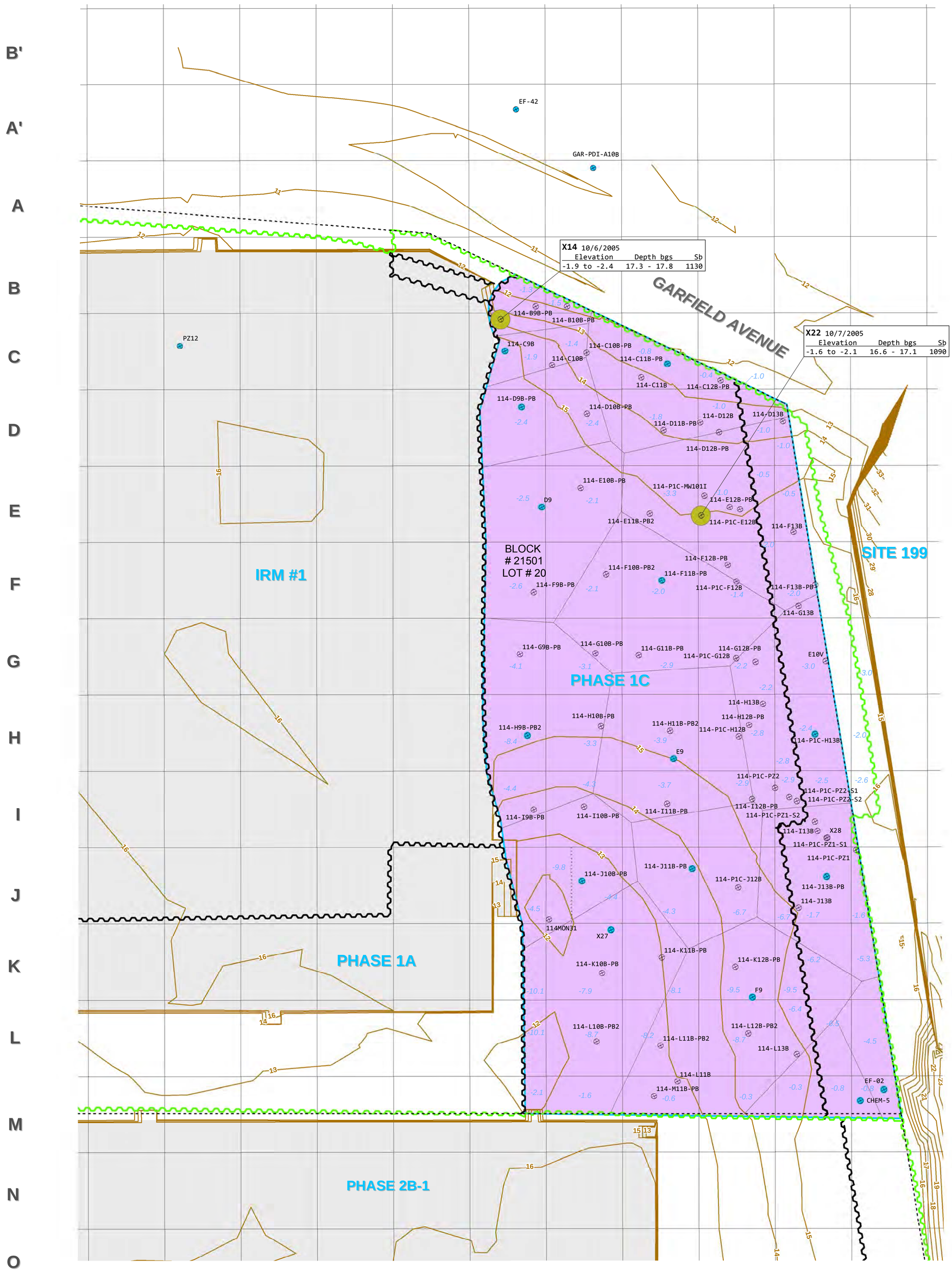
PHASE 1C
SAMPLE MAP FOR ANTIMONY
COMPARED TO SOIL REMEDIATION STANDARDS
AND FUNCTIONAL AREA (RDCSRS)

FIGURE 1

LEGEND

- SAMPLING LOCATION (REMAINING SAMPLES)
- REMAINING SAMPLES NOT ANALYZED FOR ANTIMONY
- RESULT IS BELOW THE MOST STRINGENT STANDARD
- RESULTS EXCEED THE MOST STRINGENT STANDARD, BUT IS IN COMPLIANCE WITH THE NRDCSRS
- ANTIMONY (Sb)
- IN PLACE SHEET PILE (AS OF MAY 2018)
- REMOVED SHEET PILE
- PRE-REMEDIATION ELEVATION CONTOUR (1-FOOT INTERVAL IN FT NAVD88)
- PROPERTY LINE
- APPROXIMATE LOCATION OF GRID SPLIT
- GRID LAYOUT WITH AS-BUILT TERMINAL EXCAVATION ELEVATIONS (FT NAVD88) (5.6)
- PHASE BOUNDARY
- FORMER BUILDING SLAB
- FUNCTIONAL AREA WITH THEISSEN POLYGONS

Soil Remediation Standards (mg/kg)			
Analyte	RDCSRS	RDCSRS-GAG	NRDCSRS
ANTIMONY	31	N/A	450



ABBREVIATIONS:

bgs - below ground surface

ft - feet

IRM - Interim Remedial Measure

mg/kg - milligrams per kilogram

N/A - not applicable

NAVD88 - North American Vertical Datum of 1988

NRDCSRS - New Jersey Department of Environmental Protection Non-Residential Direct Contact Soil Remediation Standard

RDCSRS - New Jersey Department of Environmental Protection Residential Direct Contact Soil Remediation Standard

RDCSRS-GAG - Residential Direct Contact Soil Remediation Standard - Garfield Avenue Group (alternative remediation standard approved by the New Jersey Department of Environmental Protection on December 28, 2016)

Sb - antimony

GENERAL NOTES:

G1. The antimony data associated with the sample locations shown on this figure are provided in Table 5-2. Data presented in call out boxes on this figure are outliers (i.e., data points that require further explanation). Specific notes for each outlier sample are provided in the Specific Notes in Table 5-2.

G2. "Elevation" refers to the sample elevation based on the pre-remediation surface elevation for samples collected from the pit bottom, and the surface elevation of the sample location when the sample was collected via boring or test pit.

G3. Elevation vertical datum is NAVD88, in U.S. survey ft.

G4. Results are reported in mg/kg.

G5. Source of block/lot information is Jersey City Parcel Data from New Jersey Geographic Information Network (NJGIN), last updated 10/6/2015 (available at: http://data.jerseycitynj.gov/dataset/jersey-city-parcel-polygon).

G6. This figure presents data for locations within the phase boundary that have samples remaining in place. In addition, this figure includes only the off-site locations in IRM #1 and the Garfield Avenue right-of-way that are within the functional area or are used to demonstrate delineation.

SPECIFIC NOTES:

S1. Property lines and pre-construction topographical contours are sourced from the "Catch Basin-Receptor Evaluation Survey, PPG Site 114, City of Jersey City, Hudson County, New Jersey" prepared by Borbas Surveying And Mapping, LLC, dated April 19, 2011.

S2. As-built terminal excavation elevations were taken from the "PPG - Jersey City Phase 1C Excavation Status," produced by ENTACT, dated 07/09/2014 with revisions.

S3. In Grid I13B, two sample locations are located adjacent; therefore, the sampling location symbols overlap on the figure.

S4. During the Phase 1C work, excavation was conducted to the northernmost sheet pile, part of which was located beyond the Site 114, Phase 1C boundary, as shown on this figure. However, data from beyond the Phase 1C boundary is not included on this figure.

S5. In Grids C12B, D12B, E12B, F12B, G13B, H13B, I13B, J13B, K13B, L13B, and M13B, temporary sheet pile was used to facilitate excavation. The as-built terminal excavation elevation for each side of the temporary sheet pile is shown in these grids.

MAP LOCATION

AECOM

0 15 30 45 60 Feet

PPG
SITE 114
GARFIELD AVENUE GROUP
JERSEY CITY, NEW JERSEY

Date: 5/3/2018

PHASE 1C
SAMPLE MAP FOR ANTIMONY
COMPARED TO SOIL REMEDIATION STANDARDS
AND FUNCTIONAL AREA (NRDCSRS)

FIGURE 2

ATTACHMENT 1

NJDEP Environmental Criteria for Antimony

New Jersey Department of Environmental Protection

Standards for Drinking Water, Ground Water, Soil and Surface Water

Antimony (Total)

CAS #: 7440-36-0

Drinking Water Standards (µ g/l or ppb)

Standard: 6 **Type:** Primary FEDERAL MCL

Ground Water Quality Standards (µ g/l or ppb)

Standard: 6 **Type:** Specific

GW-Quality Criterion: 6

PQL: 3

Surface Water Quality Standards (µ g/l or ppb)

Fresh Water-

Human Health: 5.6(h)(T) **Aquatic-Acute:** **Aquatic-Chronic:**

Saline Water-

Human Health: 640(h)(T) **Aquatic-Acute:** **Aquatic-Chronic:**

Soil Standards (mg/kg)

Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 31 **Effective:** 6/2/2008 **Interim:** ☐

Ingestion Dermal: 31

Inhalation: 360,000

Soil PQL: 6

Non-Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 450 **Effective:** 6/2/2008 **Interim:** ☐

Ingestion Dermal: 450

Inhalation: 23,000

Soil PQL: 6

AECOM
250 Apollo Drive
Chelmsford, MA 01824

978.905.2100 tel
978.905.2101 fax

Memorandum

To	Wayne Howitz, NJDEP David Doyle, NJDEP Prabal Amin, WESTON Solutions, Inc. Laura Amend Babcock, WESTON Solutions, Inc. David Spader, ERFS Bhavini Doshi, City of Jersey City James D. Ray, MDMC-Law Nancy Colson, MDMC-Law	Page 1
CC	Jody Overmyer, PPG Mark Terril, PPG Rich Feinberg, PPG Joseph Lagrotteria, LeClairRyan Dorothy Laguzza, LeClairRyan Carolyn Scott, AECOM Aimee Ruiter, AECOM Jennifer Atkins, AECOM	
Subject	PPG Site 114, Phase 1C Compliance Averaging for Arsenic in Soil (Revision 0 Supplemental)	
From	Claire Hunt	
Date	June 20, 2018	

This memorandum provides the rationale used to determine compliance for arsenic in soil with the New Jersey Department of Environmental Protection (NJDEP) Residential Direct Contact Site Remediation Standards (RDCSRS) for a site-specific soil sample set from Site 114, Phase 1C in accordance with the NJDEP *Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria* (Attainment Guidance) (September 24, 2012, Version 1.0).

Introduction

This memorandum documents the use of compliance averaging to evaluate compliance for arsenic with the 19 milligrams per kilogram (mg/kg) RDCSRS for a site-specific soil sample set that includes two arsenic sample results that were non-detect for arsenic but with a reporting limit greater than the RDCSRS collected at Site 114, Phase 1C:

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Arsenic (mg/kg)
C9B	X14	114-X14F-17.3-17.8	17.3 - 17.8	-1.9 - -2.4	44.9 UJ
E12B	X22	114-X22F-16.6-17.1	16.6 - 17.1	-1.6 - -2.1	45.4 UJ

bgs below ground surface
ft foot or feet
mg/kg milligrams per kilogram
NAVD88 North American Vertical Datum of 1988
UJ The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

Figure 1 shows borings with remaining arsenic data, the site boundary, and the location of the non-detect samples with reporting limits exceeding the arsenic RDCSRS. The in-place sample results for arsenic are provided in Table 5-3 of the *Site 114, Phase 1C Remedial Action Report (RAR) Tables and Figures (Revision 1)* submittal, May 4, 2018.

Delineation

The delineation of arsenic was implemented during the Remedial Investigation (RI) activities by PPG as documented in the *Remedial Investigation Report – Soil, Garfield Avenue Group Non-Residential Chromate Chemical Production Waste Sites 114, 132, 133, 135, 137, 143 and 186, Jersey City, New Jersey*, AECOM, February 2012 and conditionally approved by NJDEP on March 12, 2012.

Horizontal delineation was further refined during remedial action by the samples listed below and shown on **Figure 1**.

Sample 114-X14F-17.3-17.8

Sample 114-X14F-17.3-17.8 was collected in the top 0.5 ft of meadow mat (MM) encountered below historic fill. Each of the samples used for horizontal delineation was collected in the first interval of MM below historic fill. These samples are located within the functional area. In the event that multiple samples were collected at a single location, the greater of the two results is shown. Laboratory reports and data validation reports for these samples are included with the *Site 114, Phase 1C RAR Tables and Figures (Revision 0)* submittal (AECOM, December 13, 2017).

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	Arsenic Result (mg/kg)	Direction
C9B	X14	114-X14G-21.8-22.3	21.8 - 22.3	-6.4 - -6.9	10/6/2005	3.2	Vertical
C11B	114-C11B-PB	114-C11B-PB-13.5-14.0	13.5 - 14.0	-0.8 - -1.3	10/17/2013	4.9 [a]	North
D9B	114-D9B-PB	114-D9B-PB-17.3-17.8	17.3 - 17.8	-2.4 - -2.9	10/17/2013	4.2	East

bgs below ground surface
FD field duplicate sample

ft	foot or feet
mg/kg	milligrams per kilogram
NAVD88	North American Vertical Datum of 1988
[a]	Result is from field duplicate sample

There are no samples within the functional area to the south or west of 114-X14F-17.3-17.8. Delineation to the south is demonstrated by the following post-excavation pit bottom sample from IRM #1 collected from MM, as shown on **Figure 1**.

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Lab SDG	Arsenic (mg/kg)
D4B	114-D4B	114-D4B-17B	19.3 - 19.8	-3.4 - -3.9	JA64477	4.9

bgs	below ground surface
ft	foot or feet
mg/kg	milligram per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group

The laboratory report and data validation report for this sample is included in the *IRM #1 RAR Tables and Figures (Revision 1)* submittal (AECOM, July 26, 2017).

Delineation to the west is demonstrated by the following borings in Garfield Avenue, as shown on **Figure 1**. Laboratory reports and data validation reports for these samples and their boring logs were included as Attachments 3 and 4 of *PPG Site 114, Phase 1C Compliance Averaging for Arsenic in Soil (Revision 0)*, dated May 4, 2018.

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Lab SDG	Arsenic (mg/kg)
A10B	GAR-PDI-A10B	GAR-PDI-A10B-8.0-8.5	8.0 - 8.5	3.8 - 3.3	JC37505A	4.7
A10B	GAR-PDI-A10B	GAR-PDI-A10B-10.0-10.5	10.0 - 10.5	1.8 - 1.3	JC37505A	3.8
A10B	GAR-PDI-A10B	GAR-PDI-A10B-10.0-10.5X	10.0 - 10.5	1.8 - 1.3	JC37505A	4.3
A10B	GAR-PDI-A10B	GAR-PDI-A10B-12.0-12.5	12.0 - 12.5	-0.2 - -0.7	JC37505A	3.8
A10B	GAR-PDI-A10B	GAR-PDI-A10B-14.0-14.5	14.0 - 14.5	-2.2 - -2.7	JC37505A	2.7
A'9B	EF-42	EF-B42-16.0	16.0 - 16.5	-4.5 - -5.0	460259551	9.6

bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligram per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group

In boring EF-42, MM was not observed and sample EF-B42-16.0 was collected from 0.5 ft below the top of undisturbed native deposits (UND); therefore, this sample provides delineation to the

west. In addition in boring GAR-PDI-A10B, MM was not observed and the top of UND was shallower than in boring EF-42. Therefore, samples from this boring that span the interval from the top of UND to the elevation corresponding to the exceeding sample (El. -1.9 to -2.4 ft NAVD88) are included to provide supporting evidence of delineation to the west.

Sample 114-X22F-16.6-17.1

Sample 114-X22F-16.6-17.1 was collected in the top 0.5 ft of meadow mat (MM) encountered below historic fill. Each of the samples used for horizontal delineation was collected in the first interval of MM below historic fill. In the event that multiple samples were collected at a single location, the greater of the two results is shown. All of the delineation samples listed below were collected within the functional area. Laboratory reports and data validation reports for these samples are included with the *Site 114, Phase 1C RAR Tables and Figures (Revision 0)* submittal, December 13, 2017.

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	Arsenic Result (mg/kg)	Direction
E12B	X22	114-X22G-20-20.5	20.0 - 20.5	-5.0 - -5.5	10/7/2005	2.1	Vertical
C11B	114-C11B-PB	114-C11B-PB-13.5-14.0	13.5 - 14.0	-0.8 - -1.3	10/17/2013	4.9 (from FD)	West
F11B	114-F11B-PB	114-F11B-PB-17.2-17.7	17.2 - 17.7	-2.0 - -2.5	10/21/2013	11.1	East
E9B	D9 [a]	D9S14.7-15.3)	14.7 - 15.3	1.0 - 0.4	12/8/2003	4.0	South
E9B	D9 [a]	D9S16.6-17)	16.6 - 17.0	-0.9 - -1.3	12/8/2003	5.1	South
E9B	D9	D9S18.6-19.1)-694409	18.6 - 19.1	-2.9 - -3.4	12/8/2003	5.1 J	South

bgs	below ground surface
FD	field duplicate sample
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligrams per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group
[a]	The SDG for this removed sample is R2420793, and these laboratory and data validation reports were included with the *Site 114, Phase 1C RAR Tables and Figures (Revision 0)* submittal, December 13, 2017.

In boring D9, MM was not identified; therefore, the three samples collected from UND below fill are listed.

As discussed in the *Remedial Investigation Report – Soil, Garfield Avenue Group Non-Residential Chromate Chemical Production Waste Sites 114, 132, 133, 135, 137, 143 and 186, Jersey City, New Jersey*, AECOM, February 2012 and conditionally approved by NJDEP on March 12, 2012, to the north Site 114, Phase 1C borders a New Jersey Transit Hudson-Bergen Light Rail right-of-way (Light Rail) that is being addressed by other parties. The area to the north of the Light Rail property

(Berry Lane Park area) is being investigated and remediated under a separate effort. Therefore, a point by point delineation to the north is not available.

Arsenic was not actually detected in samples 114-X14F-17.3-17.8 and 114-X22F-16.6-17.1, but the method detection limit/reporting limit was greater than the RDCSRS/NRDCSRS. These samples were analyzed at a dilution to either prevent detector saturation or due to an interfering analyte, which resulted in the elevated detection limits. Arsenic was detected in historic fill removed from Phase 1C at a concentration range of non-detect to 136 mg/kg. Historic fill within Phase 1C was excavated to MM and/or UND. However, residual historic fill impacts may remain in the top of MM/UND that could be associated with the elevated detection limits caused by possible sample interference, as discussed above. Regardless, historic fill previously extended to the western and northern property lines and delineation of impacts due to historic fill is not required beyond the property line. No manufactured gas plant (MGP) impacts have been identified west of sample 114-X14F-17.3-17.8 or north of sample 114-X22F-16.6-17.1, as confirmed by disposal records and field observations (i.e., no MGP impacts were noted in the boring logs from this area), which suggests the arsenic concentrations on the western end of Phase 1C are most likely attributed to historic fill. As such delineation is assumed to the Site 114 western and northern property boundaries.

Functional Area

The arsenic RDCSRS is based on natural background (**Attachment 1**). The Attainment Guidance does not define a functional area size for criteria based on natural background. For compliance averaging compared to the RDCSRS, an area based on 0.25 acre is assumed. This area is smaller than the size defined for the inhalation pathway (0.5 acre) and more limiting for compliance area sample selection. The shape of the RDCSRS functional area is rectangular and within the Site 114 boundary. The extent of the functional area is shown in **Figure 1**.

The remaining samples within the functional area extents were collected from deeper than 2 feet below ground surface and are considered a part of the functional area for the calculation.

Compliance Averaging

Compliance with the arsenic RDCSRS is demonstrated through the 95% upper confidence level (UCL) of the mean.

The sample selection process is as follows: All of the samples for arsenic with a sample status of remaining that fall within the functional area horizontally and vertically are identified (backfill samples are excluded).

The 95% UCL of the mean was calculated using the software application ProUCL. A minimum of 10 samples are required for calculation of the 95% UCL of the mean. There are 10 remaining-in-place sample results within the functional area. An algorithm that properly addresses non-detect results was used to evaluate the data. For duplicate sample results, the higher of the sample or duplicate result is selected.

Laboratory reports and data validation reports for the samples were included with the *Site 114, Phase 1C RAR Tables and Figures (Revision 0)* submittal (AECOM, December 13, 2017) and the *IRM #1 RAR Tables and Figures (Revision 1)* submittal (AECOM, July 26, 2017).

The data listed below were selected for use in the compliance averaging calculations:

Samples 114-X14F-17.3-17.8 and 114-X22F-16.6-17.1

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Arsenic Result (mg/kg)
C9B	X14	17.3 - 17.8	-1.9 - -2.4	10/6/2005	R2528199	44.9 UJ
C9B	X14	21.8 - 22.3	-6.4 - -6.9	10/6/2005	J18128	3.2
C9B	114-C9B	22.0 - 22.5	-6.6 - -7.1	4/26/2012	JB5074R	1.7 J
C11B	114-C11B-PB	13.5 - 14.0	-0.8 - -1.3	10/17/2013	JB50487	4.9 (from FD)
D9B	114-D9B-PB	17.3 - 17.8	-2.4 - -2.9	10/17/2013	JB50487	4.2
E9B	D9	18.6 - 19.1	-2.9 - -3.4	12/8/2003	R2319419	5.1 J
E9B [a]	114-E9B-IRM1	17.8 - 18.3	-2.2 - -2.7	1/11/2011	JA65990-1A	7.7
E12B	X22	16.6 - 17.1	-1.6 - -2.1	10/7/2005	R2528199	45.4 UJ
E12B	X22	20.0 - 20.5	-5.0 - -5.5	10/7/2005	J18128	2.1
F11B	114-F11B-PB	17.2 - 17.7	-2.0 - -2.5	10/21/2013	JB50771A	11.1

bgs	below ground surface
FD	field duplicate sample
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligrams per kilogram
NAVD88	North American Vertical Datum of 1988
UJ	The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.
[a]	Location is from IRM #1

The suggested UCL to use based on the ProUCL calculation is 7 mg/kg. The ProUCL output is provided in **Attachment 2**.

Conclusion

Based on the residential exposure scenario, the 95% UCL of the mean arsenic concentration within the study area at sample 114-X14F-17.3-17.8 and 114-X22F-16.6-17.1 is 7 mg/kg, which is compliant with the 19 mg/kg RDCSRS.

Attachments:

Figure 1 Sample Map for Arsenic Compared to Soil Remediation Standards and Functional Area (RDCSRS)

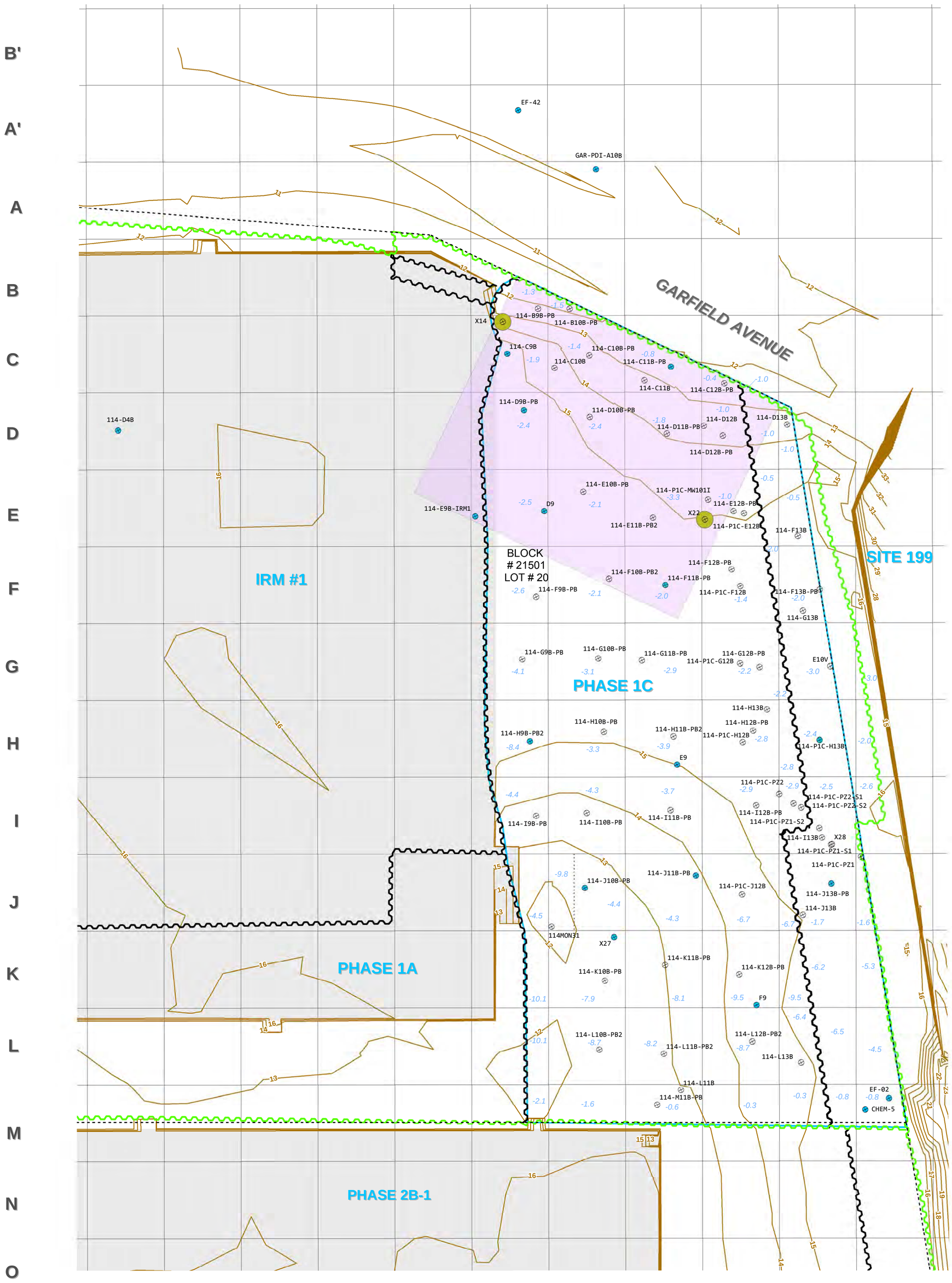
Attachment 1 NJDEP Environmental Criteria for Arsenic

Attachment 2 UCL Statistics for Data Sets with Non-Detects for the Phase 1C Arsenic Data

LEGEND

- SAMPLING LOCATION (REMAINING SAMPLES)
- REMAINING SAMPLES NOT ANALYZED FOR ARSENIC
- RESULTS ARE NON-DETECT AND EXCEED THE MOST STRINGENT STANDARD, BUT ARE IN COMPLIANCE WITH THE REMEDIATION OBJECTIVES
- RESULT IS BELOW THE MOST STRINGENT STANDARD
- IN PLACE SHEET PILE (AS OF MAY 2018)
- REMOVED SHEET PILE
- PRE-REMEDIATION ELEVATION CONTOUR (1-FOOT INTERVAL IN FT NAVD88)
- PROPERTY LINE
- APPROXIMATE LOCATION OF GRID SPLIT
- PHASE BOUNDARY
- FORMER BUILDING SLAB
- FUNCTIONAL AREA

Soil Remediation Standards (mg/kg)		
Analyte	RDCSRS	NRDCSRS
ARSENIC	19	19



ABBREVIATIONS:

ft - feet

IRM - Interim Remedial Measure

mg/kg - milligrams per kilogram

NAVD88 - North American Vertical Datum of 1988

NRDCSRS - New Jersey Department of Environmental Protection Non-Residential Direct Contact Soil Remediation Standard

N/A - not applicable

RDCSRS - New Jersey Department of Environmental Protection Residential Direct Contact Soil Remediation Standard

GENERAL NOTES:

G1. The arsenic data associated with the sample locations shown on this figure are provided in Table 5-3. None of the detected arsenic results exceeded the standards.

G2. Elevation vertical datum is NAVD88, in U.S. survey ft.

G3. Source of block/lot information is Jersey City Parcel Data from New Jersey Geographic Information Network (NJGIN), last updated 10/6/2015 (available at: http://data.jerseycitynj.gov/dataset/jersey-city-parcel-polygon).

G4. This figure presents data for locations within the phase boundary that have samples remaining in place. In addition, this figure includes only the off-site locations in IRM #1 and the Garfield Avenue right-of-way that are within the functional area or are used to demonstrate delineation.

SPECIFIC NOTES:

S1. Property lines and pre-construction topographical contours are sourced from the "Catch Basin-Receptor Evaluation Survey, PPG Site 114, City of Jersey City, Hudson County, New Jersey" prepared by Borbas Surveying And Mapping, LLC, dated April 19, 2011.

S2. As-built terminal excavation elevations were taken from the "PPG - Jersey City Phase 1C Excavation Status," produced by ENTACT, dated 07/09/2014 with revisions.

S3. In Grid I13B, two sample locations are located adjacent; therefore, the sampling location symbols overlap on the figure.

S4. During the Phase 1C work, excavation was conducted to the northernmost sheet pile, part of which was located beyond the Site 114, Phase 1C boundary, as shown on this figure. However, data from beyond the Phase 1C boundary is not included on this figure.

S5. In Grids C12B, D12B, E12B, F12B, G13B, H13B, I13B, J13B, K13B, L13B, and M13B, temporary sheet pile was used to facilitate excavation. The as-built terminal excavation elevation for each side of the temporary sheet pile is shown in these grids.

MAP LOCATION

AECOM

0 15 30 45 60 Feet

PPG
SITE 114
GARFIELD AVENUE GROUP
JERSEY CITY, NEW JERSEY

Date: 5/4/2018

PHASE 1C
SAMPLE MAP FOR ARSENIC
COMPARED TO SOIL REMEDIATION STANDARDS
AND FUNCTIONAL AREA (RDCSRS)

FIGURE 1

ATTACHMENT 1

NJDEP Environmental Criteria for Arsenic

New Jersey Department of Environmental Protection

Standards for Drinking Water, Ground Water, Soil and Surface Water

Arsenic (Total)

CAS #: 7440-38-2

Drinking Water Standards (µ g/l or ppb)

Standard: 5 **Type:** Primary STATE MCL

Ground Water Quality Standards (µ g/l or ppb)

Standard: 3 **Type:** Specific

GW-Quality Criterion: 0.02

PQL: 3

Surface Water Quality Standards (µ g/l or ppb)

Fresh Water-

Human Health: 0.017(hc)(T) **Aquatic-Acute:** 340(d)(s) **Aquatic-Chronic:** 150(d)(s)

Saline Water-

Human Health: 0.061(hc)(T) **Aquatic-Acute:** 69(d)(s) **Aquatic-Chronic:** 36(d)(s)

Soil Standards (mg/kg)

Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 19* **Effective:** 6/2/2008 **Interim:** ☐

The direct contact standard for arsenic is based on natural background

Ingestion Dermal: 0.4

Inhalation: 980

Soil PQL: 1

Non-Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 19* **Effective:** 6/2/2008 **Interim:** ☐

The direct contact standard for arsenic is based on natural background

Ingestion Dermal: 2

Inhalation: 76

Soil PQL: 1

ATTACHMENT 2

UCL Statistics for Data Sets with Non-Detects for the Phase 1C Arsenic Data

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.13/14/2018 1:34:07 PM
From File	UCL.xls
Full Precision	OFF
Confidence Coefficient	95%
mber of Bootstrap Operations	2000

As

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
Number of Detects	8	Number of Non-Detects	2
Number of Distinct Detects	8	Number of Distinct Non-Detects	2
Minimum Detect	1.7	Minimum Non-Detect	44.9
Maximum Detect	11.1	Maximum Non-Detect	45.4
Variance Detects	9.671	Percent Non-Detects	20%
Mean Detects	5	SD Detects	3.11
Median Detects	4.55	CV Detects	0.622
Skewness Detects	1.14	Kurtosis Detects	1.104
Mean of Logged Detects	1.442	SD of Logged Detects	0.626

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.906	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.237	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.283	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	5	KM Standard Error of Mean	1.1
KM SD	2.909	95% KM (BCA) UCL	6.925
95% KM (t) UCL	7.016	95% KM (Percentile Bootstrap) UCL	6.814
95% KM (z) UCL	6.809	95% KM Bootstrap t UCL	8.188
90% KM Chebyshev UCL	8.299	95% KM Chebyshev UCL	9.793
97.5% KM Chebyshev UCL	11.87	99% KM Chebyshev UCL	15.94

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.194	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.721	Detected data appear Gamma Distributed at 5% Significance Le
K-S Test Statistic	0.161	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.296	Detected data appear Gamma Distributed at 5% Significance Le

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.146	k star (bias corrected MLE)	2.05
Theta hat (MLE)	1.589	Theta star (bias corrected MLE)	2.439
nu hat (MLE)	50.34	nu star (bias corrected)	32.8
Mean (detects)	5		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

	A	B	C	D	E	F	G	H	I	J	K	L
56	This is especially true when the sample size is small.											
57	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
58					Minimum	1.7				Mean		4.917
59					Maximum	11.1				Median		4.584
60					SD	2.748				CV		0.559
61					k hat (MLE)	3.879				k star (bias corrected MLE)		2.782
62					Theta hat (MLE)	1.268				Theta star (bias corrected MLE)		1.767
63					nu hat (MLE)	77.58				nu star (bias corrected)		55.64
64					Adjusted Level of Significance (β)	0.0267						
65					Approximate Chi Square Value (55.64, α)	39.5				Adjusted Chi Square Value (55.64, β)		37.15
66					95% Gamma Approximate UCL (use when n>=50)	6.926				95% Gamma Adjusted UCL (use when n<50)		7.365
67												
68	**Estimates of Gamma Parameters using KM Estimates**											
69					Mean (KM)	5				SD (KM)		2.909
70					Variance (KM)	8.463				SE of Mean (KM)		1.1
71					k hat (KM)	2.954				k star (KM)		2.135
72					nu hat (KM)	59.08				nu star (KM)		42.69
73					theta hat (KM)	1.693				theta star (KM)		2.342
74					80% gamma percentile (KM)	7.428				90% gamma percentile (KM)		9.577
75					95% gamma percentile (KM)	11.62				99% gamma percentile (KM)		16.13
76												
77	**Gamma Kaplan-Meier (KM) Statistics**											
78					Approximate Chi Square Value (42.69, α)	28.71				Adjusted Chi Square Value (42.69, β)		26.73
79					5% Gamma Approximate KM-UCL (use when n>=50)	7.435				95% Gamma Adjusted KM-UCL (use when n<50)		7.985
80												
81	**Lognormal GOF Test on Detected Observations Only**											
82					Shapiro Wilk Test Statistic	0.976				**Shapiro Wilk GOF Test**		
83					5% Shapiro Wilk Critical Value	0.818				Detected Data appear Lognormal at 5% Significance Level		
84					Lilliefors Test Statistic	0.133				**Lilliefors GOF Test**		
85					5% Lilliefors Critical Value	0.283				Detected Data appear Lognormal at 5% Significance Level		
86	**Detected Data appear Lognormal at 5% Significance Level**											
87												
88	**Lognormal ROS Statistics Using Imputed Non-Detects**											
89					Mean in Original Scale	4.846				Mean in Log Scale		1.442
90					SD in Original Scale	2.762				SD in Log Scale		0.552
91					95% t UCL (assumes normality of ROS data)	6.447				95% Percentile Bootstrap UCL		6.239
92					95% BCA Bootstrap UCL	6.563				95% Bootstrap t UCL		7.627
93					95% H-UCL (Log ROS)	7.518						
94												
95	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
96					KM Mean (logged)	1.442				KM Geo Mean		4.23
97					KM SD (logged)	0.586				95% Critical H Value (KM-Log)		2.346
98					KM Standard Error of Mean (logged)	0.221				95% H-UCL (KM -Log)		7.94
99					KM SD (logged)	0.586				95% Critical H Value (KM-Log)		2.346
100					KM Standard Error of Mean (logged)	0.221						
101												
102	**DL/2 Statistics**											
103	**DL/2 Normal**									**DL/2 Log-Transformed**		
104					Mean in Original Scale	8.515				Mean in Log Scale		1.777
105					SD in Original Scale	7.902				SD in Log Scale		0.896
106					95% t UCL (Assumes normality)	13.1				95% H-Stat UCL		20.99
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
108												
109	**Nonparametric Distribution Free UCL Statistics**											
110	**Detected Data appear Normal Distributed at 5% Significance Level**											

	A	B	C	D	E	F	G	H	I	J	K	L
111												
112	**Suggested UCL to Use**											
113	95% KM (t) UCL					7.016						
114												
115	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
116	Recommendations are based upon data size, data distribution, and skewness.											
117	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
118	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
119												

I-3-B Phase 1C Compliance Averaging Evaluations Supplemental Information (Provided Separately)

I-4 Phase 2B-1 Compliance Averaging Evaluations

AECOM
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Chelmsford, MA 01824

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Memorandum

To	David Doyle, NJDEP Wayne Howitz, NJDEP Prabal Amin, Weston Solutions, Inc. Laura Amend Babcock, Weston Solutions, Inc. David Spader, ERFS Bhavini Doshi, City of Jersey City James D. Ray, MDMC-Law Nancy Colson, MDMC-Law	Page 1
CC	Jody Overmyer, PPG Mark Terril, PPG Rich Feinberg, PPG Joseph Lagrotteria, LeClairRyan Dorothy Laguzza, LeClairRyan Carolyn Scott, AECOM Aimee Ruiter, AECOM Abigail Small, AECOM	
Subject	PPG Site 114, Phase 2B-1 Compliance Averaging for Arsenic and Lead in Soil (Revision 3)	
From	Claire Hunt	
Date	September 24, 2018	

This memorandum provides the rationale used to determine compliance for arsenic and lead in soil with Residential Direct Contact Site Remediation Standards (RDCSRS) for a site-specific soil sample set from Site 114, Phase 2B-1 in accordance with the New Jersey Department of Environmental Protection's (NJDEP) *Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria* (Attainment Guidance) (September 24, 2012, Version 1.0).

Introduction

This memorandum provides documentation of attainment of compliance for arsenic and lead with their RDCSRS for a site-specific soil sample set that includes arsenic exceedances in two samples and a lead exceedance in one sample collected at Site 114, Phase 2B-1:

- Arsenic in excess of the RDCSRS of 19 mg/kg in two samples:

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Arsenic (mg/kg)
P9B	X32	114-X32G 18-18.5	18.0 - 18.5	-2.0 to -2.5	19.9 J
V0	B401B	B401B-1_665743	13.0 - 13.8	-0.8 to -1.6	21.9

bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligrams per kilogram
NAVD88	North American Vertical Datum of 1988

- Lead in excess of the RDCSRS of 400 mg/kg in one sample:

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Lead (mg/kg)
V0	B401B	B401B-1_665743	13.0 - 13.8	-0.8 to -1.6	1,250

bgs	below ground surface
ft	foot or feet
mg/kg	milligrams per kilogram
NAVD88	North American Vertical Datum of 1988

Figure 1 shows borings with remaining lead and/or arsenic data, the Phase boundary, and the location of the samples exceeding the arsenic and lead RDCSRS. The in-place sample arsenic and lead results are provided in Table 5-3 of the *Site 114, Phase 2B-1 Remedial Action Report (RAR) Tables and Figures (Revision 2)* submittal, May 2018.

Delineation

Arsenic and lead concentrations in excess of the RDCSRS at each location at Site 114, Phase 2B-1 are delineated as follows:

Sample 114-X32G 18-18.5 – Arsenic

Sample 114-X32G 18-18.5 is horizontally delineated by the samples located inside the functional area as listed on the following table and shown on **Figure 1**. Each of the samples used for horizontal delineation was collected at the meadow mat (MM)/historic fill interface. Laboratory reports and data validation reports for these samples were included with the *Site 114, Phase 2B-1 RAR Tables and Figures (Revision 0)* submittal, November 8, 2017.

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Arsenic Result (mg/kg)	Direction
O9B	114-O9B-PB	18.0 - 18.5	-1.7 - -2.2	10/09/2013	JB49688A	5.7 J	Northwest
P7B	114-OP6B7B-PB	16.4 - 16.9	-0.3 - -0.8	9/05/2013	JB46523	6.0 J	Southwest
P10B	114-P10B-PB	17.6 - 18.1	-1.3 - -1.8	9/24/2013	JB48257A	5.3 J	Northeast

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Arsenic Result (mg/kg)	Direction
R9B	114-QR8B9B-PB	16.8 - 17.3	-0.8 - -1.3	9/11/2013	JB47041	9.3 J	Southeast

bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligrams per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group
U	The analyte was not detected above the sample reporting limit shown.

With respect to vertical delineation, arsenic was not analyzed for in soil beneath sample 114-X32G 18-18.5. Vertical delineation has deviated from guidance since single-point compliance was not achievable. Vertical delineation is based on the lines of evidence presented below:

- The deepest arsenic exceedance in Phase 2B-1 is from the sample location of interest (114-X32G 18-18.5 [El. -2.0 to -2.5 ft NAVD88]).
- The arsenic concentration in soil was not detected or was less than the RDCSRS in 50 samples collected from 34 unique locations at elevations deeper than El. -2.5 ft NAVD88 in Site 114, Phase 2B-1.
- As described in the *Remedial Investigation Report – Soil, Garfield Avenue Group Non-Residential Chromate Chemical Production Waste Sites 114, 132, 133, 135, 137, 143 and 186, Jersey City, New Jersey* (AECOM, February 2012), arsenic exceedances throughout the Garfield Avenue Group Sites were generally limited to fill material above MM or undisturbed native deposit (UND). The sample of interest (114-X32 18-18.5) was collected at the interface of historic fill and MM. The sample interval was logged as a no-recovery zone in the boring from 2005 so the sample may have been entirely from historic fill or from the MM immediately adjacent to historic fill. In either case, it was likely impacted by historic fill. Excavation throughout Site 114, Phase 2B-1 was conducted to native material. Based on the historical results, there is no evidence that arsenic exceedances extend deeper than native material.

Sample B401B-1_665743 – Arsenic and Lead

Sample B401B-1_665743 is horizontally delineated to the north, east, and south and vertically delineated by the samples located inside the functional area listed on the following table. The sample locations are shown on **Figure 1.**

Grid ID	Phase	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Arsenic Result (mg/kg)	Lead Result (mg/kg)	Direction
S0	2B-1	114-ST01B-PB	14.9 - 15.4	-2.5 - -3.0	11/20/2013	JB53710	5.0 J	10.8 J	West
U1B	2B-1	114-UV01B-PB	15.8 - 16.3	0.2 - -0.3	2/7/2014	JB59401	8.8 J	15.3 J	North
W1B	2B-2	114-W1B-PB	10.9 - 11.4	0.6 - 0.1	3/25/2014	JB63505	2.7	4.8	East

Grid ID	Phase	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Arsenic Result (mg/kg)	Lead Result (mg/kg)	Direction
V1A	2B-4	114-V1A-PB	12.9 - 13.4	-0.8 - -1.3	04/01/2014	JB63498	6.8	37.1	South
V0	2B-1	B401B	18.0 - 18.5	-5.8 - -6.3	08/20/2003	R2318093	11.8 U	17	Vertically

bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligrams per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group
U	The analyte was not detected above the sample reporting limit shown.

The laboratory reports and data validation reports for the sample locations in Phase 2B-1 were included with the *Site 114, Phase 2B-1 RAR Tables and Figures (Revision 0)* submittal, November 8, 2017. Laboratory reports and data validation reports for samples from Phase 2B-2 and Phase 2B-4 were included in the *Site 114, Phase 2B-2 Remedial Action Report Tables and Figures (Revision 0)* submittal, July 13, 2017, and the *Site 114, Phase 2B-4 Remedial Action Report Tables and Figures (Revision 0)* submittal, July 27, 2017.

Functional Area

The arsenic RDCSRS is based on natural background (**Attachment 1**). The Attainment Guidance does not define a functional area size for criteria based on natural background. For compliance averaging compared to the RDCSRS, an area based on 0.25 acre is assumed. This area is smaller than the size defined for the inhalation pathway (0.5 acre) and more limiting for compliance area sample selection. The lead RDCSRS is based on the ingestion-dermal pathway (**Attachment 1**). The functional area for the ingestion-dermal pathway is 0.25 acre for residential use. The shapes of the RDCSRS functional areas are square and within the Site 114 boundary. The extents of the functional areas are shown in **Figure 1**. The remaining samples within the functional area extents were collected from deeper than 2 feet below ground surface and are considered a part of the functional areas for the calculation.

Compliance Averaging

Compliance with the arsenic and lead RDCSRS is demonstrated through spatial averaging. Thiessen polygons were created within Site 114, Phase 2B-1 and the adjacent phases of Site 114 from all sample locations with remaining-in-place arsenic and/or lead sample results. The functional area was intersected with the Thiessen polygons as shown in **Figure 1**. The maximum concentration is selected at each sample location associated with a Thiessen polygon that is intersected by the functional area for use in the weighted average. The maximum of the concentration for detections or the Method Detection Limit (MDL)/Reporting Limit (RL) for non-detects is selected.

Laboratory reports and data validation reports for the samples were included with the *Site 114, Phase 2B-1 RAR Tables and Figures (Revision 0)* submittal, November 8, 2017. In addition, samples from Phase 2B-2 and Phase 2B-4 were used in the compliance averaging. Their laboratory

reports and data validation reports were included in the *Site 114, Phase 2B-2 Remedial Action Report Tables and Figures (Revision 0)* submittal, July 13, 2017, and the *Site 114, Phase 2B-4 Remedial Action Report Tables and Figures (Revision 0)* submittal, July 27, 2017.

Sample 114-X32G 18-18.5 – Arsenic RDCSRS

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Maximum Arsenic Result (mg/kg)	Area (sf)	Area x Maximum Arsenic Result (sf*mg/kg)
N9B	F8	18.5 - 19.0	-2.4 - -2.9	9/3/2003	R2318284	2.5 B	45	113
N10B	SB22	18.0 - 18.5	-1.5 - -2.0	11/18/2003	R2319208	3 UJ	5	15
O9B	114-O9B-PB	18.0 - 18.5	-1.7 - -2.2	10/9/2013	JB49688A	5.7 J	1,984	11,309
O10B	114-OP10B11B-PB	18.1 - 18.6	-1.8 - -2.3	10/9/2013	JB49687	1.3	1	1
P7B	114-OP6B7B-PB	16.4 - 16.9	-0.3 - -0.8	9/5/2013	JB46523	6 J	1,866	11,196
P9B	X32	18.0 - 18.5	-2.0 - -2.5	10/7/2005	J12052	19.9 J	1,801	35,840
P10B	114-P10B-PB	17.6 - 18.1	-1.3 - -1.8	9/24/2013	JB48257A	5.3 J	687	3,641
Q7B	114-QR6B7B-PB	11.2 - 11.7	0.0 - -0.5	8/14/2013	JB44735	0.31 U	1,213	376
Q9B	SB21	18.0 - 18.5	-2.1 - -2.6	11/19/2003	R2319208	17.3 J	1,167	20,189
R7B	B1401	20.0 - 20.5	-3.9 - -4.4	8/19/2003	R2318079	1.5	657	986
R9B	114-QR8B9B-PB	16.8 - 17.3	-0.8 - -1.3	9/11/2013	JB47041	9.3 J	1,433	13,327
S8B	114-P2B1-S8B	16.5 - 17.0	-0.6 - -1.1	12/13/2012	JB23763	5 J	8	40
S8B	G7	17.0 - 17.5	-0.9 - -1.4	9/2/2003	R2318257	1 J	22	22
						Total	10,889	97,055

B	Indicates that the analyte was detected at a concentration less than the Practical Quantitation Limit but greater than or equal to the Instrument Detection Limit.
bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligrams per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group
sf	square feet
U	The analyte was not detected above the sample reporting limit shown.
UJ	The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

Weighted Average Concentration = 97,055 sf x mg/kg / 10,889 sf = 9 mg/kg

Sample B401B-1_665743 – Arsenic RDCSRS

Grid ID	Phase	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Maximum Arsenic Result (mg/kg)	Area (sf)	Area x Maximum Arsenic Result (sf*mg/kg)
S0	2B-1	114-ST01B-PB	14.9 - 15.4	-2.5 - -3.0	11/20/2013	JB53710	5 J	1,505	7,525
T1A	2B-4	114-T1A-PB	13.9 - 14.4	-1.8 - -2.3	3/26/2014	JB62991	3.9	647	2,523
T2B	2B-1	X34	20.0 - 20.5	-3.6 - -4.1	10/10/2005	R2528259	6.2	463	2,871
U1B	2B-1	114-UV01B-PB	15.8 - 16.3	0.2 - -0.3	2/7/2014	JB59401	8.8 J	1,603	14,106
U2B	2B-1	114-UV2B3B-PB	16.1 - 16.6	0.3 - -0.2	2/7/2014	JB59401	6 J	1,623	9,738
U3B	2B-1	B1303	18.0 - 18.5	-1.7 - -2.2	8/19/2003	R2318079	9.9	236	2,336
V2A	2B-4	114-V2A-PB	12.9 - 13.4	-0.8 - -1.3	4/3/2014	JB63763A	4.8 J	59	283
V1A	2B-4	114-V1A-PB	12.9 - 13.4	-0.8 - -1.3	4/1/2014	JB63498	6.8	791	5,379
V0	2B-1	B401B	13.0 - 13.8	-0.8 - -1.6	8/20/2003	R2318093	21.9	1,245	27,266
V0	2B-1	SB6	16.0 - 16.5	-3.9 - -4.4	11/12/2003	R2319155	4 BJ	1,343	5,372
W1B	2B-2	114-W1B-PB	10.9 - 11.4	0.6 - 0.1	3/25/2014	JB63505	2.7	1,086	2,932
W2B	2B-2	114-W2B-PB	12.4 - 12.9	0.0 - -0.5	3/20/2014	JB62478	2.3 J	289	665
							Total	10,890	80,996

bgs	below ground surface
BJ	The positive result for the given analyte was qualified as estimated (J) and present in the laboratory blank (B) since the concentrations were greater than three times the Action Level but less than ten times the Action Level.
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligrams per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group
sf	square feet

Weighted Average Concentration = 80,996 sf x mg/kg / 10,890 sf = 7 mg/kg

Sample B401B-1_665743 – Lead RDCSRS

Grid ID	Phase	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Maximum Lead Result (mg/kg)	Area (sf)	Area x Maximum Lead Result (sf*mg/kg)
S0	2B-1	114-ST01B-PB	14.9 - 15.4	-2.5 - -3.0	11/20/2013	JB53710	10.8 J	1,505	16,254
T1A	2B-4	114-T1A-PB	13.9 - 14.4	-1.8 - -2.3	3/26/2014	JB62991	6.8	647	4,400
T2B	2B-1	X34	20.0 - 20.5	-3.6 - -4.1	10/10/2005	R2528259	26.7 J	463	12,362
U1B	2B-1	114-UV01B-PB	15.8 - 16.3	0.2 - -0.3	2/7/2014	JB59401	15.3 J	1,603	24,526
U2B	2B-1	114-UV2B3B-PB	16.1 - 16.6	0.3 - -0.2	2/7/2014	JB59401	19.5 J	1,623	31,649

Grid ID	Phase	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Maximum Lead Result (mg/kg)	Area (sf)	Area x Maximum Lead Result (sf*mg/kg)
U3B	2B-1	B1303	18.0 - 18.5	-1.7 - -2.2	8/19/2003	R2318079	69.6	236	16,426
V2A	2B-4	114-V2A-PB	12.9 - 13.4	-0.8 - -1.3	4/3/2014	JB63763A	9 J	59	531
V1A	2B-4	114-V1A-PB	12.9 - 13.4	-0.8 - -1.3	4/1/2014	JB63498	37.1	791	29,346
V0	2B-1	B401B	13.0 - 13.8	-0.8 - -1.6	8/20/2003	R2318093	1250	1,245	1,556,250
V0	2B-1	SB6	14.0 - 14.5	-1.9 - -2.4	11/12/2003	R2319155	20.4 J	1,343	27,397
W1B	2B-2	114-W1B-PB	10.9 - 11.4	0.6 - 0.1	3/25/2014	JB63505	4.8	1,086	5,213
W2B	2B-2	114-W2B-PB	12.4 - 12.9	0.0 - -0.5	3/20/2014	JB62478	6.0	289	1,734
							Total	10,890	1,726,087

bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligrams per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group
sf	square feet

Weighted Average Concentration = 1,726,087 sf x mg/kg / 10,890 sf = 159 mg/kg

Conclusion

Based on the residential exposure scenario, the spatially weighted average arsenic concentration within the study area at sample 114-X32G 18-18.5 is 9 mg/kg, which is compliant with the 19 mg/kg RDCSRS.

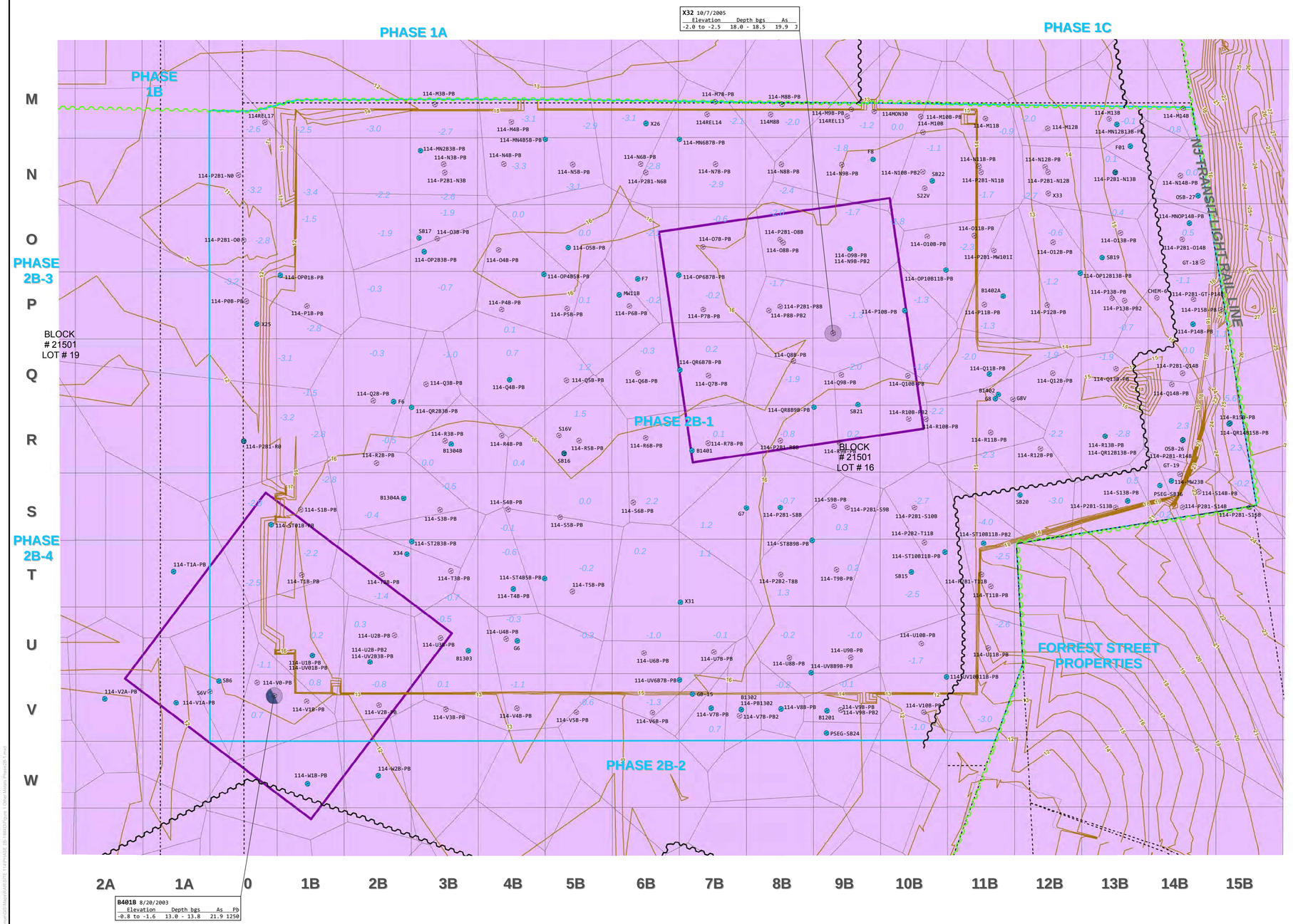
Based on the residential exposure scenario, the spatially weighted average arsenic concentration within the study area at sample B401B-1_665743 is 7 mg/kg, which is compliant with the 19 mg/kg RDCSRS.

Based on the residential exposure scenario, the spatially weighted average lead concentration within the study area at sample B401B-1_665743 is 159 mg/kg, which is compliant with the 400 mg/kg RDCSRS.

Attachments:

Figure 1 Sample Map for Arsenic and Lead Compared to Soil Remediation Standards and Functional Area

Attachment 1 NJDEP Environmental Criteria



ABBREVIATIONS:

As - arsenic

bgs - below ground surface

ft - feet

mg/kg - milligrams per kilogram

NAVD88 - North American Vertical Datum of 1988

NRDCSRS - New Jersey Department of Environmental Protection Non-Residential Direct Contact Soil Remediation Standard

Pb - lead

RDCSRS - New Jersey Department of Environmental Protection Residential Direct Contact Soil Remediation Standard

QUALIFIERS:

J - The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.

GENERAL NOTES:

G1. The arsenic and lead data associated with the sample locations shown on this figure are provided in Table 5-3. Data presented in call out boxes on this figure are outliers (i.e., data points that require further explanation). Specific notes for each outlier sample are provided in the Specific Notes in Table 5-3.

G2. "Elevation" refers to the sample elevation based on the pre-remediation surface elevation for samples collected from the pit bottom, and the surface elevation of the sample location when the sample was collected via boring or test pit.

G3. Elevation vertical datum is NAVD88, in U.S. survey ft.

G4. Results are reported in mg/kg.

G5. Source of block/lot information is Jersey City Parcel Data from New Jersey Geographic Information Network (NJGIN), last updated 10/6/2015 (available at: http://data.jerseycitynj.gov/dataset/jersey-city-parcel-polygon).

G6. This figure presents data for locations within the Phase boundary that have samples remaining in place. Sample locations from Phase 2B-2 and Phase 2b-4 used for delineation or associated with Thiessen polygons that intersect the functional area are also included on the figure. In addition, removed samples may be shown to demonstrate compliance with the remediation objectives. The Specific Notes on Table 5-3 include discussion of these situations, if necessary.

SPECIFIC NOTES:

S1. Property lines and pre-construction topographical contours are sourced from the "Catch Basin-Receptor Evaluation Survey, PPG Site 114, City of Jersey City, Hudson County, New Jersey" prepared by Borbas Surveying and Mapping, LLC, dated April 19, 2011.

S2. As-built terminal excavation elevations were taken from "PPG – Jersey City Phase 2B-1 Excavation, Excavation Status, Corrected" produced by ENTACT, dated 07/30/2014 with revisions.

S3. In Grids O9B, R13B, R14B, R15B, U1B, U2B, V7B, and V9B, two sample locations are located adjacent; therefore, the sampling location symbols overlap on the figure.

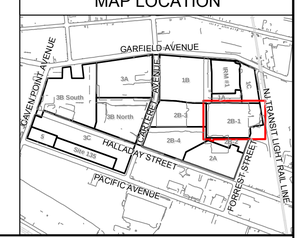
LEGEND

- SAMPLING LOCATION (REMAINING SAMPLES)
- SAMPLING LOCATION (REMOVED SAMPLES)
- REMAINING SAMPLES NOT ANALYZED FOR ARSENIC OR LEAD
- RESULT IS BELOW THE MOST STRINGENT STANDARD
- RESULTS EXCEED THE MOST STRINGENT STANDARD, BUT ARE IN COMPLIANCE WITH REMEDIATION OBJECTIVES
- ARSENIC (As)
- LEAD (Pb)
- IN PLACE SHEET PILE (AS OF MARCH 2018)
- REMOVED SHEET PILE
- PRE-REMEDIATION ELEVATION CONTOUR (1-FOOT INTERVAL IN FT NAVD88)
- PROPERTY LINE
- FORMER BUILDING SLAB (AVERAGE ELEVATION 15.8 FT NAVD88)
- 5.6 GRID LAYOUT WITH AS-BUILT TERMINAL EXCAVATION ELEVATIONS (FT NAVD88)
- PHASE BOUNDARY
- THIESSEN POLYGON
- FUNCTIONAL AREA

Soil Remediation Standards (mg/kg)

Analyte	RDCSRS	NRDCSRS
ARSENIC	19	19
LEAD	400	800

MAP LOCATION



0 20 40 60 Feet

AECOM

PPG SITE 114 GARFIELD AVENUE GROUP JERSEY CITY, NEW JERSEY			PHASE 2B-1 SAMPLE MAP FOR ARSENIC AND LEAD COMPARED TO SOIL REMEDIATION STANDARDS AND FUNCTIONAL AREA
DATE: 05/23/2018			FIGURE 1

ATTACHMENT 1

NJDEP Environmental Criteria

New Jersey Department of Environmental Protection

Standards for Drinking Water, Ground Water, Soil and Surface Water

Lead (Total)

CAS #: 7439-92-1

Drinking Water Standards (µ g/l or ppb)

Standard: 15 **Type:** Primary FEDERAL Action Level

Ground Water Quality Standards (µ g/l or ppb)

Standard: 5 **Type:** Specific

GW-Quality Criterion: 5

PQL: 5

Surface Water Quality Standards (µ g/l or ppb)

Fresh Water-

Human Health: 5.0(h)(T) **Aquatic-Acute:** 38(d)(s) **Aquatic-Chronic:** 5.4(d)(s)

Saline Water-

Human Health: **Aquatic-Acute:** 210(d)(s) **Aquatic-Chronic:** 24(d)(s)

Soil Standards (mg/kg)

Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 400 **Effective:** 6/2/2008 **Interim:** ☐

Ingestion Dermal: 400

Inhalation: 44,000

Soil PQL: 1

Non-Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 800 **Effective:** 6/2/2008 **Interim:** ☐

Ingestion Dermal: 800

Inhalation: 12,000

Soil PQL: 1

New Jersey Department of Environmental Protection

Standards for Drinking Water, Ground Water, Soil and Surface Water

Arsenic (Total)

CAS #: 7440-38-2

Drinking Water Standards (µ g/l or ppb)

Standard: 5 **Type:** Primary STATE MCL

Ground Water Quality Standards (µ g/l or ppb)

Standard: 3 **Type:** Specific

GW-Quality Criterion: 0.02

PQL: 3

Surface Water Quality Standards (µ g/l or ppb)

Fresh Water-

Human Health: 0.017(hc)(T) **Aquatic-Acute:** 340(d)(s) **Aquatic-Chronic:** 150(d)(s)

Saline Water-

Human Health: 0.061(hc)(T) **Aquatic-Acute:** 69(d)(s) **Aquatic-Chronic:** 36(d)(s)

Soil Standards (mg/kg)

Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 19* **Effective:** 6/2/2008 **Interim:** ☐

The direct contact standard for arsenic is based on natural background

Ingestion Dermal: 0.4

Inhalation: 980

Soil PQL: 1

Non-Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 19* **Effective:** 6/2/2008 **Interim:** ☐

The direct contact standard for arsenic is based on natural background

Ingestion Dermal: 2

Inhalation: 76

Soil PQL: 1

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Memorandum

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Subject	PPG Site 114, Phase 2B-1 Compliance Averaging for Antimony in Soil (Revision 3)	
From	Claire Hunt	
Date	September 24, 2018	

This memorandum provides documentation of attainment of compliance for antimony in soil with the 31 milligrams per kilogram (mg/kg) Residential Direct Contact Site Remediation Standard (RDCSRS) for a site-specific soil sample set from Site 114, Phase 2B-1 in accordance with the New Jersey Department of Environmental Protection's (NJDEP) *Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria* (Attainment Guidance) (September 24, 2012, Version 1.0).

Introduction

This memorandum provides documentation of attainment of compliance for antimony with the 31 mg/kg RDCSRS for a site-specific soil sample set that includes an antimony exceedance in one sample collected at Site 114, Phase 2B-1:

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Antimony (mg/kg)
P6B	MW11B	114-MW-11BA-17-17.5	17.0 - 17.5	-1.2 to -1.7	112 J

bgs below ground surface
ft foot or feet
J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg milligrams per kilogram
NAVD88 North American Vertical Datum of 1988

Figure 1 shows borings with remaining antimony data, the Phase boundary, and the location of the sample exceeding the antimony RDCSRS. The remaining-in-place antimony results are provided in Table 5-2 of the *Site 114, Phase 2B-1 Remedial Action Report (RAR) Tables and Figures (Revision 2)* submittal, May 2018.

Delineation

The delineation of antimony was implemented during the Remedial Investigation (RI) activities by PPG as documented in the *Remedial Investigation Report – Soil, Garfield Avenue Group Non-Residential Chromate Chemical Production Waste Sites 114, 132, 133, 135, 137, 143 and 186, Jersey City, New Jersey*, AECOM, February 2012 and conditionally approved by NJDEP on March 12, 2012.

Horizontal delineation was further refined during remedial action by the samples listed on the following table and shown on **Figure 1** that fall within the functional area.

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Antimony Result (mg/kg)	Direction
P7B	114-OP6B7B-PB	16.4 - 16.9	-0.3 - -0.8	09/05/2013	JB46523	0.67 J	North
O5B	114-O5B-PB	16.3 - 16.8	-0.1 - -0.6	8/26/2013	JB45719A	0.60 UJ	West
Q4B	114-Q4B-PB	10.0 - 10.5	0.7 - 0.2	7/25/2013	JB43138A	0.69 UJ 0.63 UJ FD	South
Q7B	114-QR6B7B-PB	11.2 - 11.7	0.0 - -0.5	8/14/2013	JB44735	0.32 U	East

bgs below ground surface
FD field duplicate result
ft foot or feet
J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg milligrams per kilogram
NAVD88 North American Vertical Datum of 1988
SDG sample delivery group
U The analyte was not detected above the sample reporting limit shown.
UJ The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

Sample 114-MW-11BA-17-17.5 was collected in the top 1.5 ft of meadow mat (MM) encountered below historic fill. Each of the samples used for horizontal delineation was collected in the first interval of MM below historic fill. In the event that multiple samples were collected at a single location, the greater of the two results is shown. Laboratory reports and data validation reports for these samples are included with the *Site 114, Phase 2B-1 RAR Tables and Figures (Revision 0)* submittal, November 8, 2017.

At sample 114-MW-11BA-17-17.5, antimony was not analyzed for in soil beneath the location where the exceedance remains at Site 114, Phase 2B-1. Vertical delineation has deviated from guidance since single-point compliance was not achievable. Vertical delineation is based on the lines of evidence presented below:

- The deepest antimony exceedance in Phase 2B-1 is from the sample location of interest (114-MW-11BA-17-17.5 [El. -1.2 to -1.7 ft NAVD88]).
- The antimony concentration in soil was not detected at concentrations greater than the MDL/RL or was less than the RDCSRS in 72 samples collected from 47 unique locations with starting elevations at or deeper than El. -1.7 ft NAVD88 in Phase 2B-1.
- As described in the *Remedial Investigation Report – Soil, Garfield Avenue Group Non-Residential Chromate Chemical Production Waste Sites 114, 132, 133, 135, 137, 143 and 186, Jersey City, New Jersey,* AECOM, February 2012, the vertical limit of Chromate Chemical Production Waste (CCPW) metals including antimony throughout the Garfield Avenue Group of Sites was at depths of less than 20 feet, roughly corresponding to the depth of the MM. The exceedance of antimony in Site 114, Phase 2B-1 was collected from the top 1.5 ft of MM encountered below historic fill. Antimony exceedances were not recorded in any samples in Phase 2B-1 below the MM. Excavation throughout Site 114, Phase 2B-1 was conducted to native material.

Functional Area

The antimony RDCSRS is based on the ingestion-dermal pathway (**Attachment 1**). The functional area for the ingestion-dermal pathway is limited to 0.25 acre for residential use. The extent of the functional area within the phase boundary is shown in **Figure 1**. The shape is generally square within the Phase boundary. Remaining samples within the functional area extent were collected from deeper than 2 feet below ground surface and are considered a part of the functional area for the calculation.

Compliance Averaging

Compliance with the antimony RDCSRS is demonstrated through spatial averaging. Thiessen polygons were created within Site 114, Phase 2B-1 from all sample locations with remaining in place antimony sample results. The functional area was intersected with the Thiessen polygons as shown in **Figure 1**. The maximum concentration is selected at each sample location associated with a Thiessen polygon that is intersected by the functional area for use in the weighted average. The maximum of the concentration for detections or the Method Detection Limit (MDL)/Reporting Limit (RL) for non-detects is selected. Laboratory reports and data validation reports for the samples were included with the *Site 114, Phase 2B-1 RAR Tables and Figures (Revision 0)* submittal, November 8, 2017.

Grid ID	Location ID	Sample Depth (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Maximum Antimony Result (mg/kg)	Area (sf)	Area x Maximum Antimony Result (sf*mg/kg)
M6B	X26	20.0 - 20.5	-4.5 - -5.0	10/10/2005	R2528259	2.5 U	116	290
N5B	114-MN4B5B-PB	12.3 - 12.8	-2.9 - -3.4	10/28/2013	JB51379	0.79 UJ	165	130
N7B	114-MN6B7B-PB	13.9 - 14.4	-2.9 - -3.4	10/28/2013	JB51379	0.76 UJ	609	463

Grid ID	Location ID	Sample Depth (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Maximum Antimony Result (mg/kg)	Area (sf)	Area x Maximum Antimony Result (sf*mg/kg)
O3B	114-OP2B3B-PB	18.2 - 18.7	-1.9 - -2.4	10/28/2013	JB51379	0.55 UJ	21	12
O3B	SB17	23.0 - 23.5	-7.2 - -7.7	11/18/2003	03-10468	1.17 U	52	61
O5B	114-O5B-PB	16.3 - 16.8	-0.1 - -0.6	8/26/2013	JB45719A	0.6 UJ	1,423	854
P4B	114-OP4B5B-PB	16.1 - 16.6	0.1 - -0.4	9/5/2013	JB46523	0.72 UJ	1,450	1,044
P6B	F7	15.5 - 16.0	0.2 - -0.3	9/2/2003	R2318257	2.1 B	760	1,596
P6B	MW11B	17.0 - 17.5	-1.2 - -1.7	10/18/2005	R2528387	112 J	1,172	131,264
P7B	114-OP6B7B-PB	16.4 - 16.9	-0.3 - -0.8	9/5/2013	JB46523	0.67 J	1,613	1,081
Q4B	114-Q4B-PB	10.0 - 10.5	0.7 - 0.2	7/25/2013	JB43138A	0.69 UJ	1,131	780
Q7B	114-QR6B7B-PB	11.2 - 11.7	0.0 - -0.5	8/14/2013	JB44735	0.32 U	1,943	622
R5B	SB16	21.0 - 21.5	-6.0 - -6.5	11/14/2003	R2319155	1.13 U	435	492
R9B	114-QR8B9B-PB	16.8 - 17.3	-0.8 - -1.3	9/11/2013	JB47041	0.61 UJ	1	1
						Total	10,891	138,690

B	Indicates that the analyte was detected at a concentration less than the Practical Quantitation Limit but greater than or equal to the Instrument Detection Limit.
bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligrams per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group
sf	square feet
U	The analyte was not detected above the sample reporting limit shown.
UJ	The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

Weighted Average Concentration = 138,690 sf x mg/kg / 10,891 sf = 13 mg/kg

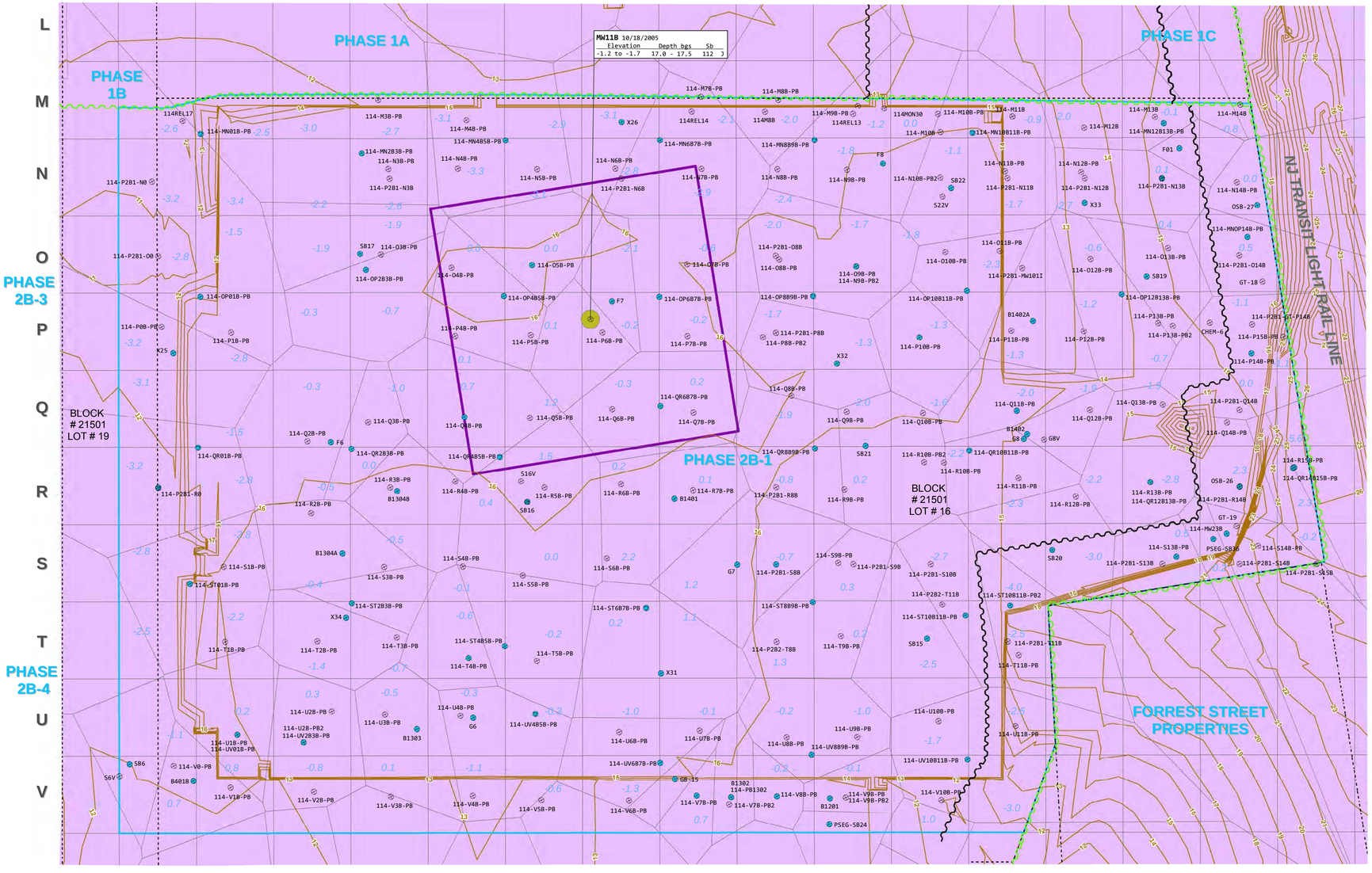
Conclusion

The spatially-weighted average antimony concentration within the study area at Site 114, Phase 2B-1 is 13 mg/kg, which is compliant with the 31 mg/kg RDCSRS.

Attachments:

Figure 1 Phase 2B-1 Sample Map for Antimony Compared to Soil Remediation Standards and Functional Area

Attachment 1 NJDEP Environmental Criteria for Antimony



ABBREVIATIONS:

bgs - below ground surface

ft - feet

mg/kg - milligrams per kilogram

N/A - not applicable

NAVD88 - North American Vertical Datum of 1988

NRDCSRS - New Jersey Department of Environmental Protection Non-Residential Direct Contact Soil Remediation Standard

RDCSRS - New Jersey Department of Environmental Protection Residential Direct Contact Soil Remediation Standard

RDCSRS-GAG - Residential Direct Contact Soil Remediation Standard - Garfield Avenue Group (alternative remediation standard approved by the New Jersey Department of Environmental Protection on December 28, 2016)

Sb - antimony

QUALIFIERS:

J - The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.

GENERAL NOTES:

G1. The antimony data associated with the sample locations shown on this figure are provided in Table 5-2. Data presented in call out boxes on this figure are outliers (i.e., data points that require further explanation). Specific notes for each outlier sample are provided in the Specific Notes in Table 5-2.

G2. "Elevation" refers to the sample elevation based on the pre-remediation surface elevation for samples collected from the pit bottom, and the surface elevation of the sample location when the sample was collected via boring or test pit.

G3. Elevation vertical datum is NAVD88, in U.S. survey ft.

G4. Results are reported in mg/kg.

G5. Source of block/lot information is Jersey City Parcel Data from New Jersey Geographic Information Network (NJGIN), last updated 10/6/2015 (available at: http://data.jerseycitynj.gov/dataset/jersey-city-parcel-polygon).

G6. This figure presents data for locations within the Phase boundary that have samples remaining in place. In addition, removed samples may be shown to demonstrate compliance with the remediation objectives. The Specific Notes on Table 5-2 include discussion of these situations, if necessary.

SPECIFIC NOTE:

S1. Property lines and pre-construction topographical contours are sourced from the "Catch Basin-Receptor Evaluation Survey, PPG Site 114, City of Jersey City, Hudson County, New Jersey" prepared by Borbas Surveying and Mapping, LLC, dated April 19, 2011.

S2. As-built terminal excavation elevations were taken from "PPG – Jersey City Phase 2B-1 Excavation, Excavation Status, Corrected" produced by ENTACT, dated 07/30/2014 with revisions.

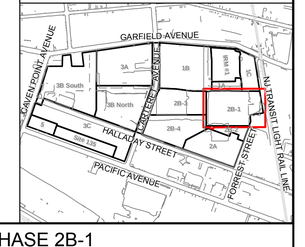
S3. In Grids O9B, R13B, R14B, R15B, U1B, U2B, V7B, and V9B, two sample locations are located adjacent; therefore, the sampling location symbols overlap on the figure.

LEGEND

- SAMPLING LOCATION (REMAINING SAMPLES)
- SAMPLING LOCATION (REMOVED SAMPLES)
- REMAINING SAMPLES NOT ANALYZED FOR ANTIMONY
- RESULT IS BELOW THE MOST STRINGENT STANDARD
- RESULTS EXCEED THE MOST STRINGENT STANDARD, BUT ARE IN COMPLIANCE WITH REMEDIATION OBJECTIVES
- ANTIMONY (Sb)
- IN PLACE SHEET PILE (AS OF MARCH 2018)
- REMOVED SHEET PILE
- PRE-REMEDIATION ELEVATION CONTOUR (1-FOOT INTERVAL IN FT NAVD88)
- PROPERTY LINE
- FORMER BUILDING SLAB (AVERAGE ELEVATION 15.8 FT NAVD88)
- GRID LAYOUT WITH AS-BUILT TERMINAL EXCAVATION ELEVATIONS (FT NAVD88)
- 5.6 PHASE BOUNDARY
- THIESSEN POLYGON
- FUNCTIONAL AREA

Soil Remediation Standards (mg/kg)			
Analyte	RDCSRS	RDCSRS-GAG	NRDCSRS
ANTIMONY	31	N/A	450

MAP LOCATION



0 20 40 60 Feet

AECOM

PPG SITE 114 GARFIELD AVENUE GROUP JERSEY CITY, NEW JERSEY	PHASE 2B-1 SAMPLE MAP FOR ANTIMONY COMPARED TO SOIL REMEDIATION STANDARDS AND FUNCTIONAL AREA
DATE: 05/23/2018	FIGURE 1

ATTACHMENT 1

NJDEP Environmental Criteria for Antimony

New Jersey Department of Environmental Protection

Standards for Drinking Water, Ground Water, Soil and Surface Water

Antimony (Total)

CAS #: 7440-36-0

Drinking Water Standards (µ g/l or ppb)

Standard: 6 **Type:** Primary FEDERAL MCL

Ground Water Quality Standards (µ g/l or ppb)

Standard: 6 **Type:** Specific

GW-Quality Criterion: 6

PQL: 3

Surface Water Quality Standards (µ g/l or ppb)

Fresh Water-

Human Health: 5.6(h)(T) **Aquatic-Acute:** **Aquatic-Chronic:**

Saline Water-

Human Health: 640(h)(T) **Aquatic-Acute:** **Aquatic-Chronic:**

Soil Standards (mg/kg)

Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 31 **Effective:** 6/2/2008 **Interim:** ☐

Ingestion Dermal: 31

Inhalation: 360,000

Soil PQL: 6

Non-Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 450 **Effective:** 6/2/2008 **Interim:** ☐

Ingestion Dermal: 450

Inhalation: 23,000

Soil PQL: 6

I-5 Phase 2B-3 Compliance Averaging Evaluations

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Memorandum

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Subject	PPG Site 114, Phase 2B-3	
	Compliance Averaging for Arsenic in Soil (Revision 1)	
From	Claire Hunt	
Date	February 23, 2018	

This memorandum provides the rationale used to determine attainment of compliance for arsenic in soil with the New Jersey Department of Environmental Protection (NJDEP) Residential Direct Contact Site Remediation Standards (RDCSRS) for a site-specific soil sample set from Site 114, Phase 2B-3 in accordance with the *NJDEP Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria* (September 24, 2012, Version 1.0).

Introduction

Based on investigation and remediation findings to date, the following arsenic concentrations remain in place in excess of the RDCSRS (19 milligrams per kilogram [mg/kg]) at Site 114, Phase 2B-3 when using single point compliance, and for which we have applied compliance averaging for the attainment of compliance:

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Arsenic (mg/kg)
N4A	SB5	SB-5(20.0-20)	20.0 - 20.5	-7.1 - -7.6	30.1
P3A	E5A	114-E5A(15.33-16)	15.3 - 16.0	-3.7 - -4.4	19.1
P8A	114-P8A-PB	114-P8A-PB-17.7-18.2	17.7 - 18.2	-2.1 - -2.6	41.7 J
R6A	114-R6A-PB	114-R6A-PB-15.4-15.9	15.4 - 15.9	-2.6 - -3.1	20.3
R8A	114-R8A-PB	114-R8A-PB-16.5-17.0	16.5 - 17.0	-1.3 - -1.8	24.1

bgs below ground surface
ft foot or feet
J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg milligram per kilogram
NAVD88 North American Vertical Datum of 1988

Figure 1 shows borings with remaining arsenic data, the Phase boundary, and the location of the samples exceeding the arsenic RDCSRS. The remaining in-place arsenic results are provided in Table 5-3 of the Site 114, Phase 2B-3 Remedial Action Report (RAR) Tables and Figures (Revision 1 Supplemental) submittal, February 23, 2018.

Delineation

Delineation of the arsenic concentrations remaining in place in excess of the RDCSRS at the locations listed above at Site 114, Phase 2B-3 is discussed in the two following subsections (Horizontal Delineation and Vertical Delineation).

Horizontal Delineation

Sample SB-5(20.0-20)

The horizontal delineation sample SB-5(20.0-20) was collected during the Remedial Investigation (RI) activities by PSEG and PPG, as documented in the *Remedial Investigation Report, Former Halladay Street Gas Works, Jersey City, New Jersey* (PSEG RIR), PSEG, December 2007 and the *Remedial Investigation Report – Soil, Garfield Avenue Group Non-Residential Chromate Chemical Production Waste Sites 114, 132, 133, 135, 137, 143 and 186, Jersey City, New Jersey* (PPG RIR), AECOM, February 2012. The PPG RIR was conditionally approved by NJDEP on March 3, 2012.

Horizontal delineation was further refined during remedial action by the samples listed on the following table and shown on **Figure 2**.

Phase	Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Arsenic Result (mg/kg)	Direction
IRM #1	G3B	MW9C	22.0 - 22.5	-6.3 - -6.8	11/03/2005	J18133	8.6	North
Phase 1B	K8A	114K8A	19.0 - 19.5	-6.1 - -6.6	03/01/2012	JB562	9.9	West
Phase 2B-1	O3B	SB17	23.0 - 23.5	-7.2 - -7.7	11/18/2003	03-10468	< 1.17 U	East
Phase 2B-4	U14A	E2	19.5 - 20.0	-6.9 - -7.4	08/25/2003	R2318149	2.3 J	South

bgs below ground surface
ft foot or feet
J The result was an estimated value; the associated numerical value was an

	approximate concentration of the analyte in the sample.
mg/kg	milligram per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	Sample Delivery Group
U	The analyte was not detected above the sample reporting limit shown.

Laboratory reports and data validation reports for these samples were included with the Site 114 RAR Tables and Figure submittal associated with the given phase including:

- Site 114, IRM #1 RAR Tables and Figures (Revision 0) submittal, January 11, 2017;
- Site 114, Phase 1B RAR Tables and Figures (Revision 0) submittal, January 18, 2018;
- Site 114, Phase 2B-1 RAR Tables and Figures (Revision 0) submittal, November 8, 2017 and;
- Site 114, Phase 2B-4 RAR Tables and Figures (Revision 0) submittal, July 27, 2017.

Sample 114-E5A(15.33-16)

Sample 114-E5A(15.33-16) is horizontally delineated by the samples listed on the following table and shown on **Figure 1**. Sample 114-E5A(15.33-16) was collected in the first interval of meadow mat (MM) encountered below historic fill. Each of the samples used for horizontal delineation was also collected in the first interval of MM or MM/undisturbed native deposits (UND) below historic fill. Laboratory reports and data validation reports for these samples were included with the Site 114, Phase 2B-3 RAR Tables and Figures (Revision 0) submittal, July 20, 2017.

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Arsenic Result (mg/kg)	Direction
N2A	114-N2A-PB	12.8 - 13.3	-0.9 - -1.4	12/20/2013	JB56218	9.4	North
N4A	114-N4A-PB	16.0 - 16.5	-1.7 - -2.2	2/27/2014	JB60730	16.4	West
P2A	114-P2A-PB	13.9 - 14.4	-1.6 - -2.1	2/12/2014	JB59707	5.8 J	East
P4A	114-P4A-PB	13.7 - 14.2	-1.8 - -2.3	2/25/2014	JB60541	4.2	South

bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligram per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	Sample Delivery Group

Sample 114-P8A-PB-17.7-18.2

Sample 114-P8A-PB-17.7-18.2 is horizontally delineated by the samples listed on the following table and shown on **Figure 1**. Sample 114-P8A-PB-17.7-18.2 was collected in the first interval of MM encountered below historic fill. Each of the samples used for horizontal delineation was also collected in the first interval of MM or UND below historic fill. Laboratory reports and data validation reports for these samples were included with the Site 114, Phase 2B-3 RAR Tables and Figures (Revision 0) submittal, July 20, 2017.

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Arsenic Result (mg/kg)	Direction
N4A	114-N4A-PB	16.0 – 16.5	-1.7 - -2.2	2/27/2014	JB60730	16.4	North
Q7A	E4	15.5 - 16.0	-2.2 - -2.7	8/27/2003	R2318189	11.9 J	East
R10A	114-R10A-PB	15.9 - 16.4	-2.7 - -3.2	8/4/2014	JB73198	7.1	South
N9A	114-N9A-PB	15.7 - 16.2	-2.5 - -3.0	4/29/2014	JB65812A	7.9 J	West

bgs below ground surface
ft foot or feet
J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg milligram per kilogram
NAVD88 North American Vertical Datum of 1988
SDG Sample Delivery Group
U The analyte was not detected above the sample reporting limit shown.

Sample 114-R6A-PB-15.4-15.9

Sample 114-R6A-PB-15.4-15.9 is horizontally delineated by the samples listed on the following table and shown on **Figure 1**. Sample 114-R6A-PB-15.4-15.9 was collected in the first interval of MM encountered below historic fill. Each of the samples used for horizontal delineation was also collected in the first interval of MM below historic fill. Laboratory reports and data validation reports for these samples were included with the Site 114, Phase 2B-3 RAR Tables and Figures (Revision 0) submittal, July 20, 2017.

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Arsenic Result (mg/kg)	Direction
S6A	114-S6A-PB	14.2 - 14.7	-1.5 - -2.0	4/16/2014	JB64850A	16.6 J	East
Q7A	E4	15.5 - 16.0	-2.2 - -2.7	8/27/2003	R2318189	11.9 J	West
P4A	114-P4A-PB	13.7 - 14.2	-1.8 - -2.3	2/25/2014	JB60541	4.2	North
S10A	E3	15.5 - 16.0	-2.3 - -2.8	8/26/2003	R2318164	14.4 J	South

bgs below ground surface
ft foot or feet
J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg milligram per kilogram
SDG Sample Delivery Group
NAVD88 North American Vertical Datum of 1988

Sample 114-R8A-PB-16.5-17.0

Sample 114-R8A-PB-16.5-17.0 is horizontally delineated by the samples listed on the following table and shown on **Figure 1**. Sample 114-R8A-PB-16.5-17.0 was collected in the first interval of MM encountered below historic fill. Each of the samples used for horizontal delineation was also

collected in the first interval of MM below historic fill. Laboratory reports and data validation reports for most of the delineation samples were included with the Site 114, Phase 2B-3 RAR Tables and Figures (Revision 0) submittal, July 20, 2017. The laboratory report and data validation report for sample 114-P2B3-S8A is included with the Site 114, Phase 2B-3 RAR Tables and Figures (Revision 1 Supplemental) submittal, February 23, 2018.

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Arsenic Result (mg/kg)	Direction
S6A	114-S6A-PB	14.2 - 14.7	-1.5 - -2.0	4/16/2014	JB64850A	16.6 J	Northeast
P7A	114-P7A-PB	15.8 - 16.3	-2.5 - -3.0	4/23/2014	JB65409A	12.4	Northwest
S8A	114-P2B3-S8A	14.5 - 15.0	-1.1 - -1.6	5/6/2013	JB36251	5.1 J	Southeast
Q10A	114-Q10A-PB	15.2 - 15.7	-2.0 - -2.5	7/17/2014	JB71937A	8.2	Southwest

bgs below ground surface
ft foot or feet
J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg milligram per kilogram
NAVD88 North American Vertical Datum of 1988
SDG Sample Delivery Group

Vertical Delineation

At sample SB-5(20.0-20), vertical delineation was achieved at nearby sample location D5A as shown on **Figure 2** and in the table below, and documented in the PSEG RIR and the PPG RIR.

Phase	Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Arsenic Result (mg/kg)	Direction
Phase 1B	L4A	D5	23.0 - 23.5	-9.4 - -9.9	8/20/2003	R2318096	4.5 J	Vertical

bgs below ground surface
ft foot or feet
J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg milligram per kilogram
NAVD88 North American Vertical Datum of 1988
SDG Sample Delivery Group

At 114-E5A(15.33-16), 114-P8A-PB-17.7-18.2, 114-R6A-PB-15.4-15.9, and 114-R8A-PB-16.5-17.0, arsenic was not analyzed for in soil beneath the locations where exceedances remain at Site 114, Phase 2B-3. Vertical delineation has deviated from guidance since single-point compliance was not achievable. Vertical delineation is demonstrated based on the lines of evidence presented below:

- The PSEG RIR for manufactured gas plant (MGP)-related constituents indicates that vertical delineation of arsenic, lead and mercury has been achieved and arsenic is found no deeper than 50.5 feet below ground surface.

- On Site 114, Phase 2B-3, arsenic concentrations in soil are not detected or are less than the most stringent standard in all seven samples collected from six unique locations at elevations deeper than El. -7.6 ft NAVD88 (see Figure and Table 5-3 of the Site 114, Phase 2B-3 Remedial Action Report [RAR] Tables and Figures [Revision 1 Supplemental] submittal, February 23, 2018).

Study Area

The definition of the study area has been selected based on the Attainment Guidance for determining a functional area. The arsenic RDCSRS is based on natural background (Attachment 1). The Attainment Guidance does not define a functional area size for criteria based on natural background. For compliance averaging compared to the RDCSRS, an area based on 0.25 acre is assumed. This area is smaller than the size defined for the inhalation pathway (0.5 acre) and more limiting for compliance area sample selection.

The shapes of the RDCSRS study areas are generally square and within the Phase boundary. The extents of the study areas for comparison to the arsenic RDCSRS are shown in **Figure 1**.

The remaining samples within the study area extents were collected from deeper than 2 feet below ground surface and are considered a part of the study areas for the calculation.

Compliance Averaging

Compliance with the arsenic RDCSRS is demonstrated through the arithmetic mean because there are less than ten samples remaining in both study areas. The sample selection process is as follows:

1. All of the samples for arsenic with a sample status of remaining that fall within the study area horizontally and vertically are identified (backfill samples are excluded).
2. All remaining samples are used in the arithmetic mean. Zero is substituted for the Method Detection Limit (MDL)/Reporting Limit (RL) for non-detects. For this sample set, all sample results were detections.
3. For duplicate sample results, the higher of the sample or duplicate result is selected.

Laboratory reports and data validation reports for the samples were included with the Site 114, Phase 2B-3 RAR Tables and Figures (Revision 0) submittal, July 20, 2017.

Samples SB-5(20.0-20) and 114-E5A(15.33-16)

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Arsenic Result (mg/kg)
N2A	114-N2A-PB	12.8 - 13.3	-0.9 - -1.4	12/20/2013	JB56218	9.4
N4A	SB5	20.0 - 20.5	-7.1 - -7.6	11/11/2003	03-10170	30.1
P2A	114-P2A-PB	13.9 - 14.4	-1.6 - -2.1	2/12/2014	JB59707	5.8 J
P3A	E5	13.5 - 14.0	-1.9 - -2.4	8/29/2003	R2318235	6.5

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Arsenic Result (mg/kg)
P3A	E5A	13.6 - 14.6	-2.0 - -3.0	9/6/2005	J8861	1.8
P3A	E5A	15.3 - 16.0	-3.7 - -4.4	9/6/2005	J8861	19.1
					Sum	72.7

bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligram per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group
sf	square feet

Arithmetic Mean Concentration = 72.7 mg/kg / 6 samples = 12 mg/kg

Samples 114-P8A-PB-17.7-18.2, 114-R6A-PB-15.4-15.9 and 114-R8A-PB-16.5-17.0

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	SDG	Arsenic Result (mg/kg)
P6A	114-P6A-PB	15.1 - 15.6	-3.0 - -3.5	3/12/2014	JB61695	6.4
P7A	114-P7A-PB	15.8 - 16.3	-2.5 - -3.0	4/23/2014	JB65409A	12.4
P8A	114-P8A-PB	17.7 - 18.2	-2.1 - -2.6	4/23/2014	JB65401	41.7 J
P9A	SB4	22.0 - 22.5	-8.7 - -9.2	11/11/2003	03-10170	1.69
Q7A	E4	15.5 - 16.0	-2.2 - -2.7	8/27/2003	R2318189	11.9 J
R6A	114-R6A-PB	15.4 - 15.9	-2.6 - -3.1	4/15/2014	JB64765	20.3
R8A	114-R8A-PB	16.5 - 17.0	-1.3 - -1.8	6/12/2014	JB69140	24.1
					Sum	118.5

bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligram per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group
sf	square feet

Arithmetic Mean Concentration = 118.5 mg/kg / 7 samples = 17 mg/kg

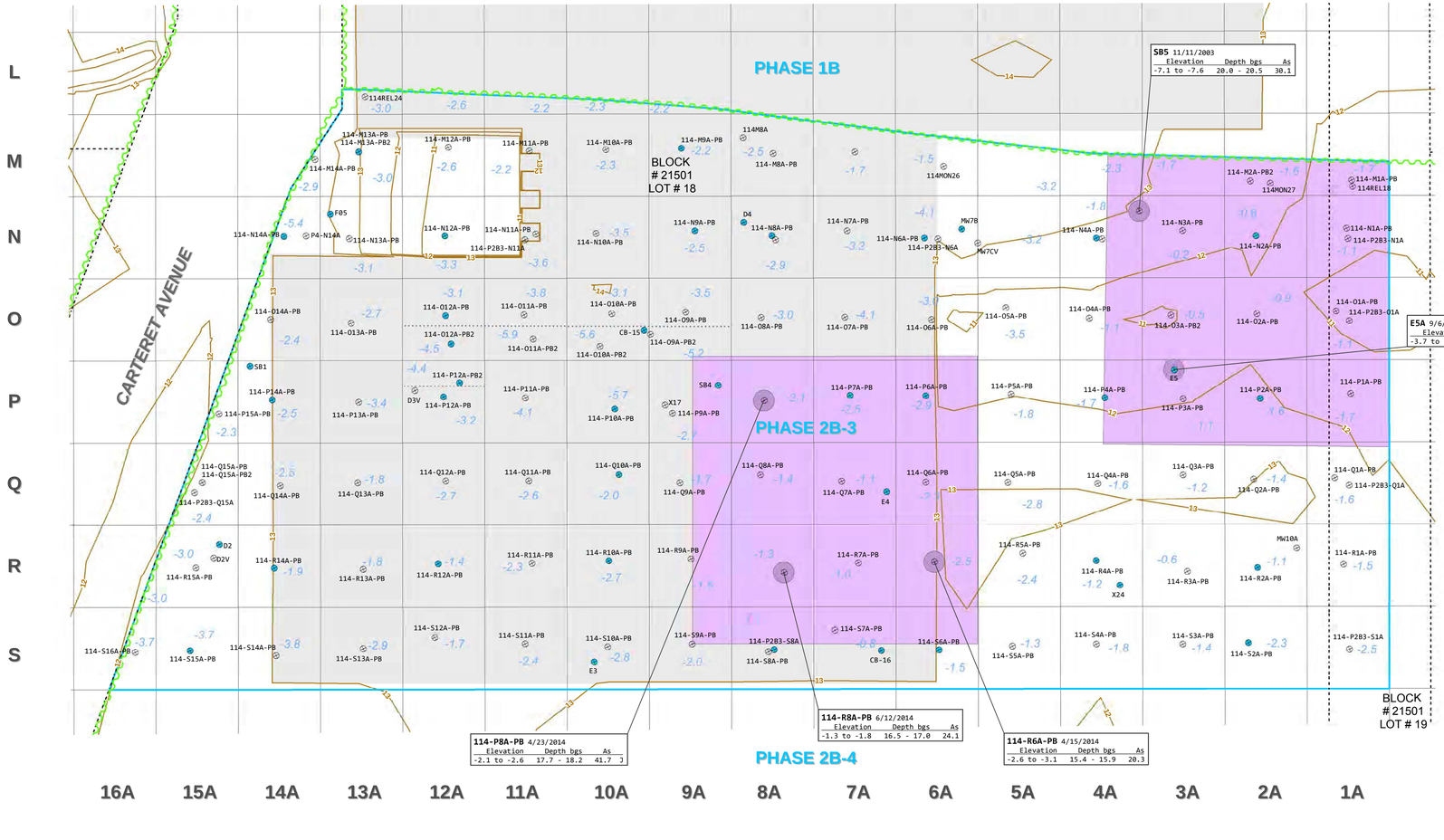
Conclusion

Based on the direct contact exposure pathway, the arithmetic mean arsenic concentration within the study area at samples SB-5(20.0-20) and 114-E5A(15.33-16) is 12 mg/kg, which is compliant with the 19 mg/kg RDCSRS.

Based on the direct contact exposure pathway, the arithmetic mean arsenic concentration within the study area at samples 114-P8A-PB-17.7-18.2, 114-R6A-PB-15.4-15.9 and 114-R8A-PB-16.5-17.0 is 17 mg/kg, which is compliant with the 19 mg/kg RDCSRS.

Attachments:

Figure 1	Sample Map for Other Metals Compared to Soil Remediation Standards and Study Area (RDCSRS)
Figure 2	Delineation of Arsenic at Location SB5
Attachment 1	NJDEP Remediation Standards for Arsenic



ABBREVIATIONS:

As - arsenic

bgs - below ground surface

ft - feet

mg/kg - milligrams per kilogram

N/A - not applicable

NAVD88 - North American Vertical Datum of 1988

NRDCSRS - New Jersey Department of Environmental Protection Non-Residential Direct Contact Soil Remediation Standard

RDCSRS - New Jersey Department of Environmental Protection Residential Direct Contact Soil Remediation Standard

QUALIFIERS:

J - The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample

GENERAL NOTES:

G1. The metals data associated with the sample locations shown on this figure are provided in Table 5-3. Data presented in call out boxes on this figure are outliers (i.e., data points that require further explanation). Specific notes for each outlier sample are provided in the Specific Notes in Table 5-3.

G2. "Elevation" refers to the sample elevation based on the pre-remediation surface elevation for samples collected from the pit bottom, and the surface elevation of the sample location when the sample was collected via boring or test pit.

G3. Elevation vertical datum is NAVD88, in U.S. survey ft.

G4. Results are reported in mg/kg.

G5. Source of block/lot lines is Jersey City Parcel Data from New Jersey Geographic Information Network (NJGIN), last updated 10/6/2015 (available at: http://data.jerseycitynj.gov/dataset/jersey-city-parcel-polygon).

G6. This figure presents data for locations within the Site boundary that have samples remaining in place.

SPECIFIC NOTES:

S1. Property lines and pre-construction topographical contours are sourced from the "Catch Basin-Receptor Evaluation Survey, PPG Site 114, City of Jersey City, Hudson County, New Jersey" prepared by Borbas Surveying and Mapping, LLC, dated April 19, 2011.

S2. As-built terminal excavation elevations were taken from "PPG – Jersey City Phase 2B-3 Excavation, Excavation Status," produced by ENTACT, dated 09/24/2014 with revisions.

S3. In Grids M13A, P3A, and Q15A, two sample locations are located adjacent; therefore, the sampling location symbols overlap on the figure.

LEGEND

- REMAINING SAMPLES NOT ANALYZED FOR OTHER METALS
- SAMPLING LOCATION (REMAINING SAMPLES)
- RESULT IS BELOW THE MOST STRINGENT STANDARD
- RESULTS EXCEED THE MOST STRINGENT STANDARD, BUT ARE IN COMPLIANCE WITH REMEDIATION OBJECTIVES
- ARSENIC (As)
- IN PLACE SHEET PILE (AS OF NOVEMBER 2017)
- APPROXIMATE LOCATION OF GRID SPLIT
- PROPERTY LINE
- PRE-REMEDIATION ELEVATION CONTOUR (1-FOOT INTERVAL IN FT NAVD88)
- 0.5 GRID LAYOUT WITH AS-BUILT TERMINAL EXCAVATION ELEVATIONS (FT NAVD88)
- STUDY AREA
- FORMER BUILDING SLAB (AVERAGE ELEVATION 13.2 FT NAVD88)
- PHASE 2B-3 BOUNDARY

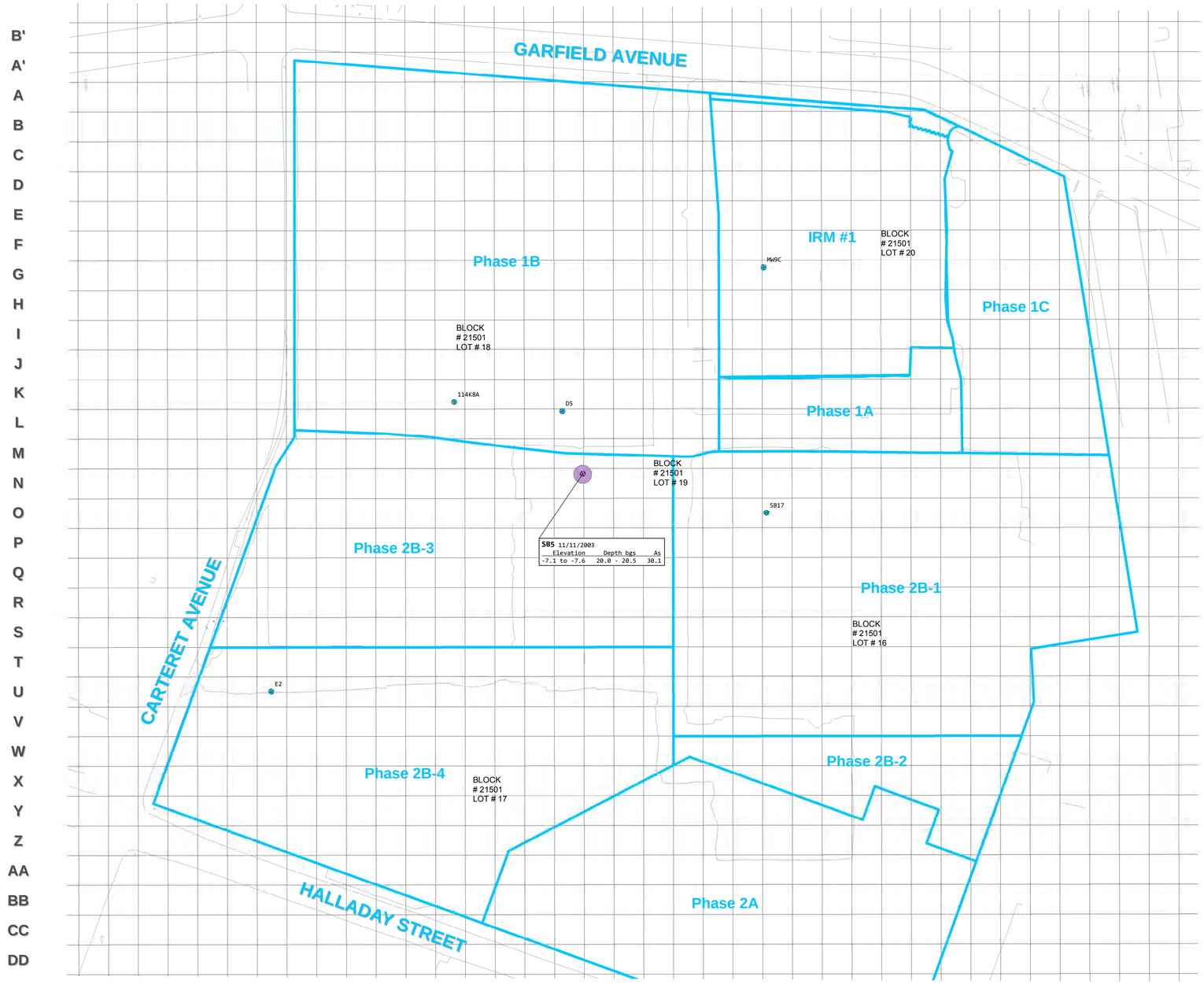
Soil Remediation Standards (mg/kg)		
Analyte	**RDCSRS**	**NRDCSRS**
ALUMINUM	78000	N/A
ARSENIC	19	19
BARIUM	16000	59000
BERYLLIUM	16	140
CADMIUM	78	78
CALCIUM METAL	N/A	N/A
COBALT	1600	590
COPPER	3100	45000
CYANIDE	47	680
IRON	N/A	N/A
LEAD	400	800
MAGNESIUM	N/A	N/A
MANGANESE	11000	5900
MERCURY	23	65
POTASSIUM	N/A	N/A
SELENIUM	390	5700
SILVER	390	5700
SODIUM	N/A	N/A
ZINC	23000	110000

MAP LOCATION

0 20 40 Feet

AECOM

PPG SITE 114 GARFIELD AVENUE GROUP JERSEY CITY, NEW JERSEY			PHASE 2B-3 SAMPLE MAP FOR OTHER METALS COMPARED TO SOIL REMEDIATION STANDARDS AND STUDY AREA (RDCSRS)
DATE: 02/23/2018			FIGURE 1



ABBREVIATIONS:

As - arsenic

bgs - below ground surface

ft - feet

mg/kg - milligrams per kilogram

NAVD88 - North American Vertical Datum of 1988

NRDCSRS - New Jersey Department of Environmental Protection Non-Residential Direct Contact Soil Remediation Standard

RDCSRS - New Jersey Department of Environmental Protection Residential Direct Contact Soil Remediation Standard

GENERAL NOTES:

G1. The metals data associated with the sample locations shown on this figure are provided in the Technical Memorandum, *PPG Site 114, Phase 2B-3, Compliance Averaging for Arsenic in Soil*, AECOM, February 2018.

G2. "Elevation" refers to the sample elevation based on the pre-remediation surface elevation for samples collected from the pit bottom, and the surface elevation of the sample location when the sample was collected via boring or test pit.

G3. Elevation vertical datum is NAVD88, in U.S. survey ft.

G4. Results are reported in mg/kg.

G5. Source of block/lot information is Jersey City Parcel Data from New Jersey Geographic Information Network (NJGIN), last updated 10/6/2015 (available at: http://data.jerseycitynj.gov/dataset/jersey-city-parcel-polygon).

G6. This figure presents data only for locations intended to delineate the arsenic exceedance at location SB-5.

SPECIFIC NOTES:

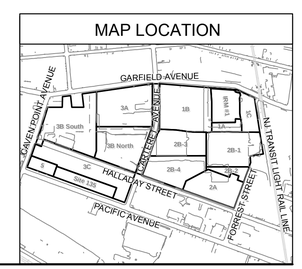
S1. Property lines are sourced from the "Catch Basin-Receptor Evaluation Survey, PPG Site 114, City of Jersey City,Hudson County, New Jersey" prepared by Borbas Surveying and Mapping, LLC, dated April 19, 2011.

Soil Remediation Standards (mg/kg)		
Analyte	RDCSRS	NRDCSRS
ARSENIC	19	19

LEGEND

- SAMPLING LOCATION (REMAINING SAMPLES)
- RESULT IS BELOW THE MOST STRINGENT STANDARD
- RESULTS EXCEED THE MOST STRINGENT STANDARD, BUT ARE IN COMPLIANCE WITH REMEDIATION OBJECTIVES
- ARSENIC (As)
- PHASE BOUNDARY
- GRID LAYOUT

MAP LOCATION



0 60 Feet

AECOM

PPG SITE 114 GARFIELD AVENUE GROUP JERSEY CITY, NEW JERSEY			DELINEATION OF ARSENIC AT LOCATION SB5
DATE: 02/23/2018			FIGURE 2

Path: P:\Jobs\Ren_Eng\Project Files\PPG Industries\Garfield Avenue\GIS\Maps\MXD\SITE 114\SITE 114 All Loc Groups.mxd

ATTACHMENT 1

NJDEP Remediation Standards for Arsenic

New Jersey Department of Environmental Protection

Standards for Drinking Water, Ground Water, Soil and Surface Water

Arsenic (Total)

CAS #: 7440-38-2

Drinking Water Standards (µ g/l or ppb)

Standard: 5 **Type:** Primary STATE MCL

Ground Water Quality Standards (µ g/l or ppb)

Standard: 3 **Type:** Specific

GW-Quality Criterion: 0.02

PQL: 3

Surface Water Quality Standards (µ g/l or ppb)

Fresh Water-

Human Health: 0.017(hc)(T) **Aquatic-Acute:** 340(d)(s) **Aquatic-Chronic:** 150(d)(s)

Saline Water-

Human Health: 0.061(hc)(T) **Aquatic-Acute:** 69(d)(s) **Aquatic-Chronic:** 36(d)(s)

Soil Standards (mg/kg)

Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 19* **Effective:** 6/2/2008 **Interim:** ☐

The direct contact standard for arsenic is based on natural background

Ingestion Dermal: 0.4

Inhalation: 980

Soil PQL: 1

Non-Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 19* **Effective:** 6/2/2008 **Interim:** ☐

The direct contact standard for arsenic is based on natural background

Ingestion Dermal: 2

Inhalation: 76

Soil PQL: 1

AECOM
250 Apollo Drive
Chelmsford, MA 01824

978.905.2100 tel
978.905.2101 fax

Memorandum

To	Tom Cozzi, NJDEP David Doyle, NJDEP Prabal Amin, WESTON Solutions Laura Amend Babcock, WESTON Solutions David Spader, ERFS Bhavini Doshi, City of Jersey City James D. Ray, MDMC-Law Nancy Colson, MDMC-Law Ben Delisle, JCRA	Page 1
CC	Jody Overmyer, PPG Mark Terril, PPG Rich Feinberg, PPG Joseph Lagrotteria, LeClairRyan Dorothy Laguzza, LeClairRyan Scott Mikaelian, AECOM Carolyn Scott, AECOM Aimee Ruiter, AECOM Abigail Small, AECOM	
Subject	PPG Site 114, Phase 2B-3 Compliance Averaging for Carbazole in Soil (Revision 1)	
From	Claire Hunt	
Date	February 23, 2018	

This memorandum provides the rationale used to determine attainment of compliance for carbazole in soil with the New Jersey Department of Environmental Protection (NJDEP) Residential Direct Contact Soil Remediation Standards (RDCSRS) for a site-specific soil sample set from Site 114, Phase 2B-3 in accordance with NJDEP Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria (September 24, 2012, Version 1.0).

Introduction

Based on investigation and remediation findings to date, the following carbazole concentration remains in place in excess of the RDCSRS (24 milligrams per kilogram [mg/kg]) at Site 114, Phase 2B-3 when using single point compliance, and for which we have applied compliance averaging for the attainment of compliance:

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD 88)	Carbazole (mg/kg)
P8A	114-P8A-PB	114-P8A-PB-17.7-18.2	17.7 - 18.2	-2.1 - -2.6	45.8 J

bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligram per kilogram
NAVD88	North American Vertical Datum of 1988

Figure 1 shows sample locations with remaining carbazole data, the Phase boundary, and the location of the sample exceeding the carbazole RDCSRS. The remaining in-place carbazole results are provided in Table 5-5 of the Site 114, Phase 2B-3 Remedial Action Report (RAR) Tables and Figures (Revision 1 Supplemental) submittal, February 23, 2018.

Delineation

The remaining soil sample exceeding the carbazole RDCSRS is delineated by the following samples, which are shown on **Figure 1.** Laboratory reports and data validation reports for the samples were included with the Site 114, Phase 2B-3 RAR Tables and Figures (Revision 0) submittal, July 20, 2017.

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	Carbazole Result (mg/kg)	Direction
N4A	114-N4A-PB	16.0 - 16.5	-1.7 - -2.2	2/27/2014	0.027 U	North
Q7A	E4	15.5 - 16.0	-2.2 - -2.7	8/27/2003	1.2 U	East
R10A	114-R10A-PB	15.9 - 16.4	-2.7 - -3.2	8/4/2014	0.029 U	South
N9A	114-N9A-PB	15.7 - 16.2	-2.5 - -3.0	4/29/2014	0.032 UJ	West
P9A	SB4	22.0 - 22.5	-8.7 - -9.2	11/11/2003	0.109 U	Vertically

bgs	below ground surface
ft	foot or feet
mg/kg	milligram per kilogram
NAVD88	North American Vertical Datum of 1988
U	The analyte was not detected above the sample reporting limit shown.
UJ	The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

Functional Area

The carbazole RDCSRS is based on the ingestion-dermal pathway (**Attachment 1**). The functional area for the ingestion-dermal pathway is limited to 0.25 acre for residential exposure scenario. The extent of the functional area within the Phase boundary is shown in **Figure 1**. The shape is generally rectangular and within the Phase boundary. Remaining samples within the functional area extents were collected from deeper than 2 feet below ground surface and are considered a part of the functional area for the calculation.

Compliance Averaging

Compliance with the carbazole RDCSRS is demonstrated through spatial averaging. Theissen polygons were created within the functional area as shown in **Figure 1**. The sample selection process is as follows:

1. All of the samples for carbazole with a sample status of remaining that fall within the functional area horizontally and vertically are identified (backfill samples are excluded).
2. The maximum concentration is selected at each sample location for use in the weighted average. The maximum of the concentration for detections or the Method Detection Limit (MDL)/Reporting Limit (RL) for non-detects is selected.

Laboratory reports and data validation reports for the samples were included with the Site 114, Phase 2B-3 RAR Tables and Figures (Revision 0) submittal, July 20, 2017.

Sample 114-P8A-PB-17.7-18.2 – Carbazole RDCSRS

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	Maximum Carbazole Result (mg/kg)	Area (sf)	Area x Maximum Carbazole Result (sf*mg/kg)
P10A	114-P10A-PB	18.9 - 19.4	-5.7 - -6.2	7/1/2014	0.024 U	777	19
N8A	D4	16.0 - 16.5	-2.8 - -3.3	12/2/2003	11 U	826	9,086
P9A	SB4	22.0 - 22.5	-8.7 - -9.2	11/11/2003	0.109 U	1,085	118
P8A	114-P8A-PB	17.7 - 18.2	-2.1 - -2.6	4/23/2014	45.8 J	1,281	58,670
N9A	114-N9A-PB	15.7 - 16.2	-2.5 - -3.0	4/29/2014	0.032 UJ	1,398	45
O10A	CB-15	30.0 - 30.5	-16.8 - -17.3	3/1/2012	0.016 U	1,574	25
N8A	114-N8A-PB	18.0 - 18.5	-2.9 - -3.4	4/21/2014	0.027 U	1,861	50
M9A	114-M9A-PB	17.0 - 17.5	-2.3 - -2.8	4/29/2014	0.027 U	1,863	50
					Total	10,665	68,063

bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligram per kilogram

NAVD88	North American Vertical Datum of 1988
sf	square feet
U	The analyte was not detected above the sample reporting limit shown.
UJ	The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

Weighted Average Concentration = 68,063 sf x mg/kg / 10,665 sf = 6 mg/kg

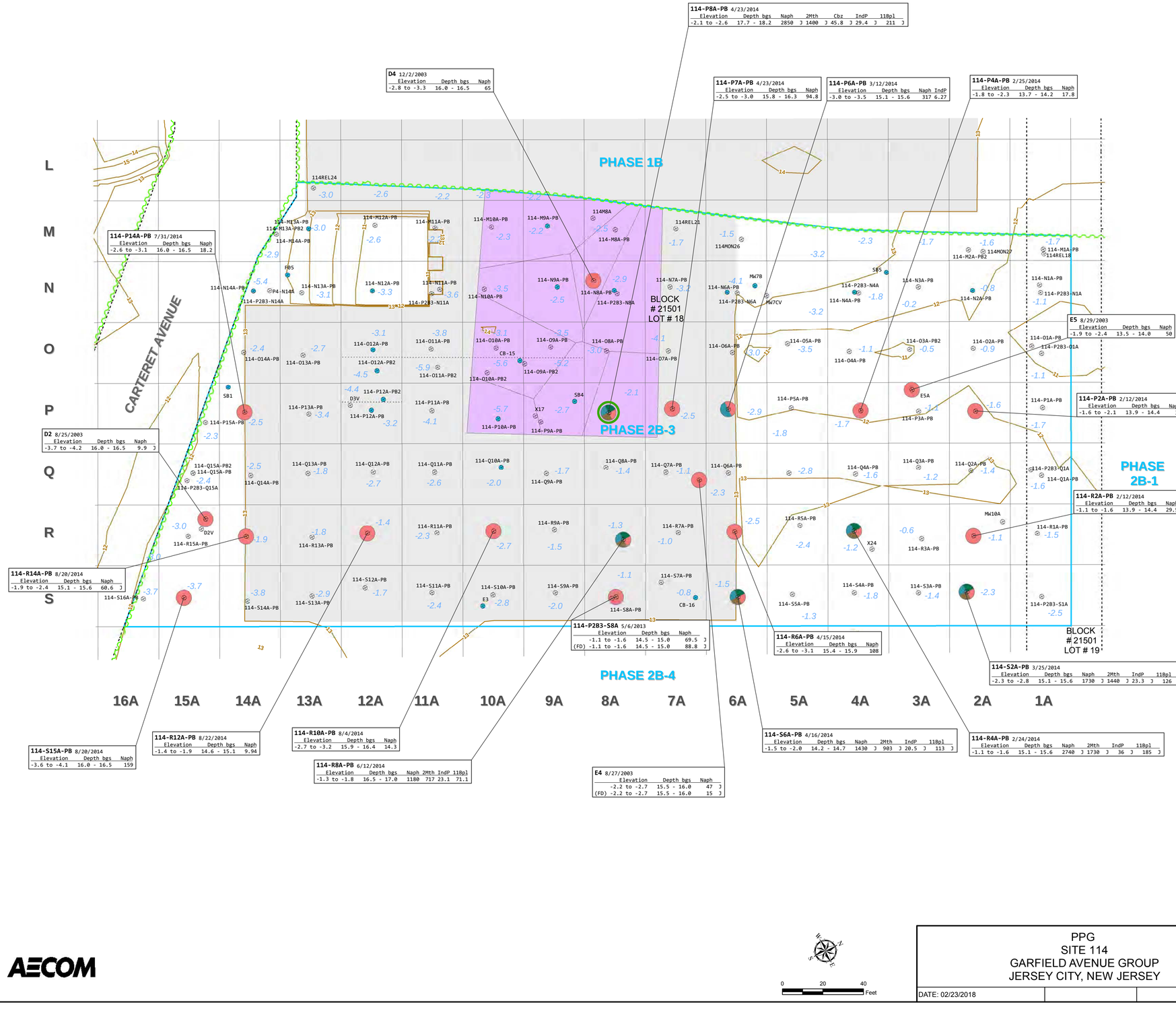
Conclusion

Based on the residential exposure scenario, the spatially weighted average carbazole concentration within the study area at sample 114-P8A-PB-17.7-18.2 is 6 mg/kg, which is compliant with the 24 mg/kg RDCSRS.

Attachments:

Figure 1 Sample Map for SVOCs Compared to Soil Remediation Standards and Functional Area

Attachment 1 NJDEP Remediation Standards for Carbazole



ABBREVIATIONS:

11Bpl - 1-1'-biphenyl
2Mth - 2-methylnaphthalene
bgs - below ground surface
Cbz - carbazole
IndP - indeno(1,2,3-cd)pyrene
FD - field duplicate
ft - feet
mg/kg - milligram per kilogram
Naph - naphthalene
NAVD88 - North American Vertical Datum of 1988
SVOC - semi-volatile organic compound

QUALIFIERS:

J - The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.

GENERAL NOTES:

G1. The SVOC data associated with the sample locations shown on this figure are provided in Table 5-5. Additional SVOC exceedances are shown on Figure 5-5A. Data presented in call out boxes on this figure are outliers (i.e., data points that require further explanation). Specific notes on how the New Jersey Department of Environmental Protection's remedial standards are being met and/or how remedial completion is being achieved/completed for each outlier sample are provided in the Specific Notes in Table 5-5.

G2. "Elevation" refers to the sample elevation based on the pre-remediation surface elevation for samples collected from the pit bottom, and the surface elevation of the sample location when the sample was collected via boring or test pit.

G3. Elevation vertical datum is NAVD88, in U.S. survey ft.

G4. Results are reported in mg/kg.

G5. Source of block/lot information is Jersey City Parcel Data from New Jersey Geographic Information Network (NJGIN), last updated 10/6/2015 (available at: http://data.jerseycitynj.gov/dataset/jersey-city-parcel-polygon).

G6. This figure presents data for locations within the Phase boundary that have samples remaining in place.

SPECIFIC NOTES:

S1. Property lines and pre-construction topographical contours are sourced from the "Catch Basin-Receptor Evaluation Survey, PPG Site 114, City of Jersey City, Hudson County, New Jersey" prepared by Borbas Surveying and Mapping, LLC, dated April 19, 2011.

S2. As-built terminal excavation elevations were taken from "PPG – Jersey City Phase 2B-3 Excavation, Excavation Status," produced by ENTACT, dated 09/24/2014 with revisions.

S3. In Grids M13A, P3A, and Q15A, two sample locations are located adjacent; therefore, the sampling location symbols overlap on the figure.

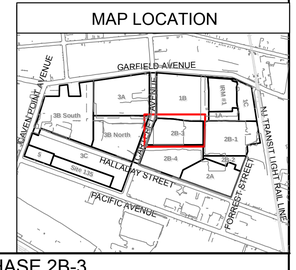
LEGEND

- REMAINING SAMPLES NOT ANALYZED FOR SVOCs
- SAMPLING LOCATION (REMAINING SAMPLES)
- RESULT IS BELOW THE MOST STRINGENT STANDARD
- CARBAZOLE RESULTS EXCEED THE MOST STRINGENT STANDARD, BUT ARE IN COMPLIANCE WITH THE REMEDIATION OBJECTIVES
- RESULTS EXCEED THE MOST STRINGENT STANDARD, BUT WILL BE ADDRESSED BY ENGINEERING AND INSTITUTIONAL CONTROLS
- NAPHTHALENE (Naph)
- 2-METHYLNAPHTHALENE (2Mth)
- 1-1'BIPHENYL (11Bpl)
- INDENO(1,2,3-CD)PYRENE (IndP)
- IN PLACE SHEET PILE (AS OF NOVEMBER 2017)
- APPROXIMATE LOCATION OF GRID SPLIT
- PROPERTY LINE
- PRE-REMEDIATION ELEVATION CONTOUR (1-FOOT INTERVAL IN FT NAVD88)
- GRID LAYOUT WITH AS-BUILT TERMINAL EXCAVATION ELEVATIONS(FT NAVD88)
- THEISSEN POLYGON
- FORMER BUILDING SLAB (AVERAGE ELEVATION 13.2 FT NAVD88)
- PHASE 2B-3 BOUNDARY

Soil Remediation Standards (mg/kg)

Analyte	RDCSRS	NRDCSRS	Analyte	RDCSRS	NRDCSRS
1,2,4,5-TETRACHLOROBENZENE	N/A	N/A	DIBENZOFURAN	N/A	N/A
1,2,4-TRICHLOROBENZENE	73	820	DIETHYL PHTHALATE	49000	550000
1,2-DICHLOROBENZENE	5300	59000	DIMETHYL PHTHALATE	N/A	N/A
1,4-DICHLOROBENZENE	5	13	DI-N-BUTYLPHTHALATE	6100	68000
1,4-DIOXANE	N/A	N/A	DI-N-OCTYL PHTHALATE	2400	27000
1-1'-BIPHENYL	61	240	FLUORANTHENE	2300	24000
2,2'-OXYBIS(1-CHLOROPROPANE)	22	87	FLUORENE	2300	24000
2,3,4,6-Tetrachlorophenol	N/A	N/A	HEXACHLORO-1,3-BUTADIENE	6	25
2,4,5-TRICHLOROPHENOL	6100	68000	HEXACHLOROBENZENE	0.3	1
2,4,6-TRICHLOROPHENOL	19	74	HEXACHLOROCYCLOPENTADIENE	45	110
2,4-DICHLOROPHENOL	180	2100	HEXACHLOROETHANE	12	48
2,4-DIMETHYLPHENOL	1200	14000	INDENO(1,2,3-CD)PYRENE	5	17
2,4-DINITROPHENOL	120	1400	M-DICHLOROBENZENE	5300	59000
2,4-DINITROTOLUENE	0.7	3	METHANAMINE, N-METHYL-N-NITROSO	0.7	0.7
2,6-DINITROTOLUENE	0.7	3	NAPHTHALENE	6	17
2-CHLORONAPHTHALENE	N/A	N/A	NITROBENZENE	5	14
2-CHLOROPHENOL	310	2200	N-NITROSO-DI-N-PROPYLAMINE	0.2	0.3
2-METHYLNAPHTHALENE	230	2400	N-NITROSODIPHENYLAMINE	99	390
2-METHYLPHENOL	310	3400	P-CHLOROANILINE	N/A	N/A
2-NITROANILINE	39	23000	PENTACHLOROPHENOL	0.9	3
2-NITROPHENOL	N/A	N/A	PHENANTHRENE	N/A	300000
3,3'-DICHLOROBENZIDINE	1	4	PHENOL	18000	210000
3,5,5-TRIMETHYL-2-CYCLOHEXENE-1-ONE	510	2000	P-NITROANILINE	N/A	N/A
3+4-METHYLPHENOL	31	340	PYRENE	1700	18000
3-NITROANILINE	N/A	N/A			
4,6-DINITRO-2-METHYLPHENOL	6	68			
4-BROMOPHENYL PHENYL ETHER	N/A	N/A			
4-CHLORO-3-METHYLPHENOL	N/A	N/A			
4-CHLOROPHENYL PHENYL ETHER	N/A	N/A			
4-NITROPHENOL	N/A	N/A			
ACENAPHTHENE	3400	37000			
ACENAPHTHYLENE	N/A	300000			
ACETOPHENONE	2	5			
ANTHRACENE	17000	30000			
ATRAZINE	210	2400			
BENZALDEHYDE	6100	68000			
BENZO(A)ANTHRACENE	5	17			
BENZO(A)PYRENE	0.5	2			
BENZO(B)FLUORANTHENE	5	17			
BENZO(G,H,I)PERYLENE	380000	30000			
BENZO(K)FLUORANTHENE	45	170			
BENZYL ALCOHOL	N/A	N/A			
BENZYL BUTYL PHTHALATE	1200	14000			
BIS(-2-CHLOROETHOXY)METHANE	N/A	N/A			
BIS(2-CHLOROETHYL)ETHER	0.4	2			
BIS(2-ETHYLHEXYL)PHTHALATE	35	140			
CAPROLACTAM	31000	340000			
CARBAZOLE	24	96			
CHRYSENE	450	1700			
DIBENZO(A,H)ANTHRACENE	0.5	2			

MAP LOCATION



AECOM

PPG
SITE 114
GARFIELD AVENUE GROUP
JERSEY CITY, NEW JERSEY

DATE: 02/23/2018

PHASE 2B-3
SAMPLE MAP FOR SVOCs
COMPARED TO SOIL REMEDIATION STANDARDS
AND FUNCTIONAL AREA

FIGURE 1

ATTACHMENT 1

NJDEP Remediation Standards for Carbazole

New Jersey Department of Environmental Protection

Standards for Drinking Water, Ground Water, Soil and Surface Water

Carbazole

CAS #: 86-74-8

Drinking Water Standards (μ g/l or ppb)

Standard: **Type:**

Ground Water Quality Standards (μ g/l or ppb)

Standard: **Type:**

GW-Quality Criterion:

PQL:

Surface Water Quality Standards (μ g/l or ppb)

Fresh Water-

Human Health: **Aquatic-Acute:** **Aquatic-Chronic:**

Saline Water-

Human Health: **Aquatic-Acute:** **Aquatic-Chronic:**

Soil Standards (mg/kg)

Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 24 **Effective:** 6/2/2008 **Interim:** ☐

Ingestion Dermal: 24

Inhalation: 740,000

Soil PQL: 0.2

Non-Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 96 **Effective:** 6/2/2008 **Interim:** ☐

Ingestion Dermal: 96

Inhalation: 58,000

Soil PQL: 0.2

I-6 Phase 2B-4 Compliance Averaging Evaluations

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Memorandum

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	Abigail Small, AECOM	
Subject	PPG Site 114, Phase 2B-4 Compliance Averaging for Antimony in Soil (Revision 1)	
From	Claire Hunt	
Date	February 26, 2018	

This memorandum provides documentation of attainment of compliance for antimony in soil with the New Jersey Department of Environmental Protection (NJDEP) Residential Direct Contact Site Remediation Standard (RDCSRS) for a site-specific soil sample set from Site 114, Phase 2B-4 in accordance with the NJDEP *Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria* (September 24, 2012, Version 1.0).

Introduction

Based on investigation and remediation findings to date, the following antimony concentration remains in place in excess of the RDCSRS (31 milligrams per kilogram [mg/kg]) at Site 114, Phase 2B-4 when using single point compliance, and for which we have applied compliance averaging for the attainment of compliance:

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Antimony (mg/kg)
Y12A	F2	F2S21-21.5	21.0 - 21.5	-5.6 - -6.1	69.8 BJ

bgs below ground surface
BJ A particular metal was present in the laboratory blank (B) and a positive result for the metal was qualified as estimated (J) because the concentration was greater than or equal to three times but less than or equal to ten times the maximum blank contamination.
ft foot or feet
mg/kg milligram per kilogram
NAVD88 North American Vertical Datum of

Figure 1 shows borings with remaining antimony data, the phase boundary, and the location of the sample exceeding the antimony RDCSRS. The remaining in-place antimony results are provided in Table 5-2 of the Site 114, Phase 2B-4 Remedial Action Report (RAR) Tables and Figures (Revision 1 Supplemental), February 26, 2018

Delineation

The delineation of antimony was implemented during the Remedial Investigation (RI) activities by PPG as documented in the *Remedial Investigation Report – Soil, Garfield Avenue Group Non-Residential Chromate Chemical Production Waste Sites 114, 132, 133, 135, 137, 143 and 186, Jersey City, New Jersey*, AECOM, February 2012, as approved by NJDEP on March 12, 2012.

Horizontal delineation was further refined during remedial action by the samples listed on the following table and shown on **Figure 1**. In the event that field duplicate samples were collected at a single location, the greater concentration of the two results is shown below.

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	Antimony Result (mg/kg)	Direction
X11A	114-X11A-PB	20.1 - 20.6	-3.8 - -4.3	10/17/2014	< 0.88 UJ	North
X13A	114-X13A-PB	19.5 - 20.0	-4.7 - -5.2	10/21/2014	< 0.75 UJ	West
Z11A	114-Z11A-PB	18.7 - 19.2	-5.3 - -5.8	10/17/2014	< 0.74 UJ	East
Z13A	114-Z13A-PB2	17.5 - 18.0	-4.8 - -5.3	11/24/2014	< 0.42 U	South

bgs below ground surface
ft foot or feet
mg/kg milligram per kilogram
NAVD88 North American Vertical Datum of 1988
U The analyte was not detected above the sample reporting limit shown.
UJ The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

Sample F2S21-21.5 was collected in the top interval of meadow mat (MM) encountered below historic fill. Each of the samples listed above for horizontal delineation was collected in the first interval of MM below historic fill. Laboratory reports and data validation reports for these samples were included with the Site 114, Phase 2B-4 RAR Tables and Figures (Revision 0) submittal, July 27, 2017.

Antimony was not analyzed for in soil beneath the location where the exceedance remains at Site 114, Phase 2B-4. Vertical delineation has deviated from guidance since single-point compliance was not achievable. Vertical delineation is based on the lines of evidence presented below:

- The deepest antimony exceedance in Phase 2B-4 is from the sample location of interest (F2S21-21.5 [El. -5.6 to -6.1 ft NAVD88]).
- Antimony was not detected in soil or was less than the RDCSRS in 23 samples and three field duplicate samples collected from 14 unique locations at elevations deeper than El. -6.1 ft NAVD88 in Phase 2B-4 (See Table 5-2 of the Site 114, Phase 2B-4 RAR Tables and Figures (Revision 1 Supplemental) submittal, February 26, 2018)
- As described in the 2012 *Remedial Investigation Report – Soil, Garfield Avenue Group Non-Residential Chromate Chemical Production Waste Sites 114, 132, 133, 135, 137, 143 and 186, Jersey City, New Jersey,* AECOM, February 2012, the vertical limit of Chromate Chemical Production Waste (CCPW) metals, including antimony, throughout the Garfield Avenue Group was roughly the depth of the MM. The exceedance of antimony in Site 114, Phase 2B-4 was collected from the top half foot of MM encountered below historic fill. Antimony exceedances were not recorded in any samples in Phase 2B-4 below the MM. Excavation throughout Site 114, Phase 2B-4 was conducted to native material.

Functional Area

The antimony RDCSRS is based on the ingestion-dermal pathway (**Attachment 1**). The functional area for the ingestion-dermal pathway is limited to 0.25 acre for the residential exposure scenario. The extent of the functional area within the Phase boundary is shown in **Figure 1**. The shape is generally square within the Phase boundary. Remaining samples within the functional area extents were collected from deeper than 2 feet below ground surface and are considered a part of the functional area for the calculation.

Compliance Averaging

Compliance with the antimony RDCSRS is demonstrated through spatial averaging. Theissen polygons were created within the functional area as shown in **Figure 1**. The sample selection process is as follows:

1. All of the samples for antimony with a sample status of remaining that fall within the functional area horizontally and vertically are identified (backfill samples are excluded).
2. The maximum concentration is selected at each sample location for use in the weighted average. The maximum of the concentration for detections or the Method Detection Limit (MDL)/Reporting Limit (RL) for non-detects is selected.

Laboratory reports and data validation reports for the samples were included with the Site 114, Phase 2B-4 RAR Tables and Figures (Revision 0) submittal, July 27, 2017.

Grid ID	Location ID	Sample Depth (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	Maximum Antimony Result (mg/kg)	Area (sf)	Area x Maximum Antimony Result (sf*mg/kg)
Y12A	F2	21.0 - 21.5	-5.6 - 6.1	8/22/2003	69.8 BJ	2,325	162,285
AA12A	X29	17.1 - 17.6	-4.9 - 5.4	10/21/2005	1.2 UJ	1,444	1,733
X11A	114-X11A-PB	20.1 - 20.6	-3.8 - 4.3	10/17/2014	0.88 UJ	1,127	992
Z13A	114-Z13A-PB2	17.5 - 18.0	-4.8 - 5.3	11/24/2014	0.42 U	2,601	1,092
X13A	114-X13A-PB	19.5 - 20.0	-4.7 - 5.2	10/21/2014	0.75 UJ	3,319	2,489
					Total	10,816	168,591

bgs	below ground surface
BJ	A particular metal was present in the laboratory blank (B) and a positive result for the metal was qualified as estimated (J) because the concentration was greater than or equal to three times but less than or equal to ten times the maximum blank contamination.
ft	foot or feet
mg/kg	milligram per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group
sf	square feet
U	The analyte was not detected above the sample reporting limit shown.
UJ	The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

Weighted Average Concentration = 168,591 sf x mg/kg / 10,816 sf = 16 mg/kg

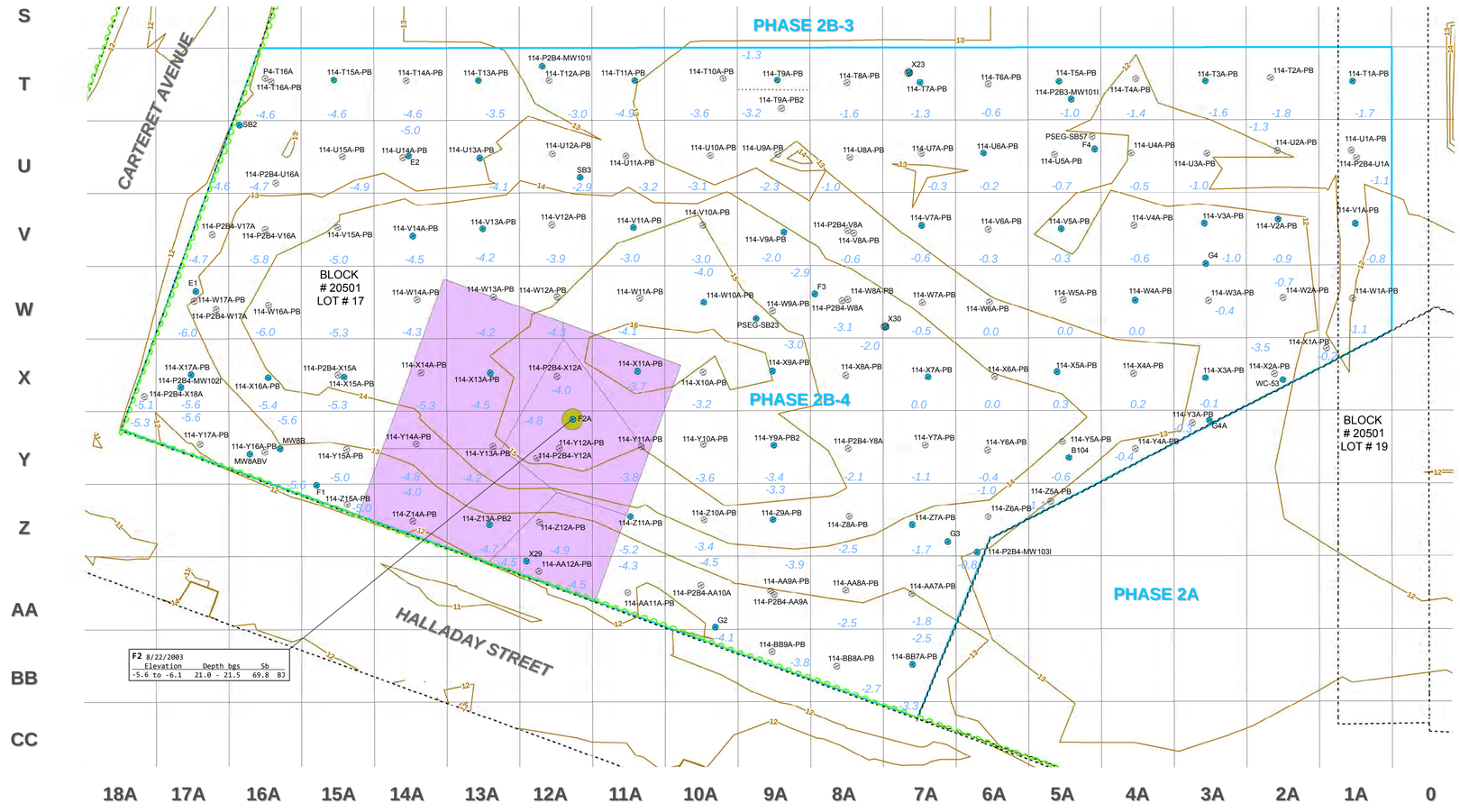
Conclusion

The spatially weighted average antimony concentration within the study area at Site 114, Phase 2B-4 is 16 mg/kg, which is compliant with the 31 mg/kg RDCSRS.

Attachments:

Figure 1 Phase 2B-4 Sample Map for CCPW Metals Compared to Soil Remediation Standards and Functional Area

Attachment 1 NJDEP Remediation Standards for Antimony



ABBREVIATIONS:

bgs - below ground surface

CCPW - Chromate Chemical Production Waste

Cr - total chromium

Cr^{+3} - trivalent chromium

ft - feet

mg/kg - milligrams per kilogram

N/A - not applicable

NAVD88 - North American Vertical Datum of 1988

NJDEP - New Jersey Department of Environmental Protection

NRDCSRS - New Jersey Department of Environmental Protection Non-Residential Direct Contact Soil Remediation Standard

RDCSRS - New Jersey Department of Environmental Protection Residential Direct Contact Soil Remediation Standard

RDCSRS-GAG - Residential Direct Contact Soil Remediation Standard - Garfield Avenue Group (alternative remediation standard approved by the New Jersey Department of Environmental Protection on December 28, 2016)

Sb - antimony

SCC - Soil Cleanup Criteria

SRS - Soil Remediation Standard

QUALIFIERS:

BJ - The analyte concentration is greater than three times, but less than or equal to ten times the concentration in the associated method/prep blank. The presence of that analyte in the sample is considered "real". The concentration is quantitatively qualified due to method blank contamination.

GENERAL NOTES:

G1. The CCPW metals data associated with the sample locations shown on this figure are provided in Table 5-2. Data presented in call out boxes on this figure are outliers (i.e., data points that require further explanation). Specific notes for each outlier sample are provided in the Specific Notes in Table 5-2.

G2. "Elevation" refers to the sample elevation based on the pre-remediation surface elevation for samples collected from the pit bottom, and the surface elevation of the sample location when the sample was collected via boring or test pit.

G3. Elevation vertical datum is NAVD88, in U.S. survey ft.

G4. Results are reported in mg/kg.

G5. Source of block/lot information is Jersey City Parcel Data from New Jersey Geographic Information Network (NJGIN), last updated 10/6/2015 (available at: http://data.jerseycitynj.gov/dataset/jersey-city-parcel-polygon).

G6. This figure presents data for locations within the Phase boundary that have samples remaining in place. In addition, removed samples may be shown to demonstrate compliance with the remediation objectives. The Specific Notes on Table 5-2 include discussion of these situations, if necessary.

G7. There is currently no NJDEP SRS and no NJDEP SCC for total Cr. Therefore, total Cr results are compared to the interim NJDEP Residential SCC for Cr^{+3} of 120,000 mg/kg as the cleanup criteria for soil at the Garfield Avenue Group Sites. There is no non-residential SCC for Cr^{+3}.

SPECIFIC NOTES:

S1. Property lines and pre-construction topographical contours are sourced from the "Catch Basin-Receptor Evaluation Survey, PPG Site 114, City of Jersey City, Hudson County, New Jersey" prepared by Borbas Surveying and Mapping, LLC, dated April 19, 2011.

S2. As-built terminal excavation elevations were taken from "PPG – Jersey City Phase 2B-4 Excavation, Excavation Status," produced by ENTACT, dated 12/17/2014 with revisions.

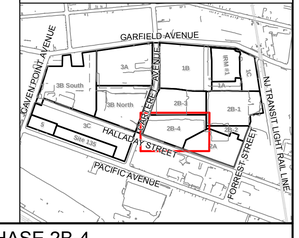
S3. In Grid Y12A, two sample locations are located adjacent; therefore, the sampling location symbols overlap on the figure.

LEGEND

- REMAINING SAMPLES NOT ANALYZED FOR CCPW METALS
- SAMPLING LOCATION (REMAINING SAMPLES)
- SAMPLING LOCATION (REMOVED SAMPLES)
- RESULT IS BELOW THE MOST STRINGENT STANDARD
- RESULTS EXCEED THE MOST STRINGENT STANDARD, BUT ARE IN COMPLIANCE WITH REMEDIATION OBJECTIVES
- ANTIMONY (Sb)
- IN PLACE SHEET PILE (AS OF DECEMBER 2017)
- REMOVED SHEET PILE
- APPROXIMATE LOCATION OF GRID SPLIT
- PROPERTY LINE
- PRE-REMEDIATION ELEVATION CONTOUR (1-FOOT INTERVAL IN FT NAVD88)
- 0.5 GRID LAYOUT WITH AS-BUILT TERMINAL EXCAVATION ELEVATIONS (FT NAVD88)
- THEISSEN POLYGON
- PHASE 2B-4 BOUNDARY

Soil Remediation Standards (mg/kg)			
Analyte	RDCSRS	RDCSRS-GAG	NRDCSRS
ANTIMONY	31	N/A	450
CHROMIUM	120000	N/A	N/A
NICKEL	1600	N/A	23000
THALLIUM	N/A	N/A	N/A
VANADIUM	N/A	390	1100

MAP LOCATION



0 30 60 Feet

AECOM

PPG SITE 114 GARFIELD AVENUE GROUP JERSEY CITY, NEW JERSEY			PHASE 2B-4 SAMPLE MAP FOR CCPW METALS COMPARED TO SOIL REMEDIATION STANDARDS AND FUNCTIONAL AREA
DATE: 02/23/2018			FIGURE 1

ATTACHMENT 1

NJDEP Remediation Standards for Antimony

New Jersey Department of Environmental Protection

Standards for Drinking Water, Ground Water, Soil and Surface Water

Antimony (Total)

CAS #: 7440-36-0

Drinking Water Standards (µ g/l or ppb)

Standard: 6 **Type:** Primary FEDERAL MCL

Ground Water Quality Standards (µ g/l or ppb)

Standard: 6 **Type:** Specific

GW-Quality Criterion: 6

PQL: 3

Surface Water Quality Standards (µ g/l or ppb)

Fresh Water-

Human Health: 5.6(h)(T) **Aquatic-Acute:** **Aquatic-Chronic:**

Saline Water-

Human Health: 640(h)(T) **Aquatic-Acute:** **Aquatic-Chronic:**

Soil Standards (mg/kg)

Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 31 **Effective:** 6/2/2008 **Interim:** ☐

Ingestion Dermal: 31

Inhalation: 360,000

Soil PQL: 6

Non-Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 450 **Effective:** 6/2/2008 **Interim:** ☐

Ingestion Dermal: 450

Inhalation: 23,000

Soil PQL: 6

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Memorandum

To	Tom Cozzi, NJDEP	Page 1
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	Carolyn Scott, AECOM	
	Aimee Ruiter, AECOM	
	Abigail Small, AECOM	
Subject	PPG Site 114, Phase 2B-4	
	Compliance Averaging for Arsenic in Soil (Revision 2)	
From	Claire Hunt	
Date	March 23, 2018	

This memorandum provides the rationale used to determine compliance for arsenic in soil with the New Jersey Department of Environmental Protection (NJDEP) Residential Direct Contact Site Remediation Standards (RDCSRS) for a site-specific soil sample set from Site 114, Phase 2B-4 in accordance with the NJDEP *Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria* (Attainment Guidance) (September 24, 2012, Version 1.0).

Introduction

Based on investigation and remediation findings to date, the following arsenic concentrations remain in place in excess of RDCSRS (19 milligrams per kilogram [mg/kg]) at Site 114, Phase 2B-4 when using single point compliance, and for which we have applied compliance averaging for the attainment of compliance:

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Arsenic (mg/kg)
T3A	114-T3A-PB	114-T3A-PB-13.8-14.3	13.8 - 14.3	-1.6 - -2.1	19.7 J
X9A	114-X9A-PB	114-X9A-PB-18.9-19.4	18.9 - 19.4	-3.0 - -3.5	21.4 J
Y12A	F2	F2S21-21.5	21.0 - 21.5	-5.6 - -6.1	62.9 J

bgs below ground surface
ft foot or feet
J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg milligrams per kilogram
NAVD88 North American Vertical Datum of 1988

Figure 1 shows borings with remaining arsenic data, the phase boundary, and the location of the samples exceeding the arsenic RDCSRS. The remaining in-place arsenic results are provided in Table 5-3 of the Site 114, Phase 2B-4 Remedial Action Report (RAR) Tables and Figures (Revision 1 Supplemental), February 26, 2018.

Delineation

Arsenic concentrations in excess of the RDCSRS at each location at Site 114, Phase 2B-4 are delineated as follows:

Horizontal Delineation

Sample 114-T3A-PB-13.8-14.3

Sample 114-T3A-PB-13.8-14.3 is horizontally delineated by the samples listed on the following table and shown on **Figure 1**. Sample 114-T3A-PB-13.8-14.3 was collected in the first interval of meadow mat (MM) encountered below historic fill. Each of the samples used for horizontal delineation was also collected in the first interval of MM or MM/undisturbed native deposits (UND) below historic fill. Vertical delineation is discussed below. In the event that multiple samples were collected at a single location, the greater concentration of the two results is shown below. Laboratory reports and data validation reports for most of these samples were included with the Site 114, Phase 2B-4 RAR Tables and Figures (Revision 0) submittal, July 27, 2017. The laboratory report and data validation report associated with sample 114-R4A-PB were included with the Site 114, Phase 2B-3 RAR Tables and Figures (Revision 0) submittal, July 20, 2017.

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	Arsenic Result (mg/kg)	Direction
T1A	114-T1A-PB	13.9 - 14.4	-1.8 - -2.3	3/26/2014	3.9	North
V2A	114-V2A-PB	12.9 - 13.4	-0.8 - -1.3	4/3/2014	4.8 J	East
T5A	114-T5A-PB	13.1 - 13.6	-1.0 - -1.5	4/14/2014	9.4	South
R4A	114-R4A-PB	15.1 - 15.6	-1.2 - -1.7	02/24/2014	10.2 J	West

bgs below ground surface
ft foot or feet
J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg milligrams per kilogram
NAVD88 North American Vertical Datum of 1988
U The analyte was not detected above the sample reporting limit shown.

Sample 114-X9A-PB-18.9-19.4

Sample 114-X9A-PB-18.9-19.4 is horizontally delineated by the samples listed on the following table. The sample locations in are shown on **Figure 1.** Sample 114-X9A-PB-18.9-19.4 was collected in the first interval of MM encountered below historic fill. Each of the samples used for horizontal delineation was also collected in the first interval of MM or MM/UND below historic fill. Vertical delineation is discussed below. The laboratory reports and data validation reports for the sample locations in Phase 2B-4 were included with the Site 114, Phase 2B-4 RAR Tables and Figures (Revision 0) submittal, July 27, 2017.

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	Arsenic Result (mg/kg)	Direction
X7A	114-X7A-PB	14.7 - 15.2	-0.1 - -0.6	06/12/2014	5.8	North
Y9A	114-Y9A-PB2	18.5 - 19.0	-3.4 - -3.9	10/14/2014	17.8 J	East
X11A	114-X11A-PB	20.1 - 20.6	-3.8 - -4.3	10/17/2014	10.4 J	South
W9A	PSEG-SB23	18.5 - 19.0	-3.4 - -3.9	4/9/2004	18.6	West

bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligrams per kilogram
NAVD88	North American Vertical Datum of 1988
U	The analyte was not detected above the sample reporting limit shown.

Sample F2S21-21.5

The horizontal and vertical delineation of arsenic at location F2S21-21.5 was implemented during the Remedial Investigation (RI) activities by PPG as documented in the *Remedial Investigation Report – Soil, Garfield Avenue Group Non-Residential Chromate Chemical Production Waste Sites 114, 132, 133, 135, 137, 143 and 186, Jersey City, New Jersey*, AECOM, February 2012, as approved by NJDEP on March 12, 2012. Horizontal delineation was further refined during remedial action by the following samples shown on **Figure 1**. Sample F2S21-21.5 was collected in the first interval of MM encountered below historic fill. Each of the samples used for horizontal delineation was also collected in the first interval of MM or MM/UND below historic fill. In the event that field duplicate samples were collected at a single location, the greater concentration of the two results is shown below. The laboratory reports and data validation reports for the sample locations in Phase 2B-4 were included with the Site 114, Phase 2B-4 RAR Tables and Figures (Revision 0) submittal, July 27, 2017.

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	Arsenic Result (mg/kg)	Direction
X11A	114-X11A-PB	20.1 - 20.6	-3.8 - -4.3	10/17/2014	10.4 J	North
Z11A	114-Z11A-PB	18.7 - 19.2	-5.3 - -5.8	10/17/2014	6.4 J	East
Z13A	114-Z13A-PB2	17.5 - 18.0	-4.8 - -5.3	11/24/2014	3.0 J	South
X13A	114-X13A-PB	19.5 - 20.0	-4.7 - -5.2	10/21/2014	7.0 J	West
Y12A	F2S28-28.5	28.0 - 28.5	-12.6 - -13.1	8/25/2003	2.3 J	Vertically

bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligrams per kilogram
NAVD88	North American Vertical Datum of 1988
U	The analyte was not detected above the sample reporting limit shown.

Vertical Delineation

At sample F2S21-21.5, single-point vertical delineation was achieved as presented in the table above.

At samples 114-T3A-PB-13.8-14.3 and 114-X9A-PB-18.9-19.4, arsenic was not analyzed for in soil beneath the locations where these two exceedances remain at Site 114, Phase 2B-4. Vertical delineation has deviated from guidance since single-point compliance was not achievable. Vertical delineation is based on the lines of evidence presented below:

- The deepest arsenic exceedance in Phase 2B-4 is from the sample F2 (El. -5.6 to -6.1 ft NAVD88), which is vertically delineated at El. -12.6 to -13.1 ft NAVD88.
- The arsenic concentration in soil was not detected or was less than the RDCSRS in 28 samples collected from 16 unique locations at elevations deeper than El. -5.6 ft NAVD88 in Phase 2B-4 (see Figure and Table 5-3 of the Site 114, Phase 2B-4 RAR Tables and Figures [Revision 1 Supplemental] submittal, February 26, 2018).
- As described in the 2012 *Remedial Investigation Report – Soil, Garfield Avenue Group Non-Residential Chromate Chemical Production Waste Sites 114, 132, 133, 135, 137, 143 and 186, Jersey City, New Jersey,* AECOM, February 2012, arsenic exceedances throughout the Garfield Avenue Group of Sites were generally limited to fill material above MM or UND. The three exceedances in Site 114, Phase 2B-4 were collected from the first observed MM below historic fill. Arsenic exceedances were not recorded in any samples in Phase 2B-4 below the first interval of MM. Excavation throughout Site 114, Phase 2B-4 was conducted to native material. Based on the historical results, there is no evidence that arsenic exceedances extend deeper than the first interval of native material below historic fill.

Functional Area

The arsenic RDCSRS is based on natural background (**Attachment 1**). The Attainment Guidance does not define a functional area size for criteria based on natural background. For compliance averaging compared to the RDCSRS, an area based on 0.25 acre is assumed. This area is smaller than the size defined for the inhalation pathway (0.5 acre) and more limiting for compliance area sample selection. The shapes of the RDCSRS functional areas are generally square and within the Phase boundary. The extent of the functional areas is shown in **Figure 1**.

The remaining samples within the functional area extents were collected from deeper than 2 feet below ground surface and are considered a part of the functional areas for the calculation.

Compliance Averaging

Compliance with the arsenic RDCSRS is demonstrated through spatial averaging. Theissen polygons were created within the functional area as shown in **Figure 1**. The sample selection process is as follows:

1. All of the samples for arsenic with a sample status of remaining that fall within the functional area horizontally and vertically are identified (backfill samples are excluded).
2. The maximum concentration is selected at each sample location for use in the weighted average. The maximum of the concentration for detections or the Method Detection Limit (MDL)/Reporting Limit (RL) for non-detects is selected.

Laboratory reports and data validation reports for most of the samples were included with the Site 114, Phase 2B-4 RAR Tables and Figures (Revision 0) submittal, July 27, 2017. Laboratory Reports and data validation reports for the samples from Grids R4A and S2A were included with the Site 114, Phase 2B-3 RAR Tables and Figures (Revision 0) submittal, July 20, 2017.

Sample 114-T3A-PB-13.8-14.3

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	Maximum Arsenic Result (mg/kg)	Area (sf)	Area x Maximum Arsenic Result (sf*mg/kg)
R4A	X24	17.6 - 18.1	-5.4 - -5.9	10/11/2005	2.7	1,704	4,601
S2A	114-S2A-PB	15.1 - 15.6	-2.3 - -2.8	3/25/2014	2.7 J	2,469	6,666
T3A	114-T3A-PB	13.8 - 14.3	-1.6 - -2.1	4/4/2014	19.7 J	4,576	90,147
U5A	F4	18.0 - 18.5	-5.7 - -6.2	8/29/2003	16.1	2,171	34,953
					Total	10,920	136,367

bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligrams per kilogram
NAVD88	North American Vertical Datum of 1988
SDG	sample delivery group
sf	square feet

Weighted Average Concentration = 136,367 sf x mg/kg / 10,920 sf = 12 mg/kg

Samples 114-X9A-PB-18.9-19.4 and F2S21-21.5

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	Maximum Arsenic Result (mg/kg)	Area (sf)	Area x Maximum Arsenic Result (sf*mg/kg)
W8A	F3	24.5 - 25.0	-10.2 - -10.7	8/25/2003	3.8 J	289	1,098
W9A	PSEG-SB23	18.5 - 19.0	-3.4 - -3.9	4/9/2004	18.6	633	11,774
W10A	114-W10A-PB	19.5 - 20.0	-4.0 - -4.5	10/6/2014	15.7 J	889	13,957
X9A	114-X9A-PB	18.9 - 19.4	-3.0 - -3.5	10/14/2014	21.4 J	1,189	25,445
X11A	114-X11A-PB	20.1 - 20.6	-3.8 - -4.3	10/17/2014	10.4 J	2,402	24,981
Y9A	114-Y9A-PB2	18.5 - 19.0	-3.4 - -3.9	10/14/2014	17.8 J	1,576	28,053
Y12A	F2	21.0 - 21.5	-5.6 - -6.1	8/22/2003	62.9 J	899	56,547
Z9A	114-Z9A-PB	17.9 - 18.4	-3.3 - -3.8	10/14/2014	15.2 J	1,126	17,115
Z11A	114-Z11A-PB	18.7 - 19.2	-5.3 - -5.8	10/17/2014	6.4 J	1,812	11,597
					Total	10,815	190,567

bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligrams per kilogram

NAVD88	North American Vertical Datum of 1988
sf	square feet

Weighted Average Concentration = 190,567 sf x mg/kg / 10,815 sf = 18 mg/kg

Conclusion

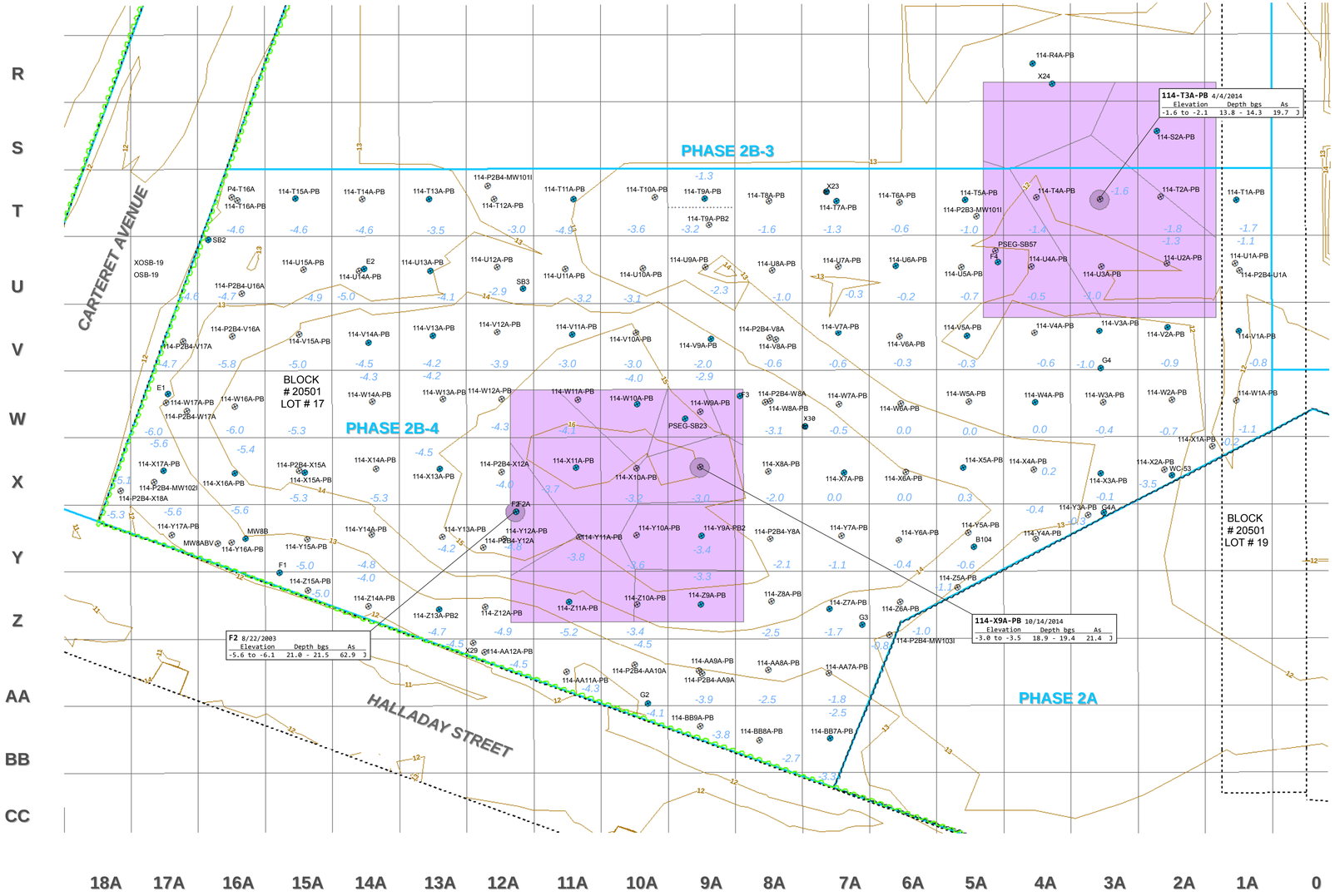
Based on the residential exposure scenario, the spatially weighted average arsenic concentration within the study area at sample 114-T3A-PB-13.8-14.3 is 12 mg/kg, which is compliant with the 19 mg/kg RDCSRS.

Based on the residential exposure scenario, the spatially weighted average arsenic concentration within the study area at samples 114-X9A-PB-18.9-19.4 and F2S21-21.5 is 18 mg/kg, which is compliant with the 19 mg/kg RDCSRS.

Attachments:

Figure 1 Phase 2B-4 Sample Map for Arsenic Compared to Soil Remediation Standards and Functional Area (RDCSRS)

Attachment 1 NJDEP Soil Standards for Arsenic



ABBREVIATIONS:

As - arsenic

bgs - below ground surface

ft - feet

mg/kg - milligrams per kilogram

N/A - not applicable

NAVD88 - North American Vertical Datum of 1988

NRDCSRS - New Jersey Department of Environmental Protection Non-Residential Direct Contact Soil Remediation Standard

RDCSRS - New Jersey Department of Environmental Protection Residential Direct Contact Soil Remediation Standard

QUALIFIER:

J - The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.

GENERAL NOTES:

G1. The metals data associated with the sample locations shown on this figure are provided in Table 5-3. Data presented in call out boxes on this figure are outliers (i.e., data points that require further explanation). Specific notes on how the New Jersey Department of Environmental Protection's remedial standards are being met and/or how remediation is being achieved/completed for each outlier sample are provided in the specific notes in Table 5-3.

G2. "Elevation" refers to the sample elevation based on the pre-remediation surface elevation for samples collected from the pit bottom, and the surface elevation of the sample location when the sample was collected via boring or test pit.

G3. Elevation vertical datum is NAVD88, in U.S. survey ft.

G4. Results are reported in mg/kg.

G5. Source of block/lot information is Jersey City Parcel Data from New Jersey Geographic Information Network (NJGIN), last updated 10/6/2015 (available at: http://data.jerseycitynj.gov/dataset/jersey-city-parcel-polygon).

G6. This figure presents data for locations within the Phase boundary that have samples remaining in place. In addition, removed samples may be shown to demonstrate compliance with the remediation objectives. The Specific Notes on Table 5-3 include discussion of these situations, if necessary.

SPECIFIC NOTES:

S1. Property lines and pre-construction topographical contours are sourced from the "Catch Basin-Receptor Evaluation Survey, PPG Site 114, City of Jersey City, Hudson County, New Jersey" prepared by Borbas Surveying and Mapping, LLC, dated April 19, 2011.

S2. As-built terminal excavation elevations were taken from "PPG – Jersey City Phase 2B-4 Excavation, Excavation Status," produced by ENTACT, dated 12/17/2014 with revisions.

S3. In Grid Y12A, two sample locations are located adjacent; therefore, the sampling location symbols overlap on the figure.

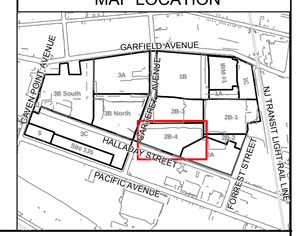
LEGEND

- REMAINING SAMPLES NOT ANALYZED FOR OTHER METALS
- SAMPLING LOCATION (REMAINING SAMPLES)
- SAMPLING LOCATION (REMOVED SAMPLES)
- RESULT IS BELOW THE MOST STRINGENT STANDARD
- RESULTS EXCEED THE MOST STRINGENT STANDARD, BUT ARE IN COMPLIANCE WITH REMEDIATION OBJECTIVES
- ARSENIC (As)
- IN PLACE SHEET PILE (AS OF DECEMBER 2017)
- REMOVED SHEET PILE
- APPROXIMATE LOCATION OF GRID SPLIT
- PROPERTY LINE
- PRE-REMEDIATION ELEVATION CONTOUR (1-FOOT INTERVAL IN FT NAVD88)
- 0.5 GRID LAYOUT WITH AS-BUILT TERMINAL EXCAVATION ELEVATIONS (FT NAVD88)
- THEISSEN POLYGON
- PHASE 2B-4 BOUNDARY

Soil Remediation Standards (mg/kg)

Analyte	RDCSRS	NRDCSRS
ARSENIC	19	19

MAP LOCATION



0 30 60 Feet

AECOM

PPG SITE 114 GARFIELD AVENUE GROUP JERSEY CITY, NEW JERSEY	PHASE 2B-4 SAMPLE MAP FOR ARSENIC COMPARED TO SOIL REMEDIATION STANDARDS AND FUNCTIONAL AREA (RDCSRS)
DATE: 03/23/2018	FIGURE 1

ATTACHMENT 1

NJDEP Soil Standards for Arsenic

New Jersey Department of Environmental Protection

Standards for Drinking Water, Ground Water, Soil and Surface Water

Arsenic (Total)

CAS #: 7440-38-2

Drinking Water Standards (µ g/l or ppb)

Standard: 5 **Type:** Primary STATE MCL

Ground Water Quality Standards (µ g/l or ppb)

Standard: 3 **Type:** Specific

GW-Quality Criterion: 0.02

PQL: 3

Surface Water Quality Standards (µ g/l or ppb)

Fresh Water-

Human Health: 0.017(hc)(T) **Aquatic-Acute:** 340(d)(s) **Aquatic-Chronic:** 150(d)(s)

Saline Water-

Human Health: 0.061(hc)(T) **Aquatic-Acute:** 69(d)(s) **Aquatic-Chronic:** 36(d)(s)

Soil Standards (mg/kg)

Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 19* **Effective:** 6/2/2008 **Interim:** ☐

The direct contact standard for arsenic is based on natural background

Ingestion Dermal: 0.4

Inhalation: 980

Soil PQL: 1

Non-Residential Direct Contact Health Based Criteria and Soil Remediation Standard

Soil Remediation Standard: 19* **Effective:** 6/2/2008 **Interim:** ☐

The direct contact standard for arsenic is based on natural background

Ingestion Dermal: 2

Inhalation: 76

Soil PQL: 1