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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
Final

NJDEP Program Interest Number: G000005480
Notice of Intent: TMS # N11-7757, Activity # UCL110001
Notice of Intent: TMS # N13-8760, Activity # UCL130001

PPG Garfield Avenue Group
Hudson County Chromate Sites
Jersey City, New Jersey

Document No. 114-007B

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List of Acronyms and Abbreviations

AAC	Acceptable Ambient Concentration
ACO	Administrative Consent Order
AMP	Air Monitoring Plan
AOC	Area of Concern
bgs	below ground surface
BOL	bill of lading
BTEX	benzene, toluene, ethylbenzene, and total xylenes
CBS	Construction Bid Specifications
CCPW	Chromate Chemical Production Waste
CEI	Creamer Environmental, Incorporated
CEP	Clean Earth of Philadelphia
CENJ	Clean Earth of North Jersey
CID	Case Inventory Document
CLP	Contract Laboratory Program
CMAA	Construction Manager as Agent
COC	chain-of-custody
COPR	Chromite Ore Processing Residue
Cr^{+6}	hexavalent chromium
CrSCC	Chromium Soil Cleanup Criteria
CVOC	chlorinated volatile organic compound
DCP	Dust Control Plan
DGA	dense-graded aggregate
DIGWSSL	Default Impact to Groundwater Soil Screening Level
DRO	diesel range organic
EDD	electronic data deliverable
El.	elevation
ENTACT	ENTACT Environmental Services of Latrobe, Pennsylvania
EPH	extractable petroleum hydrocarbons
EQ	Environmental Quality Company
ERFS	Environmental Remediation and Financial Services, LLC
FSP-QAPP	Field Sampling Plan – Quality Assurance Project Plan
ft	foot or feet
GA Group	Garfield Avenue Group
GPS	Global Positioning System
GRO	gasoline range organic
HASP	Health and Safety Plan
HCC	Hudson County Chromate
HDPE	high-density polyethylene
IGWSRS-GAG	Impact to Groundwater Soil Remediation Standard - Garfield Avenue Group
IRM	Interim Remedial Measure
JCMUA	Jersey City Municipal Utilities Authority
JCO	Judicial Consent Order
JCRA	Jersey City Redevelopment Agency
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LSRP	Licensed Site Remediation Professional
mg/kg	milligrams per kilogram

MGP	manufactured gas plant
MS	matrix spike
MSD	matrix spike duplicate
NAVD88	North American Vertical Datum of 1988
NJ	New Jersey
N.J.A.C.	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
NJGIN	New Jersey Geographic Information Network
NRDCSRS	Non-Residential Direct Contact Soil Remediation Standard
OGS	open grade stone
OM	oil material
OSHA	Occupational Safety and Health Administration or Act
oz/sy	ounces per square yard
PAH	polycyclic aromatic hydrocarbon
PCBs	polychlorinated biphenyls
PCE	tetrachloroethene
PDI	pre-design investigation
PI	Program Interest
PPE	personal protective equipment
PSEG	Public Service Electric and Gas Company
PVSC	Passaic Valley Sewerage Commission
QA	quality assurance
QC	quality control
RA	remedial action
RAP	Remedial Action Permit
RAR	Remedial Action Report
RAWP	Remedial Action Work Plan
RDCSRS	Residential Direct Contact Soil Remediation Standard
RE	receptor evaluation
RI	Remedial Investigation
RIR	Remedial Investigation Report
RIWP	Remedial Investigation Work Plan
ROW	right-of-way
RPD	relative percent difference
SESCP	Soil Erosion and Sediment Control Plan
SOP	standard operating procedure
SRP	Site Remediation Program
SRS	Soil Remediation Standard
SSRIR	Supplemental Soil Remedial Investigation Report
SVOC	semi-volatile organic compound
SW	Southwestern
TAL	Target Analyte List
TCE	trichloroethylene
TEE	Terminal Excavation Elevation
TEP	Technical Execution Plan
TM	tar material
TMS	Tank Management System
TOC	total organic carbon
TPH	total petroleum hydrocarbons

TRSR	Technical Requirements for Site Remediation
TSCA	Toxic Substances Control Act
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	underground storage tank
VOC	volatile organic compound
Weston	Weston Solutions, Inc.

Regulatory Cross Reference Table

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N.J.A.C. 7:26E (last amended August 6, 2018) and 7:26C (last amended August 6, 2018) regulations are the primary source of Remedial Action Report (RAR) requirements. This document is not to be used as a replacement for the Technical Regulations.

Regulation	Description	Document Location	
N.J.A.C. 7:26E-5.7	**Remedial Action Report Requirements**	**Report**	**Location**
5.7(a)	The person responsible for conducting the remediation shall implement the remedial action and submit to the Department a remedial action report, along with a form found on the Department's website at www.nj.gov/dep/srp/srra/forms, pursuant to (b) below, and according to the applicable regulatory timeframe in N.J.A.C. 7:26E-5.8.	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	throughout
5.7(b)	The person responsible for conducting the remediation shall present and discuss in the remedial action report all of the information identified or collected pursuant to N.J.A.C. 7:26E-5.1 through 5.6, along with all of the following:	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	throughout
5.7(b) 1	The general reporting requirements in N.J.A.C. 7:26E-1.6;	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	see below
1.6(a) 1	Submit all documents, forms, spreadsheets and worksheets required in this chapter;	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 Cover/Certification Form is included with the Regulatory Forms. The paper Remedial Action Report form is no longer accepted and is intended for work conducted under the Licensed Site Remediation Professional Program. As this work is being conducted under direct oversight and not being submitted online, no Remedial Action Report form is included.

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Regulation	Description	Document Location	
N.J.A.C. 7:26E-5.7	**Remedial Action Report Requirements**	**Report**	**Location**
1.6(a) 2	Certify and have the licensed site remediation professional certify, pursuant to N.J.A.C. 7:26C-1.5, all forms and documents prepared to pursuant to this chapter;	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	Regulatory Forms
1.6(a) 3	Submit a completed case inventory document (CID) worksheet available on the Department's website at www.nj.gov/dep/srp/srra/forms at the front of each remedial phase workplan and report required by this chapter, except for a preliminary assessment report where no areas of concern were identified;	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	Regulatory Forms
1.6(a) 4	Submit a quality assurance project plan (QAPP) prepared pursuant to N.J.A.C. 7:26E-2.2 with each remedial phase workplan and report required by this chapter, except for a preliminary assessment report and remedial action report;	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	Not Applicable for this Remedial Action Report
1.6(a) 5	Except where a final remediation document for unrestricted use is filed with the Department within one year after the earliest applicable trigger to remediate listed in N.J.A.C. 7:26C-2.2, submit all sampling data electronically in a summary table using the format outlined in the Site Remediation Program's "Electronic Data Interchange Manual," available at www.nj.gov/dep/srp/hazsite/docs/, in effect as of the date the document is submitted and include items described in subsections 1.6(a) 5.i-iii of Tech Reg.	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	Electronic data deliverables provided to NJDEP for data used to document compliance with remedial action goals; receipts of submittals included in Appendix F - Laboratory Analytical Reports.

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Regulation	Description	Document Location	
N.J.A.C. 7:26E-5.7	**Remedial Action Report Requirements**	**Report**	**Location**
1.6(a) 6	Submit a geographic information system (GIS) compatible site plan that includes the site boundaries and the location of all areas of concern as polygons.	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	Figure 1-2 - Site Plan for Site 114
1.6(b) 1	The physical setting of the site that includes a general description of soils, geology, hydrology, hydrogeology, and topography of the site and surroundings;	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	Section 2.2 - Physical Setting of the Site
1.6(b) 2	A description of any significant events or seasonal variations that may have influenced sampling procedures or analytical results;	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	No significant events or seasonal variations influenced sampling procedures or analytical results. Soil sampling results are discussed in: Section 2.1 - Summary of Soil Remedial Investigation Findings Section 4.2.1 - Proposed Terminal Excavation Elevations and Pre-Design Investigation Section 5.4 - Confirmation Soil Samples Section 5.5 - In-Situ Treatment in Phase 1B
1.6(b) 3	A description of the results and implications of field measurements or area-specific changes in sampling protocol due to field conditions;	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	Not Applicable for this Site

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Regulation	Description	Document Location	
N.J.A.C. 7:26E-5.7	**Remedial Action Report Requirements**	**Report**	**Location**
1.6(b) 4	A list of: i. All variances from the requirements of this chapter submitted pursuant to N.J.A.C. 7:26E-1.7; and ii. All rationales submitted for deviations from any technical guidance pursuant to N.J.A.C. 7:26C-1.2(a)3;	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	Not Applicable for this Site
1.6(b) 5	The applicable regulatory timeframe, including: i. Regulatory citation of the regulatory timeframe; and ii. Calendar date of the regulatory timeframe;	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	Master Schedule, referenced in Section 1.0
1.6(b) 6	A summary table(s), organized by area of concern, of all sampling results, including sample location, medium, sample depth, field and laboratory identification numbers, analytical results, and comparison to remediation standards, and the following: i. Identification of each contaminant concentration exceeding a remediation standard; ii. Identification of each sample with a method detection limit or a practical quantitation level that exceeds a remediation standard, along with an explanation in the table key; and iii. A report of all soils and solids sample results in milligrams per kilogram on a dry weight basis, aqueous sample results in micrograms per liter, and air results in micrograms per cubic meter;	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	Appendix D - Sample Maps and Analytical Results Tables
1.6(b) 7	For soil borings, test pits and monitoring wells: i. Stratigraphic logs, which include soil/rock physical descriptions and field instrument readings detected during drilling for each soil boring, test pit and monitoring well; ii. State permit numbers and as-built specifications, if applicable; and iii. Monitoring well certification forms A (the well construction as built certification) and B (the well location certification) available on the Department's website at www.nj.gov/dep/srp/regs/guidance.htm;	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. Appendix K - Boring Logs ii and iii. Not Applicable

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N.J.A.C. 7:26E-5.7	**Remedial Action Report Requirements**	**Report**	**Location**
1.6(b) 8	Maps and figures, with map scale and orientation, including: i. Site location, land use, receptor evaluation, and area of concern maps; ii. Sample location map(s), that include the following: (1) Field identification numbers for all samples; (2) Sample locations, sample depths and contaminant concentrations plotted on the map; and (3) If data for more than 25 samples are presented for an area of concern, soil, ground water and sediment contaminant isopleth maps and cross section diagram(s), including the horizontal and vertical distribution of contaminants in each media, with sample point location numbers and contaminant concentrations; and iii. Ground water elevation contour maps showing the location of all monitoring wells, piezometers, or other ground water sampling points, for each set of static ground water level measurements for each aquifer;	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. Site Location: Figure 1-1 - USGS Site Location Map; Land Use: Regulatory Forms - Receptor Evaluation (located immediately behind the report cover page); Areas of Concern: Figure 1-2 - Site Plan for Site 114 ii. Sample Location Maps: Appendix D - Sample Maps and Analytical Results Tables iii. Groundwater Maps - Not Applicable
1.6(b) 9	A discussion of the usability of laboratory analytical data;	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	Section 6.0 - Reliability of Data: Data Validation and Usability
1.6(b) 10	A description of the significance of information generated in the library search of tentatively identified compounds and unknown compounds.	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	Not Applicable for this Site
5.7(b) 2	A presentation and discussion of all of the information identified or collected, pursuant to N.J.A.C. 7:26E-1.10 through 1.16 and an updated receptor evaluation on a form found on the Department's website at www.nj.gov/dep/srp/srra/forms;	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	Regulatory Forms, Receptor Evaluation (located immediately behind the report cover page) and Section 8.0 - Receptor Evaluation Update

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Regulation	Description	Document Location	
N.J.A.C. 7:26E-5.7	**Remedial Action Report Requirements**	**Report**	**Location**
5.7(b) 3	A summary of the findings and recommendations for each area of concern from the remedial investigation report prepared pursuant to N.J.A.C. 7:26E-4.9;	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	Section 2.3 - Recommended Remedial Action
5.7(b) 4	A description, by area of concern, of each remedial action implemented;	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	Section 5.0 - Description of the Remedial Action
5.7(b) 5	A list, by remedial action, of the remediation standards that apply to each remedial action;	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	Section 3.0 - Identification of Applicable Remedial Standards/Criteria and Table 3-1 - Soil Remediation Standards/Criteria
5.7(b) 6	Documentation, by area of concern, that each remedial action is effective in protecting the public health and safety and the environment by: i. Providing an overview of the data to establish the remedial action is operating as designed; or ii. Demonstrating compliance with the applicable remediation standards;	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	Section 7.0 - Documentation of the Protectiveness of the Remedial Action

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Regulation	Description	Document Location	
N.J.A.C. 7:26E-5.7	**Remedial Action Report Requirements**	**Report**	**Location**
5.7(b) 7	A remedial action permit application prepared pursuant to N.J.A.C. 7:26C-7, if applicable;	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 remedial action permits will be filed and submitted following approval of the Remedial Action Report and filing of the deed notices.
5.7(b) 8	"As-built" diagrams for any permanent structures associated with the remedial action including, without limitation, caps or other structures associated with the remedial action and engineering controls, if applicable;	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	Section 7.0 - Documentation of the Protectiveness of the Remedial Action Appendix H - As-Built Diagrams
5.7(b) 9	A detailed description of site restoration activities, if applicable;	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	Section 7.2 - Description of Site Restoration Activities
5.7(b) 10	The total remediation costs through the implementation of the remedial action;	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	Section 7.3 - Total Remedial Action Cost

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N.J.A.C. 7:26E-5.7	**Remedial Action Report Requirements**	**Report**	**Location**
5.7(b) 11	Documentation of all types and quantities of waste generated by the remedial action, including copies of fully executed manifests or bill(s) of lading documenting any off-site transport of waste;	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	Section 7.4 - Documentation of Waste Generation and Disposal Appendix L - Hazardous Waste Disposal Documentation Appendix M - Non-Hazardous Waste Disposal Documentation
5.7(b) 12	Documentation of the source, type, quantities, and location of each alternative fill and clean fill used as part of the remedial action at the site; and	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	Section 7.5 - Documentation of Source, Type, Quantities, and Location of Fill Appendix N - Clean Fill Documentation
5.7(b) 13	A description of each permit required and obtained to implement the remedial action.	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	Section 7.6 - Identification of Required Permits and Authorizations Appendix B - Permits and Approvals

Executive Summary

This Remedial Action Report (RAR) has been prepared by AECOM on behalf of PPG to document the remedial action (RA) for Chromate Chemical Production Waste (CCPW), CCPW-impacted soil, and other impacted soil at Site 114 (the Site). Site 114 is part of the Garfield Avenue Group (GA Group) Sites, which include Sites 114, 132, 133, 135, 137, 143, and 186, and adjacent roadways and properties (**Figure 1-1**). Site 114 is the former location of a chromite ore processing facility, previously owned by PPG, and the former Halladay Street Gas Works manufactured gas plant (MGP), previously owned by Public Service Electric and Gas Company (PSEG). Site 114 is tracked under the New Jersey Department of Environmental Protection (NJDEP) Site Remediation Program (SRP) Program Interest (PI) number G000005480 (Activity Number RPC000051). Work was previously conducted at the Site under PI number G000008791.

Site 114 is located at 880-900 Garfield Avenue, 2 Dakota Street, and 70 Carteret Avenue in Jersey City, New Jersey (NJ) (**Figure 1-2**). Site 114 is identified as Block 21501, Lots 16-20 in the Jersey City Parcel Data from the New Jersey Geographic Information Network (NJGIN), last updated October 6, 2015 (available at: https://njgin.state.nj.us/OGIS_IW, last accessed in December 2018). Site 114 is bordered to the north by Forrest Street and an active railroad (Site 199) operated by New Jersey Transit, to the east by Halladay Street, to the south by Carteret Avenue, and to the west by Garfield Avenue. The total area encompassed by Site 114 is approximately 16 acres.

This RAR addresses the soil impacts for which PPG is responsible under the *Administrative Consent Order* (ACO) (NJDEP, 1990) and the *Partial Consent Judgment Concerning the PPG Sites* (Judicial Consent Order [JCO]) (Superior Court of New Jersey Law Division – Hudson County, 2009). PPG and PSEG are jointly responsible for remediation of MGP parameters associated with the former Halladay Street Gas Works MGP located in the eastern portion of Site 114 (designated as Phase 2A and Phase 2B). At Site 114, these constituents include:

- CCPW and hexavalent chromium (Cr^{+6});
- CCPW metals (antimony, total chromium, nickel, thallium, and vanadium);
- MGP-related constituents (certain volatile organic compounds [VOCs] and certain semi-volatile organic compounds [SVOCs]);
- Historic fill; and
- Other constituents related to historical site operations and land use, including VOCs, SVOCs, polychlorinated biphenyls (PCBs), non-CCPW metals, pesticides, and extractable and total petroleum hydrocarbons (EPH/TPH).

PSEG is taking the lead on closing out MGP-related impacts in accordance with the Licensed Site Remediation Professional (LSRP) Program under PI number G000005480, activity number LSR120001, per the July 2019 agreement between PPG and PSEG (PPG and PSEG, 2019). MGP-related information has been included in this RAR for informational purposes only. For example, MGP-related information is provided in Sample Maps and Analytical Results Tables in Appendices D-5 through D-9, the Draft Deed Notice in Appendix J-4, and As-Built Diagrams in Appendix H-5. The MGP Area of Concern (AOC) identified herein is superseded by MGP AOCs established by PSEG

and is no longer relevant. Information required to document remediation of MGP-related impacts will be presented by PSEG in their forthcoming RAR.

The Case Inventory Document (CID) summarizes the presence of eight AOCs for the Site, including one for groundwater. This RAR presents a summary of the implemented RA for the following six soil AOCs:

- AOC 114-1A: CCPW-impacted soil in Site 114, except in AOC 114-1B (CCPW-impacted soil in portions of Grids A5B, A6B, A7B, and B7B within the Western Sliver);
- AOC 114-2: MGP-impacted soil associated with the former MGP in the eastern portion of Site 114;
- AOC 114-3: Historic fill material in soil in Site 114;
- AOCs 114-4A and 114-4B: Underground storage tank (UST)-impacted soil in Site 114; and
- AOC 114-5: Soil impacted by other historical operations and land use in Site 114.

Documentation of the RA for the remaining two AOCs (which follow) will be presented in separate submittals:

- AOC 114-1B: CCPW-impacted soil in portions of Grids A5B, A6B, A7B, and B7B within the Western Sliver; and
- GA Group Groundwater: Groundwater impacted by historical operations and land use at Site 114 and CCPW and MGP groundwater impacts on other GA Group Sites.

Based on the findings of the Remedial Investigation (RI), the recommended RA for CCPW-impacted soil at the Site (AOC 114-1A) included the excavation and removal of visible CCPW and soil with concentrations of Cr^{+6} greater than the Chromium Soil Cleanup Criteria (CrSCC).

The overall objectives for Cr^{+6} and CCPW-impacted soil, as stated in the PPG Remedial Action Work Plan (PPG RAWP) (see **Section 4.1.1** for the PPG RAWP submittal history) were:

- Elimination of potential exposure to Cr^{+6} in CCPW and CCPW-impacted soil (Cr^{+6} at concentrations greater than 20 milligrams per kilogram [mg/kg]) due to direct contact or windborne dust;
- Removal of accessible impacted soil at depths less than 20 feet (ft) below ground surface (bgs) and above the meadow mat;
- Removal of CCPW and certain impacted soil to depths greater than 20 ft bgs but to a maximum of 35 ft bgs where: a) the meadow mat is not present, and b) removal is technically prudent and beneficial to the future groundwater remediation; and
- Establishment of site conditions suitable for future uses of the Site.

For the purposes of planning and implementing the RA, Site 114 was approached in phases consisting of Interim Remedial Measure (IRM) #1 (which encompasses the Western Sliver and Northwest Grids), and Phases 1A, 1B, 1C, 2A, and 2B (consisting of sub-Phases 2B-1, 2B-2, 2B-3, and 2B-4). The RA was implemented by PPG in multiple mobilizations beginning in 2010. Excavation was completed in November 2014. Backfilling was completed in January 2015. Restoration was completed (except in IRM #1) in January 2018.

In the MGP-impacted area (AOC 114-2 consisting of Phases 2A and 2B), the recommended RA included excavation of oil material/tar material (OM/TM) to the underlying meadow mat layer, where it was present, or 30 ft bgs along with engineering controls (Clean Fill Soil Cap) and institutional controls (deed notices) for soil remaining in place with contaminants at concentrations greater than the unrestricted use NJDEP Soil Remediation Standards (SRS).

The remediation of the Phase 2A portion of Site 114 was primarily conducted by PSEG and the remediation of the Phase 2B portion of Site 114 was primarily conducted by PPG. The Phase 2A area is included in this RAR; however, documentation of some aspects of the remediation (including remediation costs, waste manifests, and backfill documentation) will be provided in PSEG's Final RAR (Wood, pending submittal). In cases where documentation will be presented in PSEG's Final RAR, it will be noted, where pertinent, in this RAR.

In accordance with the PPG RAWP and the PSEG RAWP (see **Section 4.1.2** for the PSEG RAWP submittal history), following excavation, CCPW metals and other constituents remaining in place at concentrations greater than the CrSCC or SRS, are addressed through the placement of an engineering control (capping), institutional controls (deed notices), and corresponding Remedial Action Permits (RAPs).

Confirmation sampling results presented on figures and tables in this report indicate remedial objectives have been achieved as follows:

<u>AOC 114-1A: CCPW-impacted soil in Site 114</u>

- Excavation of soil containing Cr^{+6} met the requirements specified in the NJDEP Memorandum entitled *Chromium Moratorium*, February 8, 2007 (the Chromium Policy) (NJDEP, 2007) in accordance with the *Updated Method to Determine Compliance with the Department's Chromium Policy, Garfield Avenue – Sites 114, 132, 133, 135, 137, and 143, Jersey City, NJ* (Method to Determine Compliance) (NJDEP, 2013b).
- Soil concentrations for CCPW metals, except for antimony, are in compliance with the CrSCC or SRS.
- Antimony remains in place at concentrations greater than the SRS in IRM #1 and Phase 1C (Block 21501, Lot 20) and is addressed through an engineering control (Clean Fill Soil Cap) and institutional controls (deed notice).
- Soil in the unsaturated zone has been removed and, therefore, Default Impact to Groundwater Soil Screening Levels (DIGWSSLs) do not apply.

<u>AOC 114-2: MGP-impacted soil associated with the former MGP in the eastern portion of Site 114</u>

- A majority of soil contaminated with OM/TM (MGP-impacted soil) has been excavated.
- Certain VOCs (benzene and 1,4-dichlorobenzene), and certain SVOCs (1-1'-biphenyl; 2-methylnaphthalene; 3+4-methylphenol; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(k)fluoranthene; dibenzo(a,h)anthracene; indeno(1,2,3-cd)pyrene; and naphthalene) remain in place at concentrations greater than the SRS and are addressed through an engineering control (Clean Fill Soil Cap) and institutional controls (deed notices).
- Soil in the unsaturated zone has been removed and, therefore, DIGWSSLs do not apply.

AOC 114-3: Historic fill material in soil in Site 114

- Historic fill has been removed from IRM #1 and Phases 1A, 1C, 2A, and 2B.
- Historic fill remains in place in Phase 1B (in portions of Block 21501, Lots 18, 19, and 20). Historic fill that may contain ash, cinders, brick, and glass is present in a portion of the property. This historic fill may include, but is not limited to, contaminants such as polycyclic aromatic hydrocarbons (PAHs) and metals at concentrations greater than unrestricted use standards. Historic fill remaining in place is addressed through an engineering control (Clean Fill Soil Cap) and institutional controls (deed notices).
- Soil in the unsaturated zone has been removed and, therefore, DIGWSSLs do not apply.

AOCs 114-4A and 114-4B: UST-impacted soil in Site 114

- Soil concentrations of EPH and TPH are in compliance with the EPH Remediation Criterion.
- Soil concentrations of VOCs, SVOCs, PCBs, and Target Analyte List (TAL) metals are in compliance with the SRS.
- Soil in the unsaturated zone has been removed and, therefore, DIGWSSLs do not apply.

AOC 114-5: Soil impacted by other historical operations and land use in Site 114

- Soil concentrations for other metals, SVOCs, VOCs, PCBs, pesticides, EPH, and TPH not addressed in another AOC are in compliance with the SRS.
- Soil in the unsaturated zone has been removed and, therefore, DIGWSSLs do not apply.

The soil RA for Site 114 (AOCs 114-1A, 114-2, 114-3, 114-4A, 114-4B, and 114-5) is effective in protecting public health and safety and the environment and no further soil remediation is warranted for these AOCs. This RAR demonstrates compliance with the applicable remediation requirements for the soil on Site 114 (AOCs 114-1A, 114-2, 114-3, 114-4A, 114-4-B, and 114-5), and no further action with regard to the soil in AOCs 114-1A, 114-2, 114-3, 114-4A, 114-4-B, and 114-5 is needed (other than filing the deed notices and implementing the RAPs). PPG requests the closure of AOCs 114-1A, 114-2, 114-3, 114-4A, 114-4-B, and 114-5 by the NJDEP through the issuance of a Consent Judgment Compliance Letter.

1.0 Introduction

This Remedial Action Report (RAR) has been prepared by AECOM on behalf of PPG to document the remedial action (RA) for Chromate Chemical Production Waste (CCPW), CCPW-impacted soil, and other impacted soil at Site 114 (the Site). Site 114 is part of the Garfield Avenue Group (GA Group) Sites, which include Sites 114, 132, 133, 135, 137, 143, and 186, and adjacent roadways and properties (**Figure 1-1**). Site 114 is the former location of a chromite ore processing facility previously owned by PPG, and the former Halladay Street Gas Works manufactured gas plant (MGP) previously owned by Public Service Electric and Gas Company (PSEG). Site 114 is tracked under the New Jersey Department of Environmental Protection (NJDEP) Site Remediation Program (SRP) Program Interest (PI) number G000005480 (Activity Number RPC000051). Work was previously conducted at the Site under PI number G000008791.

Site 114 is located at 880-900 Garfield Avenue, 2 Dakota Street, and 70 Carteret Avenue in Jersey City, New Jersey (NJ) (**Figure 1-2**). Site 114 is identified as Block 21501, Lots 16-20 in the Jersey City Parcel Data from New Jersey Geographic Information Network (NJGIN), last updated October 6, 2015 (available at: https://njgin.state.nj.us/OGIS_IW, last accessed in December 2018). Site 114 is bordered to the north by Forrest Street and an active railroad (Site 199) operated by New Jersey Transit, to the east by Halladay Street, to the south by Carteret Avenue, and to the west by Garfield Avenue. The total area encompassed by Site 114 is approximately 16 acres.

In 1990, PPG and the NJDEP entered into an *Administrative Consent Order* (ACO) (NJDEP, 1990) to investigate and remediate locations where CCPW or CCPW-impacted materials related to former PPG operations may be present. On June 26, 2009, NJDEP, PPG, and the City of Jersey City entered into a *Partial Consent Judgment Concerning the PPG Sites*, also referred to as the Judicial Consent Order (JCO) (Superior Court of New Jersey Law Division – Hudson County, 2009), with the purpose of remediating soil and sources of contamination at these Hudson County Chromate (HCC) sites. Priority for the remedial activities was given to residential locations where the CCPW and CCPW-impacted materials were present. The provisions of the original ACO remain in effect with the JCO taking precedence where there are conflicts between the two documents.

As part of the JCO, a judicially enforceable master schedule was created, establishing RA milestone dates for the NJ Chrome Remediation Sites, including Site 114. Since its establishment in 2009, the master schedule has been revised several times. The most recent revision to the Master Schedule was finalized on July 31, 2019 (Riccio, 2019).

This RAR addresses the soil impacts for which PPG is responsible under the ACO and JCO. At Site 114, these constituents include:

- CCPW and hexavalent chromium (Cr^{+6});
- CCPW metals (antimony, total chromium, nickel, thallium, and vanadium);
- MGP-related constituents (certain volatile organic compounds [VOCs] [benzene and 1,4-dichlorobenzene]), and certain semi-volatile organic compounds (SVOCs) (1-1'-biphenyl; 2-methylnaphthalene; 3+4-methylphenol; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(k)fluoranthene; dibenzo(a,h)anthracene; indeno(1,2,3-cd)pyrene; and naphthalene);

- Historic fill; and
- Other constituents related to historical site operations and land, including VOCs, SVOCs, polychlorinated biphenyls (PCBs), non-CCPW metals, pesticides, and extractable and total petroleum hydrocarbons (EPH/TPH) not addressed in the other Areas of Concern (AOCs).

PPG and PSEG are jointly responsible for remediation of MGP parameters associated with the former Halladay Street Gas Works MGP located in the eastern portion of Site 114 (designated as Phase 2A and Phase 2B). PSEG, as the former Halladay Street Gas Works MGP operator, is the lead party for addressing these impacts. The remediation of the Phase 2A portion of Site 114 was primarily conducted by PSEG and the remediation of the Phase 2B portion of Site 114 was primarily conducted by PPG. The Phase 2A area is included in this RAR; however, documentation of some aspects of the remediation (including remediation costs, waste manifests, and backfill documentation) will be provided in PSEG's Final RAR (Wood, pending submittal). In cases where documentation will be presented in PSEG's Final RAR, it will be noted, where pertinent, in this RAR.

PSEG is taking the lead on closing out MGP-related impacts in accordance with the Licensed Site Remediation Professional (LSRP) Program under PI number G000005480, activity number LSR120001, per the July 2019 agreement between PPG and PSEG (PPG and PSEG, 2019). MGP-related information has been included in this RAR for informational purposes only. For example, MGP-related information is provided in Sample Maps and Analytical Results Tables in Appendices D-5 through D-9, the Draft Deed Notice in Appendix J-4, and As-Built Diagrams in Appendix H-5. The MGP AOC identified herein is superseded by MGP AOCs established by PSEG and is no longer relevant. Information required to document remediation of MGP-related impacts will be presented by PSEG in their forthcoming RAR.

Site 114 is currently vacant land owned by the Jersey City Redevelopment Agency (JCRA) and 900 Garfield Ave, % Ryann LLC (900 Garfield Avenue, LLC). The Former Morris Canal, a man-made surface water body trending northeast/southwest, formerly bisected Site 114 into eastern and western portions. The canal was decommissioned in the 1920s and was later filled. The MGP facility operated on the portion of Site 114 located east of the Former Morris Canal from about 1886 to the mid-1930s. The western half of Site 114 was the location of the former chromite ore processing facility that operated from about 1911 to 1963. The chromite ore processing operation included, but was not limited to, the placement of a large stockpile of CCPW, primarily consisting of Chromite Ore Processing Residue (COPR), extending from the eastern portion of Site 114 southward onto Site 137. The locations of the former processing facility and the CCPW storage pile were identified using historical aerial photographs that are provided in the March 2011 *Remedial Investigation Work Plan* (RIWP) (AECOM, 2011b).

Following demolition of above-grade structures associated with the chromite ore processing facility and the MGP facility, the remaining foundations were buried, raising the ground surface elevation by several feet. Subsequently, three warehouse structures were constructed on the property in the late 1960s. These warehouses were demolished down to the concrete floor slabs between August and December 2002.

The Case Inventory Document (CID) summarizes the presence of eight AOCs for the Site, including one for groundwater. For the following six AOCs, the RA has been fully implemented:

- AOC 114-1A: CCPW-impacted soil in Site 114, except in AOC 114-1B (CCPW-impacted soil in portions of Grids A5B, A6B, A7B, and B7B within the Western Sliver);

- AOC 114-2: MGP-impacted soil associated with the former MGP in the eastern portion of Site 114;
- AOC 114-3: Historic fill material in soil in Site 114;
- AOCs 114-4A and 114-4B: Underground storage tank (UST)-impacted soil in Site 114; and
- AOC 114-5: Soil impacted by other historical operations and land use in Site 114.

The RA for the remaining two AOCs (which follow) will be presented in separate submittals:

- AOC 114-1B: CCPW-impacted soil in portions of Grids A5B, A6B, A7B, and B7B within the Western Sliver; and
- GA Group Groundwater: Groundwater impacted by historical operations and land use at Site 114 and CCPW and MGP groundwater impacts on other GA Group Sites.

Table 1-1 provides a description of each AOC and summarizes the RA implemented for the AOCs. The survey limits of the Site 114 soil AOCs are shown on **Figure 1-2**.

This RAR was prepared in accordance with the requirements set forth in the *Technical Requirements for Site Remediation* (TRSR), New Jersey Administrative Code (N.J.A.C.), Title 7, Chapter 26E, Subchapter 5.5 (N.J.A.C. 7:26E-5.5) (NJDEP, 1993b), Appendix A of the 1990 ACO (NJDEP, 1990), and the June 26, 2009 JCO (Superior Court of New Jersey Law Division – Hudson County, 2009).

The remainder of this RAR is organized as follows:

- **Section 2** provides the summary of soil remedial investigation (RI) findings and recommendations;
- **Section 3** identifies the applicable remedial standards/criteria;
- **Section 4** presents the summary of pre-remedial action design activities;
- **Section 5** provides the description of the RA implemented;
- **Section 6** discusses the reliability of the data including data validation and usability;
- **Section 7** includes documentation of the protectiveness of the remedy;
- **Section 8** provides the updated receptor evaluation information;
- **Section 9** presents the conclusions and recommendations; and
- **Section 10** lists the references cited in the report.

Supporting information is presented in the appendices.

2.0 Summary of Soil Remedial Investigation Findings and Recommendations

2.1 Summary of Soil Remedial Investigation Findings

RI activities performed at the GA Group Sites were detailed in the following reports, including RIWPs and Remedial Investigation Reports (RIRs), previously submitted to the NJDEP:

- April 2003 *Remedial Investigation Work Plan – Site 114* (ENSR, 2003).
- March 2006 *Remedial Investigation Report – Site 114* (Site 114 RIR) (ENSR, 2006a).
- March 2006 *Remedial Investigation Work Plan – Site 114 (Off Site)* (ENSR, 2006b).
- December 2007 *Remedial Investigation Report Former Halladay Street Gas Works, Jersey City, New Jersey* (Halladay Street Gas Works RIR) (CMX, 2007).
- July 2008 *Remedial Investigation Report Addendum, Supplemental Offsite Soil Sampling, Former Halladay Street Gas Works, Jersey City, New Jersey* (RIR Addendum) (CMX, 2008).
- December 2009 *Remedial Investigation Report - Non-Residential Chromate Chemical Production Waste Sites, Sites 114, 132, 133, 135, 137, and 143* (AECOM, 2009).
- March 2011 *Soil Remedial Investigation Work Plan – Sites 114, 132, 133, 135, 137, 143 and Site 186* (AECOM, 2011b).
- February 2012 *Remedial Investigation Report – Soil Garfield Avenue Group Non-Residential CCPW Sites 114, 132, 133, 135, 137, 143 and 186* (2012 RIR) (AECOM, 2012a).
- May 2014 *Remedial Investigation Report Former Halladay Street Gas Works Jersey City, New Jersey* (AMEC, 2014).
- August 2018 *Supplemental Soil Remedial Investigation Report, Final Revision 1, PPG Garfield Avenue Group, Hudson County Chromium Sites, Jersey City, New Jersey* (August 2018 SSRIR) (AECOM, 2018b), as approved by NJDEP on October 22, 2018 (NJDEP, 2018b).

The 2012 RIR provides a detailed summary of the previous RI investigations throughout the GA Group Sites. No additional data specific to Site 114 was collected as part of the August 2018 SSRIR; however, delineation of constituents of concern emanating from Site 114 was completed as part of the August 2018 SSRIR. The following is a summary of the information provided in the 2012 RIR with respect to Site 114.

RI activities were conducted between 2005 and 2008. The results of these activities were included in the Site 114 RIR (ENSR, 2006a), and the Halladay Street Gas Works RIR (CMX, 2007) and RIR Addendum (CMX, 2008).

RI activities were also conducted by PSEG for impacts related to the former MGP located in the northeastern portion of Site 114. PPG and PSEG conducted several RI phases throughout the GA Group Sites. The 2012 RIR incorporated the RI work conducted by both PPG and PSEG through 2011. The RI work was designed to delineate the compounds on or potentially emanating from Site

114 related to former chromite ore processing operations and related to PPG's former ownership of the Site. The compounds present on Site 114 included VOCs, SVOCs, PCBs, metals, and Cr^{+6}, as well as CCPW.

The RI activities identified the presence of Cr^{+6} in soil at Site 114 at concentrations greater than the NJDEP Chromium Soil Cleanup Criterion (CrSCC). Most of the Cr^{+6} detected at concentrations greater than the CrSCC was found within the fill material that was placed on top of the meadow mat or on top of native materials. Concentrations of Cr^{+6} greater than the CrSCC within Site 114 were primarily limited to depths shallower than 20 feet (ft) below ground surface (bgs). Hexavalent chromium was found between 20 and 65 ft bgs in some areas, where it appears to have been transported downward from the CCPW source material via groundwater flow, primarily where the meadow mat was missing or discontinuous. Concentrations of Cr^{+6} greater than the CrSCC were found to extend horizontally beyond the Site 114 property boundary in all four directions. RA of adjacent properties is being addressed as stand-alone sites.

The RI activities identified the presence of CCPW metals (antimony, total chromium, nickel, thallium, and vanadium) in soil at Site 114 at concentrations greater than the most stringent NJDEP Soil Remediation Standards (SRS). In general, CCPW metals exceedances, particularly antimony and vanadium, were coincident with Cr^{+6}. Thallium and total chromium exceedances were few and were co-located within the CCPW-impacted areas. Since the completion of the 2012 RIR, the NJDEP has eliminated the SRS for thallium. None of the RI data had nickel concentrations that exceeded the NJDEP SRS.

The RI activities associated with the MGP identified the presence of benzene, toluene, ethylbenzene and total xylenes (BTEX), polycyclic aromatic hydrocarbons (PAHs), and metals (arsenic, lead, and mercury) in the eastern portion of Site 114 at concentrations greater than the most stringent NJDEP SRS. The vertical extent of these constituents was delineated to a maximum depth of approximately 50.5 ft bgs. Visual oil material/tar material (OM/TM) was observed to a depth of 20 to 35 ft bgs in Phase 2A and up to 55 ft bgs in Phase 2B.

In addition to CCPW, CCPW-impacted materials, and MGP-impacted materials present in Site 114, RI activities identified additional constituents of concern on Site 114 including:

- **Chlorinated volatile organic compounds (CVOCs)** - CVOCs were reported at concentrations exceeding the SRS and/or Default Impact to Groundwater Soil Screening Levels (DIGWSSLs) in soil samples primarily at the northern and northeastern portions of Site 114. The suspected source of these CVOCs is likely the former commercial businesses succeeding PPG's operations at the Site. These CVOCs primarily consisted of tetrachloroethene (PCE), trichloroethylene (TCE), and vinyl chloride and were limited to shallow soil.
- **Metals** - Several additional metals related to general site issues and historic fill were reported at concentrations exceeding the SRS and/or DIGWSSLs.
- **Polychlorinated biphenyls (PCBs)** - PCBs were reported at concentrations exceeding the SRS and/or DIGWSSLs in a few isolated areas at Site 114 in the fill above the meadow mat. In Grid V7B, PCBs were found above the 50 mg/kg USEPA *Toxic Substances Control Act* (TSCA) threshold value in one 2003 surface soil sample (B1302-(0-0.5). Based on the greater than 50 ppm PCB concentration, PPG determined that a TSCA-compliant delineation of PCBs was required to confirm this exceedance and for delineation of PCBs around this sample point for removal specific to TSCA-level PCBs. PPG was prepared to implement such

a removal and developed and conducted an in-situ PCB characterization sampling program in 2012, following the requirements of TSCA, Subpart N, to confirm and delineate TSCA-level PCBs. This characterization sampling program included but was not limited to TSCA requirements such as sampling on a 10 ft sampling grid, sampling at multiple depths at each location across a narrow sample interval, and following TSCA extraction, analytical, and decontamination protocols. The greater than 50 ppm PCB concentration reported at B1302 during the 2003 RI was not confirmed by the 2012 characterization sampling program. PCBs were not detected at concentrations greater than the 1 milligram per kilogram (mg/kg) TSCA unrestricted use standard in 68 of 69 samples collected in the 2012 characterization sampling program. One sample had a concentration greater than the 1.0 mg/kg standard, but well below the TSCA threshold value of 50 mg/kg. Therefore, the soil in Grid V7B was determined not to be TSCA-regulated and TSCA compliant removal was not required; USEPA involvement was not required. The 2012 characterization sampling program was reported in Appendix G of the 2012 RIR (AECOM, 2012a). In addition, PCB concentrations below the TSCA threshold value were identified in Grids C5A, A2A, DD3A, X6B, W11B, Y6B, and W7B.

- **Historic Fill -** Based upon numerous soil borings, visual observations, analytical data, and published information from the New Jersey Geologic Survey (NJGS, 2004), the GA Group Sites (from the ground surface to the meadow mat at approximately 20 ft bgs) are mostly underlain by non-native fill material. Much of the land along the present-day Jersey City shoreline was land reclaimed from the Upper New York Bay. Based upon the boring logs and analytical data collected during the RIs conducted in the GA Group Sites, several of the SVOCs and metals detected at concentrations exceeding the SRS or the DIGWSSL are considered to be result of the presence of historic fill material and not PPG or PSEG Site operations. In many samples that did not exhibit evidence of CCPW impacts, the observed concentrations of these compounds often fell within the range of concentrations presented in the NJDEP historic fill database (Table 4-2 of the 2011 version of *N.J.A.C. 7:26E*) (NJDEP, 2011a) and are found within materials identified as fill based upon visual observations.

2.2 Physical Setting of the Site

The GA Group Sites, including Site 114, are located in an urban area in Jersey City, Hudson County, NJ between Garfield Avenue, Caven Point Avenue, Pacific Avenue, and the NJ Transit Light Rail. The GA Group Sites consist of former industrial and commercial properties and businesses. The GA Group Sites, including Site 114, are located within the Canal Crossing Redevelopment Area, which encompasses 111 acres of planned redevelopment space in the southeastern section of Jersey City, NJ (City of Jersey City, 2009).

There is little topographic relief within and surrounding the GA Group Sites, where the topography ranges from elevation (El.) 9 ft to 16 ft relative to the North American Vertical Datum of 1988 (NAVD88). However, west of Garfield Avenue, the land surface slopes upward and reaches approximately El. 100 ft NAVD88 about one-half mile to the west. The topography east of the GA Group Sites is fairly flat, extending to the Hudson River and the Upper New York Bay. Due to highly compacted surface soils and other impervious features, storm water runoff within the GA Group Sites is primarily channeled into the municipal storm sewer system (ENSR, 2006a).

The GA Group Sites are located in a section of Jersey City that experienced significant industrial development in the early 1900s. To create more available land, developers filled the surrounding marshlands and estuarine areas. Research indicates that the fill included construction spoils consisting of silts and sands, garbage from New York City, ship ballast, coal ash, and incinerator ash. It is unknown what specific fill material was used in which locations. The meadow mat associated with

wetland areas was covered with fill materials and/or removed for building foundations or other improvement projects (ENSR, 2006a).

2.2.1 Topography

The United States Geological Survey (USGS) Jersey City, NJ topographic quadrangle map (**Figure 1-1**) presents the regional topography for the GA Group Sites and surrounding area. Site 114 has little topographic relief, with ground surface ranging from El. 10 to 17 ft NAVD88 outside the building slabs. In general, the former building foundations at Site 114 were approximately 2 to 4 ft above the surrounding ground surface. However, just to the west of Garfield Avenue, the topography rises approximately 30 to 40 ft in elevation within several hundred yards of the GA Group Sites, and to about El. 100 ft NAVD88 about a half-mile west of the GA Group Sites. As of October 2018, the surface elevation of Site 114 following soil remediation and restoration ranges from El. 10 to 16 ft NAVD88.

2.2.2 Regional Geology

The regional geology includes unconsolidated sediments of Recent and Pleistocene age. According to the New Jersey Geologic Survey, these sediments include alluvial, estuarine, eolian (windblown), and glacial lacustrine deposits, as well as glacial till of late Wisconsin age. The Triassic age bedrock of the Newark Group (Lockatong and Stockton formations) throughout the region is comprised of non-marine sedimentary rocks, consisting mainly of sandstone, mudstone, and conglomerate. A diabase sill (i.e., the Palisades Sill) intruded into the Lockatong formation west of Garfield Avenue approximately 200 million years ago.

2.2.3 Site 114 Geology

Site 114 is located on miscellaneous fill material that was used to reclaim the salt marsh for the construction of this portion of Jersey City. The estuarine native soils beneath the fill material include an organic meadow mat layer and a thick sequence of unconsolidated natural material. The major geologic units in the area of Site 114 from top to bottom include:

- A non-native fill layer (the shallow zone);
- Native soils consisting of sand, silty sand, and clays (the intermediate zone) generally separated from the fill by organic sediments or meadow mat;
- Till directly above the bedrock underlying sand with occasional gravel lenses generally separated from the intermediate zone by a layer of lower hydraulic conductivity silts and clayey silts (the deep zone); and
- Bedrock of the Lockatong and Stockton Formations (bedrock zone).

The bedrock surface is relatively shallow west of Garfield Avenue, but fairly deep beneath Site 114. Bedrock was observed at depths less than 10 ft bgs west of Site 114 along Garfield Avenue, at depths exceeding 100 ft bgs below the center of Site 114, and at an approximate depth of 80 ft bgs at Halladay Street to the east of Site 114 (AECOM, 2012a).

East of the GA Group Sites, the bedrock surface rises to a large bedrock plateau that extends to the shoreline of New York Bay. The bedrock slopes downward again east of Ellis Island (Stanford, 1995).

Estuarine organic-rich deposits (i.e., meadow mat) were identified at a number of boring locations. Observations have indicated that the meadow mat is not continuous, particularly near the location in

which the Former Morris Canal passed through Site 114 (running northeast/southwest, formerly bisecting Site 114 into eastern and western portions). Meadow mat is not present within the footprint of the Former Morris Canal. Depths of the meadow mat range from approximately 10 to 21 ft bgs (AECOM, 2012a). Shallow soils (predominantly fill) extend from the ground surface to the top of the meadow mat, where the meadow mat is present, or to a similar depth where meadow mat is not present.

Below the meadow mat, soils are unconsolidated and are characterized by fine to medium sand and silt with clay and some gravel, typical of the current understanding of the geologic depositional history of the area. The native, unconsolidated soils range in thickness from approximately 56 to 77 ft, based on borings that extended to bedrock.

Excavation of the impacted miscellaneous fill at Site 114 is discussed in **Section 5.0** of this RAR. A summary of the restoration activities, including backfilling, is provided in **Section 7.2** of this RAR.

2.2.4 Hydrogeology

This RAR only addresses the RA of soil at Site 114. Groundwater impacted by CCPW and/or MGP material throughout the GA Group Sites is being tracked under the PI number G000005480 for Site 114 (the location of the former Chromate Chemical Production Facility and MGP). The status of the groundwater investigation throughout the GA Group is documented in the *Groundwater Remedial Investigation Report, Draft* submitted to the NJDEP on October 1, 2018 (AECOM, 2018d). A separate RAR will be prepared and submitted to document the groundwater RA at the GA Group Sites. This description of hydrogeology is provided herein solely to meet the regulatory requirements of N.J.A.C. 7:26E-5.7(b)1 as specified by N.J.A.C. 7:26E-1.6(b)1.

2.2.4.1 *Regional Groundwater Flow*

Groundwater occurs regionally in the following hydrogeologic zones: the fill; the meadow mat and the unconsolidated overburden soils; and the bedrock. A summary of the groundwater flow in these formations is included below:

- **Fill (Shallow Water-Bearing Zone):** Groundwater in the fill is typically encountered within 10 ft bgs. In general, shallow groundwater flow patterns represent a subdued version of the land surface topography. Variations from this can be attributed to heterogeneities in the fill. For instance, tightly compacted dredged sediments would be expected to restrict water flow much more than construction debris. Subsurface infrastructure (e.g., basements, drains, sheet pile, utility corridors, etc.) would also affect groundwater flow patterns. Groundwater elevations in the shallow fill can also be influenced by recharge events.
- **Overburden (Intermediate and Deep Water-Bearing Zones) and Meadow Mat:** Groundwater flow in the overburden is controlled by hydraulic conductivity or flow through the connected porous spaces in the soil matrix. Groundwater flows horizontally in these soils, but may be influenced by local recharge and discharge zones (i.e., surface water bodies and drainage divides). Meadow mat is a dense matrix of organic material and fine-grained soils; the hydraulic conductivity of the meadow mat is expected to be three or more orders-of-magnitude less than the underlying overburden.
- **Bedrock (Bedrock Water-Bearing Zone):** Well yields from bedrock have been reported to range from several gallons to several hundred gallons per minute, with yields generally decreasing with depth. Groundwater in the bedrock formations occurs under both unconfined and confined conditions, primarily within secondary porosity due to fractures and joints. The

Palisades Sill is understood to be a no flow boundary and has low permeability. In general, groundwater flow in bedrock is a very small fraction of the total groundwater flux through the area.

2.2.4.2 *GA Group Sites Groundwater Flow*

Like the regional hydrogeology, groundwater at the GA Group Sites occurs in several hydrogeologic zones:

- The shallow fill zone (shallow water-bearing zone);
- The intermediate sand and silty sand zone including the meadow mat (intermediate water-bearing zone);
- The deep sand, gravel lenses, silts, clays, and glacial till (deep water-bearing zone); and
- Bedrock of the Stockton Formation and Lockatong Formation (bedrock water-bearing zone).

Shallow groundwater flow is complex and is affected by various on- and off-site activities and features, including excavations, placement of clean and/or amended fill, sheet pile, implementation of interim groundwater remedial measures, other subsurface infrastructure, and localized variability in recharge. The principal direction of groundwater flow in the intermediate and deep water-bearing zones is from northwest to southeast. This flow direction is consistent with the geologic setting where the GA Group area is recharged from groundwater coming off the topographic high to the west. Recharge to the intermediate water-bearing zone is also occurring due to downward gradients in the fill and upward gradients in the deep water-bearing zone.

During a May/June 2018 groundwater sampling round, groundwater elevations throughout the GA Group Sites in the shallow, intermediate, and deep overburden, and bedrock groundwater zones ranged from El. 3.25 to 12.78 ft NAVD88 (shallow), El. 6.16 to 9.67 ft NAVD88 (intermediate), El. 6.44 to 8.03 ft NAVD88 (deep), and El. 7.55 to 10.48 ft NAVD88 (bedrock).

The 50th percentile groundwater elevation for Site 114 was estimated to be El. 9.0 ft NAVD88 based on data from 66 monitoring wells located on or adjacent to Site 114 gauged between December 2003 and December 2016. The monitoring well locations and data are included in **Appendix A**.

2.3 Recommended Remedial Action

PPG and PSEG developed a coordinated remedial approach in areas where both CCPW and MGP material was present (Phase 2A and Phase 2B). Separate Remedial Action Work Plans (RAWPs) were prepared by PPG and PSEG to address the CCPW and MGP material, respectively.

Based on the findings of the RI, the recommended RA for the CCPW-impacted soils at the Site (AOC 114-1A) included the excavation and removal of visible CCPW and soils with concentrations of Cr^{+6} greater than the CrSCC. See **Section 4.1.1** for a more detailed discussion of the remedial action work plan for CCPW-impacted materials. It was anticipated that the presence of CCPW metals (antimony, total chromium, nickel, thallium, and vanadium) at concentrations greater than the CrSCC, SRS, DIGWSSLs, or the site-specific Impact to Groundwater Soil Remediation Standards for the GA Group (IGWSRS-GAGs) would be resolved as a result of the excavation being driven by the presence of Cr^{+6} and visible CCPW impacts.

In the MGP-impacted areas (AOC 114-2), the recommended RA for the MGP-impacted soil at the Site was excavation of OM/TM material to the underlying meadow mat layer, where it was present, along with engineering controls (Clean Fill Soil Cap) and institutional controls (deed notices) for soil remaining in place with contaminants at concentrations greater than unrestricted-use SRS. See **Section 4.1.2** for a more detailed discussion of the remedial action work plan for MGP-impacted materials.

The excavation extent was not driven by the presence of other constituents associated with historical site operations (AOCs 114-3, 114-4A, 114-4B, and 114-5). It was anticipated that the presence of other constituents would be resolved as a result of the excavation being driven by the presence of Cr^{+6} and visible CCPW. Following excavation, CCPW metals and MGP-related constituents remaining in place at concentrations greater than the CrSCC or SRS were addressed through the placement of an engineering control (capping), institutional controls (deed notices), and corresponding Remedial Action Permits (RAPs).

3.0 Identification of Applicable Remedial Standards/Criteria

3.1 Regulatory Requirements, Guidance, and Alternative/Site-Specific Determinations

The RAs described in the PPG RAWP (see **Section 4.1.1** for the PPG RAWP submittal history) were performed in accordance with the following regulatory requirements, NJDEP Guidance, and Site-specific determinations:

- N.J.A.C. 7:9D – *Well Construction and Maintenance; Sealing of Abandoned Wells*, last amended January 2, 2018 (NJDEP, 2001).
- N.J.A.C. 7:26C – *Administrative Requirements for the Remediation of Contaminated Sites*, last amended August 6, 2018 (NJDEP, 1993a).
- N.J.A.C. 7:26D – *Soil Remediation Standards*, last amended September 18, 2017 (NJDEP, 2008a).
- N.J.A.C. 7:26E – *Technical Requirements for Site Remediation*, last amended August 6, 2018 (NJDEP, 1993b).
- NJDEP *Field Sampling Procedures Manual*, dated August 2005, last updated April 2011 (NJDEP, 2005).
- NJDEP *Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria*, dated September 2012 (NJDEP, 2012h).
- NJDEP Memorandum from Lisa P. Jackson to Irene Kropp, Subject: *Chromium Moratorium*, February 8, 2007 (the Chromium Policy) (NJDEP, 2007).
- NJDEP *Chromium Soil Cleanup Criteria*, September 2008, revised April 2010 (NJDEP, 2008b).
- NJDEP *Administrative Consent Order*, dated July 19, 1990 (NJDEP, 1990).
- *Partial Consent Judgment Concerning the PPG Sites* (JCO) between NJDEP, PPG, and the City of Jersey City, June 26, 2009 (Superior Court of New Jersey Law Division - Hudson County, 2009).
- Letter from Thomas J. Cozzi to M. [sic] Michael McCabe, Subject: *Method to Determine Compliance with the Department's Chromium Policy, Garfield Avenue Group – Sites 114, 132, 133, 135, 137, and 143, Jersey City, New Jersey*. September 13, 2012 (NJDEP, 2012i).
- Letter from Thomas J. Cozzi to W. Michael McCabe, Subject: *Updated Method to Determine Compliance with the Department's Chromium Policy*, *Garfield Avenue – Sites 114, 132, 133, 135, 137, and 143, Jersey City, NJ*. August 13, 2013 (Method to Determine Compliance) (NJDEP, 2013b).
- NJDEP Memorandum from Diane Groth to David Doyle, Subject *PPG Garfield Avenue Group Sites, Adjacent Streets and Nearby Properties, Jersey City, NJ: Alternative Remediation Standard for Vanadium,* December 28, 2016 (NJDEP, 2016).

- August 2018 *Supplemental Soil Remedial Investigation Report, Final Revision 1, PPG Garfield Avenue Group, Hudson County Chromium Sites, Jersey City, New Jersey* (August 2018 SSRIR) (AECOM, 2018b), which presented the IGWSRS-GAG for antimony and nickel. The August 2018 SSRIR was approved by NJDEP on October 22, 2018 (NJDEP, 2018b).

3.2 Soil Remediation Standards/Criteria

The primary constituents of concern for Site 114 were related to former chromite ore processing operations and MGP operations at Site 114. PPG was also responsible for other constituents exceeding NJDEP SRS that may be present at the Site.

The NJDEP SRS and other criteria relevant to the remediation at Site 114 are presented in **Tables 3-1A** through **3-1G**.

Note that, because the excavation at Site 114 was extended to below the average groundwater table as described in **Section 2.2.4.2**, the DIGWSSLs do not apply.

4.0 Summary of Pre-Remedial Action Design Activities

Based on the findings of the RI (as summarized in **Section 2.0**), the recommended RA for soil at the Site included:

- The excavation and removal of visible CCPW, CCPW-impacted soil, and soil with concentrations of Cr^{+6} greater than the CrSCC;
- The excavation and removal of MGP-impacted material in Phase 2A to 20 to 30 ft bgs and in Phase 2B to the meadow mat; and
- The use of engineering controls (Clean Fill Soil Cap) and institutional controls (deed notices) for impacted soil remaining in place at concentrations greater than unrestricted-use SRS.

For the purposes of planning and implementing the RA, the Site was divided into phases: Interim Remedial Measure (IRM) #1, Phase 1 (divided into Phase 1A, Phase 1B, and Phase 1C), Phase 2A, and Phase 2B (divided into Phase 2B-1, Phase 2B-2, Phase 2B-3, and Phase 2B-4). IRM #1 includes two areas where additional excavation was conducted: the Western Sliver and the Northwest Grids. Phase 1 areas were also referred to as zones in early correspondence related to the RA: Zones 1 through 5 are in Phase 1B, Zone 6 is Phase 1A, and Zone 7 is Phase 1C. This progression of work minimized re-contamination of placed clean fill, over-excavation, and relocation of support facilities.

4.1 Summary of the Remedial Action Work Plan (Soil)

PPG and PSEG developed a coordinated remedial approach in areas where both CCPW and MGP material was present (Phase 2A and Phase 2B). Separate RAWPs were prepared by PPG and PSEG to address the CCPW-impacted and MGP-impacted material, respectively. Based on the nature and extent of impacts, the PPG RAWP was implemented by PPG in Phase 1, the PPG RAWP and the PSEG RAWP were implemented by PSEG in Phase 2A, and the PPG RAWP and PSEG RAWP were implemented by PPG in Phase 2B.

4.1.1 Remedial Action Work Plans for CCPW and CCPW-Impacted Soil (PPG RAWP)

Prior to development of the PPG RAWP for CCPW and CCPW-impacted soil, an IRM was developed to address CCPW for the 900 Garfield Avenue slab; this was designated as IRM #1. IRM #1 activities were conducted under the following plans:

- *Draft Interim Remedial Measures Work Plan #1, 900 Garfield Avenue - PPG Site 114*, dated February 3, 2010 (AECOM, 2010a).
- Comments on the *Interim Remedial Measures Work Plan #1; 900 Garfield Avenue - PPG Site 114; Jersey City, New Jersey* provided by ERFS (consultant to Jersey City) dated February 25, 2010 and submitted on March 1, 2010 (ERFS, 2010).
- Comments on the *Interim Remedial Measures Work Plan #1; 900 Garfield Avenue - PPG Site 114; Jersey City, New Jersey* received from NJDEP on March 16, 2010 (NJDEP, 2010a).

- *PPG Judicial Consent Order - Chromium Program, Response to Comments on the Interim Remedial Measures Work Plan #1, 900 Garfield Avenue – PPG Site 114; Jersey City, New Jersey*, dated April 9, 2010 (AECOM, 2010b).
- *Adequacy of Response to Comments on April 2010 Revised Interim Remedial Measures Work Plan #1; 900 Garfield Avenue – PPG Site 114; Jersey City, New Jersey*, received from NJDEP on April 20, 2010 (NJDEP, 2010b).
- *Final Interim Remedial Measures Work Plan #1 - 900 Garfield Avenue - PPG Site 114,* dated June 2010 (AECOM, 2010e).
- *FINAL Interim Remedial Measures Work Plan #1 and #2, 900 Garfield Avenue and 2 Dakota Street, PPG Site 114; Jersey City, New Jersey*, dated July 7, 2010 (AECOM, 2010f).
- NJDEP Approval Letter entitled *Interim Remedial Measures Work Plan #1 – June 2010, Interim Remedial Measures Work Plan #2 – July 2010, 900 Garfield Avenue and 2 Dakota Street, Jersey City, New Jersey, Hudson County Chromate Site 114*, dated August 12, 2010 (NJDEP, 2010c)
- *Interim Remedial Measures Work Plan #1 Addendum, 900 Garfield Avenue – PPG Site 114; Jersey City, New Jersey*, dated January 31, 2011 (AECOM, 2011a).

The initial objectives of the IRM were to excavate CCPW with Cr^{+6} concentrations greater than 600 to 1,000 milligrams per kilograms (mg/kg) and buried debris, and to backfill the area in preparation for future feasibility studies and pilot testing of reductant injections to treat remaining non-CCPW soil and groundwater. It was later decided to fully excavate and dispose of CCPW and non-CCPW soil encountered at depths with Cr^{+6} concentrations greater than the CrSCC of 20 mg/kg or to excavate down to meadow mat, whichever depth was encountered first.

In December of 2010, PPG worked with the NJDEP and other stakeholders to develop a conceptual plan for remediation of the GA Group Sites. The Conceptual Plan (AECOM, 2010g) specified the removal of Accessible CCPW (including COPR, green-gray mud, and fill mixed with COPR or green-gray mud) in accessible areas to a maximum depth of 35 ft bgs. Subsequently, PPG expanded the excavation plan to include Impacted Soil (soil containing Cr^{+6} greater than 20 mg/kg) to the meadow mat or a depth of 20 ft bgs. Excavation of Impacted Soil below 20 ft bgs to a maximum depth of 35 ft bgs was also planned under certain circumstances. Containment or treatment and institutional controls were specified for areas that were inaccessible at that time.

Following the preparation and submittal of the RIR and the Conceptual Plan (AECOM, 2010g), AECOM (on behalf of PPG) prepared the PPG RAWP to address the CCPW-impacted material at Site 114 (AOC 114-1A). A summary of the PPG RAWP submittal/approval history is as follows:

- On June 20, 2011, PPG/AECOM issued the *Draft Remedial Action Work Plan (Soil), Garfield Avenue Group – Sites 114, 132, 133, 135, 137 and 143, Jersey City, New Jersey* (2011 PPG RAWP) (AECOM, 2011c).
- On July 27, 2011, ERFS, on behalf of the City of Jersey City, provided comments on the *Draft Remedial Action Work Plan (Soil), Garfield Avenue Group – Sites 114, 132, 133, 135, 137 and 143, Jersey City, New Jersey* (2011 PPG RAWP) (ERFS, 2011a).
- On August 5, 2011, Weston Solutions, Inc. (Weston), on behalf of NJDEP, issued an email with high-level comments on the 2011 PPG RAWP (Weston, 2011).

- On November 17, 2011, NJDEP issued comments on the *Technical Execution Plan; Southwestern Area Soil Excavation; PPG-Site 114 – Garfield Avenue; Jersey City, New Jersey* (NJDEP, 2011b), which applied to the 2011 PPG RAWP.
- On December 9, 2011, PPG/AECOM issued the *Draft Remedial Action Work Plan (Soil), Rev. 1, Garfield Avenue Group – Sites 114, 132, 133, 135, 137 and 143, Jersey City, New Jersey* (2011 PPG RAWP Rev. 1) (AECOM, 2011e), along with a response to Weston's August 2011 comments and NJDEP's November 2011 comments.
- On January 13, 2012, ERFS, on behalf of the City of Jersey City, provided comments on the 2011 PPG RAWP Rev. 1 (ERFS, 2012b).
- On February 10, 2012, NJDEP issued comments on the 2011 PPG RAWP Rev. 1 (NJDEP, 2012b).
- On April 17, 2012, PPG/AECOM issued the *Draft Remedial Action Work Plan (Soil), Rev. 2, Garfield Avenue Group – Sites 114, 132, 133, 135, 137 and 143, Jersey City, New Jersey* (2012 PPG RAWP) (AECOM, 2012e).
- On May 8, 2012, ERFS, on behalf of the City of Jersey City, provided comments on the *Draft Remedial Action Work Plan (Soil), Rev. 2, Garfield Avenue Group – Sites 114, 132, 133, 135, 137 and 143, Jersey City, New Jersey* (2012 PPG RAWP) (ERFS, 2012c).
- On May 14, 2012, NJDEP found the 2012 PPG RAWP to be administratively complete and issued a Conditional Approval in a letter from Thomas J. Cozzi to M. [sic] Michael McCabe, Subject: *Remedial Action Work Plan (Soil), Rev. 2, Garfield Avenue Group – Sites 114, 132, 133, 135, 137 and 143, Jersey City, New Jersey* (NJDEP, 2012e).
- On June 1, 2012, PPG/AECOM issued a letter via email to Mr. Michael McCabe, *Response to Comments for the Garfield Avenue Group FINAL Remedial Action Work Plan Garfield Avenue Group - Sites 114,132, 133, 135, 137, and 143 Jersey City, Hudson County, New Jersey* (AECOM, 2012h).
- On April 29, 2014, PPG/AECOM issued the Final Soil RAWP via email to Mr. Michael McCabe (AECOM, 2014i); however, this submittal was withdrawn by the Site Administrator on May 5, 2014 (McCabe, 2014).
- On December 5, 2014, PPG/AECOM issued the *Draft Remedial Action Work Plan (Soil) Rev. 3, Garfield Avenue Group – Sites 114, 132, 133, 135, 137 and 143, Jersey City, New Jersey* (Draft 2014 PPG RAWP) (AECOM, 2014l), documenting compliance with the conditions of NJDEP's Conditional Approval.
- On February 28, 2018, Weston, on behalf of NJDEP, issued an email that requested minor editorial changes to the Draft 2014 PPG RAWP (Weston, 2018a).
- On May 15, 2018, PPG/AECOM issued the *Final Remedial Action Work Plan (Soil) Rev. 3, Garfield Avenue Group Sites, Jersey City, New Jersey* (Final PPG RAWP Rev. 3) (AECOM, 2018a).
- On July 12, 2018, Weston, on behalf of NJDEP, issued an email that requested one additional minor editorial change to the Final PPG RAWP Rev. 3 (Weston, 2018b).
- On August 21, 2018, on behalf of the City of Jersey City, Environmental Remediation and Financial Services, LLC (ERFS) provided comments on the Final RAWP Rev. 3 (ERFS, 2018a), which was distributed by the Site Administrator by email on August 21, 2018.

- On September 27, 2018, PPG/AECOM issued the *Final Remedial Action Work Plan (Soil) Rev. 4, Garfield Avenue Group Sites, Jersey City, New Jersey* (Final PPG RAWP Rev. 4) (AECOM, 2018c).
- On October 10, 2018, on behalf of the City of Jersey City, ERFS provided concurrence on the Final PPG RAWP Rev. 4 (ERFS, 2018b).
- On November 9, 2018, NJDEP approved the Final PPG RAWP Rev. 4 (NJDEP, 2018c).

The overall objectives for Cr^{+6} and CCPW-impacted soil, as stated in the PPG RAWP were:

- Elimination of potential exposure to Cr^{+6} in CCPW and CCPW-impacted soil (Cr^{+6} at concentrations greater than 20 mg/kg) due to direct contact or windborne dust;
- Removal of accessible impacted soil at depths less than 20 ft bgs and above the meadow mat;
- Removal of CCPW and certain impacted soil to depths greater than 20 ft bgs but to a maximum of 35 ft bgs where: a) the meadow mat is not present, and b) removal is technically prudent and beneficial to the future groundwater remediation; and
- Establishment of site conditions suitable for future uses of the Site.

The selected RA for Cr^{+6} and CCPW-impacted soil (AOC 114-1A) was excavation (in areas where the impacted soil was present and accessible) to depths no deeper than 35 ft bgs and off-site disposal. When excavation began in 2010, excavation and treatment of soil containing Cr^{+6} was to meet the requirements of the Chromium Policy (NJDEP, 2007). On September 13, 2012, NJDEP issued the *Method to Determine Compliance with the Department's Chromium Policy, Garfield Avenue Group – Sites 114, 132, 133, 135, 137, and 143, Jersey City, New Jersey* (NJDEP, 2012i) to provide clarification for the GA Group Sites on how to demonstrate compliance with the Chromium Policy. Subsequently, on August 13, 2013 NJDEP issued the updated *Method to Determine Compliance with the Department's Chromium Policy* (NJDEP, 2013b) to provide further clarification. Meadow mat, where present, was to be protected to the extent practical since it provides a natural barrier to chromium migration and can reduce Cr^{+6} to trivalent chromium.

In Grid A'13A, the RA also incorporated in-situ treatment of Cr^{+6} exceedances in soil at depths greater than 11 ft bgs by manual mixing of reductant into deeper soils. Additional information on work plans and approvals is provided in **Section 4.2.**1 and information on implementation is provided in **Section 5.5**.

PPG was also responsible for the remediation of metals, SVOCs, VOCs, PCBs, pesticides, EPH, and TPH at concentrations greater than the SRS (AOCs 114-3, 114-4A, 114-4B, and 114-5). However, the excavation extent was not driven by the presence of these other constituents; it was anticipated that the presence of these other constituents would be resolved as a result of the excavation being driven by the presence of Cr^{+6} and visible CCPW. These other constituents present at concentrations greater than SRS that were not removed as part of the primary Cr^{+6} remediation would be addressed through the placement of an engineering control (capping), institutional controls (deed notices), and corresponding RAPs.

Excavation areas were to be backfilled with soil suitable for residential, commercial, or other possible purposes. In areas where deemed necessary, a capillary break was to be installed between groundwater and the ground surface to eliminate the chance of chromate crystallization from impacted groundwater wicking to the surface. As described in the *Capillary Break Design Final Report (Revision 2)* (AECOM, 2017d), it was determined that a capillary break was required within portions of Site 114.

Note that the capillary break and related institutional controls are part of the groundwater remedy and will be addressed in the groundwater RAP (and not as part of the soil remediation). The capillary break construction method and extent of the capillary break are described in **Section 7.2**.

To improve the design of the PPG RAWP, several pre-design activities were planned. These activities were to include actions such as soil borings, test pits, utility surveys, geotechnical assessments and sampling, and obtaining permits where required. The goals of these events were: to define the limits of excavation and the locations of underground utilities under adjacent roadways; to obtain geotechnical data for the design of excavation support; and to determine the depth of excavation in specific grids.

Sampling in soil borings prior to excavation (i.e., pre-excavation sampling) would be used to define the proposed terminal excavation elevation (TEE) for specific grids, subject to review and concurrence by NJDEP. Technical Execution Plans (TEPs) were to be prepared and submitted to NJDEP to define the sample collection and excavation methods to be used.

The excavation was to be implemented on a 30-ft by 30-ft grid pattern. To determine compliance with the remediation objectives, post-excavation sampling of pit bottoms or sampling in soil borings prior to excavation (i.e., pre-excavation sampling) was to be conducted in excavation areas at a sampling frequency of one confirmation sample per 900 square ft, with analysis for Cr^{+6}. Samples for VOCs, SVOCs, and metals were to be collected at a frequency of ten percent of the Cr^{+6} confirmation samples. In grids where above ground storage tanks or USTs were present, additional pit bottom sampling for VOCs, SVOCs, PCBs, TAL metals, and EPH was required. At locations where PCBs were detected during RI sampling, confirmation pit bottom samples were to be collected and analyzed for PCBs. Where excavation grids were enclosed by sheet pile and/or adjacent to other grids being excavated, sidewall sampling was not required.

The final phase of remedial activities to be conducted at Site 114 was to include site restoration activities before demobilization from the area.

4.1.2 Remedial Action Work Plan for MGP-Impacted Soil (PSEG RAWP)

AMEC (on behalf of PSEG) prepared the PSEG RAWP to present the remedial approach to address MGP-impacted soil present in Phase 2A and Phase 2B (AOC 114-2). A summary of the PSEG RAWP submittal/approval history is as follows:

- On December 1, 2011, AMEC, on behalf of PSEG, issued the *Remedial Action Work Plan for On-Site Soils* (2011 PSEG RAWP), dated November 2011 (AMEC, 2011).
- On April 25, 2012, the NJDEP issued a letter that provided comments on the 2011 PSEG RAWP (NJDEP, 2012d).
- On July 6, 2012, PSEG submitted a *Response to NJDEP Comments dated April 25, 2012*, by letter (PSEG, 2012).
- On August 17, 2012, the NJDEP issued a conditional approval of the 2011 PSEG RAWP by letter (NJDEP, 2012g).
- On August 28, 2012, AMEC, on behalf of PSEG, submitted the *Remedial Action Work Plan Addendum for On-Site Soils* (2012 PSEG RAWP Addendum) (AMEC, 2012) to provide additional information and address NJDEP comments dated April 25, 2012.

The selected RA for MGP-impacted soil in AOC 114-2 (consisting of Phases 2A and 2B) included excavation and off-site treatment/disposal of soil containing MGP-impacted material. Based on the data obtained during the RI and the preliminary design investigation (PDI), meadow mat was found to be not present in Phase 2A. The targeted excavation depth in Phase 2A ranged between 20 and 30 ft bgs. Within the remainder of AOC 114-2 (Phase 2B, where meadow mat is present), excavation of soil was proposed to the top of the meadow mat in order to maintain meadow mat integrity, which serves as a component of the Cr^{+6} remedy. As a result, the RA at Phase 2A was implemented in accordance with the PSEG RAWP and RA at Phase 2B was implemented in accordance with the PPG RAWP.

In MGP-impacted areas (AOC 114-2), soil containing OM/TM and contaminants at concentrations greater than unrestricted use NJDEP SRS that were not removed by excavation would be addressed by engineering controls (Clean Fill Soil Cap) and institutional controls (deed notices). It was proposed that MGP-impacted materials deeper than the proposed and completed excavations would also be contained by installation of sealed-steel sheet pile installed at the perimeter of AOC 114-2. Note that the sheet pile is part of the groundwater remedy and will be addressed in a separate document.

In the MGP-impacted areas (AOC 114-2), confirmatory sampling for MGP-related constituents was not intended to demonstrate compliance with the SRS, but to characterize the soil contamination that would remain after excavation was completed. As such, a reduced sampling frequency of one sample per 3,500 square ft, with analysis for VOCs, SVOCs, and metals was proposed in the 2012 PSEG RAWP Addendum (AMEC, 2012).

4.2 Summary of the Technical Execution Plan and Related Activities

AECOM, on behalf of PPG, developed TEE memoranda and TEPs to propose the final excavation elevations and define the sample collection and excavation methods to be used for Phase 1, Phase 2B, and the Western Sliver and Northwest Grids portions of IRM #1 where PPG would be conducting the remediation in accordance with the PPG RAWP (see **Section 4.1.1** for the RAWP submittal history).

A stand-alone TEE memorandum and a TEP were not prepared for Phase 2A where PSEG conducted the remediation. The 2011 PSEG RAWP (AMEC, 2011) and the 2012 PSEG RAWP Addendum (AMEC, 2012) provided PDI results and proposed TEEs.

4.2.1 Proposed Terminal Excavation Elevations and Pre-Design Investigation

Proposed TEEs for excavation of Phase 1, Phase 2B, and the Western Sliver and Northwest Grids portions of IRM #1 were provided in a series of memoranda from AECOM to NJDEP/Weston (TEE submittals). The memoranda typically included detailed information demonstrating how the final excavation depth in each grid would comply with the Chromium Policy (NJDEP, 2007) and the Cr^{+6} decision tree in the Method to Determine Compliance (NJDEP, 2012i and NJDEP, 2013b). The process of using TEE submittals began in 2012. For most of IRM #1, where excavation began prior to 2010, excavation was conducted in accordance with the PPG RAWP described in **Section 4.1.1**. For the Western Sliver and Northwest Grids portions of IRM #1, TEE submittals were used to communicate excavation depths as listed below.

In some phases, as part of the pre-RA activities, and in an effort to better define the TEEs and planned excavation, PDI activities were implemented.

The following is a listing of the deliverables and correspondence that detailed the proposed TEEs and PDI investigation activities in Phase 1, Phase 2B, and the Western Sliver and Northwest Grids portions of IRM #1 of Site 114:

Phase 1A

- On April 30, 2012, PPG/AECOM submitted the memorandum entitled *PPG Site 114, Excavation Depths in Zone 6* (AECOM, 2012f).
- On May 11, 2012, NJDEP/Weston provided comments via email (Weston, 2012a).
- On May 31, 2012, PPG/AECOM provided an email to NJDEP/Weston entitled *FW: Zone 6 Excavation Figures for DEP_5-31-12.pdf* (AECOM, 2012g), providing target elevations for Zone 6 to demonstrate achieving the minimum compliant depth in all grids.

Phase 1B

- On June 19, 2012, PPG/AECOM submitted the memorandum entitled *PPG Site 114, Excavation Depths in Zones 1 & 2 (Row A' to B)* (AECOM, 2012j), which was followed by a conference call on June 20, 2012 that included NJDEP and Weston as participants.
- On June 27, 2012, PPG/AECOM submitted the memorandum entitled *PPG Site 114, Excavation Depths in Zones 1 & 2 Revision 1* dated June 17, 2012 (date not corrected/updated in memorandum) (AECOM, 2012i), which addressed NJDEP comments from the June 20, 2012 conference call.
- On July 11, 2012, NJDEP/Weston issued the email entitled *RE: PPG GAG SW TEP Excavation Terminal Excavation Depth (Rows A' thru B)* (Weston, 2012b), that provided a tabular assessment of terminal elevations for each cell in Rows A' and A in Zones 1 and 2 of the SW Area TEP, and was followed by a meeting between AECOM and Weston on July 12, 2012.
- On July 23, 2012, PPG/AECOM sent the email entitled *latest table for rows A and A'* (AECOM, 2012k) that included Excel Table 1 Grid Elevations Zones 1 through 2 (Rows A' to B).
- On July 24, 2012, NJDEP/Weston provided comments via email entitled *FW: latest table for rows A and A'* (Weston, 2012c) on the AECOM July 23, 2012 email.
- On July 27, 2012, PPG/AECOM submitted the memorandum entitled *Submittal GAG SWTEP A' thru A Rows Excavation Depths* (AECOM, 2012l), addressing Weston's July 24, 2012 comments.
- On July 30, 2012, NJDEP/Weston provided the email entitled *SW TEP Area, Zone 1&2, Row B* (Weston, 2012d), providing comments on Row B from PPG/AECOM's July 23, 2012 email.
- On July 31, 2012, NJDEP/Weston provided the email entitled *RE: Rows A" and A* (Weston, 2012e), with approval for some cells and a request to document compliance with the Chromium Policy (NJDEP, 2007).
- On August 6, 2012, PPG/AECOM provided the email entitled *RE: SW TEP Area, Zone 1&2, Row B* (AECOM, 2012m) requesting clarification on the Weston July 30, 2012 email.
- On August 8, 2012, NJDEP/Weston provided the email entitled *SW TEP Area, Zone 1&2, Row B* (Weston, 2012f), providing a response to AECOM's August 6, 2012 request for clarification.

- On September 18, 2012, PPG/AECOM provided the email entitled *Target Elevations for Site 114 Grids* which included submittals for Zone 5 (Southern Half of Morris Canal) and Row B of SW Area (AECOM, 2012o).
- On September 28, 2012, NJDEP/Weston provided the email entitled RE: *Target Elevations for Site 114 Grids* (Weston, 2012g), providing a response to AECOM's September 18, 2012 email related to Row B.
- On October 1, 2012, PPG/AECOM provided the email entitled *Target Elevations for Site 114 Grids* (AECOM, 2012p), providing a response to Weston's September 28, 2012 email.
- On October 1, 2012, NJDEP/Weston provided the email entitled RE: *Target Elevations for Site 114 Grids* (Weston, 2012h), providing a response to AECOM's October 1, 2012 email and suggesting a call.
- On October 2, 2012, NJDEP/Weston provided an email entitled *RE: Target Elevations for Site 114 Grids* (Weston, 2012i), documenting items discussed/resolved on the October 2, 2012 call for Row B.
- On October 19, 2012, PPG/AECOM submitted the memorandum entitled *Submittal SWTEP Site 114 Target Elevations Rows C thru E* (AECOM, 2012q).
- On October 26, 2012, PPG/AECOM submitted the memorandum entitled *PPG Site 114, Excavation Depths in Row B and Grid C13A, Zones 1 & 2,* providing target excavation depths for Row B and Grid C13A of Zones 1 and 2 of the Site 114 excavation (note that this document was resubmitted on November 5, 2012 due to technical issues with the electronic transmittal) (AECOM, 2012r).
- On November 2, 2012, PPG/AECOM submitted the memorandum entitled *PPG Site 114, Excavation Depths in Row B and Grid C13A, Zones 1 & 2* (AECOM, 2012s), providing the target excavation in Row F of Zones 3 and 4 of the Site 114 excavation.
- On November 7, 2012, PPG/AECOM submitted the memorandum entitled *PPG Site 114, Excavation Depths in Rows A' and A, Zones 1 & 2* (AECOM, 2012t) (note that this submittal was provided on November 8, 2012 in an email entitled*, PPG GAG Rows A' and A Resubmittal*).
- On November 14, 2012, NJDEP/Weston provided the email entitled *Target Elevations for Site 114 Grids, Zone 1&2, Rows C, D, and E* (Weston, 2012k), providing comments on AECOM's October 19, 2012 submittal.
- On November 15, 2012, PPG/AECOM submitted the memorandum entitled PPG *Site 114, Excavation Depths in Row H and Rows G-J (Columns 9A-13A), Zones 3 & 4* (AECOM, 2012v), providing the target excavation depths for Row H and Rows G through J (Columns 9A through 13A) of Zones 3 and 4 of the Site 114 excavation.
- On November 20, 2012, NJDEP/Weston provided the email entitled *Target Elevations for resubmitted information for Site 114 Grids, Zone 1&2, Row B* (Weston, 2012l), providing concurrence and comments on AECOM's October 26, 2012 submittal.
- On November 29, 2012, NJDEP/Weston provided the email entitled *RE: PPG GAG Rows A' and A Resubmittal* (Weston, 2012m), providing comments on AECOM's November 7, 2012 resubmitted Row A' and A information.
- On December 6, 2012, NJDEP/Weston provided the email entitled *RE: Target Elevations for Row F* (Weston, 2012n), providing comments on AECOM's November 2, 2012 submittal table on Row F.

- On December 6, 2012, NJDEP/Weston provided the email entitled *Target Elevations for Site 114 Grids, Zone 5 Rows K, L, and a portion of M* (Weston, 2012o), providing comments on AECOM's September 18, 2012 submittal on Zone 5 Rows K, L, and M .
- On December 7, 2012, PPG/AECOM provided the email entitled *FW: Response for Target Elevations for Row F* (AECOM, 2012w), providing a response to Weston's December 6, 2012 comments.
- On December 10, 2012, NJDEP/Weston provided the email entitled *RE: Response for Target Elevations for Row F* (Weston, 2012p), which documented the discussion/agreement reached between NJDEP, AECOM, and Weston on Row F.
- On December 10, 2012, PPG/AECOM provided the email entitled *Target Elevations for Grids G1B-G8A, I1B-I8A, J1B-J8A*, (AECOM, 2012x), which included the target excavation depths for excavation in Rows G, I, J (Columns 1B through 8A) of Zones 3 and 4 of the Site 114 excavation.
- On December 10, 2012, NJDEP/Weston provided the email entitled *question regarding boring logs for partial rows G, I, J, and full row H* (Weston, 2012q), requesting additional information on AECOM's November 15, 2012 submittal.
- On December 11, 2012, PPG/AECOM provided the email entitled *RE: question regarding boring logs for partial rows G, I, J, and full row H* (AECOM, 2012y), providing a response to Weston's December 10, 2012 email (Weston, 2012-17).
- On December 17, 2012, NJDEP/Weston provided the email entitled *Target Elevations for GAG SW TEP Area, Zones 3 & 4, Cells 9A-13A in Rows G, I, and J, and the entirety of Row H* (Weston, 2012r), providing comments on AECOM's November 15, 2012 submittal and the December 11, 2012 update to that submittal.
- On December 19, 2012, NJDEP/Weston provided the email entitled *Target Elevations for GAG SW TEP Area, Zones 3 & 4, Cells 1B-8A in Rows G, I, and J* (Weston, 2012s), providing comments on AECOM's December 10, 2012 email and updated Table 1 from AECOM's December 11, 2012 email.
- On December 21, 2012, PPG/AECOM provided the email entitled *FW: Target Elevations for GAG SW TEP Area, Zones 3 & 4, Cells 1B-8A in Rows G, I, and J* (AECOM, 2012z), providing a response to Weston's December 19, 2012 email.
- On December 21, 2012, PPG/AECOM provided the email entitled *FW: Target Elevations for GAG SW TEP Area, Zones 3 & 4, Cells 9A-13A in Rows G, I, and J, and the entirety of Row H* (AECOM, 2012aa), providing a response to Weston's December 17, 2012 email.
- On December 21, 2012, PPG/AECOM provided the email entitled *RE: Target Elevations for Site 114 Grids, Zone 5 Rows K, L, and a portion of M* (AECOM, 2012ab), providing a response to Weston's December 6, 2012 email (Weston, 2012o).
- On January 9, 2013, NJDEP/Weston provided the email entitled *RE: Target Elevations for GAG SW TEP Area, Zones 3 & 4, Cells 1B-8A in Rows G, I, and J* (Weston, 2013a), providing comments on AECOM's December 21, 2012 responses to Weston's December 17, 2012 comments (AECOM, 2012aa).
- On January 9, 2013, NJDEP/Weston provided the email entitled *RE: Target Elevations for GAG SW TEP Area, Zones 3 & 4, Cells 1B-8A in Rows G, I, and J and the entirety of Row H* (Weston, 2013b), providing comments on AECOM's December 21, 2012 responses to Weston's December 17, 2012 comments (AECOM, 2012aa).

- On January 10, 2013, NJDEP/Weston provided the email entitled *RE: Target Elevations for Site 114 Grids, Zone 5 Rows K, L, and a portion of M* (Weston, 2013c), providing comments on AECOM's December 21, 2012 responses to Weston's December 17, 2012 comments (AECOM, 2012ab).
- On January 11, 2013, PPG/AECOM submitted the memorandum entitled *PPG Site 114, Excavation Depths in Grids A5A, A13A, D13A and A'13A*, dated January 10, 2013 (AECOM, 2013a), providing recommendations for final excavation depth for Grids A5A, A13A, D13A, and A'13A and including plans for the in-situ remediation of Cr^{+6} exceedances in soil in Grid A'13A at depths greater than 11 feet bgs by manual mixing of reductant into deeper soils.
- On January 31, 2013, NJDEP provided conditional approval of the remedial approach presented in PPG/AECOM's January 10, 2013 memorandum entitled *PPG Site 114, Excavation Depths in Grids A5A, A13A, D13A and A'13A (AECOM, 2013a) by issuing a letter from Thomas J. Cozzi to Mr. Michael McCabe, Subject: Excavation Depths in Grids A5A, A13A, D13A, and A'13A PPG Site 114; SRP PI No. G000008791* (NJDEP, 2013a).

Phase 1C

For Phase 1C, the proposed TEE information was incorporated into the TEP submittals. See **Section 4.2.2** for the Phase 1C TEP submittals.

Phase 2B-1

- On March 7, 2013, PPG/AECOM submitted the memorandum entitled *PPG Site 114, Excavation Depths in Phase 2B-1, Rows N-S, Columns 0-15B*, included as Attachment 1 to the March 2013 *Technical Execution Plan, Southwest TEP Addendum (Phase 2B-1 Area Soil Excavation)* (AECOM, 2013c).
- On April 15, 2013, NJDEP/Weston provided the email entitled *Preliminary Target Elevations for GAG Phase 2B-1 TEP* (Weston, 2013e), providing comments on the memorandum included as Attachment 1 to the March 2013 *Technical Execution Plan, Southwest TEP Addendum (Phase 2B-1 Area Soil Excavation)* (AECOM, 2013c).
- On July 1, 2014, PPG/AECOM submitted the memorandum entitled *PPG Supplemental Terminal Excavation Elevations in Phase 2B-1: Grids U11B and Q15B* (AECOM, 2014j).
- On July 29, 2014, NJDEP/Weston provided comments via email (Weston, 2014d) on AECOM's July 1, 2014 memorandum.
- On August 26, 2014, PPG/AECOM submitted the memorandum entitled *Response to Weston's 7/29/14 Comments on "PPG Supplemental Terminal Excavation Elevations in Phase 2B-1: Grids U11B and Q15B*" (AECOM, 2014k).
- On September 19, 2014, NJDEP/Weston provided concurrence via email (Weston, 2014e) on PPG/AECOM's August 26, 2014 response to comments.

Phase 2B-2 (including portions of Phase 2B-1 in Grid Columns T, U and V)

- On April 18, 2013, PPG/AECOM submitted the memorandum entitled *PPG Site 114, Excavation Depths in Phase 2B-2 Rows T-Z, Columns 0-11B,* dated April 5, 2013 (AECOM, 2013d).

- On April 25, 2013, NJDEP/Weston provided the email entitled *Questions on Phase 2B-2 terminal elevation data set* (Weston, 2013f), regarding AECOM's April 18, 2013 submittal.
- On April 26, 2013, PPG/AECOM provided the email entitled *RE: Questions on Phase 2B-2 terminal elevation data set* (AECOM, 2013f), in response to Weston's April 25, 2013 email.
- On April 26, 2013, NJDEP/Weston provided comments on AECOM's April 18, 2013 Phase 2B-2 TEE submittal via the email entitled *Preliminary Target Elevations for GAG Phase 2B-2 TEP, and Phase 2B TEP Comments* (Weston, 2013g). This email provided comments on the April 18, 2013 Phase 2B-2 TEE submittal (AECOM, 2013d) and the Phase 2B-1 TEP submittal (AECOM, 2013c), despite the subject line indicating comments on other submittals.
- On June 19, 2013, PPG/AECOM provided the email entitled *RE: Preliminary Target Elevations for GAG Phase 2B-2 TEP, and Phase 2B TEP Comments* (AECOM, 2013g), in response to NJDEP/Weston's April 26, 2013 comments.

Phase 2B-3 and Phase 2B-4

- On July 8, 2013, PPG/AECOM submitted the memorandum entitled *PPG Site 114, Excavation Depths in Phases 2B-3 and 2B-4* (AECOM, 2013h).
- On July 24, 2013, NJDEP/Weston provided comments via email (Weston, 2013h) on AECOM's July 8, 2013 memorandum.
- On September 10, 2013, PPG/AECOM submitted the memorandum entitled *Response to Weston's 7/24/13 Comments on "PPG Site 114 Excavation Depths in Phase 2B-3 & 2B-4, Priority Grids,"* dated September 6, 2013 (AECOM, 2013j).
- On September 27, 2013, PPG/AECOM submitted the memorandum entitled *PPG Site 114, Excavation Depths in Phases 2B-3* (AECOM, 2013l).
- On October 11, 2013, NJDEP/Weston provided comments via the email entitled *Excavation Depths in Phases 2B-3 and 2B-4* (Weston, 2013j) on AECOM's September 6, 2013 memorandum.
- On October 11, 2013, NJDEP/Weston provided comments via the email entitled *RE: Phase 2B-3 Supplemental Excavation Depth Submittal* (Weston, 2013k) on AECOM's September 27, 2013 memorandum.
- On November 7, 2013, PPG/AECOM provided the email entitled *Phase 2B-3/2B-4 Excavation Depths* (AECOM, 2013n), documenting acceptance of NJDEP/Weston's October 11, 2013 comments (Weston, 2013j; Weston, 2013k).

IRM #1 Western Sliver

- On January 30, 2014, PPG/AECOM submitted the memorandum entitled *PPG Site 114, Terminal Excavation Elevations in the Western Sliver* (AECOM, 2014c).
- On February 4, 2014, NJDEP/Weston provided comments (Weston, 2014a) on AECOM's January 30, 2014 memorandum.
- On February 10, 2014, PPG/AECOM submitted the memorandum entitled *PPG Site 114, Western Sliver Remediation Plan (Revision 1)* (AECOM, 2014d), which combined the *PPG Site 114, Western Sliver Remediation Plan* (AECOM, 2014a) and the *PPG Site 114, Terminal Excavation Elevations in the Western Sliver* (AECOM, 2014c) and addressed NJDEP/Weston comments.

IRM #1 Northwest Grids

- On February 18, 2014, PPG/AECOM submitted the memorandum entitled *PPG Site 114, Terminal Excavation Elevations in the Northwest Corner of IRM #1*, dated February 14, 2018 (AECOM, 2014e).
- On March 10, 2014, PPG/AECOM submitted the memorandum entitled *PPG Site 114, Terminal Excavation Elevations in the Northwest Corner of IRM #1 (Revision 1)* (AECOM, 2014f), which addressed verbal comments received from Weston, on behalf of NJDEP, on February 25, 2014.
- On May 7, 2014, NJDEP/Weston issued concurrence via email (Weston, 2014c).

4.2.2 Technical Execution Plan and Remediation Plans

The TEPs and remediation plans for Phase 1, Phase 2B, and the Western Sliver and Northwest Grids portions of IRM #1 provided more detailed information on the planned RA, including descriptions of the remediation activities and goals as well as depictions of the anticipated horizontal extent of excavation and shoring, and the post-excavation sampling approach. The TEP and remediation plan submittals for these portions of Site 114 are summarized below.

Site 114 Southwestern (SW) Area TEP

- On October 17, 2011, PPG/AECOM issued the *Technical Execution Plan; Southwestern Area Soil Excavation; PPG-Site 114 – Garfield Avenue; Jersey City, New Jersey* (SW Area TEP), dated October 14, 2011 (AECOM, 2011d).
- On November 4, 2011, ERFS, on behalf of the City of Jersey City, provided comments on the SW Area TEP (ERFS, 2011b).
- On November 17, 2011, NJDEP issued comments on the SW Area TEP (NJDEP, 2011b).
- On December 12, 2011, PPG/AECOM issued the *DRAFT Technical Execution Plan, Southwestern Area Soil Excavation, PPG Site 114 - Garfield Avenue, Jersey City, New Jersey* (AECOM, 2011f), which included responses to NJDEP's November 17, 2011 comments.
- On January 10, 2012, ERFS, on behalf of the City of Jersey City, provided comments on the December 12, 2011 SW Area TEP (ERFS, 2012a).
- On January 27, 2012, NJDEP issued the *Assessment of Adequacy of Response to NJDEP Comments on October 14, 2011 Technical Execution Plan; Southwestern Area Soil Excavation; PPG-Site 114 – Garfield Avenue; Jersey City, New Jersey* (NJDEP, 2012a).
- On March 9, 2012, PPG/AECOM issued the *Technical Execution Plan, Southwestern Area Soil Excavation; PPG Site114 – Garfield Avenue, Jersey City, New Jersey* (SW Area TEP) (AECOM, 2012b) and the Response to Comments reference table.
- On March 27, 2012, the NJDEP conditionally approved the SW Area TEP (NJDEP, 2012c).
- On April 23, 2012, PPG/AECOM submitted the *Final Technical Execution Plan, Southwestern Area Soil Excavation, PPG Site 114 – Garfield Avenue, Jersey City, New Jersey* (AECOM, 2012d).

Phase 1C TEP

- On August 30, 2012, PPG/AECOM issued the *Technical Execution Plan, Southwest TEP Addendum (Phase 1C Area Soil Excavation)* (Phase 1C TEP) (AECOM, 2012n).
- On October 19, 2012, NJDEP/Weston provided comments on the Phase 1C TEP via email (Weston, 2012j) (note that the email was forwarded to PPG by Brian McPeak of Planning Progress, LLC on October 22, 2012).
- On November 12, 2012, PPG/AECOM issued the *Technical Execution Plan (Rev.1), Southwest TEP Addendum (Phase 1C Area Soil Excavation), PPG Site 114 – Garfield Avenue, Jersey City, New Jersey* (Phase 1C TEP, Rev. 1) (AECOM, 2012u) and responded to the October 19, 2012 comments from NJDEP/Weston.
- On February 25, 2013, ERFS provided comments on the Phase 1C (light rail) shoring system (ERFS, 2013a).
- On February 4, 2013 NJDEP/Weston provided comments on the Phase 1C TEP, Rev. 1 via email (Weston, 2013d).
- On February 12, 2013, PPG/AECOM issued the *Technical Execution Plan (Rev 2) Southwest TEP Addendum (Phase 1C TEP) (Phase 1C Area Soil Excavation)* (AECOM, 2013b).
- On April 18, 2013, PPG/AECOM provided a response to the February 25, 2013 ERFS Comments on Phase 1C Baseline V&S Monitoring (AECOM, 2013e).

Phase 2B-1

- On March 7, 2013, PPG/AECOM issued the *Technical Execution Plan, Southwest TEP Addendum (Phase 2B-1 Area Soil Excavation)* (Phase 2B-1 TEP) (AECOM, 2013c).
- On March 29, 2013, ERFS provided comments on behalf of City of Jersey City via email entitled *AECOM draft TEP – Phase 2b-1* (ERFS, 2013b).
- On April 12, 2013, JM Sorge, Inc., on behalf of Hampshire Urban Renewal Redevelopment, LLC, provided comments via letter entitled *RE: Technical Execution Plan Southwest TEP Addendum (Phase 2B-1 Area Soil Excavation) PPG Site 114 - Garfield Avenue, Jersey City, New Jersey* (JM Sorge, Inc., 2013).
- On April 26, 2013, NJDEP/Weston provided comments on AECOM's March 7, 2013 Phase 2B-1 TEP via the email entitled *Preliminary Target Elevations for GAG Phase 2B-2 TEP, and Phase 2B TEP Comments* (Weston, 2013g). This email provided comments on the April 18, 2013 Phase 2B-2 TEE submittal (AECOM, 2013d) and the Phase 2B-1 TEP submittal (AECOM, 2013c), despite the subject line indicating comments on other submittals.
- On June 19, 2013, PPG/AECOM responded to Weston's April 26, 2013 comments on the Phase 2B-1 TEP via the email entitled *RE: Preliminary Target Elevations for GAG Phase 2B-2 TEP, and Phase 2B TEP Comments* (AECOM, 2013g). The comments and responses did not require a revision to the March 7, 2013 Phase 2B-1 TEP.

Phase 2B-2 through Phase 2B-4 TEP

- On September 17, 2013, PPG/AECOM issued the *Technical Execution Plan, Southwest TEP Addendum (Phase 2B-2 through 2B-4 Area Soil Excavation)* (Phase 2B-2 through 2B-4 TEP) (AECOM, 2013k).

- On October 18, 2013, NJDEP/Weston provided comments on the Phase 2B-2 through 2B-4 TEP via email (Weston, 2013l).
- On October 31, 2013, PPG/AECOM issued the *Technical Execution Plan (Rev. 1), Southwest TEP Addendum (Phase 2B-2 through 2B-4 Area Soil Excavation)* (AECOM, 2013m) and a response to comments via email.

IRM #1 Western Sliver

- On January 10, 2014, PPG/AECOM submitted the memorandum entitled *PPG Site 114, Western Sliver Remediation Plan* (AECOM, 2014a).
- On February 4, 2014, NJDEP/Weston provided comments on AECOM's January 10, 2014 submittal via email (Weston, 2014a).
- On February 10, 2014, PPG/AECOM submitted the memorandum entitled *PPG Site 114, Western Sliver Remediation Plan (Revision 1)* (AECOM, 2014d), which combined the *PPG Site 114, Western Sliver Remediation Plan* (AECOM, 2014a) and the *PPG Site 114, Terminal Excavation Elevations in the Western Sliver* (AECOM, 2014c) and addressed NJDEP/Weston comments.
- On April 1, 2014, PPG/AECOM submitted the memorandum entitled *PPG Site 114, Western Sliver Remediation Plan (Revision 2)* (AECOM, 2014g).
- On April 7, 2014, PPG/AECOM submitted supplemental information via email regarding the final excavation depth at Grid B8B (AECOM, 2014h).
- On April 11, 2014, NJDEP/Weston provided conditional concurrence via email (Weston, 2014b) of the *PPG Site 114, Western Sliver Remediation Plan (Revision 2)* (AECOM, 2014g), including determination of final excavation depths.

5.0 Description of the Remedial Action

The RA at Site 114 included the following activities: excavation of CCPW, CCPW-impacted soil, and MGP-impacted soil; off-site transport and disposal of affected soil; in-situ treatment; backfilling of the excavations including, in some areas, placement of an engineering control (Clean Fill Soil Cap); restoration of the affected areas; and implementation of institutional controls (deed notices). The implemented RA(s) for each AOC are listed in **Table 1-1**.

The RA was performed in accordance with the plans as described in **Section 4.1** including the NJDEP-conditionally-approved 2012 PPG RAWP (AECOM, 2012e), 2011 PSEG RAWP (AMEC, 2011), 2012 PSEG RAWP Addendum (AMEC, 2012), and the TEPs and TEE submittals, as described in **Section 4.2**.

As described in **Section 4.0**, excavation of Site 114 was conducted in phases to minimize re-contamination of placed clean fill, over-excavation, and relocation of support facilities. The Phases and dates of excavation as well as backfill activities are summarized in **Table 5-1**.

The RA for IRM #1, Phase 1, and Phase 2B of Site 114 was implemented by PPG, and the RA for Phase 2A was implemented by PSEG. As discussed in **Section 1.0**, the results of the RA in the Phase 2A area are included in this RAR; however, details of some aspects of implementation of those remedial activities will be provided in PSEG's Final RAR (Wood, pending submittal).

Additional remediation was conducted by PPG in AOC 114-1B (which is part of the Western Sliver) in accordance with the *PPG Garfield Avenue Group Sites, Remedial Action Workplan Addendum, Site 114 Western Sliver Remediation* (Arcadis, 2018), as approved by NJDEP (NJDEP, 2018a). Additional information is provided in **Section 5.4.2**.

Preparatory activities for the remediation of the GA Group Sites, overall, began in 2010 with obtaining regulatory permits and/or approvals to facilitate implementation of the RA. Mobilization and preparation for the RA of the GA Group Sites began in June 2010.

For IRM #1, Phase 1, and Phase 2B of Site 114, AECOM served as Construction Manager as Agent (CMAA) to manage and coordinate the work of multiple contractors hired by PPG to perform the required remedial construction and support work until December 9, 2013. Between December 9, 2013 and March 9, 2015, WCD Group, LLC of Pennington, NJ served as CMAA; subsequently, AECOM resumed the role of CMAA. In Phase 2A, construction oversight was performed by AMEC for PSEG. AMEC was acquired by the Wood Group in 2017.

For IRM #1, Phase 1, and Phase 2B of Site 114, AECOM coordinated the air monitoring at Site 114 during demolition and excavation activities, in accordance with the December 2010 revision of the *Air Monitoring Workplan for Ground Intrusive Activities at the Garfield Avenue Site in Jersey City, New Jersey* (AMP) and AMP Amendments (01, 02, 04, 06, 11, and 16) (AECOM, 2010h). During the IRM #1 work, air monitoring technicians from EAI, Inc. of Jersey City, NJ operated, maintained, and collected air samples in accordance with the AMP. For subsequent phases, AECOM performed the air monitoring. For Phase 2A, the air monitoring was conducted by AMEC on behalf of PSEG during field work activities in accordance with the same AMP.

For IRM #1, Phase 1, and Phase 2B of Site 114, ENTACT Environmental Services of Latrobe, Pennsylvania (ENTACT) performed the remedial construction activities. These services consisted of coordination and disconnection of utilities, excavation and backfilling, decontamination, demolition, dewatering, and Site restoration. For Phase 2A, Creamer Environmental, Incorporated (CEI) of Cedar Grove, NJ performed the remedial construction activities, with oversight conducted by AMEC on behalf of PSEG.

For IRM #1, Phase 1, and Phase 2B of Site 114, WTS Transportation Services, LLC coordinated transportation and disposal of the waste streams generated from the RA activities. PSEG used J. Fletcher Creamer & Son, Inc. to coordinate the transportation and disposal of the waste streams from the RA activities at Phase 2A. In addition, soil in Phase 2B contaminated only with MGP-related contaminants were disposed of by PSEG as MGP waste. For IRM #1, Phase 1, and Phase 2B of Site 114, initially Groundwater and Environmental Services, Inc. of Wall, NJ provided operation and maintenance, inspections, and support of the seep/sump system used to handle surface water runoff, storm water, and groundwater entering the excavation and decontamination water during RA activities. Following installation and startup of the groundwater treatment system in 2012, ProAct Services Corporation of Bordentown, NJ (formerly Acqua Bella, Inc.) managed the treatment of water generated during remedial activities and operation of the groundwater treatment system for PPG. WTS Transportation Services, LLC arranged for off-site liquid waste shipments primarily from the sump system handing groundwater. See **Section 7.4** for details on waste disposal. For Phase 2A, PSEG operated a separate groundwater treatment system.

For IRM #1, Phase 1, and Phase 2B of Site 114, SGS Environmental Drilling of West Creek, NJ was the primary licensed well driller who installed and decommissioned wells during the RA. B & B Drilling Inc., Morris, NJ and East Coast Drilling, Inc., Moorestown, NJ also installed and/or decommissioned wells for PPG. For Phase 2A, Zebra Environmental was the licensed well driller used by PSEG.

The following sections summarize the RA activities as implemented.

5.1 Pre-Construction Activities

The following activities were conducted prior to starting excavation of CCPW and CCPW-impacted soil:

- Obtaining access agreement from property owners.
- Approval of permit applications and plans submitted to the state and local agencies.
- Implementation of a Soil Erosion and Sediment Control Plan (SESCP).
- Implementation of the AMP.
- Development of a site-specific Health and Safety Plan (HASP).
- Site utility clearance activities.
- Abandonment of monitoring wells located within the extent of excavation.
- Mobilization of equipment and set up of temporary facilities.
- Establishment of work zones.
- Installation of excavation shoring.

The necessary permits were obtained from and approved by the state, local, and county agencies prior to initiation of activities covered by the permits, as detailed in **Section 7.6**. For IRM #1, Phase 1, and Phase 2B of Site 114, necessary permits and approvals are documented in **Appendix B**. Phase 2A permits and approvals will be included in PSEG's Final RAR (Wood, pending submittal).

Access agreements were obtained from the Site property owners, JCRA and 900 Garfield Avenue, LLC.

Pre-construction activities included mobilization and set up of temporary facilities, removal of guard rails, placement of Jersey barriers and temporary fencing, implementation of the SESCP, establishment of work zones, utility clearance, clearing vegetation, removal of debris (garbage), and slab demolition. Note that the on-site buildings were demolished in 2002 and are not considered part of the remedial action.

The erosion and sediment controls consisted primarily of the placement of hay bales to contain soil that was potentially displaced during remedial activities. Hay bales were placed in areas where contractors were actively working at the Site and were relocated throughout the remediation activities, as needed, in accordance with the SESCP. Hay bales were installed along the downgradient perimeter of the Site.

The AMP was developed to provide specific procedures for measuring, documenting, and responding to potential airborne impacts during remedial activities at the Site. The AMP was approved by NJDEP prior to the initiation of work.

A HASP was developed for the RA at the GA Group Sites (including IRM #1, Phase 1, and Phase 2B of Site 114) in accordance with the Occupational Safety and Health Act (OSHA) 1910.120. The HASP documents policies and procedures to be followed to protect workers and the public from potential hazards posed at the GA Group Sites. The HASP includes training program protocols, a medical surveillance program, equipment maintenance programs, personal hygiene practices, a project air monitoring plan, a dust control plan, and other information. The Phase 2A HASP, developed by CEI, specified the health and safety procedures and equipment required for those RA work activities to minimize the potential for exposure to field personnel and the community, including site control measures, engineering controls and work practices, air monitoring procedures, decontamination and residuals management procedures, and emergency response information.

In addition to contacting the New Jersey One-Call system, a utility survey was conducted prior to undertaking intrusive Site activities. For IRM #1, Phase 1, and Phase 2B of Site 114, the private utility line locating firms TPI Environmental, Inc. and Enviroscan, Inc. of Lancaster, Pennsylvania performed a geophysical survey to mark underground utilities (gas, sewer, water, phone, cable, electrical, etc.) that existed within the proposed excavation area. Details on utility clearance in Phase 2A will be included in PSEG's Final RAR (Wood, pending submittal).

Appendix C provides information on wells (including monitoring wells, piezometers, gauging wells, and extractions wells) decommissioned prior to and during the remedial activities.

There are three groups of wells presented in **Appendix C**: (1) wells decommissioned prior to the start of remedial activities where documentation was previously submitted to NJDEP; (2) previously-existing wells decommissioned as part of the remedial activities; and (3) wells installed and decommissioned as part of the remedial activities. Monitoring wells listed in **Appendix C** were properly decommissioned by New Jersey-licensed well drillers in accordance with the NJDEP's *Well*

Construction and Maintenance; Sealing of Abandoned Wells (N.J.A.C. 7:9D) (NJDEP, 2001), unless otherwise noted.

The wells abandoned prior to the remediation were documented in a 2010 letter report to the Site Administrator (AECOM, 2010c) and are provided in **Appendix C-1**. The wells that were previously-existing and that were abandoned as part of the remedial activities are provided in **Appendix C-2**. This appendix contains a list of these wells and the well decommissioning records. Wells that were installed and decommissioned as part of the remedial activities are listed in **Appendix C-3.** This appendix contains a list of these wells and copies of the applicable well permits and decommissioning records for each of the wells. During excavation activities there were six wells that were not formally decommissioned. Based on field observations, these wells are believed to have been removed/damaged beyond repair during soil remediation activities (i.e., excavation and restoration). In accordance with NJDEP's *Well Construction and Maintenance; Sealing of Abandoned Wells* Subchapter 3 (N.J.A.C. 7:9D) (NJDEP, 2001), alternate decommissioning reports were requested via submission of a Memorandum to the Bureau of Water Allocation and Well Permitting. The Memorandum entitled *Request for Alternate Well Decommissioning Reports – Garfield Avenue Group Sites* (AECOM, 2019c) is included as **Appendix C-4**.

Equipment was delivered during the initial mobilization phase for the RA activities at the GA Group Sites and on an as-needed basis as work progressed. Temporary facilities including field office trailers, sanitary facilities, and Conex/intermodal boxes for equipment storage were mobilized onto Site 114 and set up for use during the RAs. As remediation progressed, some support trailers were relocated, as necessary, to improve logistics.

Work zones were established to exclude unauthorized personnel from entering IRM #1, Phase 1, and Phase 2B of Site 114, and to prevent contamination from being tracked off site or into clean work zones. The following work zones were established:

- A Secure Zone was established to exclude unauthorized personnel from entering the Site. The Secure Zone consisted of a steel chain-link fence and locking gates. Warning signs were placed on the fence to prevent unauthorized entry into work areas.
- A Support Zone was established to stage office trailers, sanitary facilities, and Conex/intermodal storage boxes, and to provide for vehicle parking.
- An Exclusion Zone encompassed areas associated with impacted material and/or heavy equipment hazards. Temporary fencing was installed to isolate the exclusion zones and modified Level D personal protective equipment (PPE), including Tyvek, was required during work in the exclusion zone.
- A Contamination Reduction Zone and a truck decontamination pad were constructed for transition from the Exclusion Zone. The Contaminant Reduction Zone prevented the track-out of sediment onto off-Site streets, other paved areas, and onto sidewalks from vehicles and personnel exiting the Site.

In Phase 2A (PSEG, 2015), site control measures included the establishment of:

- Support zones for field offices with a physical barrier to work zone;
- Work zones defined by areas of the Site where active construction activities were performed; and

- A Contaminant Reduction Zone to provide a decontamination and PPE upgrade/downgrade passage way between exclusion zones and work zones.

Prior to the RA, in the 1960s, the above-grade structures associated with the chromite ore processing facility and the MGP were removed. The remaining foundations were buried, raising the ground surface elevation by several feet, and three warehouse structures were constructed on the property in the late 1960s. These warehouses were demolished down to the concrete floor slabs between August and December 2002. Information pertaining to the demolition of Site 114 buildings was previously submitted in the March 2011 RIWP (AECOM, 2011b).

The warehouse concrete floor stabs and foundations remained on the property and covered an area of approximately 5.2 acres. The 900 Garfield Avenue slab was removed as part of the IRM #1 RA. The slabs of two of the former warehouses at 880 Garfield Avenue and 2 Dakota Street were removed as part of the RA under the SW TEP (AECOM, 2012d) and the Phase 2B-1 TEP (AECOM, 2013c), respectively.

Shoring was installed around the perimeter of Site 114 and along some internal Phase boundaries to facilitate implementation of remedial soil excavation. Sheet pile varied in depth depending on the required depth of excavation and proximity to features that needed to be protected. Sheet pile was installed in the various phases as described below.

- IRM #1 sheet pile was installed in July and August 2010 on the western portion of IRM #1 (near Garfield Avenue) and on the eastern portion of IRM #1 (near Morris Canal) to facilitate IRM #1 excavation. Along Garfield Avenue, the sheet pile was offset 5 to 10 ft from the property line in order to streamline the start of work. The remaining portion of IRM #1 located between the sheet pile and Garfield Avenue is known as the Western Sliver. Sheet pile on the remainder of the perimeter of IRM #1 was installed to facilitate excavation in subsequent phases of work.
- Phase 1A sheet pile was installed in January and February 2012 along the Former Morris Canal. The sheet pile along the of the eastern IRM #1 perimeter was removed and reinstalled approximately 40 ft west of the original location to facilitate deeper excavation in Phase 1A.
- In Phase 1B and 1C, pre-trenching and sheet pile installation along Carteret Avenue and Garfield Avenue began in February 2012. Sheet pile was also installed along the Phase 1/Phase 2 boundary.
- Phase 2A sheet pile was installed by PSEG's contractor around the perimeter of Phase 2A from November 2012 to December 2012.
- Phase 1C sheet pile installation along the NJ Transit Light Rail began in April 2013, but was stopped on April 29, 2013 due to settlement of the Light Rail embankment associated with exceedances of the vibration and settlement limits caused by sheet pile installation. A redesign of the sheet pile was submitted on August 2, 2013 that shifted the alignment from approximately 10 ft north of Site 114 to the property line and added installation of temporary sheet pile with bracing approximately 30 ft south of the permanent sheet pile. Following stakeholder acceptance of the redesign of the sheet pile, permanent alignment installation resumed on September 9, 2013 using an alternate sheet pile installation method designed to minimize vibration. Sheet pile installation along the NJ Transit Light Rail right-of-way (ROW) was completed on October 4, 2013.
- Phase 2 sheet pile was installed along Carteret Avenue, Halladay Street North, Forrest Street, and along the Phase 1/Phase 2 Boundary from May 2013 to July 2014. This sheet pile, on the eastern side of the Former Morris Canal, was driven to 50 ft bgs or deeper in

order to prevent migration of MGP-related material and to allow deeper excavation. Details of the Phase 2 sheet pile will be documented in PSEG's Final RAR (Wood, pending submittal).

- In Phase 2B-1, a temporary sheet pile wall was installed near the northern boundary of Phase 2B-1 in April 2013, and remedial soil excavation commenced on May 23, 2013. The temporary sheet pile wall was installed to allow for remedial soil excavation to continue while the final sheet pile wall, located along the property line, was designed.
- For the Western Sliver and Northwest Grids, sheet pile was later removed and reinstalled installed along the Garfield Avenue property line in June 2014 to facilitate deep excavation in Grids A8B, B8B, and B9B, and around the western portion of the Northwest Grids in Grids B8B and B9B.

5.2 Soil Excavation

This section discusses the soil excavation and management methods used primarily for the portion of the RA implemented by PPG in IRM #1, Phase 1, and Phase 2B. The Phase 2A soil excavation will be further discussed in PSEG's Final RAR (Wood, pending submittal).

In accordance with the Site 114 planning documents (as described in **Section 4.0**), the soil in IRM #1, Phase 1, and Phase 2B was excavated in 30-ft by 30-ft grid cells. The Phases in Site 114 included the following grid rows and columns, as shown on **Figure 1-2** for Site 114 overall, and for each phase, as shown in the following appendices:

- IRM #1: **Appendix D-1**, Grid Rows A through J (extending west to east) and Grid Columns 1B through Grid 9B (extending from south to north);
- Phase 1A: **Appendix D-2**, Grid Rows J through M (extending west to east) and Grid Columns 1B through 9B (extending from south to north);
- Phase 1B: **Appendix D-3**, Grid Rows A' through M (extending west to east) and Grid Columns 13A through 1B (extending from south to north);
- Phase 1C: **Appendix D-4**, Grid Rows B through M (extending west to east) and Grid Columns 9B through 14B (extending from south to north);
- Phase 2A: **Appendix D-5**, Grid Rows W through HH (extending west to east) and Grid Columns 7A through 10B (extending from south to north);
- Phase 2B-1: **Appendix D-6**, Grid Rows M through V (extending west to east) and Grid Columns 0 through 15B (extending from south to north);
- Phase 2B-2: **Appendix D-7**, Grid Rows W through AA (extending west to east) and Grid Columns 0 through 11B (extending from south to north);
- Phase 2B-3: **Appendix D-8**, Grid Rows L through S (extending west to east) and Grid Columns 16A through 1A (extending from south to north); and
- Phase 2B-4: **Appendix D-9**, Grid Rows T through CC (extending west to east) and Grid Columns 18A through 1A (extending from south to north).

Each grid was excavated to meadow mat or to a target depth. Soil analytical results from the RI soil boring and test pitting program and the PDI soil boring program were used to determine the planned depths of the excavation. See **Section 2.0** for further information regarding the RI and **Section 4.0** for further information regarding the PDI activities, planned TEEs, and TEPs.

RA activities at Site 114 started with the IRM #1 area and progressed to Phase 1A, Phase 1B, Phase 2A, Phase 1C, and Phase 2B in chronological order, although some activities overlapped between the Phases and some grids were returned to and re-excavated at later dates (**Table 5-1**). This progression of work minimized re-contamination of placed clean fill, over-excavation, and relocation of support facilities. Excavation in IRM #1, Phase 1A, Phase 1B, Phase 1C, and Phase 2B was performed by ENTACT utilizing an excavator. At Phase 2A, excavation was conducted by CEI.

AECOM implemented dust control measures at IRM #1, Phase 1, and Phase 2B at Site 114, in accordance with the Dust Control Plan (DCP) and applicable DCP Amendments, during excavation, stockpiling, transportation, backfilling, and associated activities during the RA. Results of the air monitoring and sampling during the Site 114 activities were documented as part of the activities associated with the larger scale GA Group Sites, available on the Chromium Cleanup Website (http://www.chromiumcleanup.com/, last accessed in December 2018) in the form of Monthly/Annual Reports and Event Documentation Reports. The concentrations and the short-duration metrics demonstrated that the dust control measures were effective at maintaining Cr^{+6} in dust at concentrations less than the Acceptable Ambient Concentration (AAC). Information on Phase 2A dust control measures will be provided in PSEG's Final RAR (Wood, pending submittal).

During IRM #1, Borbas Surveying & Mapping, LLC of Boonton, NJ provided surveying services to verify excavation depths. In Phase 1 and Phase 2B, ENTACT verified vertical excavation extents using global positioning system (GPS) survey equipment to document that proposed excavation depths were achieved. For Phase 2A, PSEG contracted Louis J. Weber & Associates, Inc. as the surveyor of record.

In IRM #1, Phase 1, and Phase 2B of Site 114, once the excavation limits were met to the targeted depths within each grid cell, a representative from Weston and/or an AECOM geologist inspected the completed excavation for visible CCPW. If visible CCPW was noted, excavation would continue in half-foot increments until inspection revealed that there was no CCPW present. Post-excavation samples were collected, if required, to document compliance in accordance with the Chromium Policy (NJDEP, 2007) and the Method to Determine Compliance (NJDEP, 2012i and NJDEP, 2013b). In Phase 2A, soil was excavated to 20 to 30 feet bgs. Post-excavation samples were collected, if required, to document compliance in accordance with the Chromium Policy (NJDEP, 2007) and the Method to Determine Compliance (NJDEP, 2012i and NJDEP, 2013b). For non-CCPW parameters, post-excavation samples were collected to characterize the soil contamination remaining after excavation (and addressed by engineering and institutional controls). The grid layout of Site 114 and the final as-built TEEs are shown on the figures in **Appendix D**, as listed above.

For IRM #1, Phase 1, and Phase 2B of Site 114, excavated materials were live-loaded into lined dump trucks where required. Some excavated materials were stockpiled and managed in accordance with the Stockpile Management Plan in the *Final Interim Remedial Measures Work Plan #1, 900 Garfield Avenue - PPG Site 114* (AECOM, 2010e) and the *Soil and Stockpile Management Plan for the Garfield Avenue Group Sites*, included in the PPG RAWP (see **Section 4.1.1** for the PPG RAWP submittal history). The stockpiles were located on un-remediated portions of the Site. Since the stockpile locations were to undergo excavation as part of a subsequent phase of work, post-removal soil samples were not collected from below the stockpiles. During times when excavation was progressing, but trucks were not on site, day piles were created in areas that had not yet been remediated, adjacent to or within the excavation. The ground surface was pitched so that liquid that may have drained out of the soil returned into the excavation prior to its transport for off-site disposal (see **Section 7.4** on waste generation and disposal). The Stockpile Management Plans were amended by various Field Change Notifications (**Table 5-2**). In Phase 2A, stockpiles were managed in accordance with the PSEG RAWP (see **Section 4.1.2** for the PSEG RAWP submittal history).

For IRM #1, Phase 1, and Phase 2B of Site 114, initially surface water runoff, storm water, groundwater entering the excavation, and decontamination water were transferred using pumps to convey the water into closed-top fixed-axle storage (frac) tanks or Modutanks. After receiving analytical results for the water in the frac tanks or Modutanks, WTS Transportation Services, LLC coordinated the transportation and disposal of the water. Following the design and installation of PPG's GA Group Sites groundwater treatment plant in 2012, water was diverted to the plant for pre-treatment. Discharges were conveyed through Jersey City Municipal Utilities Authority (JCMUA)-owned sewers and pump station to Passaic Valley Sewerage Commission (PVSC) for final treatment and discharge to the Upper New York Bay (**Appendix B** contains the sewer use permit). For Phase 2A, PSEG operated a separate groundwater treatment system.

5.2.1 Western Sliver

The Western Sliver is the 5- to 10-foot wide strip of land located between the sheet pile for IRM #1 and the Site 114 property line along Garfield Avenue, which was not excavated during the initial IRM #1 excavation. Sheet pile was installed 5 to 10 ft to the east of the Site 114 property line along Garfield Avenue in order to avoid the Jersey City ROW for Garfield Avenue, thereby expediting the start of the IRM #1 excavation.

The Western Sliver was planned to be excavated to the same elevation of the clean confirmation samples in adjacent IRM #1 grids, which were excavated to the depth of the meadow mat as part of the initial IRM #1 activities. Some of these grids (Grids A1B, A2B, A3B, A4B, A5B, A6B, A7B, and B7B) were excavated to undisturbed native deposits, but to depths shallower than the clean confirmation samples collected from the adjacent IRM #1 grids. Excavation and backfill dates are provided in **Table 5-1**.

Samples were collected in May 2017 (via soil boring) to document the soil conditions at the as-built TEEs within the Western Sliver. The concentrations of Cr^{+6} in the soil samples from May 2017 were in compliance with the Method to Determine Compliance, with the exception of samples in Grids A6B and A7B/B7B. These samples are included on the tables and figures in **Appendix D-1**.

Soil in Grids A6B and A7B/B7B where the concentrations of Cr^{+6} in soil samples did not meet the Chromium Policy (per the Method to Determine Compliance) are being addressed as AOC 114-1B, as discussed in **Section 5.4.2**.

5.2.2 Northwest Grids

The Northwest Grids (Grids B8B, B9B, and C8B) in the northwest corner of IRM #1 required re-excavation because the work was originally conducted under the June 2010 *Final Interim Remedial Measures Work Plan #1* (AECOM, 2010e) and the remedial objectives were revised under the PPG RAWP. The remedial objectives of the IRM #1 Work Plan, which required source removal, were revised in the PPG RAWP to include excavation of soil with concentrations of Cr^{+6} greater than the CrSCC and removal of accessible impacted soil at depths less than 20 ft bgs and above the meadow mat where the meadow mat was at least one foot thick. The goals established for the PPG RAWP required re-excavation to remove some of the impacted meadow mat where concentrations were greater than 20 mg/kg and the meadow mat was thicker than 1 foot. Clean samples collected during the subsequent PDI determined the new TEEs for these grids. After sheet pile installation was completed around Northwest Grids B8B and C8B, ENTACT began re-excavating Grids B8B, B9B, and C8B to the TEEs. A clean excavation bottom was encountered at the pre-determined TEEs in the three grids; post-excavation confirmatory samples were not required. Excavation and backfill dates are provided in **Table 5-1**.

5.3 UST Excavation and Removal

Four underground storage tanks (USTs) were discovered on Site 114 during CCPW remedial excavation activities. Two USTs were located in IRM #1 (AOC 114-4A) and two were located in Phase 1B (AOC 114-4B). Applicable closure documentation for the USTs is provided in **Appendix E**.

5.3.1 AOC 114-4A: UST- impacted Soil in Site 114

In 2010 to 2011, two USTs were discovered in Grid B1B and Grids E3B/E4B of IRM #1: a 2,000-gallon UST (Tank No. 0001) and a 1,000-gallon UST (Tank No. 0002), respectively. The Notice of Intent (TMS # N11-7757, Facility # 554479) for Tank Nos. 0001 and 0002 was filed with the NJDEP on May 10, 2011.

The USTs were buried in the fill material and did not appear to be associated with nearby buildings or structures. UST closure activities were conducted on June 2, 2012 by NJDEP-certified UST Contractor ARECON Ltd. (Certification No. US00025). The USTs were removed from the excavation area and staged on site, while excavation activities continued to the full extent (to the required TEE for CCPW remediation) for IRM #1 remediation on Site 114. Tank conditions were documented in the ARECON Ltd. closure report included in **Appendix E**. The tanks were cleaned, cut up, and disposed of off site. Liquid and sludge associated with the tanks were drummed for off-site disposal. Waste management was conducted in conjunction with site-wide waste disposal as described in **Section 7.4**. Each grid was over-excavated below the tank inverts as part of the CCPW remediation.

Sampling and disposal of the USTs was managed in conjunction with active remediation excavation activities in IRM#1 at Site 114. In lieu of sampling in accordance with the *Technical Guidance for Investigation of Underground Storage Tank Systems* (NJDEP, 2012f), post-excavation samples were collected from the bottom of the excavation within each 30-ft by 30-ft grid in accordance with the PPG RAWP.

5.3.2 AOC 114-4B: UST-impacted Soil in Site 114

A 2,000-gallon UST (Tank 0004) was discovered in Grid B10A in Phase 1B on August 1, 2012. During the week of November 12, 2012, a 500-gallon UST (Tank No. 0003) was uncovered in Grid G1A in Phase 1B. The Notice of Intent (TMS# N13-8760, Facility # 554479) for Tank Nos. 0003 and 0004 was filed on January 22, 2013. Since the Site was already under NJDEP Direct Oversight and the tanks were not in use and were discovered as part of buried debris/fill, it was later determined that the tanks did not need to be processed through the LSRP Program. The NJDEP approval to remove the USTs as part of the remediation activities was provided in an email dated December 7, 2012 (in **Appendix E)**.

UST closure activities were conducted on December 7, 2012 and December 12, 2012 by NJDEP-certified UST Contractor ARECON Ltd. (Certification No. US00025). Tank conditions were documented in the ARECON Ltd. closure report included in **Appendix E**. The tanks were cleaned, cut up and disposed of off site. Liquid and sludge associated with the tanks were drummed for off-site disposal. Waste management was conducted in conjunction with site-wide waste disposal as described in **Section 7.4**. Each grid was over-excavated below the tank inverts as part of the CCPW remediation.

Sampling and disposal of the USTs was managed in conjunction with active remediation excavation activities in Phase 1B at Site 114. In lieu of sampling in accordance with the *Technical Guidance for Investigation of Underground Storage Tank Systems* (NJDEP, 2012f), post-excavation samples were

collected from the bottom of the excavation within each 30-ft by 30-ft grid in accordance with the PPG RAWP.

5.4 Confirmation Soil Samples

The data for locations within the Site 114 boundary that have samples remaining in place are provided as indicated below. In addition, locations from outside the Site 114 boundary and/or removed samples may be included in these tables and figures to demonstrate compliance with the RA objectives.

- IRM #1: **Appendix D-1**, Tables 5-1 to 5-8 and Figures 5-1 to 5-8;
- Phase 1A: **Appendix D-2**, Tables 5-1 to 5-7 and Figures 5-1 to 5-7;
- Phase 1B: **Appendix D-3**, Tables 5-1 to 5-8 and Figures 5-1 to 5-8;
- Phase 1C: **Appendix D-4**, Tables 5-1 to 5-6 and Figures 5-1 to 5-6;
- Phase 2A: **Appendix D-5**, Tables 5-1 to 5-7 and Figures 5-1 to 5-7;
- Phase 2B-1: **Appendix D-6**, Tables 5-1 to 5-8 and Figures 5-1 to 5-8;
- Phase 2B-2: **Appendix D-7**, Tables 5-1 to 5-6 and Figures 5-1 to 5-6;
- Phase 2B-3: **Appendix D-8**, Tables 5-1 to 5-7 and Figures 5-1 to 5-7; and
- Phase 2B-4: **Appendix D-9**, Tables 5-1 to 5-7 and Figures 5-1 to 5-7.

Laboratory analytical reports and data validation reports for the data presented in these tables and figures are included in **Appendices F** and **G**, respectively. The laboratory electronic data deliverables (EDDs) passed submission and have been logged into the NJDEP database, as documented in **Appendix F**.

5.4.1 AOC 114-1A: CCPW-Impacted Soil in Site 114

To demonstrate compliance with the remediation objectives for AOC 114-1A, during the course of RA activities, post-excavation pit bottom samples were collected, if required, to document compliance with the Chromium Policy (NJDEP, 2007) in accordance with the Method to Determine Compliance (NJDEP, 2012i and NJDEP, 2013b). No post-excavation sidewall samples were collected at Site 114 because the sidewalls were bounded by other excavation grids or sheet pile.

For IRM #1, Phase 1, and Phase 2B of Site 114, where the excavation was expanded to remove visible CCPW beyond the original proposed excavation extents, either post-excavation samples or samples from soil borings prior to excavation (i.e., pre-excavation sampling) were used as confirmation samples. In addition, the areas were visually inspected by the Site Administrator's independent technical consultant, Weston, and/or an AECOM geologist to confirm that the excavation bottom and sidewalls were free of visible CCPW.

The post-excavation/confirmation samples for Site 114 were analyzed for:

- Cr^{+6} using United States Environmental Protection Agency (USEPA) SW-846 Method 3060A digestion and USEPA SW-846 Method 7196A, as modified by NJDEP;
- pH using USEPA SW-846 Method 9045C, D;
- Redox Potential using ASTM International Method D1498-76M; and

- Total chromium, antimony, nickel, thallium, and vanadium using USEPA SW-846 Method 6010C (in 10% of selected samples only per the PPG RAWP [see **Section 4.1.1** for the PPG RAWP submittal history) and Field Change Notification SWTEP 1 discussed in **Section 5.8**). Prior to May 2012, all confirmation samples were analyzed for total chromium.

Additional excavation (re-dig) was completed where the concentrations of Cr^{+6} in post-excavation soil samples exceeded the CrSCC (see **Section 3.0**) or where CCPW was identified. Typically, the full 30-ft by 30-ft grid was excavated to remove the CrSCC exceedance or CCPW. However, in some cases, grids were excavated to multiple elevations (split grids) with NJDEP/Weston approval.

5.4.1.1 *IRM #1, Grid D4B*

In Grid D4B, the clean confirmation sample collected from the pit bottom at 114-D4B (El. -3.4 to -3.9 ft NAVD88) during remedial excavation on December 17, 2010 was rejected during the data validation process. The non-detect hexavalent chromium result was rejected due to extremely low matrix spike percent recovery, as discussed in the data validation report for SDG JA64477 included in **Appendix G**. Given that the pit bottom sample was rejected, a replacement sample from El. -3.3 to -3.7 ft NAVD88 at 114-D4B-17BR was subsequently collected in May 2017 (from saturated soil via soil boring) to confirm that the remedial objectives were achieved in this grid. The Cr^{+6} concentration in this sample was greater than the CrSCC (20 mg/kg); however, this concentration (34.5 J mg/kg) is attributed to impacted groundwater. An RA design is underway to address groundwater remediation. No further soil remediation or sampling is warranted for this grid.

5.4.2 AOC 114-1B: CCPW-Impacted Soil in Portions of Grids A5B, A6B, A7B, and B7B within the Western Sliver

As discussed in **Section 5.2.1**, the results for the May 2017 samples in Grids A6B and A7B/B7B exceeded the CrSCC. The nearest clean sample in Row A is located in Grid A5B; therefore, AOC 114-1B was defined as CCPW-impacted soil in portions of Grids A5B, A6B, A7B, and B7B not fully remediated by excavation. Additional remediation (via in-situ treatment) in AOC 114-1B was conducted by PPG under the *PPG Garfield Avenue Group Sites, Remedial Action Workplan Addendum, Site 114 Western Sliver Remediation* (Arcadis, 2018), as approved by NJDEP (NJDEP, 2018a). Results were reported in the Western Sliver Post-Injection Sampling Results Memorandum (AECOM, 2019b). NJDEP, the City of Jersey City, Hampshire Group, and PPG conceptually agree with the proposed approach of putting the Western Sliver into an easement that encompasses the future eastern edge of the Garfield Avenue right-of-way, as defined in the Canal Crossing Redevelopment Plan. The Cr^{+6} impacts remaining in place within the Western Sliver could then be addressed with the contiguous impacts remaining in Garfield Avenue, in accordance with the *Remedial Action Work Plan (Soil) – Garfield Avenue Roadway* (AECOM, 2019a). Documentation of remediation for AOC 114-1B would be reported in the forthcoming Garfield Avenue Roadway RAR.

5.4.3 AOC 114-2: MGP-Impacted Soil Associated with the Former MGP in the Eastern Portion of Site 114

In AOC 114-2, confirmation samples were collected at a frequency of one bottom sample per 3,500 square ft. These samples were not intended to demonstrate compliance with the SRS, but to characterize the soil contamination that remains after excavation for CCPW and CCPW-related constituents was completed. No sidewall samples were collected because AOC 114-2 grids were surrounded by sheet pile or other grids requiring excavation. Confirmation samples were analyzed for:

- VOCs using USEPA SW-846 Method SW8260;
- SVOCs using USEPA SW-846 Method SW8270; and

- Target Analyte List (TAL) metals using USEPA SW-846 Method 6010C.

5.4.4 AOC 114-3: Historic Fill Material in Soil in Site 114

During RI and PDI activities, the extent of historic fill was fully characterized at Site 114. VOCs, SVOCs, and non-CCPW metals were also analyzed for in 10% of the post-excavation/confirmation samples (as described in **Section 5.4.6**), which further characterized historic fill. Fill was identified horizontally to the Site 114 boundaries. Historic fill typically extended vertically from the ground surface to the native materials (approximately 20 ft bgs) in areas where the fill was not predominantly CCPW materials. The PPG RAWP did not require removal of all historic fill; therefore, no confirmation sampling was required for this AOC.

5.4.5 AOC 114-4A and AOC 114-4B: UST-Impacted Soil in Site 114

As described in **Section 5.3**, four USTs were discovered and removed during the course of excavation in IRM #1 and Phase 1B. Sampling and disposal of the USTs was managed in conjunction with active remediation excavation activities. In lieu of sampling at the frequency described in accordance with the *Technical Guidance for Investigation of Underground Storage Tank Systems* (NJDEP, 2012f), post-excavation samples were collected from the bottom of the excavation within each 30-ft by 30-ft grid in accordance with the PPG RAWP. Samples were analyzed for petroleum hydrocarbons plus contingency analysis in accordance with the requirements of N.J.A.C 7.26E Table 2-1 in effect at the time of sampling.

In Grid B1B (IRM #1), pit bottom sample 114-B1B-14B was collected from the 30-ft by 30-ft grid where the UST was discovered. The sample was analyzed for the following parameters:

- TPH-diesel range organics (DRO) and TPH- gasoline range organics (GRO) using USEPA SW-846 Method 8015;
- VOCs using USEPA SW-846 Method SW8260;
- SVOCs using USEPA SW-846 Method SW8270;
- TAL metals using USEPA SW-846 Method 6010C; and
- PCBs using USEPA SW-846 Method 8082.

In Grids E3B and E4B (IRM #1), post-excavation bit bottom samples 114-E3B_14.5B and 114-E4B_15B were collected from the two 30-ft by 30-ft grids adjacent to where the UST was discovered. The samples were analyzed for:

- EPH using the NJDEP EPH Method Revision 3;
- VOCs using USEPA SW-846 Method SW8260;
- SVOCs using USEPA SW-846 Method SW8270;
- Lead using USEPA SW-846 Method 6010C; and
- PCBs using USEPA SW-846 Method 8082.

An additional sample 114-F3B was collected from adjacent Grid F3B and analyzed for EPH using the NJDEP EPH Method Revision 3, providing additional supporting data for the UST removal in Grids E3B and E4B.

In Grids B10A and G1A (Phase 1B), post-excavation pit bottom samples 114-B10A-9.6-10.1 and 114-G1A-15.4-15.9 were collected within the 30-ft by 30-ft grid space where the USTs were discovered. The samples were analyzed for:

- EPH using the NJDEP EPH Method Revision 3;
- VOCs using USEPA SW-846 Method SW8260;
- SVOCs using USEPA SW-846 Method SW8270;
- TAL metals using USEPA SW-846 Method 6010C; and
- PCBs using USEPA SW-846 Method 8082.

5.4.6 AOC 114-5: Soil Impacted by Other Historical Operations and Land Use in Site 114

The other constituents for which PPG was responsible (non-CCPW metals, and select SVOCs and VOCs identified as parameters on Site 114) were analyzed for in 10% of the post-excavation/confirmation samples per the RAWP (see **Section 4.1.1** for the RAWP submittal history) and per Field Change Notification SWTEP 1 (see **Section 5.8**), as follows:

- VOCs using USEPA SW-846 Method SW8260 (in 10% of selected samples only);
- SVOCs using USEPA SW-846 Method SW8270 (in 10% of selected samples only); and
- TAL metals using USEPA SW-846 Method 6010C (in 10% of selected samples only).

In Grids C5A, A2A, DD3A, X6B, W11B, Y6B, and W7B where PCBs were detected at concentrations exceeding the SRS during the RI (**Section 2.1**), confirmation samples were collected at the final TEEs and analyzed for PCBs using USEPA SW-846 Method 8082.

In Grid B1B located in IRM #1, an empty drum encased in concrete was encountered during excavation. Post-excavation sample B1B was collected within the 30-ft by 30-ft grid space where the drum was encountered and analyzed for:

- TPH-DRO and TPH-GRO using USEPA SW-846 Method 8015;
- VOCs using USEPA SW-846 Method SW8260;
- SVOCs using USEPA SW-846 Method SW8270;
- TAL metals using USEPA SW-846 Method 6010C; and
- PCBs using USEPA SW-846 Method 8082.

In Grid D4B located in IRM #1, a 550-gallon tank, believed to be a former aboveground storage tank, was encountered during excavation. Post-excavation sample D4B was collected within the 30-ft by 30-ft grid space where the tank was encountered and analyzed for:

- TPH-DRO and TPH-GRO using USEPA SW-846 Method 8015;
- VOCs using USEPA SW-846 Method SW8260;
- SVOCs using USEPA SW-846 Method SW8270;
- TAL metals using USEPA SW-846 Method 6010C; and

- PCBs using USEPA SW-846 Method 8082.

5.5 In-Situ Treatment in Phase 1B

In partial Grid A'13A (20 ft by 20 ft) in the southwest corner of Phase 1B, remedial excavation was conducted to approximately 11 ft bgs to an as-built TEE of El. 0.2 ft NAVD88. From 11 to 20 ft bgs, the remedial approach was in-situ blending of a soil amendment, FerroBlack®-H. In-situ treatment was conducted instead of deeper excavation due to the proximity of this grid to Garfield and Carteret Avenues and the potential for further excavation to cause structural damage to utilities (active gas line and combined sanitary storm sewer) and streets, as well as the relatively low Cr^{+6} concentrations in soil within 11 to 20 ft bgs (El. 0.2 ft NAVD88 to approximately El. -8.9 ft NAVD88). In addition, sheet pile could only be driven to a final depth of 29 ft bgs in this area due to the presence of subsurface obstructions.

PPG/AECOM proposed this remedial approach in a technical memorandum from AECOM to the NJDEP entitled *Excavation Depths in Grids A5A, A13A, D13A, and A'13A*, dated January 10, 2013 (AECOM, 2013a). Conditional approval from NJDEP was documented in a letter to Michael McCabe, the project's Site Administrator, dated January 31, 2013 (NJDEP, 2013a). Soil blending was initially conducted on February 28, 2013. Additional blending was conducted on April 23 and 24, 2013. Split samples were first analyzed without reductant removal preparation. A second set of split samples designated "RM" was analyzed utilizing the reductant removal preparation method only if the original samples failed to meet the spike recovery criteria. Post-treatment sampling was performed via a GeoProbe rig between May 14 and 17, 2013. Results were summarized in the AECOM technical memorandum entitled *PPG Site 114 Grid A'13A Final Sampling Results*, dated July 12, 2013 (AECOM, 2013i). NJDEP/Weston provided comments on August 4, 2013 (Weston, 2013i), requesting additional sampling to monitor soil conditions in the 17.5 to 18.0 ft bgs soil interval. Another two rounds of post-treatment sampling were conducted on June 2 and December 4, 2014.

On February 12, 2015, PPG/AECOM issued a memorandum with the Grid A'13A post-remediation sampling results (AECOM, 2015a), and on March 20, 2015, NJDEP/Weston provided comments (Weston, 2015a). A final round of clean confirmation samples from the 17.5 to 18.0 ft bgs sample interval was collected on April 23, 2015. The results of these samples met the remedial objectives and were included in a report from PPG/AECOM to NJDEP dated June 24, 2015 (AECOM, 2015b). In an email dated July 29, 2015 (Weston, 2015b), NJDEP/Weston stated that they had reviewed the data and had concluded that the treatment of soil within Grid A'13A was successful; they indicated that no additional monitoring was required and remediation in this grid was considered complete.

5.6 PCB Backfill Re-excavation

On April 15, 2013, a sample collected from off-site backfill material placed within six grids in Phase 1B (Grids H6A, H7A, K1A, K2A, L1A, and L2A) had an analytical result of 0.675 mg/kg for PCB 1248, which exceeded the Residential Direct Contact Soil Remediation Standard (RDCSRS) and DIGWSSL values of 0.2 mg/kg. As a result, these grids were re-excavated and the backfill material was replaced with backfill material that did not exceed the RDCSRS and DIGWSSL standards. The technical memorandum entitled *Garfield Avenue Group Site 114, Phase 1B PCB Backfill Re-Excavation Plan (Revision 3)* dated January 17, 2014 detailed the plans for this re-excavation work (AECOM, 2014b).

Temporary sheet pile was installed to support the planned removal of the impacted backfill as well as to limit groundwater infiltration. Re-excavation of the impacted backfill began on January 21, 2014 and backfilling of the affected grids was completed on August 27, 2014.

5.7 Institutional and Engineering Controls

The following AOCs have exceedances of the SRS and require engineering controls (Clean Fill Soil Cap) and institutional controls (deed notices):

- AOC 114-1A: CCPW-impacted soil in Site 114;
- AOC 114-2: MGP-impacted soil associated with the former MGP in the eastern portion of Site 114); and
- AOC 114-3: Historic fill material in soil in Site 114.

The horizontal extents of the engineering controls apply to the following block and lots, as shown on **Figure 5-1**: Block 21501, Lot 16; Block 21501, Lot 17; Block 21501, Lot 18; Block 21501, Lot 19; and Block 21501, Lot 20.

Following remediation of soil in each AOC, dense-graded aggregate (DGA) backfill material (i.e., Clean Fill Soil Cap engineering control) was placed at the bottom of the excavation and compacted to final backfill subgrades at a minimum thickness of 2 ft as an engineering control to restrict access and exposure to soil with contaminants at concentrations greater than the unrestricted-use SRS.

The Clean Fill Soil Cap engineering control only includes the first 2 ft of material placed above the bottom of the excavation. The approximate elevations of the top of the Clean Fill Soil Cap throughout the restricted areas subject to deed notices are depicted on the as-built diagrams in **Appendix H.** In IRM #1 and Phases 1A, 1B, 1C, and 2B, a visible change in soil type between DGA and native materials serves as the visible demarcation between the Clean Fill Soil Cap and impacted material beneath it. In Phase 2A, orange construction fence plastic serves as the demarcation layer between the clean fill cap and impacted material beneath it.

Deed notices have been prepared for the applicable blocks and lots to address exceedances of the SRS or the presence of historic fill. Information related to the engineering controls and institutional controls is provided below by AOC. The deed notices are subject to the approval and acceptance of the property owners. Once the NJDEP approves the RAR, and once the property owners execute the final deed notices, the deed notices will be filed with the County Clerk. Once the deed notices are filed, PPG will submit the RAP application for the remaining-in-place soil impacts, along with the final RAR, to NJDEP for approval.

Additional information on site restoration and documentation of clean fill is included in **Sections 7.2** and **7.5**.

5.7.1 AOC 114-1A: CCPW-Impacted Soil in Site 114

In Block 21501, Lot 20, antimony remains in place at concentrations greater than the RDCSRS at two sample locations within Phase 1C (see **Figure 5-1** for the extent). The remedy for antimony in soil in AOC 114-1A at concentrations greater than the SRS consists of an engineering control (Clean Fill Soil Cap) and an institutional control (deed notice) to address the two locations with SRS exceedances within Block 21501, Lot 20. The horizontal extent of the Clean Fill Soil Cap engineering control to address antimony is depicted on the as-built diagrams included in **Appendix H.** The horizontal extent of the restricted area was determined based on an iterative approach to compliance averaging described in **Appendix I.**

PPG has prepared a deed notice for Block 21501, Lot 20. The deed notice included in **Appendix J** covers the antimony remaining in place as well as historic fill remaining in place in the southern portion of Block 21501, Lot 20, as further discussed in **Section 5.7.3**.

5.7.2 AOC 114-2: MGP-impacted Soil Associated with Former MGP in Eastern Portion of Site 114

MGP-impacted soil remains in place on the following block and lots:

- Block 21501, Lot 16;
- Block 21501, Lot 17;
- Block 21501, Lot 18 (portion located in Phase 2); and
- Block 21501, Lot 19 (portion located in Phase 2).

These four lots are shown in **Figure 1-2**. Certain VOCs (benzene and 1,4-dichlorobenzene), and certain SVOCs (1-1'-biphenyl; 2-methylnaphthalene; 3+4-methylphenol; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(k)fluoranthene; dibenzo(a,h)anthracene; indeno(1,2,3-cd)pyrene; and naphthalene) remain in place at concentrations greater than the SRS in the abovementioned block/lots in Phase 2. The remedy for certain VOCs and certain SVOCs in soil in AOC 114-2 at concentrations greater than the SRS consists of an engineering control (Clean Fill Soil Cap) and an institutional control (deed notice). The horizontal extent of the Clean Fill Soil Cap engineering control to address certain VOCs and certain SVOCs in Phase 2 is depicted on the as-built diagram included in **Appendix H.** The horizontal extent of the restricted area is based on the delineated area of MGP impacts from the PSEG RI and PPG RI.

One deed notice to cover the applicable blocks/lots has been prepared by PSEG to address constituents in AOC 114-2 remaining in place at concentrations greater than the SRS. PSEG, as the former MGP operator, is leading the RA of impacts related to the operation of the former MGP. PSEG is responsible for preparing the deed notice, which encompasses the areas where engineering controls are proposed. The deed notice is provided in **Appendix J**.

Note that the deed notice provided in **Appendix J** includes additional engineering controls (a sealed-steel sheet pile vertical barrier and a vapor intrusion barrier system) that are primarily related to groundwater, and are therefore outside the scope of this soil RAR. These additional engineering controls will be further addressed in future submittals, including PSEG's Final RAR (Wood, pending).

5.7.3 AOC 114-3: Historic Fill Material in Soil in Site 114

Historic fill remains in place in AOC 114-3, on the following block and lots:

- Block 21501, Lot 18 (portion located in Phase 1);
- Block 21501, Lot 19 (portion located in Phase 1); and
- Block 21501, Lot 20.

The portions of the abovementioned block/lots with historic fill remaining in place are located in Phase 1B (**Figure 1-2 and Figure 5-1**). Historic fill may contain ash, cinders, brick, and glass and is present in a portion of Block 21501, Lots 18, 19, and 20. This historic fill may include, but is not limited to, contaminants such as PAHs and metals at concentrations greater than unrestricted use standards. The remedy for historic fill remaining in place in AOC 114-3 consists of an engineering control (Clean

Fill Soil Cap) and a deed notice for a restricted area consisting of a portion of each of Block 21501/Lot 18, Block 21501/Lot 19, and Block 21501/Lot 20. The horizontal extent of the Clean Fill Soil Cap engineering control to address historic fill in Site 114 is depicted on the as-built diagrams included in **Appendix H.** The horizontal extent of the restricted area is based on areas where historic fill was documented to remain in place during remedial excavation.

PPG has prepared deed notices for Block 21501/Lot 18, Block 21501/Lot 19, and Block 21501/Lot 20. The three deed notices are included in **Appendix J**. Note that the deed notice included in **Appendix J** for Block 21501, Lot 20 covers both the historic fill remaining in place as well as antimony remaining in place as discussed in **Section 5.7.1**.

5.8 Field Change Notifications

Field changes made during implementation of the TEPs were documented in Field Change Notification forms. Field Change Notifications relevant to the RA activities at Site 114 are listed in **Table 5-2**.

For Phase 2A, there were no significant variations from the proposed RA as detailed in the PSEG RAWP.

6.0 Reliability of Data: Data Validation and Usability

6.1 Data Validation

Data validation of Site 114 data was performed primarily by AECOM on behalf of PPG. In Phase 2A, the majority of the data validation was performed by EDQI, LLC of Exton, PA on behalf of PSEG. Data validation was undertaken to evaluate whether the analytical data collected to demonstrate compliance with the RA objectives were scientifically defensible, properly documented, and of known quality, and met RA objectives.

AECOM data validation included the review of analytical procedures, quality control (QC) results, calibration procedures, and data reduction and completeness of the laboratory data packages as specified in the soil RIWP (AECOM, 2011b) and the Field Sampling Plan – Quality Assurance Project Plan (FSP-QAPP) (AECOM, 2010d). Deficiencies noted were communicated to the laboratory and resolutions were documented in the data validation reports. If appropriate, data were qualified for use as described later in this section.

Phase 2A sample analyses underwent an analytical quality assurance review to ensure adherence to the required protocols. Data validation procedures included validation of all confirmatory samples following NJDEP standard operating procedures for validation of analytical data. Details of the data validation will be provided in PSEG's Final RAR (Wood, pending submittal).

Quality control requirements specified in the methods and associated acceptance criteria were also used to evaluate non-Contract Laboratory Program (CLP) data. PSEG laboratory analytical reports and data validation reports are included in this RAR in **Appendix F** and **Appendix G**, respectively.

The AECOM laboratory data packages (**Appendix F**) were reviewed in accordance with the FSP-QAPP (AECOM, 2010d), the NJDEP validation SOPs for hexavalent chromium and inorganic data, and USEPA Region 2 validation guidelines for inorganic and organic parameters. The following NJDEP validation guidelines served as the basis for the actions taken during validation:

- NJDEP Office of Data Quality *SOP 5.A.10, Rev 3, SOP for Analytical Data Validation of Hexavalent Chromium – for USEPA SW-846 Method 3060A, USEPA SW-846 Method 7196A and USEPA SW-846 Method 7199,* dated September 2009 (NJDEP, 2009); and
- NJDEP Office of Data Quality *SOP 5.A.16, Rev 1, Quality Assurance Data Validation of Analytical Deliverables for Inorganics (based on USEPA SW-846 Methods),* dated May 2002 (NJDEP, 2002).

Where USEPA Region 2 inorganic and organic validation guidelines were also used in assessing metals, VOCs, SVOCs, pesticides, and PCBs, the most current guidance in effect at the time of validation was used by AECOM; the specific revision used is listed in each data validation memorandum provided in **Appendix G**. The link to USEPA Region 2 validation guidance on the USEPA website is shown below:

- https://www.epa.gov/quality/region-2-quality-assurance-guidance-and-standard-operating-procedures (last accessed in December 2018).

The level of AECOM validation ranged from a comprehensive validation according to the NJDEP guidelines to a limited validation based on QC summary information or completeness reviews, depending on the analyte and matrix. The validation procedures for the Cr^{+6} data included full validation, which involved a comprehensive review of both summary forms and raw data, whereas the metals and organics data received limited validation. Limited validation for metals, VOC, SVOC, EPH, TPH, pesticide and PCB data was based on information provided by the laboratory on its QC summary forms and did not include raw data review. At a minimum, limited validation included validation of the following data elements:

- Agreement of analyses conducted with chain-of-custody (COC) requests;
- Holding times and sample preservation;
- Method blanks/field equipment blanks/trip blanks;
- Surrogate spike recoveries;
- Laboratory Control Samples (LCS) or equivalent results;
- Matrix Spike (MS)/Matrix Spike Duplicate (MSD) results;
- Laboratory duplicate results;
- Field duplicate results; and
- Quantitation limits and sample results (limited to evaluating dilutions and re-analyses).

Full validation was conducted by AECOM on the majority of the Cr^{+6} data. Full validation included each of the data elements listed for limited validation along with review of calibration data and raw data, and spot checks for verification of calculations.

Validation reports were prepared for each data package that was validated. The validation reports are provided in **Appendix G**. The reports summarize the samples reviewed, parameters reviewed, nonconformance with the established criteria, and validation actions (including application of data qualifiers) presented in accordance with the NJDEP "hit list" format. Validation data qualifiers were based on the USEPA Region 2 validation guidelines for organic data and the NJDEP validation SOPs for the Cr^{+6}, inorganic and organic data. The following qualifiers are used in data validation:

J Indicates the result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample. J+ or J- is used when the direction of bias can be determined.

U Indicates the analyte was not detected in the sample above the sample reporting limit.

UJ Indicates the analyte was not detected above the reporting limit and the reporting limit was approximate.

UB The analyte concentration is less than or equal to three (3) times the concentration in the associated method/preparation blank. The presence of the analyte in the sample is negated due to laboratory blank contamination.

JB The analyte concentration is greater than three (3) times, but less than or equal to ten (10) times the concentration in the associated method/preparation blank. The presence of that analyte in the sample is considered "real" but the concentration is quantitatively qualified due to method blank contamination.

R The sample result was rejected due to serious deficiencies; the presence or absence of the analyte could not be confirmed.

RA The sample result was rejected due to NJ-specific data validation QC requirements; however, the result is usable for project objectives. Refer to the Data Quality and Usability section of the data validation report for further information.

This RAR includes data collected between 2003 and 2016 and data provided by other contractors; for certain data collected between 2003 and 2007, laboratory qualifiers or non-standard validation qualifiers were used in the database in place of the standard validation qualifiers listed above. These qualifiers include the following:

N Spiked sample recoveries outside of limits.

E Serial dilution results did not meet criteria.

* Duplicate analysis not within control limits.

B Equivalent to UB, above.

BJ Equivalent to JB, above.

BF The positive analyte result in this sample was qualified as negated since the concentration of the analyte in this sample was less than or equal to three (3) times the maximum field blank concentration.

JF The positive result was qualified as estimated since the concentration of chromium in this sample was greater than three (3) times, but less than or equal to ten (10) times the maximum field blank contamination.

In some cases, multiple qualifiers were combined to address multiple issues identified during validation. These qualifiers include:

UN The analyte was not detected above the sample reporting limit shown and the spike sample recovery was not within control limits.

*NE The duplicate analysis was not within control limits. The sample recovery was not within control limits. The reported value is estimated because the serial dilution did not meet criteria.

B* The analyte was detected at a concentration less than the Practical Quantitation Limit but greater than or equal to the Instrument Detection Limit. The duplicate analysis was not within control limits.

*N The duplicate analysis was not within control limits and the sample recovery was not within control limits.

U* The analyte was not detected above the sample reporting limit shown and the duplicate analysis was not within control limits.

UN The analyte was not detected above the sample reporting limit shown and the spiked sample recovery was not within control limits.

6.2 Data Usability Assessment

Soil samples collected to demonstrate compliance with the RA objectives were sent to Test America Laboratories (formerly Severn-Trent Laboratories) in Edison, NJ (NJ certification 12028), SGS-Accutest Laboratories in Dayton, NJ (NJ Certification 12129) or ALS (formerly Columbia Analytical Services) in Rochester, NY (NJ certification NY004). The analyses were performed in accordance with USEPA- and NJDEP-approved analytical protocols in place at the time the analyses were performed. Quality assurance analytical measures were implemented in accordance with the NJDEP TRSR (N.J.A.C. 7:26E) (NJDEP, 1993b) and complied with the requirements for a NJDEP-certified laboratory specified in *Regulations Governing the Certification of Laboratories and Environmental Measurements* (NJDEP, 1981). Specific quality control issues identified during validation are documented in the individual data validation reports provided in **Appendix G**. Results of the data validation indicated that, in general, the analytical data were of adequate quality to meet the project objectives. However, there were some quality assurance (QA)/QC issues identified during data validation that resulted in rejection of data or qualification of data as estimated.

Data usability was evaluated using the data quality indicators of precision, accuracy, representativeness, comparability, completeness, and sensitivity. Data that were not rejected during validation are regarded as usable.

Certain Cr^{+6} results that were rejected due to failure of the matrix spikes to meet the NJDEP-specified control limits of 50-150% were qualified “RA” to indicate the result may have value for information purposes. This qualifier is typically used for Cr^{+6} where the spiked sample matrix appears to be reducing and would not be expected to support the presence of Cr^{+6}. The presence of other indicators of a reducing environment such as total organic carbon (TOC), sulfide, or ferrous iron is a factor in the decision to utilize the “RA” qualifier. In this data set the “RA” qualifier was also applied to certain metals where the field duplicate relative percent difference (RPD) exceeded 120%. Professional judgment was used during validation to qualify positive results “RA” rather than “R” based on field duplicate precision.

6.2.1 Precision

Precision is the measure of agreement among repeated measurements of the same property under identical or substantially similar conditions and includes both field and analytical components. The information used to evaluate precision included results for field duplicates, matrix duplicates, and laboratory duplicates. For the Site 114 RAR data set (the data used to demonstrate compliance with the RA objectives), RPD non-conformances were observed for field and/or laboratory duplicates associated with several analyte groups in various phases of the program.

Field precision was assessed through the collection and analysis of field duplicates and expressed as the RPD of the sample and field duplicate pair results. Laboratory precision was assessed through the RPD results for MS/MSDs, LCS/laboratory control sample duplicate (LCSD) pairs, and duplicate sample analyses. MS/MSDs and duplicate sample analyses do not reflect laboratory precision as purely as LCS/LCSDs since sample homogeneity, which can be a significant issue for soil samples, can impact the precision of sample and matrix spike duplicates. However, no differentiation of the applied reason code is made between LCS/LCSDs and MS/MSDs or sample duplicates.

IRM #1

In the IRM #1 data set, field duplicate precision resulted in qualification of 0.96% of the CCPW metals data, 11.9% of the Cr^{+6} data, 1.6% of the non-CCPW metals and cyanide data, and 0.25% of the SVOC data. None of the results for EPH, PCB, VOC, and TPH were qualified on the basis of field duplicate precision.

Laboratory precision resulted in the qualification of 13.6% of the Cr^{+6} data; none of the other reported parameters required qualification on this basis.

Phase 1A

In the Phase 1A data set, field duplicate precision resulted in qualification of 4.2% of the CCPW metals data, and 24.7% of the Cr^{+6} data. None of the results for non-CCPW metals and cyanide, PCBs, pesticides, VOCs, or SVOCs were qualified on the basis of field duplicate precision.

Laboratory precision resulted in the qualification of 2.8% of the CCPW metals data, and 9.5% of the Cr^{+6} data. None of the Phase 1A results for non-CCPW metals and cyanide, PCBs, pesticides, VOCs, or SVOCs were qualified based on laboratory duplicate precision.

Phase 1B

In the Phase 1B data set, field duplicate precision was cited as a reason for qualification of 6.6% of the CCPW metals data, 24.1% of the Cr^{+6} data, 2.2% of the non-CCPW metals and cyanide data, and 0.08% of the VOC data. None of the EPH, PCB, pesticide, or SVOC data were qualified on the basis of field duplicate precision.

Laboratory precision resulted in the qualification of 3.1% of the CCPW metals data, 10.4% of the Cr^{+6} data, and 1.5% of the non-CCPW data. None of the PCB, pesticide, VOC, or SVOC results were qualified based on laboratory precision.

Phase 1C

In the Phase 1C data set, field duplicate precision resulted in qualification of 0.68% of the non-CCPW metals and cyanide data, 0.29% of the VOC data, and 14.0% of the Cr^{+6} data. None of the CCPW metals, PCB, or SVOC results were qualified on the basis of field duplicate precision.

Laboratory precision resulted in the qualification of 4.0% of the CCPW metals, and 14.0% of the Cr^{+6} data; none of the non-CCPW metals, PCB, SVOC, or VOC results were qualified based on laboratory precision.

Phase 2A

In the Phase 2A data set, none of the results were specifically qualified on the basis of field or laboratory precision. However, precision was cited as a reason for qualification of 0.42% of the CCPW metals and 1.4% of the non-CCPW metals and cyanide data. There was no qualification of Phase 2A PCB, SVOC, VOC, or Cr^{+6} data on the basis of precision.

Phase 2B-1

In the Phase 2B-1 data set, field duplicate precision was cited as the reason for qualification of 0.81% of the CCPW metals data, 1.4% of the non-CCPW metals and cyanide data, 0.038% of the SVOC

data, 0.37% of the VOC data, and 15.2% of the Cr^{+6} data. There was no qualification of EPH, PCB, or pesticide data based on field duplicate precision.

Laboratory precision resulted in qualification of 2.1% of the CCPW metals results, 2.7% of the non-CCPW metals and cyanide results, 9.1% of the EPH results, 0.038% of the SVOC results, 0.053% of the VOC results, and 17.1% of the Cr^{+6} data; no qualification was applied to PCB or pesticide data as a result of laboratory precision.

Phase 2B-2

In the Phase 2B-2 data set, most of the results were qualified only for general precision, not specifically field or laboratory precision. Precision resulted in the qualification of 5.7% of the CCPW metals and 3.1% of the non-CCPW metals and cyanide data. The Cr^{+6} data set did differentiate between field and laboratory precision with 13.3% of the Phase 2B-2 Cr^{+6} data being qualified on the basis of field duplicate precision and 8.3% of the data being qualified on the basis of laboratory precision.

Phase 2B-3

In the Phase 2B-3 data set, field duplicate precision resulted in the qualification of 2.7% of the CCPW metals data, 0.19% of the non-CCPW metals and cyanide data, 0.55% of the VOC data, and 2.3% of the Cr^{+6} data. Laboratory precision resulted in the qualification of 19.3% of the Cr^{+6} data.

Phase 2B-4

In the Phase 2B-4 data set, data precision resulted in the qualification of 3.5% of the CCPW metals data and 3.4% of the non-CCPW metals and cyanide data. Field duplicate precision resulted in the qualification of 0.38% of the SVOC data, 0.11% of the VOC data, and 8.9% of the Cr^{+6} data. Laboratory precision resulted in qualification of 14.4% of the Cr^{+6} data.

6.2.2 Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference or true value. The results of field and laboratory blanks, LCS data, surrogate recoveries, and MS/MSDs were used as the primary indicators of accuracy; information such as sample container type, preservation, holding time, and calibration were also considered to be impacting to analytical accuracy. Some of this information was assessed by the laboratory at the time of receipt (container type and preservation); other parameters were evaluated during the validation process.

Qualification of data as estimated (J/UJ) for accuracy was related to issues such as field or laboratory blank contamination, calibration issues, LCS results, MS results, surrogate recoveries (which are used in organic analyses to evaluate extraction efficiency and matrix interference on a sample specific basis) and percent solids. In cases where contaminants were detected in associated field or laboratory blanks, action levels were established in accordance with the NJDEP or USEPA Region 2 validation guidance documents and associated sample results were qualified accordingly.

Hexavalent chromium results were flagged as estimated based on the results of soluble and/or insoluble spike recoveries outside the range of 75-125% but within the limits of 50-150%. Data points impacted by MS and/or MSD recoveries within this range were flagged as J or UJ; individual validation memoranda address the potential for high or low bias to sample results based on matrix interferences.

Moisture content greater than 50% resulted in selected data points being qualified as estimated (J or UJ). Approximately 16.9% of the IRM #1 results, 1.1% of the Phase 1A results, 21.7% of the Phase 1B results, 13.3% of the Phase 1C results, 36.4% of the Phase 2B-1 results, 0.59% of the Phase 2B-2 results, 24.0% of the Phase 2B-3 results, and 27.5% of the Phase 2B-4 results were qualified on the basis of low percent solids. None of the Phase 2A results were qualified on the basis of low percent solids.

A summary of additional validation findings are presented for each phase of the Site 114 work in the paragraphs below.

IRM #1

In the IRM #1 data set, the presence of target analytes in laboratory blanks and/or blanks related to field activities (i.e., field blanks) was cited as a reason for qualification of 1.6% of the CCPW metals data, 5.5% of the non-CCPW metals and cyanide data, and 0.12% of the SVOC data. Qualification based on LCS results was reported only for SVOC data (0.12%) in the IRM #1 data set. No qualification based on LCS/LCSD results was reported for IRM #1 CCPW metals, non-CCPW metals and cyanide, EPH, PCB, SVOC, VOC, Cr^{+6}, or TPH results. MS/MSD results were the basis for qualification of 9.0% of the CCPW data, 46.6% of the Cr^{+6} data, 7.4% of the non-CCPW data, 0.37% of the SVOC data, and 1.8% of the VOC data in the IRM #1 data set.

Five IRM #1 data points (0.18% of the total results generated) were rejected. The rejected data included two non-detect silver results rejected due to an associated matrix spike with 0% recovery; two Cr^{+6} data points rejected due to low matrix spike recovery, and, in the case of 114-X12G-20-20.5, holding time exceedance in addition to the low matrix spike recovery; and a non-detect SVOC result associated with low matrix spike recovery. In addition, one Cr^{+6} result was qualified “RA” based on matrix spike recovery less than 50% but there was evidence of a reducing matrix, which is unable to support the presence of Cr^{+6}.

Phase 1A

In the Phase 1A data set, the detection of target analytes in associated field or laboratory blanks was the basis for qualification of 1.4% of the CCPW metals and 0.25% of the SVOC results.

LCS and/or LCSD recoveries were cited in the qualification of 5.7% of the Cr^{+6} data, 4.8% of the pesticide data, and 0.25% of the SVOC data in Phase 1A. MS and/or MSD recoveries resulted in the qualification of 24.1% of the Cr^{+6} and 1.4% of the CCPW metals data. None of the other Phase 1A parameters were qualified based on LCS/LCSD or MS/MSD recoveries. Surrogate recoveries resulted in qualification of 33% of the Phase 1A PCB data and 20% of the VOC data. Calibration-related issues resulted in qualification of 0.5% of the Phase 1A SVOC data.

None of the results associated with the Phase 1A data set were rejected (“R”). However, 13.3% of the Phase 1A Cr^{+6} results were qualified “RA” to indicate the results were rejected since both initial and reanalysis spike recoveries fell outside of the control limits of 50-150%, but the sample matrix appeared to be reducing and, therefore, unable to support the presence of Cr^{+6}.

Phase 1B

In the Phase 1B data set, laboratory and/or field blanks were cited in the qualification of 1.8% of the CCPW metals data, 3.9% of the non-CCPW metals data, 0.03% of the SVOC data, 0.08% of the VOC data, and 0.25% of the Cr^{+6} data. In the Phase 1B data set, 1.1% of the Cr^{+6} data and 5.9% of the

pesticide data were qualified on the basis of LCS and/or LCSD recoveries. MS and/or MSD recoveries resulted in qualification of 10% of the CCPW metals data, 1.6% of the non-CCPW metals data, 72.7% of the Cr^{+6} data, 0.71% of the VOC data, and 0.03% of the SVOC data. Calibration-related issues resulted in qualification of 2.1% of the Phase 1B VOC data.

The Phase 1B data set also included data qualified based on holding time; 0.76% of the Cr^{+6} results, 2.0% of the VOC results, and 1.9% of the SVOC results were qualified due to holding time exceedances. In addition, nine Cr^{+6} results (1.1%) were qualified due to the failure of the analyst to record the initial pH adjustment required during sample preparation in the laboratory preparation records and six Cr^{+6} results (0.74%) were qualified due to a storage temperature greater than 6°C resulting from an extended power failure which occurred as a result of Hurricane Sandy.

For the Phase 1B data set, one Cr^{+6} result (0.13% of the total Cr^{+6} results reported) and 1.9% of the VOC results were rejected and are not usable for project decisions. Rejection of the Cr^{+6} result was based on a significant holding time exceedance and low spike recovery; non-detect results for the VOC data were rejected due to holding time exceedance. Results for 2.4% of the CCPW metals and 0.62% of the non-CCPW metals and cyanide data were qualified "RA" due to field duplicate RPD values greater than 120%. In addition, 21.3% of the Phase 1B Cr^{+6} data was qualified "RA" due to matrix spike recoveries outside of 50-150%, but associated data indicated that the sample matrix was reducing and not capable of supporting Cr^{+6}. The Cr^{+6}, CCPW metals, and non-CCPW metals and cyanide results qualified "RA" may provide further information for project decisions but should be used with an understanding of the QC issues identified as described above.

Phase 1C

In the Phase 1C data set, laboratory and/or field blank contamination resulted in qualification of 6.7% of the CCPW metals data and 6.8% of the non-CCPW metals and cyanide data; blank contamination was not reported for the other parameters associated with Phase 1C. The Phase 1C data included qualification of 13.3% of the CCPW metals data, 5.7% of the non-CCPW metals and cyanide data, and 47.9% of the Cr^{+6} data on the basis of MS and/or MSD recoveries. None of the remaining analytes were qualified on the basis of MS or MSD recoveries and no qualification of Phase 1C data was required based on LCS or LCSD results.

Two Cr^{+6} results associated with the Phase 1C data set were rejected ("R"); one rejection was due to a significant holding time exceedance and the other was due to matrix spike recovery. The sample rejected on the basis of holding time had been submitted on hold but the laboratory was directed to perform the analysis after the holding time had expired. The rejected results should not be used for project decisions. In addition, 13 Cr^{+6} results (7.6%) from Phase 1C were qualified as "RA" due to matrix spike results outside of 50-150% with additional data indicating that the sample matrix was reducing and not capable of supporting the presence of Cr^{+6}.

Phase 2A

In the Phase 2A data set, the presence of target analytes in laboratory or field blanks was cited as the reason for qualification of 1.3% of the CCPW metals data, 2.5% of the non-CCPW metals and cyanide data, 0.023% of the SVOC data, and 0.29% of the VOC data. The Phase 2A data included qualification of 1.5% of the CCPW metals data and 1.4% of the non-CCPW metals and cyanide data based on MS and/or MSD recoveries. Additional Phase 2A results were qualified based on calibration issues identified during validation (1.0% of the SVOC data and 1.9% of the VOC data) and internal standard areas outside of criteria (0.16% of the SVOC data).

The Phase 2A data set contained rejections for: six SVOC results (0.14% of the total SVOC results) due to LCS results outside of acceptance criteria; 55 VOC results (1.2% of the total VOC results) primarily due to calibration issues identified during validation; and four non-detect Cr^{+6} results (2.6% of the total Cr^{+6} data) rejected due to low matrix spike recovery.

Phase 2B-1

The Phase 2B-1 data set included qualification of 2.1% of the CCPW metals data, 3.9% of the non-CCPW metals and cyanide data, and 2.0% of the Cr^{+6} data based on laboratory and/or field blank data. Phase 2B-1 data qualified on the basis of LCS and/or LCSD recovery included 2.7% of the non-CCPW metals results and 0.038% of the SVOC results. There were no qualifications of CCPW metals, Cr^{+6}, EPH, PCBs, pesticides, or VOCs based on LCD/LCSD recovery. Data qualified on the basis of MS and/or MSD recoveries in the Phase 2B-1 data set included 6.8% of the CCPW metals results, 4.1% of the non-CCPW metals and cyanide results, 64.4% of the Cr^{+6}results, and 1.9% of the VOC results. No EPH, PCB, pesticide, or SVOC results were qualified based on MS/MSD recoveries. Surrogate recovery and calibration-related issues resulted in qualification of 0.094% of the SVOC data; calibration-related issues also resulted in qualification of 3.0% of the PCB data. One SVOC result was reported as exceeding the calibration range and one CCPW metals result was flagged for exceedance of the serial dilution control limit.

Eight Phase 2B-1 results (0.065% of the total data set) were rejected. The rejected values included five Cr^{+6} results rejected based on matrix spike recoveries; two non-CCPW metals and cyanide results rejected based on matrix spike recoveries, and one VOC result rejected based on calibration issues. In addition, 91 Cr^{+6} results (0.74% of the Phase 2B-1 data set) were qualified “RA” due to matrix spike results outside 50-150% recovery. This qualifier is typically used for Cr^{+6} where the spiked sample matrix appears to be reducing and would not be expected to support the presence of Cr^{+6}. The presence of other indicators of a reducing environment, such as TOC, sulfide, or ferrous iron is a factor in the decision to utilize the “RA” qualifier.

Phase 2B-2

In the Phase 2B-2 data set, field and laboratory blank contamination resulted in qualification of 1.3% of the non-CCPW metals and cyanide data reported; blank contamination was not cited for the other parameters reported for this phase of work. Phase 2B-2 data included qualification of 13.8% of the CCPW metals data, 10.9% of the non-CCPW metals and cyanide data, 5.3% of the VOC data, and 56.7% of the Cr^{+6} data based on MS and/or MSD recoveries. LCS results were cited as the reason for qualification of two (1.3%) of the SVOC results. No other qualification based on MS/MSD or LCS/LCSD was reported for the Phase 2B-2 data set.

There were no rejections (“R”) in the Phase 2B-2 data set; however, six Cr^{+6} results (0.19% of the total Phase 2B-2 data set) were qualified “RA” due to low matrix spike recoveries.

Phase 2B-3

In the Phase 2B-3 data set, the presence of target analytes in field or laboratory blanks resulted in qualification of 1.0% of the CCPW metals results, 1.2% of the non-CCPW metals results, 0.09% of SVOC results and 0.04% of VOC results. Five Phase 2B-3 SVOC results (0.14% of the total SVOC data reported) were qualified on the basis of LCS recovery; none of the other Phase 2B-3 parameters were qualified due to LCS and/or LCSD data outside of control limits. MS and/or MSD recovery resulted in qualification of 3.0% of the CCPW metals results, 1.1% of the non-CCPW metals results, 1.1% of the SVOC results, 0.12% of the VOC results, and 83.3% of the Cr^{+6} results included in the

Phase 2B-3 data set. None of the Phase 2B-3 PCB or pesticide data was qualified due to MS and/or MSD results.

The Phase 2B-3 data set also included data qualified on the basis of calibration issues; 0.24% of VOC data and 0.17% of SVOC data associated with Phase 2B-3 were qualified on the basis of calibration data that did not meet acceptance criteria. In addition, one SVOC result (0.029% of the total SVOC results reported) was qualified on the basis of holding time exceedance.

The Phase 2B-3 data set had 33 rejected values (0.43% of the total data reported). The rejected data included five non-CCPW results and 24 SVOC results rejected on the basis of low matrix spike recoveries, and four VOC results rejected based on calibration issues. In addition, 27 Cr^{+6} results in the Phase 2B-3 data set were qualified "RA" based on matrix spike recoveries outside of the 50-150% recovery range. This qualifier is typically used for Cr^{+6} where the spiked sample matrix appears to be reducing and would not be expected to support the presence of Cr^{+6}. The presence of other indicators of a reducing environment such as TOC, sulfide, or ferrous iron is a factor in the decision to utilize the "RA" qualifier

Phase 2B-4

The Phase 2B-4 data set included qualification of 0.23% of the CCPW metals results, 0.32% of the non-CCPW metals and cyanide results, and 0.13% of the SVOC results on the basis of field blank contamination. In addition, 1.2% of the CCPW metals results, 1.2% of the non-CCPW metals results, and 0.06% of the SVOC results associated with Phase 2B-4 were qualified based on laboratory blank results. LCS results were cited as the reason for qualification of 0.19% of the Phase 2B-4 SVOC and 0.49% of the Cr^{+6} results. MS and/or MSD results were cited as the basis for qualification of 4.6% of the CCPW metals results, 1.2% of the non-CCPW metals and cyanide results, 2.7% of the SVOC results, 0.06% of the VOC results, and 72.3% of the Cr^{+6} results generated for Phase 2B-4.

The Phase 2B-4 data set also included two non-CCPW metals qualified on the basis of serial dilution results (0.13% of the total non-CCPW data reported). All reported Phase 2B-4 pesticide data were J qualified due to a temperature of 12°C at receipt of the samples. In addition, six Cr^{+6} results (2.9% of the total Cr^{+6} results) were qualified for duplicate injections outside the 20% RPD required for Method 7199 and one Cr^{+6} result (0.49% of the total Cr^{+6} results) was qualified on the basis of holding time exceedance.

Nineteen (0.17%) of the total results reported for Phase 2B-4 were rejected ("R"); this included five non-CCPW metals and cyanide results and 12 SVOC results rejected for low matrix spike recovery, and two Cr^{+6} results rejected due to holding time. The Phase 2B-4 data set also included 58 Cr^{+6} results (0.52% of the total reported Phase 2B-4 results) qualified as "RA" due to spike recoveries outside of the 50-150% recovery range, but additional data that indicated the sample matrices were reducing.

6.2.3 Representativeness

The representativeness of any field program is a function of the planning and procedures used to collect the samples and the locations and density of samples collected. Sampling and preservation methods were based on established methods and SOPs, outlined in the soil RIWP (AECOM, 2011b) and FSP-QAPP (AECOM, 2010d), which are known to minimize error associated with the disturbance of environmental samples from their natural setting.

Factors to be considered in evaluating representativeness are the use of standard analytical procedures, sample preservation, and the use of the appropriate sample containers. The analytical methods, preservation procedures, and containers used in this program were as specified in the FSP-QAPP.

The moisture content of samples is also a factor in the representativeness of the data. In accordance with USEPA Region 2 validation guidance, samples containing more than 50% moisture were qualified as estimated. As noted previously, this requirement resulted in the qualification of 16.9% of the IRM #1 results, 1.1% of the Phase 1A results, 21.7% of the Phase 1B results, 13.3% of the Phase 1C results, 36.4% of the Phase 2B-1 results, 0.59% of the Phase 2B-2 results, 24.0% of the Phase 2B-3 results, and 27.5% of the Phase 2B-4 results; none of the Phase 2A results were qualified on the basis of low percent solids.

6.2.4 Comparability

Comparability of the data in the RAR data set was maximized by using standard methods for sampling, analysis, and data validation.

6.2.5 Completeness

Completeness is the measure of the amount of valid data obtained from a measurement system; valid data are defined as those data judged to be usable (i.e., not rejected as a result of the validation process). For the Site 114 RAR data set, 60,328 individual data points were generated; 0.29% were qualified as rejected and are considered unusable for project decisions. An additional 0.67% of the data were qualified "RA" to indicate that, although QC exceedances were identified, the results still had value for understanding site conditions. Overall, 99% of the reported Site 114 values generated for IRM #1 and Phase 1A, Phase 1B, Phase 1C, Phase 2A, Phase 2B-1, Phase 2B-2, Phase 2B-3, and Phase 2B-4 are considered usable for project decisions.

The Cr^{+6} values qualified as "RA" do not meet the required 50-150% soluble and insoluble matrix spike recovery limits, but additional data indicate that the sample matrices do not appear to be capable of supporting the presence of Cr^{+6}. In the Site 114 RAR data set, the "RA" qualifier was also applied to CCPW and non-CCPW metals and cyanide results, which had positive results but field duplicate RPD values greater than 120%. It was the judgment of the validator that positive results should not be rejected under these circumstances. Results qualified as "RA" can be used for informational purposes with a full understanding of the limitations as described in the data validation report.

6.2.6 Sensitivity

Analytical dilutions were necessary for certain samples due to the sample matrix or elevated concentrations of target or non-target analytes. The detection limits reported by the laboratory were adjusted to reflect dilution factors and corrections for percent moisture. Limitations in analytical methodologies and/or low percent solids content for some soil samples can result in detection limits that exceed the RDCSRS. Non-detect results greater than the associated regulatory limit were reported for some VOC and SVOC target analytes in the IRM #1, Phase 1B, and Phase 2A data sets. Some of these results were provided by another contractor and data packages are either incomplete or not available, so assessment of possible analytical interferences is not possible. For data generated by Columbia Analytical Services (Lab SDG numbers beginning with R), it appears that VOCs were analyzed as medium-level methanol-preserved samples, which does result in elevation of reporting limits; this was noted in associated validation reports. For the SVOC results where a full data package was available, it appears that the non-detect values were reported as less than the laboratory

quantitation limits which, when corrected for the sample-specific percent moisture, can result in elevation of the quantitation limit. The laboratory report does indicate that the laboratory routinely reported results detected between the method detection limit and the reporting limit with a "J" qualifier, so it is assumed that the target analyte was not detected between the method detection limit and the reporting limit in cases where the result was reported as non-detect at the reporting limit.

6.3 Data Quality/Data Usability Conclusions

The findings of this Data Quality Assessment and Data Usability Evaluation indicate that the data used to demonstrate compliance with the RA objectives are sufficiently representative of actual conditions and may be used to support decisions with the exceptions identified below:

- Cr^{+6} results qualified "RA" due to matrix spike recoveries outside the range of 50-150% but having evidence of a reducing matrix which would not be expected to support the presence of Cr^{+6};
- Positive results for CCPW metals and non-CCPW metals data qualified "RA" due to RPD results which exceed the upper control limit for field duplicates; and
- Results for analytes qualified rejected ("R") are considered to have serious quality deficiencies and should not be used for site decisions.

Data qualifiers and reason codes were applied by the data validator to identify data limitations found in the validation process. Specific details regarding analytes and samples can be found in the individual data validation reports in **Appendix G.**

7.0 Documentation of the Protectiveness of the Remedial Action

Soil analytical results from the RI and PDI soil boring and test pitting programs were used to pre-determine the depths of the excavation. These sampling results, in combination with the post-excavation sampling results and supplemental investigation sampling results, were used to document the effectiveness and completeness of the soil remediation.

For IRM #1, Phase 1, and Phase 2B, once the excavation limits met the final as-built TEEs, the Site Administrator's independent technical consultant, Weston, and/or an AECOM geologist inspected the completed excavation to confirm the absence of visible CCPW.

As summarized in **Section 5.4**, the locations of samples used to demonstrate compliance with the remediation goals are depicted on the figures in **Appendix D.** The tables in **Appendix D** present the analytical results for samples used to demonstrate compliance with the remediation goals. Laboratory analytical reports and data validation reports for the data presented in these tables are included in **Appendices F** and **G**, respectively. As discussed in **Section 6.0**, the laboratory analytical data for the collected samples was found to be usable for the purposes of defining the extents of the remedial excavation. **Appendix K** presents the available boring logs from locations of samples that were used to demonstrate compliance with the remediation goals.

For the following Site 114 Phases, compliance averaging was used to attain compliance for the following constituents remaining in soil compared to the SRS, as presented in **Appendix I**:

- IRM #1: antimony and arsenic;
- Phase 1B: antimony;
- Phase 1C: antimony and arsenic (note that compliance with the RDCSRS could not be demonstrated for antimony; therefore, engineering and institutional controls are part of the remedy, as discussed in **Section 5.7**);
- Phase 2B-1: antimony, arsenic, and lead;
- Phase 2B-3: arsenic and carbazole; and
- Phase 2B-4: antimony and arsenic.

The Site 114 AOCs have been remediated as follows:

<u>AOC 114-1A: CCPW-impacted soil in Site 114</u>

- Excavation of soil containing Cr^{+6} met the requirements specified in the NJDEP Memorandum entitled *Chromium Moratorium*, February 8, 2007 (the Chromium Policy) (NJDEP, 2007) in accordance with the *Updated Method to Determine Compliance with the Department's Chromium Policy, Garfield Avenue – Sites 114, 132, 133, 135, 137, and 143, Jersey City, NJ* (Method to Determine Compliance) (NJDEP, 2013b).

- Soil concentrations for CCPW metals, except for antimony, are in compliance with the CrSCC or SRS.
- Antimony remains in place at concentrations greater than the SRS in IRM #1 and Phase 1C (Block 21501, Lot 20) and is addressed through an engineering control (Clean Fill Soil Cap) and institutional controls (deed notices).
- Soil in the unsaturated zone has been removed and, therefore, DIGWSSLs do not apply.

AOC 114-2: MGP-impacted soil associated with the former MGP in the eastern portion of Site 114

- A majority of soil contaminated with OM/TM (MGP-impacted soil) has been excavated.
- Certain VOCs (benzene and 1,4-dichlorobenzene) and certain SVOCs (1-1'-biphenyl; 2-methylnaphthalene; 3+4-methylphenol; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(k)fluoranthene; dibenzo(a,h)anthracene; indeno(1,2,3-cd)pyrene; and naphthalene) remain in place at concentrations greater than the SRS and are addressed through an engineering control (Clean Fill Soil Cap) and institutional controls (deed notices).
- Soil in the unsaturated zone has been removed and, therefore, DIGWSSLs do not apply.

AOC 114-3: Historic fill material in soil in Site 114

- Historic fill has been removed from IRM #1 and Phases 1A, 1C, 2A, and 2B.
- Historic fill remains in place in Phase 1B (in portions of Block 21501, Lots 18, 19, and 20). Historic fill that may contain ash, cinders, brick, and glass is present in a portion of the property. This historic fill may include, but is not limited to, contaminants such as PAHs and metals at concentrations greater than unrestricted use standards. Historic fill remaining in place is addressed through an engineering control (Clean Fill Soil Cap) and institutional controls (deed notices).
- Soil in the unsaturated zone has been removed and, therefore, DIGWSSLs do not apply.

AOCs 114-4A and 114-4B: UST-impacted soil in Site 114

- Soil concentrations of EPH and TPH are in compliance with the EPH Remediation Criterion.
- Soil concentrations of VOCs, SVOCs, PCBs, and TAL metals are in compliance with the SRS.
- Soil in the unsaturated zone has been removed and, therefore, DIGWSSLs do not apply.

AOC 114-5: Soil impacted by other historical operations and land use in Site 114

- Soil concentrations for other metals, SVOCs, VOCs, PCBs, pesticides, EPH, and TPH not addressed in the other AOCs are in compliance with the SRS.
- Soil in the unsaturated zone has been removed and, therefore, DIGWSSLs do not apply.

Waste manifests for soil and other materials that were loaded for off-site disposal are presented in **Appendix L** and **Appendix M**.

Clean fill documentation is provided in **Appendix N**.

7.1 As-Built Diagrams

The following as-built diagrams are included in **Appendix H**:

- An as-built diagram depicting the final extents of the excavation in IRM #1 and Phases 1A, 1B, 1C, and 2B;
- An as-built diagram depicting the final extents of the excavation in Phase 2A;
- As-built diagrams depicting the horizontal extent and typical section of the Clean Fill Soil Cap Engineering Control to address historic fill remaining in place in Block 21501, Lot 18;
- As-built diagrams depicting the horizontal extent and typical section of the Clean Fill Soil Cap Engineering Control to address historic fill remaining in place in Block 21501, Lot 19;
- As-built diagrams depicting the horizontal extents and typical sections of the Clean Fill Soil Cap Engineering Control to address historic fill and antimony remaining in place in Block 21501, Lot 20;
- As-built diagrams depicting the horizontal extents and typical sections of the Clean Fill Soil Cap Engineering Control to address MGP-impacted material remaining in place in Block 21501, Lots 16, 17, 18, and 19; and
- An as-built diagram of the final Site grades following restoration.

7.2 Description of Site Restoration Activities

After completion of the excavation activities at each grid cell, the respective grids were backfilled with DGA. In Phase 1B, Phase 1C, and Phase 2B, the backfill was amended with FerroBlack®-H by ENTACT in accordance with the plans and specifications. The placement of FerroBlack®-H serves as a phase of groundwater remediation as documented in the *Progress Report for Groundwater Pilot Study and FerroBlack®-H Amended Backfill Permits-By-Rule - 2016 Fourth Quarter (October to December)* (AECOM, 2017a). Backfilling of Site 114 was completed in stages (see **Table 5-1**). Restoration activities were completed in Site 114 between August 3, 2017 and January 31, 2018.

In IRM #1, Phase 1, and Phase 2B, clean fill for site restoration consisted of ¾-inch stone and DGA backfill material supplied by Armored, Inc., Liberty Aggregates, Tilcon, and Stavola. Information regarding the source and quality of the backfill material is provided in **Section 7.5**. Based on the compaction goal of 90% standard proctor, ENTACT satisfactorily completed compaction of the backfill placed within the limits of Site 114. Final compaction results ranged from 90.2% to 113.3%, exceeding the 90% compaction goal.

In Phase 2A, excavated areas were backfilled by CEI with clean fill and stone aggregate. Interim site restoration was performed by CEI on behalf of PSEG, pending final site restoration by ENTACT on behalf of PPG. The backfill material was supplied by Amboy Aggregates, Liberty Stone and Aggregates, GVC Contractors, and Tilcon New York, Inc. Backfill in Phase 2A was compacted to at least 95% maximum dry density in accordance with ASTM D698 in accordance with the Construction Bid Specifications (CBS) and Drawings. Additional information on backfill activities will be provided in PSEG's Final RAR (Wood, pending submittal).

A capillary break was installed within a portion of Site 114, as required by the *Capillary Break Design Final Report (Revision 2)* (AECOM, 2017d). The horizontal extent of the capillary break, as of August 2019, and cross-section details are shown on **Figure 7-1**. Two types of capillary breaks were installed. Within a portion of Phase 1B, the washed open grade stone (OGS) capillary break consists

of a 6-inch layer of washed OGS placed between layers of geotextile (10 ounces per square yard [oz/sy]) installed from El. 13.2 to 13.7 ft NAVD88. Along the western boundary of Site 114 in IRM #1, Phase 1B, and Phase 1C, the high-density polyethylene (HDPE) liner capillary break consists of a 40-mil HDPE liner placed between two 10-oz/sy non-woven geotextile layers. The HDPE liner capillary break was used instead of an OGS capillary break in this area because the final restoration grade required to tie into existing street grade was lower than the grade required to accommodate an OGS capillary break. The *Capillary Break Design Final Report (Revision 2)* (AECOM, 2017d) concluded that a capillary break was needed throughout most of IRM #1 (Garfield Avenue to Row J, and from Column 1B to 9B). As of August 2019, the HDPE liner capillary break has been installed in Row A, Row B, and a portion of Row C, as shown on **Figure 7-1**. As of August 2019, the OGS Liner in Row C through J has not yet been placed because restoration of IRM #1 is not yet complete due to active groundwater remediation activities. Prior to the final restoration, the groundwater conditions will be re-evaluated to determine if the proposed capillary break is necessary. The capillary break will be managed through a future groundwater remedial action permit.

Site 114 was backfilled and restored in accordance with the *Restoration Technical Execution Plan, Garfield Avenue Group (Revision 1)* (Restoration TEP), dated August 2017 (AECOM, 2017b) and the PPG/AECOM memorandum entitled *Response to NJDEP/Weston's 08/31/17 Comments and the City of Jersey City/ERFS's 09/12/17 Comments on the Restoration Technical Execution Plan, Garfield Avenue Group (Revision 1)*, dated October 16, 2017 (AECOM, 2017c).

As part of the restoration activities, a portion of the internal sheet pile within Site 114 was removed in 2014, 2015, and 2017. Sheet pile that is in place around the perimeter of Phase 2 is required to remain in place to address on-site impacts related to the former MGP site, in accordance with the PSEG RAWP (see **Section 4.1.2** for the PSEG RAWP submittal history). The remaining sheet pile in place at the time of the preparation of this RAR (along the Site 114 boundary for IRM #1, Phase 1B, and Phase 1C) is anticipated to remain in place at least until soil remediation of the adjacent areas, Carteret Avenue, Garfield Avenue, and Site 199, takes place.

7.3 Total Remedial Action Cost

PPG's total remediation cost for implementation of the RA at the Site 114 AOCs, except Phase 2A, is estimated at approximately $200 million. This includes costs for: RI, engineering, demolition, shoring installation, excavation and backfilling, air monitoring, construction management, groundwater management and treatment, waste transportation and disposal, and overall project management and reporting. Costs for Phase 2A will be included in PSEG's Final RAR (Wood, pending submittal).

7.4 Documentation of Waste Generation and Disposal

The approximate weight of solid material excavated from the Site114 AOCs in IRM #1, Phase 1, and Phase 2B and disposed of off site is estimated to be 564,752 tons, based on estimates from the waste manifests and bills of lading (BOLs). This total does not include the MGP-only material excavated by PPG from Phase 2, but disposed of by PSEG at Bayshore Recycling Corp in Keasbey, New Jersey.

Waste manifests and BOLs for the time period during which IRM #1, Phase 1, and Phase 2B at Site 114 (with the exception of MGP waste manifests) were excavated are included in **Appendix L** (Hazardous Waste Disposal Documentation) and **Appendix M** (Non-Hazardous Waste Disposal Documentation). Waste manifests and BOLs for Phase 2A and for MGP waste in Phase 2B will be included in PSEG's Final RAR (Wood, pending submittal).

Other materials generated as a result of the RA activities at IRM #1, Phase 1, and Phase 2B of Site 114 included contaminated concrete and debris, demolition debris, non-hazardous waste concrete, and groundwater treatment plant sludge. For Phase 2A, steel and wood waste were also disposed off site.

The following facilities were used for the off-site disposal of waste materials generated during RA activities at Site 114:

Hazardous Waste Materials

IRM #1, Phase 1, Phase 2B

- Clean Earth of North Jersey (CENJ), Kearny, NJ;
- Clean Harbors, El Dorado, Arkansas;
- Dupont Chambers Works (E.I. Dupont DeNemours & Co.), Deepwater, New Jersey (UST liquids);
- EnGlobe, Montreal-East, Quebec, Canada;
- Environmental Quality Company (EQ) Detroit Inc., Detroit, Michigan;
- EQ - Envirite, Canton, Ohio;
- EQ – Envirite of Pennsylvania, York, Pennsylvania;
- EQ - Michigan Disposal Waste Treatment Plant, Belleville, Michigan;
- PVSC, Newark, NJ; and/or
- Stablex Canada, Inc., Blainville, Québec, Canada.

Phase 2A (documentation included in PSEG's Final RAR [Wood, pending submittal])

- CENJ, Kearny, New Jersey.

Phase 2B (MGP-related waste documentation included in PSEG's Final RAR [Wood, pending submittal])

- Cumberland County Improvements Authority Landfill, Deerfield Township, NJ.

Non-Hazardous Waste Materials

IRM #1, Phase 1, Phase 2B

- Clean Earth of Philadelphia (CEP), Philadelphia, Pennsylvania;
- Clean Earth of North Jersey (CENJ), Kearny, Jew Jersey; and
- Cumberland County Improvements Authority Landfill, Deerfield Township, NJ.

Phase 2A (documentation included in PSEG's Final RAR [Wood, pending submittal]**)**

- Bayshore Soil Management, LLC, Keasbey, New Jersey (Bayshore);
- CEP, Philadelphia, New Jersey;

- Clean Earth of Southeast Pennsylvania (CESEPA), Morrisville, Pennsylvania; and
- SIMS Metal Management NE, Inc., Newark, NJ.

Liquid Waste (Water)

- Dupont Chambers Works (E.I. Dupont DeNemours & Co.), Deepwater, NJ;
- Clean Harbors, El Dorado, Arkansas;
- EQ - Envirite, York, Pennsylvania; and
- Pre-treatment through the on-site treatment plant located on Site 114 followed by discharge to the public sewer system (conveyed via JCMUA system) to the PVSC Wastewater Treatment Plant, Newark, NJ (under PVSC Sewer Use Permit #31630010, included in **Appendix B**) for final treatment and discharge.

Copies of fully executed manifests, BOLs, and certificates of disposal documenting the off-site transport of waste material (except for wastes from P2A) are presented in the following appendices:

- **Appendix L** – Hazardous Waste Disposal Documentation. This appendix includes fully executed manifests and certificates of disposal (if provided) documenting the off-site transport of soil, concrete, and other debris, such as scrap metal. Liquid manifests for hazardous waste generated prior to the operation of the groundwater treatment system are also included in this appendix.
- **Appendix M** – Non-Hazardous Waste Disposal Documentation This appendix includes BOLs documenting the off-site transport of non-hazardous soil, sludge, and asphalt. Liquid manifests for non-hazardous waste generated prior to the operation of the groundwater treatment system are also included in this appendix.

7.5 Documentation of Source, Type, Quantities, and Location of Fill

Virgin material for Site 114, IRM #1, Phase 1, and Phase 2B, backfill and restoration consisted of ¾-inch or 2- to 4-inch OGS and DGA supplied by Armored, Inc. (a.k.a. GVC Contractors, LLC) (Newark, NJ and Linden, NJ), Liberty Aggregates (Jersey City, New Jersey), Tilcon (625 Mt. Hope Road, Wharton, NJ and Broad Street, Pompton Lakes, NJ), and Stavola (Bound Brook, NJ). Armored, Inc. and Liberty Aggregates supplied fill from tunnel rock imported from the 2nd Avenue Subway Project. Tilcon and Stavola, licensed quarry facilities permitted to operate as commercial quarries by NJDEP, provided virgin licensed quarry/mine material. A list of the virgin material load reports is provided in **Appendix N-1**.

In Phase 2A, virgin backfill and restoration material was imported from the following providers: Amboy Aggregates, South Amboy, New Jersey; Liberty Stone and Aggregates, Jersey City, New Jersey; GVC Contractors, Newark, New Jersey/Grasselli Point Industries, Linden, New Jersey; and Tilcon New York Inc., Wharton, New Jersey. Load reports and analytical data associated with backfill imported to Phase 2A are included in PSEG's Final RAR (Wood, pending submittal).

The procedures for demonstrating that backfill material was not contaminated changed during the time that backfilling and restoration activities occurred at Site 114, as follows:

- During the initial part of the Site 114 backfill activities until May 2011 when material was obtained from Armored Inc. and Tilcon Mount Hope, no sampling frequency had been established. Three samples were analyzed. Analytical reports for this time period are included in **Appendix N-2**.

- From May 2011 to June 2014 when material was obtained from Armored Inc., Stavola, Liberty Aggregates, and Tilcon (Mount Hope and Pompton Lake), the SW Area TEP (AECOM, 2012d) required that backfill samples be collected at the frequency of 1 for every 2,000 tons of backfill delivered. Analytical reports for this time period are included in **Appendix N-2**.

- Following the issuance of Field Change Notification #16 dated June 27, 2014, the virgin material was obtained from Stavola and Tilcon (Mount Hope and Pompton Lake) licensed quarries. The quarry material was sampled/analyzed at a frequency of one sample analyzed per quarry backfill source per year, in accordance with NJDEP's December 2011 *Alternative and Clean Fill Guidance for Site Remediation Program Sites* (NJDEP, 2011c). This reduced sampling frequency was utilized for the remainder of Site 114 backfilling. Analytical reports for this time period are included in **Appendix N-3**.

- For restoration of Site 114 in 2017-2018, in accordance with Field Change Notification #16A dated July 24, 2015, each quarry, on an annual basis, was required to provide its License (Mining Certificate) and Annual Certification that the material was from a clean, virgin source with analytical results provided by the quarry/mine in accordance with NJDEP's *Fill Material Guidance for SRP Sites Version 3.0* (NJDEP, 2015). The Mining Certificates, Annual certification, and analytical reports for this time period are included in **Appendix N-4**.

The concentrations of the analytes in samples collected from the virgin material were compared to applicable NJDEP standards consistent with the regulations and guidance in place at the time the samples were collected. Benzo(a)pyrene exceeded the SRS and DIGWSSL in three clean fill samples collected in 2012 (the SRS was revised in 2017 and the samples no longer exceed an SRS). However, based on soil sampling of the in-place backfill, no remedial action was required (correspondence is included in **Appendix N-5**). Based on a comparison to NJDEP standards, the virgin material does not pose a potential impact to groundwater (per NJDEP's *Technical Requirements for Site Remediation NJAC* 7:26E-6.4(b) through May 2011 [NJDEP, 1993b], and per the *Fill Material Guidance for SRP Sites Version 3.0* [NJDEP, 2011c; NJDEP, 2015] as of May 2011). Therefore, the material was acceptable for on-site use.

In addition, AECOM implemented a stringent visual inspection process, by on-site AECOM personnel, to verify the quality of the backfill. Visual inspection criteria included the size of the individual stones, the presence of foreign debris, the ratio of fines in the material, and significant differences in color.

7.6 Identification of Required Permits and Authorizations

The permits and approvals obtained by PPG for the RA at Site 114 are listed below.

- SESCP approvals from Hudson-Essex-Passaic County Soil Conservation District.
- Notice of Non-Applicability, Discharge to Surface Water General Permit for Construction Activity - Stormwater (5G3), NJDEP, Division of Water Quality.
- Construction Permit Notice – Trailers, City of Jersey City, Department of Housing, Economic Development and Commerce.

- Construction Permit Notice – Groundwater Treatment System, City of Jersey City, Department of Housing, Economic Development and Commerce.
- PVSC Sewer Use Permit #31630010.
- Fire Safety Permits, Jersey City Fire Department.
- Water Use Registration, NJDEP, Division of Water Supply.
- Dewatering Permit-By-Rule – Southwest Area, NJDEP, Division of Water Supply & Geoscience.
- Dewatering Permit-By-Rule – Phase 1C, NJDEP, Division of Water Supply & Geoscience.
- Dewatering Permit-By-Rule – Phase 2B, NJDEP, Division of Water Supply & Geoscience.
- Flood Hazard Area Individual Permit for GA Group, NJDEP, Office of Dredging and Sediment Technology.
- Permit-By-Rule Discharge Authorization for Site-wide FerroBlack®-H Backfill Amendment, NJDEP, Site Remediation Program.
- Permit-By-Rule Discharge Approval for FerroBlack®-H Backfill Amendment within Former Morris Canal.
- Community Right-to-Know Survey for 2017, NJDEP.
- Registration of XRF, Radiation Survey, and Renewal, NJDEP, Division of Environmental Safety and Health.

The necessary permits were obtained from and approved by the state, local, and county agencies prior to initiation of the activities covered by the permits. Necessary permits and approvals are documented in **Appendix B**. Permits obtained by PSEG for work in Phase 2 will be provided in PSEG's Final RAR (Wood, pending submittal).

Local permits that are not included in **Appendix B** include local road closure and street opening permits (which were renewed approximately every 6 months).

8.0 Receptor Evaluation Update

The purpose of a receptor evaluation (RE) is to document the existence of human or ecological receptors, and the actions taken to protect those receptors, at contaminated sites. Pursuant to N.J.A.C. 7:25E-1.12, REs must include general site information, an evaluation of surrounding land use, a description of contamination, a discussion of groundwater use in the area, an evaluation of vapor intrusion potential, and an ecological evaluation.

The *Receptor Evaluation Report, Rev. 3, Non-Residential Chromate Chemical Production Waste Sites 114, 132, 133, 135, 137, 143 and 186 Jersey City, New Jersey,* dated March 20, 2012, was submitted to the NJDEP on March 23, 2012 (AECOM, 2012c). The Final Garfield Avenue Group RE/Ground Water RE/Baseline Ecological Evaluation Reports were submitted to the NJDEP on July 22, 2013. The updated RE form and required attachments are provided with this RAR.

9.0 Conclusions and Recommendations

9.1 Soil

This RAR documents that the soil RA for Site114 AOCs 114-1A, AOC 114-2, AOC 114-3, AOC 114-4A, AOC 114-4-B, and AOC 114-5 is effective in protecting public health and safety and the environment and remedial objectives have been achieved as follows:

AOC 114-1A: CCPW-impacted soil in Site 114

- Excavation of soil containing Cr^{+6} met the requirements specified in the NJDEP Memorandum entitled *Chromium Moratorium*, February 8, 2007 (the Chromium Policy) (NJDEP, 2007) in accordance with the *Updated Method to Determine Compliance with the Department's Chromium Policy, Garfield Avenue – Sites 114, 132, 133, 135, 137, and 143, Jersey City, NJ* (Method to Determine Compliance) (NJDEP, 2013b).
- Soil concentrations for CCPW metals, except for antimony, are in compliance with the CrSCC or SRS.
- Antimony remains in place at concentrations greater than the SRS in IRM #1 and Phase 1C (Block 21501, Lot 20) and is addressed through an engineering control (Clean Fill Soil Cap) and institutional controls (deed notice).
- Soil in the unsaturated zone has been removed and, therefore, DIGWSSLs do not apply.

AOC 114-2: MGP-impacted soil associated with the former MGP in the eastern portion of Site 114

- A majority of soil contaminated with OM/TM (MGP-impacted soil) has been excavated.
- Certain VOCs (benzene and 1,4-dichlorobenzene), and certain SVOCs (1-1'-biphenyl; 2-methylnaphthalene; 3+4-methylphenol; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(k)fluoranthene; dibenzo(a,h)anthracene; indeno(1,2,3-cd)pyrene; and naphthalene) remain in place at concentrations greater than the SRS and are addressed through an engineering control (Clean Fill Soil Cap) and institutional controls (deed notices).
- Soil in the unsaturated zone has been removed and, therefore, DIGWSSLs do not apply.

AOC 114-3: Historic fill material in soil in Site 114

- Historic fill has been removed from IRM#1 and Phases 1A, 1C, 2A, and 2B.
- Historic fill remains in place in Phase 1B (in portions of Block 21501, Lots 18, 19, and 20). Historic fill that may contain ash, cinders, brick, and glass is present in a portion of the property. This historic fill may include, but is not limited to, contaminants such as PAHs and metals at concentrations greater than unrestricted use standards. Historic fill remaining in place is addressed through an engineering control (Clean Fill Soil Cap) and institutional controls (deed notices).

- Soil in the unsaturated zone has been removed and, therefore, DIGWSSLs do not apply.

AOCs 114-4A and 114-4B: UST-impacted soil in Site 114

- Soil concentrations of EPH and TPH are in compliance with the EPH Remediation Criterion.
- Soil concentrations of VOCs, SVOCs, PCBs, and TAL metals are in compliance with the SRS.
- Soil in the unsaturated zone has been removed and, therefore, DIGWSSLs do not apply.

AOC 114-5: Soil impacted by other historical operations and land use in Site 114

- Soil concentrations for other metals, SVOCs, VOCs, PCBs, pesticides, EPH, and TPH not addressed in the other AOCs are in compliance with the SRS.
- Soil in the unsaturated zone has been removed and, therefore, DIGWSSLs do not apply.

On this basis, PPG, the responsible party, has demonstrated compliance with the applicable remediation requirements for the soil on Site 114 AOC 114-1A, AOC 114-2, AOC 114-3, AOC 114-4A, AOC 114-4-B, and AOC 114-5, and no further soil remediation is warranted for these AOCs. This RAR demonstrates compliance with the applicable remediation requirements for the soil on Site 114 (AOCs 114-1A, 114-2, 114-3, 114-4A, 114-4-B, and 114-5), and no further action with regard to the soil in AOCs 114-1A, 114-2, 114-3, 114-4A, 114-4-B, and 114-5 is needed (other than filing the deed notices and implementing the RAPs). PPG requests the closure of AOCs 114-1A, 114-2, 114-3, 114-4A, 114-4-B, and 114-5 by the NJDEP through the issuance of a Consent Judgment Compliance Letter.

9.2 Groundwater

This RAR only addresses the RA of soil at Site 114. The status of the GA Group Sites groundwater contamination and plans for groundwater RA are documented in the *Groundwater Remedial Investigation Report, Draft*, submitted on October 1, 2018 (AECOM, 2018d). A separate RAR will be prepared and submitted to document the groundwater RA at the GA Group Sites.

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Tables

Table 1-1
Areas of Concern and Remedial Action
Site 114, Garfield Avenue Group
PPG, Jersey City, New Jersey

AOC ID	AOC Name and Location	AOC Details	Remedial Action	Documentation of RA Complete
AOC 114-1A	CCPW-impacted soil in Site 114 (includes all of Site 114 except AOC 114-1B)	Location of former chromite ore processing facility (HCC Site 114). Contained fill consisting of CCPW and other materials impacted by Cr^{+6} and CCPW metals (antimony, chromium, nickel, thallium, vanadium). CCPW impacts were observed from ground surface to the underlying meadow mat or underlying un-impacted material.	Excavation In-situ Treatment in Phase 1B Engineering Controls (Clean Fill Soil Cap) for antimony in Block 21501, Lot 20 Institutional Controls (Deed Notice) for antimony in Block 21501, Lot 20	Site 114 RAR
AOC 114-1B	CCPW-impacted soils in portions of Grids A5B, A6B, A7B, and B7B within the Western Sliver	Location of former chromite ore processing facility (HCC Site 114). Contained fill consisting of CCPW and other materials impacted by Cr^{+6} and CCPW metals (antimony, chromium, nickel, thallium, vanadium). CCPW impacts were observed from ground surface to the underlying meadow mat or underlying un-impacted material.	Excavation In-situ Reductive Remediation described in the RAWP Addendum (Arcadis, 2018)	To be provided in separate document

Table 1-1
Areas of Concern and Remedial Action
Site 114, Garfield Avenue Group
PPG, Jersey City, New Jersey

AOC ID	AOC Name and Location	AOC Details	Remedial Action	Documentation of RA Complete
AOC 114-2	MGP-impacted soil associated with the former MGP in the eastern portion of Site 114 (Phase 2 area)	MGP-impacted soil from former PSEG MGP facility.	Excavation Engineering Controls (Clean Fill Soil Cap) for MGP-related materials in Phase 2 Institutional Controls (Deed Notice) for MGP-related materials in Phase 2	Site 114 RAR
AOC 114-3	Historic fill material in soil in Site 114 (includes all of Site 114)	Site 114, historic fill containing debris including ash, cinders, brick, slag, concrete, ceramic, wood chips, etc. Fill was found to a depth of approximately 0 to 20 ft below ground surface.	Excavation Engineering Controls (Clean Fill Soil Cap) in areas where historic fill remains in place (Phase 1B) Institutional Controls (Deed Notice) in areas where historic fill remains in place (Phase 1B)	Site 114 RAR
AOC 114-4A	UST-impacted soil in Site 114, IRM #1, in Grid B1B and Grids E3B/E4B	Two USTs, a 2,000-gallon UST (Tank No. 0001) in Grid B1B and 1,000-gallon UST (Tank No. 0002) in Grids E3B/E4B were identified in 2010/2011.	Excavation	Site 114 RAR

Table 1-1
Areas of Concern and Remedial Action
Site 114, Garfield Avenue Group
PPG, Jersey City, New Jersey

AOC ID	AOC Name and Location	AOC Details	Remedial Action	Documentation of RA Complete
AOC 114-4B	UST-impacted soil in Site 114, in Phase 1B, Grid G1A and Grid B10A	A 500-gallon UST (Tank No. 0003) in Grid G1A and a 2,000-gallon UST (Tank 0004) in Grid B10A were uncovered in 2012.	Excavation	Site 114 RAR
AOC 114-5	Soil impacted by other historical operations and land use in Site 114 (includes all of Site 114)	Constituents from other historical operations and land use at Site 114 that are not covered by the other AOCs.	Excavation	Site 114 RAR
GA Group Groundwater	Groundwater impacted by historical operations and land use at Site 114 and CCPW and MGP groundwater impacts on other GA Group Sites	Groundwater impacted by identified contaminants of concern.	To be determined	To be provided in separate document

Notes:

AOC	Area of Concern
CCPW	Chromite Chemical Production Waste
Cr^{+6}	hexavalent chromium
ft	feet
GA	Garfield Avenue
HCC	Hudson County Chromate
IRM	Interim Remedial Measure
MGP	manufactured gas plant
PSEG	Public Service Electric and Gas Company
RA	Remedial Action
RAWP	Remedial Action Work Plan
RAR	Remedial Action Report
UST	underground storage tank

Table 3-1A
Soil Remediation Standards/Criteria - Hexavalent Chromium and CCPW Metals
Site 114, Garfield Avenue Group
PPG, Jersey City, New Jersey

Constituent	CrSCC (mg/kg)	RDCSRS (mg/kg)	RDCSRS-GAG[1] (mg/kg)	NRDCSRS (mg/kg)
HEXAVALENT CHROMIUM	20	N/A	N/A	N/A
ANTIMONY	N/A	31	N/A	450
CHROMIUM (TOTAL)[2]	N/A	120,000	N/A	N/A
NICKEL	N/A	1,600	N/A	23,000
THALLIUM	N/A	N/A	N/A	N/A
VANADIUM	N/A	N/A	390	1,100

Notes:

[1] RDCSRS-GAG is an alternative remediation standard approved by the NJDEP on December 28, 2016 (NJDEP, 2016).

[2] There is currently no NJDEP SRS and no NJDEP SCC for total chromium. Therefore, total chromium results are compared to the interim NJDEP Residential SCC for trivalent chromium of 120,000 mg/kg as the cleanup criteria for soil at the Garfield Avenue Group Sites. There is no non-residential SCC for trivalent chromium.

CCPW - Chromate Chemical Production Waste

CrSCC - Chromium Soil Cleanup Criteria

GAG - Garfield Avenue Group

mg/kg - milligrams per kilogram

N/A - not available

NJDEP - New Jersey Department of Environmental Protection

NRDCSRS - Non-Residential Direct Contact Soil Remediation Standard

RDCSRS - Residential Direct Contact Soil Remediation Standard

SCC - Soil Cleanup Criteria

SRS - Soil Remediation Standard

Table 3-1B
Soil Remediation Standards/Criteria - Non-CCPW Metals
Site 114, Garfield Avenue Group
PPG, Jersey City, New Jersey

Constituent	NRDCSRS (mg/kg)	RDCSRS (mg/kg)
ALUMINUM	N/A	78,000
ARSENIC	19	19
BARIUM	59,000	16,000
BERYLLIUM	140	16
BORON	N/A	N/A
CADMIUM	78	78
CALCIUM METAL	N/A	N/A
COBALT	590	1,600
COPPER	45,000	3,100
CYANIDE	680	47
CYANIDE REACTIVITY	N/A	N/A
IRON	N/A	N/A
LEAD	800	400
MAGNESIUM	N/A	N/A
MANGANESE	5,900	11,000
MERCURY	65	23
POTASSIUM	N/A	N/A
SELENIUM	5,700	390
SILVER	5,700	390
SODIUM	N/A	N/A
SULFUR	N/A	N/A
ZINC	110,000	23,000

Notes:
CCPW - Chromate Chemical Production Waste
mg/kg - milligrams per kilogram
N/A - not available
NRDCSRS - Non-Residential Direct Contact Soil Remediation Standard
RDCSRS - Residential Direct Contact Soil Remediation Standard

Table 3-1C
Soil Remediation Standards/Criteria - PCBs
Site 114, Garfield Avenue Group
PPG, Jersey City, New Jersey

Constituent	NRDCSRS (mg/kg)	RDCSRS (mg/kg)
PCB 1016	1	0.2
PCB 1221	1	0.2
PCB 1232	1	0.2
PCB 1242	1	0.2
PCB 1248	1	0.2
PCB 1254	1	0.2
PCB 1260	1	0.2
PCB 1262	1	0.2
PCB 1268	1	0.2

Notes:
mg/kg - milligrams per kilogram
NRDCSRS - Non-Residential Direct Contact Soil Remediation Standard
PCB - polychlorinated biphenyl
RDCSRS - Residential Direct Contact Soil Remediation Standard

Table 3-1D
Soil Remediation Standards/Criteria - Pesticides
Site 114, Garfield Avenue Group
PPG, Jersey City, New Jersey

Constituent	NRDCSRS (mg/kg)	RDCSRS (mg/kg)
4,4'-DDD	13	3
4,4'-DDE	9	2
4,4'-DDT	8	2
ALDRIN	0.2	0.04
ALPHA-BHC	0.5	0.1
ALPHA-CHLORDANE	1	0.2
BETA-BHC	2	0.4
CHLORDANE	1	0.2
DELTA-BHC	N/A	N/A
DIELDRIN	0.2	0.04
ENDOSULFAN SULFATE	6,800	470
ENDOSULFAN-I	6,800	470
ENDOSULFAN-II	6,800	470
ENDRIN	340	23
ENDRIN ALDEHYDE	N/A	N/A
ENDRIN KETONE	N/A	N/A
GAMMA-BHC (LINDANE)	2	0.4
GAMMA-CHLORDANE	1	0.2
HEPTACHLOR	0.7	0.1
HEPTACHLOR EPOXIDE	0.3	0.07
METHOXYCHLOR	5,700	390
TOXAPHENE	3	0.6

Notes:
mg/kg - milligrams per kilogram
N/A - not available
NRDCSRS - Non-Residential Direct Contact Soil Remediation Standard
RDCSRS - Residential Direct Contact Soil Remediation Standard

Table 3-1E
Soil Remediation Standards/Criteria - SVOCs
Site 114, Garfield Avenue Group
PPG, Jersey City, New Jersey

Constituent	NRDCSRS (mg/kg)	RDCSRS (mg/kg)
1,2,4,5-TETRACHLOROBENZENE	N/A	N/A
1,2,4-TRICHLOROBENZENE	820	73
1,2-DICHLOROBENZENE	59,000	5,300
1,4-DICHLOROBENZENE	13	5
1,4-DIOXANE	N/A	N/A
1-1'-BIPHENYL	240	61
2,2'-OXYBIS(1-CHLOROPROPANE) [a]	67	23
2,3,4,6-TETRACHLOROPHENOL	N/A	N/A
2,4,5-TRICHLOROPHENOL	68,000	6,100
2,4,6-TRICHLOROPHENOL	74	19
2,4-DICHLOROPHENOL	2,100	180
2,4-DIMETHYLPHENOL	14,000	1,200
2,4-DINITROPHENOL	1,400	120
2,4-DINITROTOLUENE	3	0.7
2,6-DINITROTOLUENE	3	0.7
2-CHLORONAPHTHALENE	N/A	N/A
2-CHLOROPHENOL	2,200	310
2-METHYLNAPHTHALENE	2,400	230
2-METHYLPHENOL	3,400	310
2-NITROANILINE	23,000	39
2-NITROPHENOL	N/A	N/A
3,3'-DICHLOROBENZIDINE	4	1
3,5,5-TRIMETHYL-2-CYCLOHEXENE-1-ONE	2,000	510
3+4-METHYLPHENOL	340	31
3-NITROANILINE	N/A	N/A
4,6-DINITRO-2-METHYLPHENOL	68	6
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	37,000	3,400
ACENAPHTHYLENE	300,000	N/A
ACETOPHENONE	5	2
ANTHRACENE	30,000	17,000
ATRAZINE	2,400	210
BENZALDEHYDE	68,000	6,100
BENZO(A)ANTHRACENE	17	5
BENZO(A)PYRENE	2	0.5
BENZO(B)FLUORANTHENE	17	5
BENZO(G,H,I)PERYLENE	30,000	380,000
BENZO(K)FLUORANTHENE	170	45
BENZYL ALCOHOL	N/A	N/A
BENZYL BUTYL PHTHALATE	14,000	1,200
BIS(-2-CHLOROETHOXY)METHANE	N/A	N/A
BIS(2-CHLOROETHYL)ETHER	2	0.4
BIS(2-ETHYLHEXYL)PHTHALATE	140	35

Table 3-1E
Soil Remediation Standards/Criteria - SVOCs
Site 114, Garfield Avenue Group
PPG, Jersey City, New Jersey

Constituent	NRDCSRS (mg/kg)	RDCSRS (mg/kg)
CAPROLACTAM	340,000	31,000
CARBAZOLE	96	24
CHRYSENE	1,700	450
DIBENZO(A,H)ANTHRACENE	2	0.5
DIBENZOFURAN	N/A	N/A
DIETHYL PHTHALATE	550,000	49,000
DIMETHYL PHTHALATE	N/A	N/A
DI-N-BUTYLPHTHALATE	68,000	6,100
DI-N-OCTYL PHTHALATE	27,000	2,400
FLUORANTHENE	24,000	2,300
FLUORENE	24,000	2,300
HEXACHLORO-1,3-BUTADIENE	25	6
HEXACHLOROBENZENE	1	0.3
HEXACHLOROCYCLOPENTADIENE	110	45
HEXACHLOROETHANE	48	12
INDENO(1,2,3-CD)PYRENE	17	5
M-DICHLOROBENZENE	59,000	5,300
METHANAMINE, N-METHYL-N-NITROSO	0.7	0.7
NAPHTHALENE	17	6
NITROBENZENE	14	5
N-NITROSO-DI-N-PROPYLAMINE	0.3	0.2
N-NITROSODIPHENYLAMINE	390	99
P-CHLOROANILINE	N/A	N/A
PENTACHLOROPHENOL	3	0.9
PHENANTHRENE	300,000	N/A
PHENOL	210,000	18,000
P-NITROANILINE	N/A	N/A
PYRENE	18,000	1,700

Notes:

mg/kg - milligrams per kilogram

N/A - not available

NRDCSRS - Non-Residential Direct Contact Soil Remediation Standard

RDCSRS - Residential Direct Contact Soil Remediation Standard

SVOC - semi-volatile organic compound

[a] - Chemical name was changed by the Integrated Risk Information System (IRIS) on November 30, 2007 from bis(2-chloroisopropyl)ether to bis(2-chloro-1-methylethyl)ether (common name). This compound is also known as 2,2'-oxybis(1-chloropropane) (Chemical Abstracts Service index name). See the link at https://cfpub.epa.gov/ncea/iris/iris_documents/documents/subst/0407_summary.pdf, Section VIII, for "Synonyms" of this chemical.

Table 3-1F
Soil Remediation Standards/Criteria - VOCs
Site 114, Garfield Avenue Group
PPG, Jersey City, New Jersey

Constituent	NRDCSRS (mg/kg)	RDCSRS (mg/kg)
1,1,1-TRICHLOROETHANE	N/A	160,000
1,1,2,2-TETRACHLOROETHANE	3	1
1,1,2-TRICHLOROETHANE	6	2
1,1,2-TRICHLOROTRIFLUOROETHANE	N/A	N/A
1,1-DICHLOROETHANE	24	8
1,1-DICHLOROETHYLENE	150	11
1,2,3-TRICHLOROBENZENE	N/A	N/A
1,2,4-TRICHLOROBENZENE	820	73
1,2-DIBROMO-3-CHLOROPROPANE (DBCP)	0.2	0.08
1,2-DIBROMOETHANE(EDB)	0.04	0.008
1,2-DICHLOROBENZENE	59,000	5,300
1,2-DICHLOROETHANE	3	0.9
1,2-DICHLOROPROPANE	5	2
1,4-DICHLOROBENZENE	13	5
1,4-DIOXANE	N/A	N/A
2-BUTANONE (MEK)	44,000	3,100
4-METHYL-2-PENTANONE (MIBK)	N/A	N/A
ACETONE	N/A	70,000
BENZENE	5	2
BROMODICHLOROMETHANE	3	1
BROMOMETHANE	59	25
CARBON DISULFIDE	110,000	7,800
CARBON TETRACHLORIDE	4	2
CHLOROBENZENE	7,400	510
CHLOROBROMOMETHANE	N/A	N/A
CHLORODIBROMOMETHANE	8	3
CHLOROETHANE	1,100	220
CHLOROFORM	2	0.6
CHLOROMETHANE	12	4
CIS-1,2-DICHLOROETHENE	560	230
CIS-1,3-DICHLOROPROPENE	7	2
CYCLOHEXANE	N/A	N/A
DICHLORODIFLUOROMETHANE	230,000	490
DICHLOROMETHANE	230	46
ETHYLBENZENE	110,000	7,800
ISOPROPYLBENZENE	N/A	N/A
M+P-XYLENE	170,000	12,000
M-DICHLOROBENZENE	59,000	5,300
METHYL ACETATE	N/A	78,000
METHYL N-BUTYL KETONE	N/A	N/A
METHYLCYCLOHEXANE	N/A	N/A
METHYL-TERT-BUTYL ETHER	320	110
O-XYLENE	170,000	12,000
STYRENE (MONOMER)	260	90
TETRACHLOROETHENE	1,500	43
TOLUENE	91,000	6,300

Table 3-1F
Soil Remediation Standards/Criteria - VOCs
Site 114, Garfield Avenue Group
PPG, Jersey City, New Jersey

Constituent	NRDCSRS (mg/kg)	RDCSRS (mg/kg)
TRANS-1,2-DICHLOROETHENE	720	300
TRANS-1,3-DICHLOROPROPENE	7	2
TRIBROMOMETHANE	280	81
TRICHLOROETHYLENE	10	3
TRICHLOROFLUOROMETHANE	340,000	23,000
VINYL CHLORIDE	2	0.7
XYLENES	170,000	12,000

Notes:
mg/kg - milligrams per kilogram
N/A - not available
NRDCSRS - Non-Residential Direct Contact Soil Remediation Standard
RDCSRS - Residential Direct Contact Soil Remediation Standard
VOC - volatile organic compound

Table 3-1G
Soil Remediation Standards/Criteria - EPH and TPH
Site 114, Garfield Avenue Group
PPG, Jersey City, New Jersey

Constituent	EPH Soil Remediation Criterion (mg/kg)
EPH	
C10-C12 AROMATICS	1,700
C12-C16 ALIPHATICS	1,700
C12-C16 AROMATICS	1,700
C16-C21 ALIPHATICS	1,700
C16-C21 AROMATICS	1,700
C21-C36 AROMATICS	1,700
C21-C40 ALIPHATICS	1,700
C9-C12 ALIPHATICS	1,700
TOTAL ALIPHATICS	1,700
TOTAL AROMATICS	1,700
TOTAL EPH	1,700
TOTAL EPH (C9-C40)	1,700
TPH	
TPH-DRO (C10-C28)	1,700
TPH-GRO (C6-C10)	1,700

Notes:

DRO - diesel range organics

EPH - extractable petroleum hydrocarbons

GRO - gasoline range organics

mg/kg - milligrams per kilogram

TPH - total petroleum hydrocarbons

Table 5-1
Excavation, Backfill, and Restoration Dates by Phase
Site 114, Garfield Avenue Group
PPG, Jersey City, New Jersey

Site	Excavation Start	Excavation Complete	Backfill Start	Backfill Complete	Restoration Complete
IRM #1	7/19/2010	6/20/2014*	7/14/2010 (within test pits)	6/30/2014*	TBD
Phase 1A	4/18/11 (discontinued due to shoring in May 2011), restarted 3/08/2012	8/09/2012	5/16/2012	9/19/2012	1/31/2018
Phase 1B	7/09/2012	6/28/2013	9/10/2012	8/27/2014	
Phase 1C	4/30/2013	7/09/2014	10/24/2013	7/25/2014	
Phase 2A	12/26/2012	11/26/2013	3/01/2013**	1/17/2014**	
Phase 2B-1	5/09/2013	9/24/2014	8/01/2013	10/21/2014	
Phase 2B-2	1/10/2014	3/24/2014	3/25/2014	5/02/2014	
Phase 2B-3	10/25/2013	8/26/2014	2/21/2014	10/30/2014	
Phase 2B-4	12/30/2013	11/24/2014	4/15/2014	1/20/2015	

Notes:
IRM - Interim Remedial Measure
TBD - to be determined
*Excavation of IRM #1 was initially complete on 9/27/2011. Subsequently, there was additional excavation in the Western Sliver (3/18/2014 – 6/11/2014) and Northwest Grids (6/13/2014 - 6/20/2014), with backfill complete in the Western Sliver on 6/12/14 and in Northwest Grids on 6/30/2014. The date shown reflects the final date of excavation in the area.
**Phase 2A “Backfill Start” and “Backfill Complete” dates are based on the first and last dates that clean fill was delivered to the Site, rather than based on actual field activity dates.

Table 5-2
Field Change Notification Tracking Sheet
Site 114, Garfield Avenue Group
PPG, Jersey City, New Jersey

Field Change Notification No.	Date of Submittal	Description of Field Change Notification
IRM/FS 1	7/9/2010	Termination of Test Pits prior to 15 feet bgs when MGP tar material is encountered
IRM/FS 2	8/2/2010	Formula 480 - application on concrete stockpiles
IRM/FS 3	9/8/2010	Western IRM soil disposal procedures
IRM/FS 4	2/23/2011	Application of DustStar in lieu of poly tarps on stockpiles
1 SWTEP	4/12/2012	CCPW transportation procedures (MHF Facility)
SWTEP 1	5/7/2012	Total chromium no longer required on pit bottom samples (10% only)
SWTEP 2	5/21/2012	Termination of excavation before meadow mat
SWTEP 3	6/22/2012	Relocation of Soil Stockpile Area
SWTEP 4	7/9/2012	SWTEP CCPW excavation change
SWTEP 5	8/14/2012	New backfill source added: Liberty Aggregates, 50 Caven Point Avenue, Jersey City, NJ
SWTEP 6	8/14/2012	Variance from Approved SWTEP's Goals for Excavation in Grid L5B at PPG Site 114
SWTEP 7	6/19/2013	New backfill source added: Tilcon, 625 Mount Hope Rd, Wharton, NJ
SWTEP 7 (Rev 1)	7/3/2013	New backfill source added: Tilcon, Broad Street, Pompton Lakes, NJ
GA Group 8	9/13/2013	Backfill Process Improvements
GA Group 9	11/11/2013	Seep Sump System Removal
GA Group 9A	7/16/2014	Seep Sump System Removal
GA Group 10	12/2/2013	New backfill source added: Stavola, 810 Thompson Ave Bound Brook, NJ
GA Group 11	1/8/2014	New backfill source added: Weldon, 1 New Providence Road, Watchung, NJ
GA Group 12	1/10/2014	Re-excavation of Grids B8B and C8B in IRM #1
GA Group 12A	2/18/2014	Re-excavation of Grids B8B, C8B, and B9B in IRM #1
GA Group 12B	5/23/2014	Re-excavation of Grids B8B, C8B, and B9B in IRM #1
GA Group 13	1/30/2014	Application of Quicklime as a soil drying agent
GA Group 14	2/27/2014	Phase 3A Excavation and Backfill Traffic Routes
GA Group 15	3/12/2014	FerroBlack®-H Dosage Option in Phase 2B-2, 3A, 3B, and 3C Areas
GA Group 16	6/27/2014	Reduction in Frequency of Virgin Backfill Sampling

Table 5-2
Field Change Notification Tracking Sheet
Site 114, Garfield Avenue Group
PPG, Jersey City, New Jersey

Field Change Notification No.	Date of Submittal	Description of Field Change Notification
GA Group 16A	7/24/2015	Reduction in Frequency of Quarry/Mine Backfill Sampling Requirement, Updated Fill Guidance
GA Group 17	7/8/2014	Process to Maintain Competency of Carteret Avenue

Notes:

bgs - below ground surface

CCPW - Chromate Chemical Production Waste

FS - feasibltiy study

GA Group - Garfield Avenue Group

IRM - Interim Remedial Measure

MGP - manufactured gas plant

MHF - MHF Services

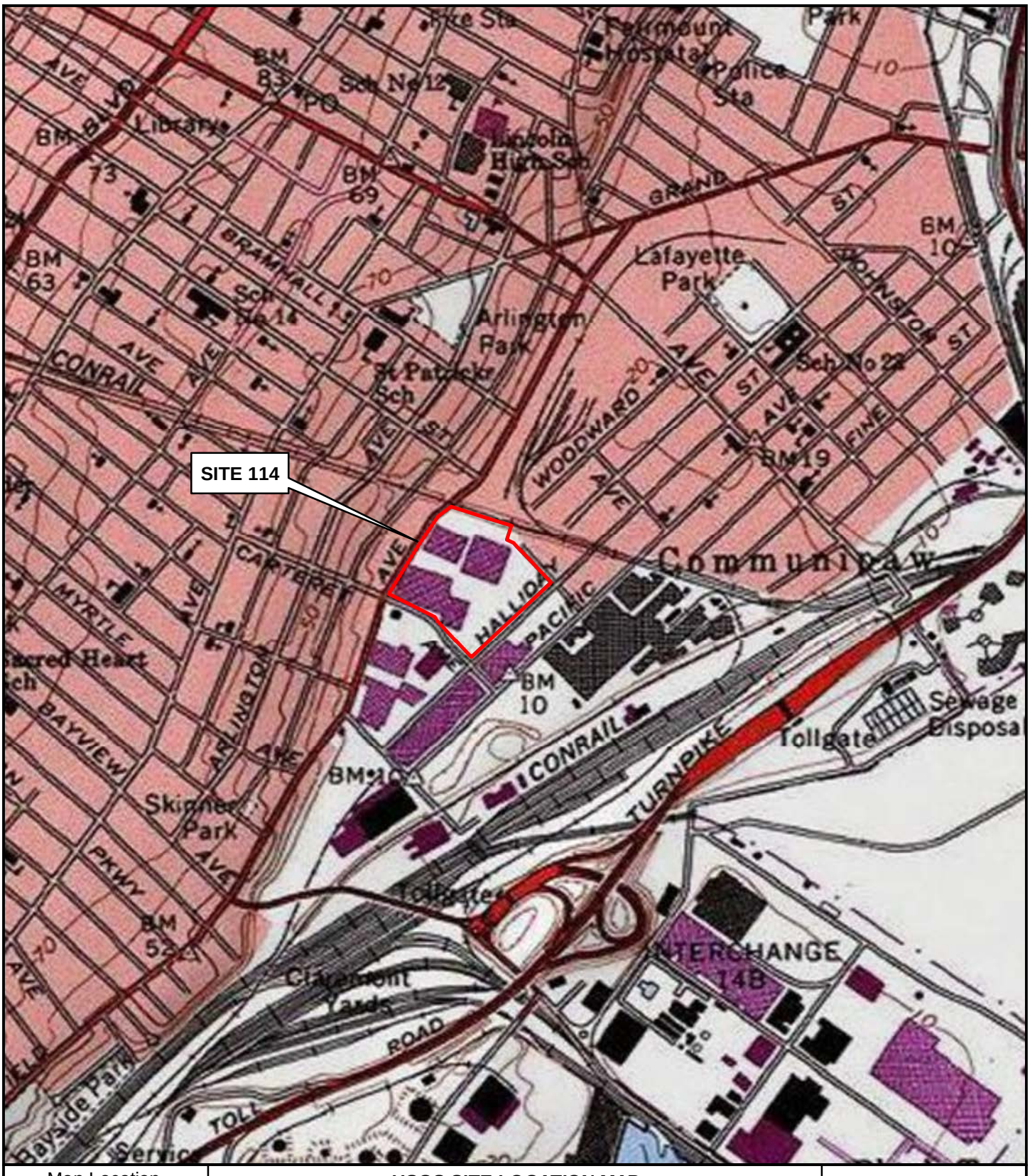
NJ - New Jersey

No. - Number

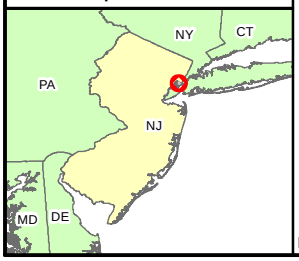
Rev - revision

SWTEP - Southwest Technical Execution Plan

Figures



Map Location



USGS SITE LOCATION MAP

SITE 114
JERSEY CITY, HUDSON COUNTY, NEW JERSEY

0 250 500 1,000 1,500 2,000 2,500 3,000 Feet

0 50 100 200 300 400 500 600 700 800 Meters

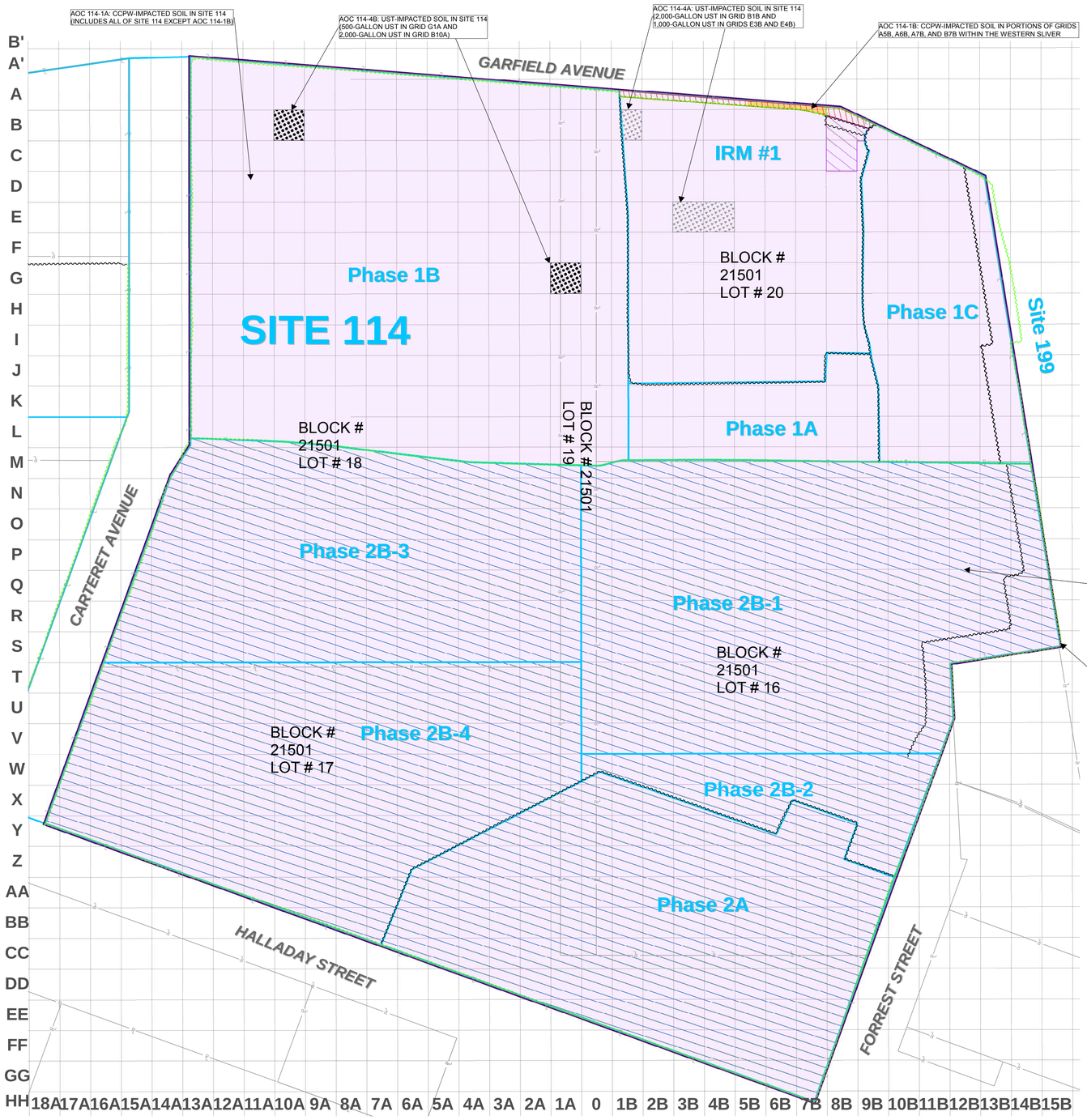
Image Source: United States Geological Survey (USGS) Topographic Quadrangle: Jersey City, NJ. Scale: 1:12,000

AECOM

Figure 1-1

Date: 11/28/2018

Project #: 60545281



ABBREVIATIONS:

AOC - Area of Concern

CCPW - Chromate Chemical Production Waste

IRM - Interim Remedial Measure

MGP - manufactured gas plant

UST - underground storage tank

GENERAL NOTES:

G1. 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).

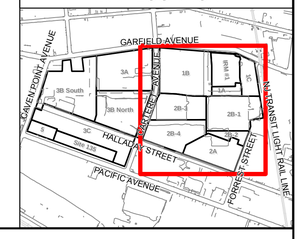
G2. Property lines are sourced from the "Deed Notice Boundary Survey Map, Tax Map Lot 16 Block 21501, PPG Industries Site 114, The City of Jersey City, Hudson Co., New Jersey" prepared by Borbas Surveying and Mapping, LLC, dated July 10, 2018.

G3. See Appendix D-1 for additional details regarding the Northwest Grids and Western Sliver.

LEGEND

- PROPERTY LINE
- GRID LAYOUT
- PHASE BOUNDARY
- IN PLACE SHEET PILE (AS OF DECEMBER 2018)
- REMOVED SHEET PILE
- NORTHWEST GRIDS
- WESTERN SLIVER
- AOC 114-1A: CCPW-IMPACTED SOIL IN SITE 114 (INCLUDES ALL OF SITE 114 EXCEPT AOC 114-1B)
- AOC 114-1B: CCPW-IMPACTED SOIL IN PORTIONS OF GRIDS A5B, A6B, A7B, AND B7B WITHIN THE WESTERN SLIVER
- AOC 114-2: MGP-IMPACTED SOIL ASSOCIATED WITH THE FORMER MGP IN THE EASTERN PORTION OF SITE 114
- AOC 114-3: HISTORIC FILL MATERIAL IN SOIL IN SITE 114 (INCLUDES ALL OF SITE 114)
  AOC 114-5: SOIL IMPACTED BY OTHER HISTORICAL OPERATIONS AND LAND USE IN SITE 114 (INCLUDES ALL OF SITE 114)
- AOC 114-4A: UST-IMPACTED SOIL IN SITE 114 (2,000-GALLON UST IN GRID B1B AND 1,000-GALLON UST IN GRIDS E3B AND E4B)
- AOC 114-4B: UST-IMPACTED SOIL IN SITE 114 (500-GALLON UST IN GRID G1A AND 2,000-GALLON UST IN GRID B10A)

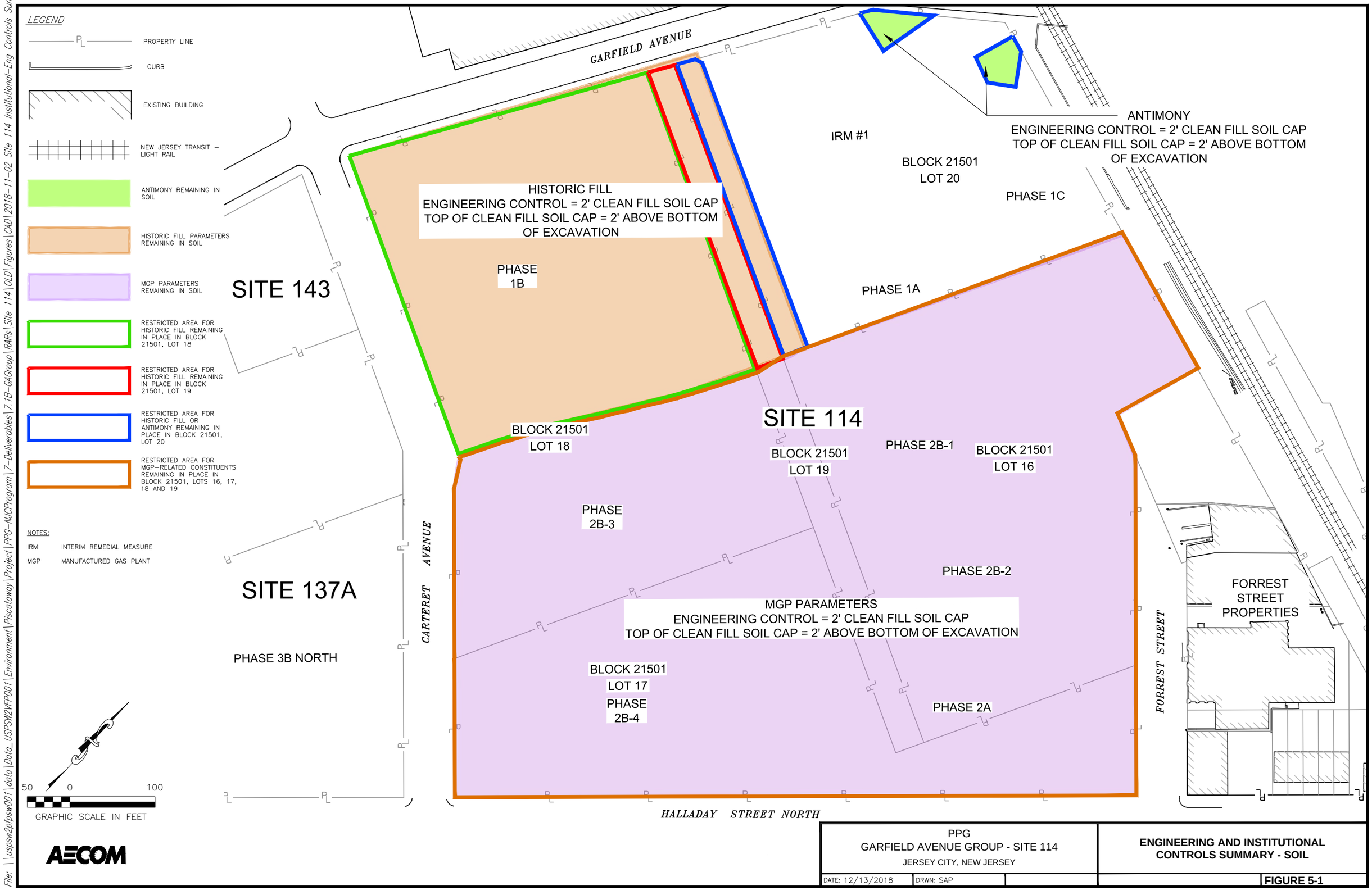
MAP LOCATION



0 20 40 60 80 100 120 140 160 Feet

AECOM

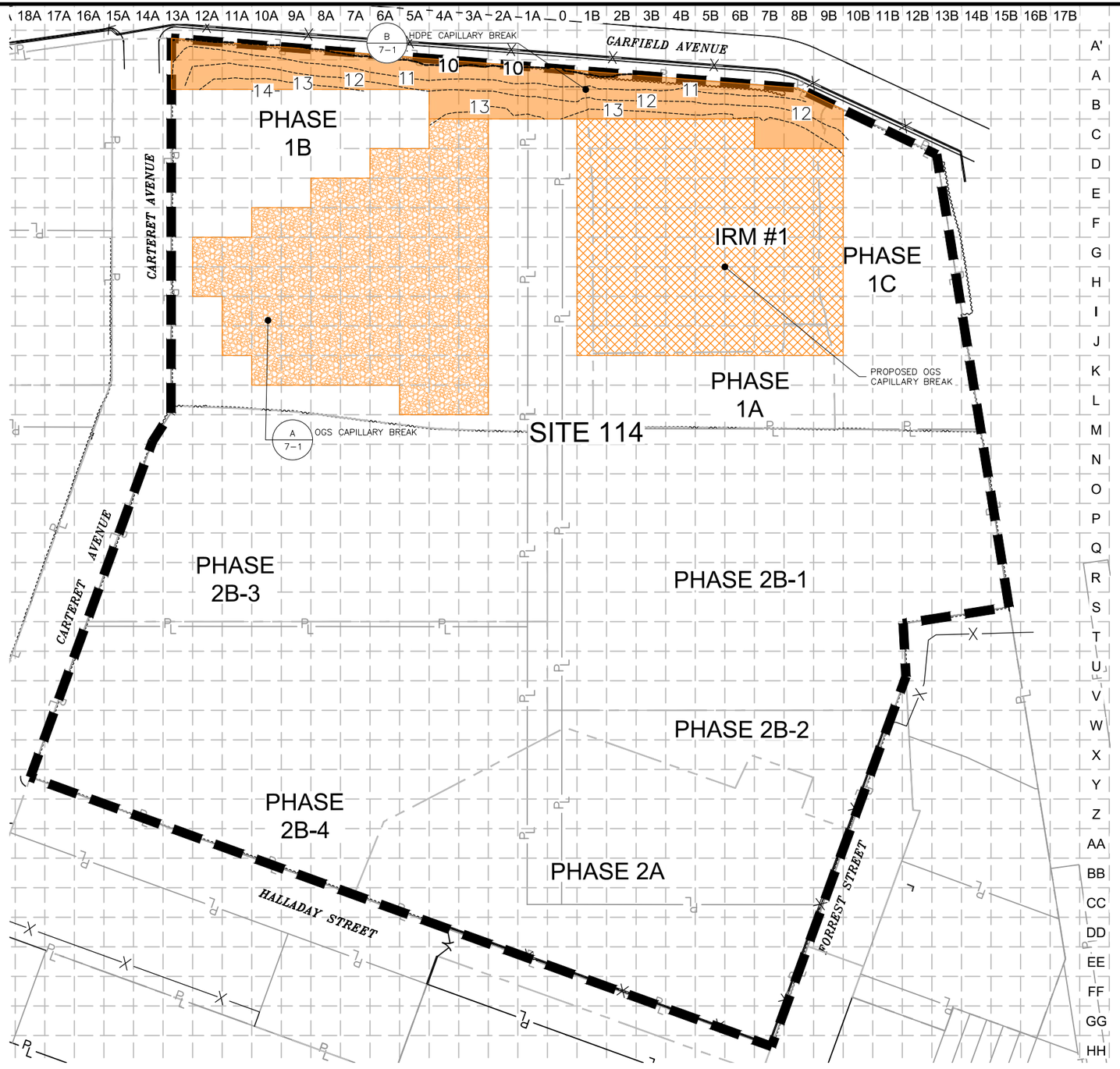
PPG SITE 114 GARFIELD AVENUE GROUP JERSEY CITY, NEW JERSEY			Site Plan for Site 114	
DATE: 12/19/2018				FIGURE 1-2



AECOM

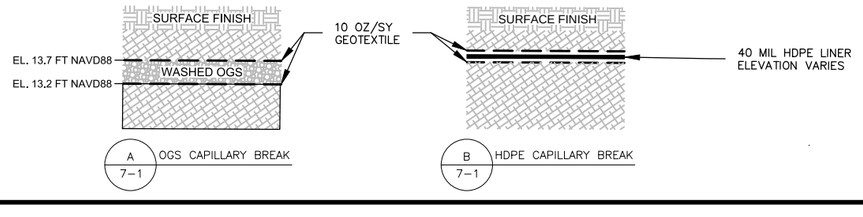
PPG GARFIELD AVENUE GROUP - SITE 114 JERSEY CITY, NEW JERSEY			**ENGINEERING AND INSTITUTIONAL CONTROLS SUMMARY - SOIL**
DATE: 12/13/2018	DRWN: SAP		**FIGURE 5-1**

File: \\uspsw2pfpsw001\data\Data_USPSW2VFP001\Environment\Piscataway\Project\PPG-NJCProgram\7-Deliverables\7.1B-CAGroup\PARs\Site 114\OLD\Figures\CAD\2018-11-02 Site 114 Institutional-Eng Controls Summary



LEGEND

- PROPOSED OGS CAPILLARY BREAK
- EXTENT OF OGS CAPILLARY BREAK
- EXTENT OF HDPE CAPILLARY BREAK
- SITE 114 BOUNDARY
- PHASE BOUNDRY
- PROPERTY LINE
- IN PLACE SHEET PILE AS OF APRIL 2018
- CURB
- DEPRESSED CURB
- 5 HDPE LINER AS-BUILT SURFACE CONTOURS 1' INTERVALS 5' INDEX
- 1



NOTES:
EL. - ELEVATION (FT NAVD88)
FT NAVD88 - FEET IN THE NORTH AMERICAN VERTICAL DATUM OF 1988
HDPE - HIGH DENSITY POLYETHYLENE
OZ/SY - OUNCES PER SQUARE YARD
OGS - OPEN GRADE STONE

1. AS OF JULY 2019, THE PROPOSED OGS LINER IN IRM #1 HAS NOT YET BEEN PLACED BECAUSE RESTORATION OF IRM #1 IS NOT COMPLETE DUE TO ACTIVE GROUNDWATER REMEDIATION ACTIVITIES. PRIOR TO THE FINAL RESTORATION, THE GROUNDWATER CONDITIONS WILL BE RE-EVALUATED TO DETERMINE IF THE PROPOSED CAPILLARY BREAK IS NECESSARY.

NORTH
NEW JERSEY STATE PLANE COORDINATE SYSTEM NAD 83

AECOM

60 0 120
GRAPHIC SCALE IN FEET

PPG
GARFIELD AVENUE GROUP
JERSEY CITY, NEW JERSEY

DATE: 07/24/2019 | DRWN: JLL

CAPILLARY BREAK EXTENT AND CROSS-SECTION SITE 114

FIGURE 7-1