



Prepared for:
PPG
Monroeville, PA

Prepared by:
AECOM
Chelmsford, MA
Project #: 60545281
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Remedial Action Report Halladay Street South (AOC HSS-1A and AOC HSS-2A) Soil Final (Revision 2)

NJDEP Program Interest Number: G000005480

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

Contents

List of Acronyms and Abbreviations

Regulatory Cross Reference Table

Executive Summary	ES-1
1.0 Introduction.....	1-1
2.0 Summary of Soil Remedial Investigation Findings and Recommendations	2-1
2.1 Summary of Soil Remedial Investigation Findings	2-1
2.2 Physical Setting of the Site	2-2
2.2.1 Topography	2-3
2.2.2 Regional Geology.....	2-3
2.2.3 Halladay Street South Geology	2-3
2.2.4 Hydrogeology.....	2-4
2.3 Recommended Remedial Action.....	2-5
3.0 Identification of Applicable Remedial Standards/Criteria.....	3-1
3.1 Regulatory Requirements, Guidance, and Alternative/Site-Specific Determinations	3-1
3.2 Soil Remediation Standards/Criteria	3-2
4.0 Summary of Pre-Remedial Action Design Activities	4-1
4.1 Summary of the Remedial Action Work Plan (Soil)	4-1
4.2 Summary of the Technical Execution Plan and Related Activities.....	4-3
4.2.1 Proposed Terminal Excavation Elevations and Pre-Design Investigation	4-3
4.2.2 Technical Execution Plan	4-5
5.0 Description of the Remedial Action	5-1
5.1 Pre-Construction Activities.....	5-2
5.2 Excavation.....	5-4
5.3 Post-Excavation Soil Sampling	5-5
5.3.1 LSRP Program Sampling.....	5-6
5.4 Institutional and Engineering Controls	5-6
5.5 Field Change Notifications.....	5-7

6.0 Reliability of Data: Data Validation and Usability	6-1
6.1 Data Validation	6-1
6.2 Data Usability Assessment	6-2
6.2.1 Precision.....	6-3
6.2.2 Accuracy.....	6-3
6.2.3 Representativeness.....	6-5
6.2.4 Comparability	6-5
6.2.5 Completeness.....	6-5
6.2.6 Sensitivity	6-6
6.2.7 Data Quality/Data Usability Conclusions.....	6-6
7.0 Documentation of the Protectiveness of the Remedial Action	7-1
7.1 As-Built Diagrams	7-2
7.2 Description of Site Restoration Activities	7-2
7.3 Total Remedial Action Cost	7-2
7.4 Documentation of Waste Generation and Disposal.....	7-3
7.5 Documentation of Source, Type, Quantities, and Location of Fill.....	7-4
7.6 Identification of Required Permits and Authorizations	7-4
8.0 Receptor Evaluation Update.....	8-1
9.0 Conclusions and Recommendations.....	9-1
9.1 Soil.....	9-1
9.2 Groundwater.....	9-1
10.0 References	10-1

List of Tables

Table 1-1	Areas of Concern
Table 3-1	Soil Remediation Standards/Criteria
Table 5-1	Cr ⁶ Analytical Results for In-Place Soil Compared to Chromium Soil Cleanup Criterion
Table 5-2	CCPW Metals Analytical Results for In-Place Soil Compared to Soil Remediation Standards
Table 5-3	Benzene and Ethylbenzene Analytical Results for In-Place Soil Compared to Soil Remediation Standards
Table 5-4	Select PAH Analytical Results for In-Place Soil Compared to Soil Remediation Standards
Table 5-5	Field Change Notification Tracking Sheet

List of Figures

Figure 1-1	USGS Site Location Map
Figure 1-2	Site Plan
Figure 5-1A	Halladay Street South (Column 38A to 46A) Sample Map for Cr ⁶ Compared to Chromium Soil Cleanup Criterion
Figure 5-1B	Halladay Street South (Column 29A to 37A) Sample Map for Cr ⁶ Compared to Chromium Soil Cleanup Criterion
Figure 5-1C	Halladay Street South (Column 20A to 28A) Sample Map for Cr ⁶ Compared to Chromium Soil Cleanup Criterion
Figure 5-2A	Halladay Street South (Column 38A to 46A) Sample Map for CCPW Metals Compared to Soil Remediation Standards
Figure 5-2B	Halladay Street South (Column 29A to 37A) Sample Map for CCPW Metals Compared to Soil Remediation Standards
Figure 5-2C	Halladay Street South (Column 20A to 28A) Sample Map for CCPW Metals Compared to Soil Remediation Standards
Figure 5-3A	Halladay Street South (Column 38A to 46A) Sample Map for Benzene and Ethylbenzene Compared to Soil Remediation Standards
Figure 5-3B	Halladay Street South (Column 29A to 37A) Sample Map for Benzene and Ethylbenzene Compared to Soil Remediation Standards
Figure 5-3C	Halladay Street South (Column 20A to 28A) Sample Map for Benzene and Ethylbenzene Compared to Soil Remediation Standards
Figure 5-4A	Halladay Street South (Column 38A to 46A) Sample Map for Select PAHs Compared to Soil Remediation Standards
Figure 5-4B	Halladay Street South (Column 29A to 37A) Sample Map for Select PAHs Compared to Soil Remediation Standards

Figure 5-4C Halladay Street South (Column 20A to 28A) Sample Map for Select PAHs Compared to Soil Remediation Standards

List of Appendices

- Appendix A Historical Water Table Elevations
- Appendix B Permits and Approvals
- Appendix C Well Decommissioning Records
- Appendix D Laboratory Analytical Reports
 - D-1 Laboratory Analytical Reports
 - D-2 Documentation of EDD Submittal
- Appendix E Data Validation Reports
- Appendix F As-Built Diagrams
- Appendix G Notice in Lieu of Deed Notice
- Appendix H Boring Logs
- Appendix I Hazardous Waste Disposal Documentation
- Appendix J Non-Hazardous Waste Disposal Documentation
- Appendix K Clean Fill Documentation
 - K-1 Clean Fill Documentation - Dense-Graded Aggregate and Open Grade Stone Load Reports
 - K-2 Quarry Information and Analytical Data Reports

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
CCPW	Chromate Chemical Production Waste
CID	Case Inventory Document
CMAA	Construction Manager as Agent
COC	chain-of-custody
Cr ⁺⁶	hexavalent chromium
CrSCC	Chromium Soil Cleanup Criteria
DCP	Dust Control Plan
DGA	dense-graded aggregate
DIGWSSL	Default Impact to Groundwater Soil Screening Level
EDD	electronic data deliverable
EI.	elevation
ENTACT	ENTACT Environmental Services of Latrobe, Pennsylvania
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
HASP	Health and Safety Plan
HCC	Hudson County Chromate
IGWSRS-GAG	Impact to Groundwater Soil Remediation Standard - Garfield Avenue Group
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

NJDOT	New Jersey Department of Transportation
NJGIN	New Jersey Geographic Information Network
OSHA	Occupational Safety and Health Administration or Act
PAH	polycyclic aromatic hydrocarbon
PCBs	polychlorinated biphenyls
PDI	pre-design investigation
PI	Program Interest
PM	Project Manager
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
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
TEE	Terminal Excavation Elevation
TEP	Technical Execution Plan
TOC	total organic carbon
TRSR	Technical Requirements for Site Remediation
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	volatile organic compound
Weston	Weston Solutions, Inc.

Regulatory Cross Reference Table

**Regulatory Cross Reference Table
Remedial Action Report
Halladay Street South, Garfield Avenue Group
PPG, Jersey City, New Jersey**

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	
		Report	Location
N.J.A.C. 7:26E-5.7	Remedial Action Report Requirements		
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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) 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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) Soil	throughout
5.7(b) 1	The general reporting requirements in N.J.A.C. 7:26E-1.6;	Remedial Action Report Halladay Street South (AOC HSS-1A and AOC HSS-2A) Soil	see below
1.6(a) 1	Submit all documents, forms, spreadsheets and worksheets required in this chapter;	Remedial Action Report Halladay Street South (AOC HSS-1A and AOC HSS-2A) Soil	The Cover/Certification Form is included with the Site Remediation Program 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.
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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) Soil	The Cover/Certification Form is included with the Regulatory Forms. The work is being conducted under direct oversight so it does not require certification by a Licensed Site Remediation Professional.
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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) 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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) 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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) Soil	Electronic data deliverable provided to NJDEP for data used to document compliance with remedial action goals; receipts of submittal included in Appendix D - Laboratory Analytical Reports
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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) Soil	Figure 1-2
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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) Soil	Section 2.2 - Physical Setting of the Site

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Regulation	Description	Document Location	
		Report	Location
N.J.A.C. 7:26E-5.7	Remedial Action Report Requirements		
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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) 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 5.3 - Post-Excavation Soil Sampling
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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) Soil	Not Applicable
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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) Soil	Not Applicable
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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) 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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) Soil	Tables 5-1A through 5-4C - Analytical Results for In-Place Soil
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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) Soil	i. Appendix H - Boring Logs ii and iii. Not Applicable
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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) Soil	i. Site Location - Figure 1-1 Areas of Concern - Figure 1-2 Land Use - Regulatory Forms - Receptor Evaluation; ii. Sample Location Maps: Figures 5-1 through 5-4 iii. Groundwater Maps - Not applicable

**Regulatory Cross Reference Table
Remedial Action Report
Halladay Street South, Garfield Avenue Group
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Regulation	Description	Document Location	
		Report	Location
N.J.A.C. 7:26E-5.7	Remedial Action Report Requirements		
1.6(b) 9	A discussion of the usability of laboratory analytical data;	Remedial Action Report Halladay Street South (AOC HSS-1A and AOC HSS-2A) 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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) 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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) Soil	Regulatory Forms Receptor Evaluation and Section 8.0 - Receptor Evaluation Update
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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) 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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) 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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) 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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) Soil	Section 7.0 - Documentation of the Protectiveness of the Remedial Action
5.7(b) 7	A remedial action permit application prepared pursuant to N.J.A.C. 7:26C-7, if applicable;	Remedial Action Report Halladay Street South (AOC HSS-1A and AOC HSS-2A) Soil	The remedial action permit will be filed and submitted following approval of the Remedial Action Report and filing of the notice in lieu of deed notice.
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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) Soil	Section 7.0 - Documentation of the Protectiveness of the Remedial Action Appendix F - As-Built Diagrams
5.7(b) 9	A detailed description of site restoration activities, if applicable;	Remedial Action Report Halladay Street South (AOC HSS-1A and AOC HSS-2A) 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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) Soil	Section 7.3 - Total Remedial Action Cost
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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) Soil	Section 7.4 - Documentation of Waste Generation and Disposal Appendix I - Hazardous Waste Disposal Documentation Appendix J - 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 Halladay Street South (AOC HSS-1A and AOC HSS-2A) Soil	Section 7.5 - Documentation of Source, Type, Quantities, and Location of Fill Appendix K - Clean Fill Documentation
5.7(b) 13	A description of each permit required and obtained to implement the remedial action.	Remedial Action Report Halladay Street South (AOC HSS-1A and AOC HSS-2A) 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) and CCPW-impacted soil at Halladay Street South Grid Columns 20A through 41A (Area of Concern [AOC] HSS-1A), and for soil impacted by manufactured gas plant (MGP)-related constituents emanating from Site 114 in Halladay Street South Grid Columns 20A through 41A (AOC HSS-2A). Note that a small portion of Grid P41A is not included in AOCs HSS-1A and HSS-2A. Halladay Street South (the Site) 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 MGP previously owned by Public Service Electric and Gas Company (PSEG). Halladay Street South is tracked under the New Jersey Department of Environmental Protection (NJDEP) Site Remediation Program (SRP) Program Interest (PI) number G000005480 for Site 114.

Halladay Street South is located on Halladay Street between Carteret Avenue to the north and Caven Point Avenue to the south in Jersey City, New Jersey (NJ) (**Figure 1-2**). The southernmost portion of Halladay Street South, immediately adjacent to Caven Point Avenue, is considered part of Phase 3B South and will be addressed in a separate submission. Halladay Street South is bordered to the west by Site 137A (Block 21510, Lot 3 as identified 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_IV, last accessed in March 2019]), Site 137B (Block 21510, Lot 4), and Site 133 West (Block 21510, Lot 5), and to the east by Site 133 East (Block 21509, Lot 1). Site 114 is located to the northwest across Carteret Avenue. The total area encompassed by Halladay Street South is approximately 0.8 acres.

This RAR addresses only 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 is responsible for CCPW and CCPW-related impacts.

PPG and PSEG are jointly responsible for remediation of MGP parameters including those emanating from Site 114. 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 Tables 5-3 and 5-4, Figures 5-3A through 5-4C, As-Built Diagrams in Appendix F, and the Draft Notice in Lieu of Deed Notice in Appendix G. 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.

Constituents covered by this Halladay Street South RAR include:

- CCPW and hexavalent chromium (Cr⁺⁶);
- CCPW metals (antimony, total chromium, nickel, thallium, and vanadium);

- Select MGP-related semi-volatile organic compounds (SVOCs) (2-methylnaphthlene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-c,d)pyrene, and naphthalene); and
- Select MGP-related volatile organic compounds (VOCs) (benzene and ethylbenzene).

Under the ACO and JCO, PPG is not responsible for other constituents exceeding the NJDEP Soil Remediation Standards (SRS) or Default Impact to Groundwater Soil Screening Levels (DIGWSSLs) that may be present at the Site. Remediation of non-CCPW-related, non-emanating-from constituents is the responsibility of the property owner under the LSRP program.

The Case Inventory Document (CID) summarizes the presence of three AOCs for the Site. This RAR presents a summary of the implemented RA for AOC HSS-1A - CCPW-impacted soil in Halladay Street South Grid Columns 20A through 41A and for AOC HSS-2A - MGP-impacted soil in Halladay Street South Grid Columns 20A through 41A. Documentation of the RA for AOC HSS-1B - CCPW-impacted soil in Halladay Street South Grid Columns 42A to 47A plus a small portion of Grid P41A will be provided in a separate document. Groundwater impacted by CCPW and/or MGP-material throughout the GA Group Sites is being tracked under the Site 114 PI number G000005480, and is not included on the CID for Halladay Street South; documentation of the RA for groundwater for the GA Group Sites will be provided in a separate document.

Based on the findings of the Remedial Investigation (RI), the recommended RA for soil at the Site 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 Remedial Action Work Plan (RAWP) (see **Section 4.1** for the 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, Halladay Street South was initially identified as part of GA Group Phase 4, which included roadways within the GA Group area (**Figure 1-2**). Following revisions to the project's Master Schedule in October 2015, Halladay Street South was incorporated into Phase 3C (which included Site 133 East and Site 135 North). Remedial excavation at the Site began on May 26, 2015. Remedial excavation in Halladay Street South was performed concurrently with Site 133 East and was completed on October 22, 2015 for Phase 3C. In Phase 3C, backfilling was completed on July 29, 2016. Restoration activities were completed across the GA Group Sites, including Halladay Street South, between August 8, 2017 and January 31, 2018.

In accordance with the RAWP, following excavation, MGP-related constituents remaining in place at concentrations greater than the SRS are addressed through the placement of an engineering control (capping), institutional controls (a notice in lieu of deed notice), and a corresponding Remedial Action Permit (RAP).

Confirmation sampling results presented on figures and tables in this report indicate remedial objectives for AOC HSS-1A and AOC HSS-2A have been achieved as follows:

- 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, 2013).
- Soil concentrations for CCPW metals are in compliance with the CrSCC or SRS.
- Soil concentrations of select MGP-related SVOCs (2-methylnaphthalene, benzo(a)anthracene, benzo(b)fluoranthene, and indeno(1,2,3-c,d)pyrene) and select MGP-related VOCs (benzene and ethylbenzene) are in compliance with the SRS.
- Benzo(a)pyrene and dibenzo(a,h)anthracene remain in place at concentrations greater than the SRS at the southern end of the Site. It has been determined that these exceedances are associated with the presence of historic fill and not MGP operations and, therefore, do not fall under the purview of the ACO and the JCO. Therefore, PPG is not responsible for the remedy for historic fill impacts, which are the responsibility of the City of Jersey City since the historic fill impacts are within the public right-of-way.
- Naphthalene, emanating from Site 114, remains in place at concentrations greater than the SRS and is addressed by institutional controls (notice in lieu of deed notice) and an engineering control (clean fill cap).
- Soil in the unsaturated zone has been removed throughout AOC HSS-1A and AOC HSS-2A; therefore, the DIGWSSLs and/or the site-specific Impact to Groundwater Soil Remediation Standards for the GA Group (IGWSRS-GAGs) do not apply.

The soil RA for Halladay Street South AOC HSS-1A and AOC HSS-2A 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 Halladay Street South AOC HSS-1A and AOC HSS-2A, and no further action with regard to AOC HSS-1A and AOC HSS-2A soil is needed (other than filing the notice in lieu of deed notice and implementing of the RAP). PPG requests the closure of AOC HSS-1A and AOC HSS-2A 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) and CCPW-impacted soil, in the Halladay Street South Grid Columns 20A through 41A (Area of Concern [AOC] HSS-1A) and for soil impacted by manufactured gas plant (MGP)-related constituents emanating from Site 114 in Halladay Street South Grid Columns 20A through 41A (AOC HSS-2A). Halladay Street South (the Site) is one 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 Work MGP previously owned by Public Service Electric and Gas Company (PSEG). Halladay Street South is tracked under the New Jersey Department of Environmental Protection (NJDEP) Site Remediation Program (SRP) Program Interest (PI) number G000005480 for Site 114.

Halladay Street South is located on Halladay Street between Carteret Avenue to the north and Caven Point Avenue to the south in Jersey City, New Jersey (NJ) (**Figure 1-2**). The southernmost portion of Halladay Street South, immediately adjacent to Caven Point Avenue, is considered part of Phase 3B South and will be addressed in a separate submission. Halladay Street South is bordered to the west by Site 137A (Block 21510, Lot 3 as identified 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_IV, last accessed in March 2019]), Site 137B (Block 21510, Lot 4), and Site 133 West (Block 21510, Lot 5), and to the east by Site 133 East (Block 21509, Lot 1). Site 114 is located to the northwest across Carteret Avenue. The total area encompassed by Halladay Street South is approximately 0.8 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 Halladay Street South. Since its establishment in 2009, the master schedule has been revised several times. The most recent revision to the Master Schedule was finalized on January 24, 2019 (Riccio, 2019).

PPG and PSEG are jointly responsible for remediation of MGP parameters related to the former Halladay Street Gas Works MGP. PSEG, as the former Halladay Street Gas Works MGP operator, is the lead party for addressing these impacts.

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 Tables 5-3 and 5-4, Figures 5-3A through 5-4C, As-Built Diagrams in Appendix F, and the Draft Notice in Lieu of Deed Notice in Appendix G. 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.

Halladay Street South is currently vacant land owned by the City of Jersey City. Prior to remediation, the property consisted of a two-lane asphalted roadway underlain by underground water, combined sewer, and gas utility lines.

The Case Inventory Document (CID) summarizes the presence of three AOCs for soil, as presented on **Table 1-1**. As part of the Supplemental Soil Remedial Investigation Report for the Garfield Avenue Group Sites, contaminated soil within Halladay Street South were considered a single AOC (Halladay Street South - Soil) (AECOM, 2018b). As part of this RAR, the single soil AOC has been divided into three separate AOCs based on contaminants of concern and RA status. The survey limits of each AOC are shown on **Figure 1-2**. This RAR presents a summary of the implemented RA for AOC HSS-1A - CCPW-impacted soil in Halladay Street South Grid Columns 20A through 41A and for AOC HSS-2A - MGP-impacted soil in Halladay Street South Grid Columns 20A through 41A.

Documentation of the RA for additional AOCs will be provided in separate documents. Due to access concerns, the southern portion of Halladay Street South (Columns 42A through 47A) could not be fully excavated at the time of remediation as depicted on **Figure 1-2**. These grids are assigned to a separate AOC (AOC HSS-1B). Note that a small portion of Grid P41A falls in AOC HSS-1B. Groundwater impacted by CCPW and/or MGP material throughout the GA Group Sites is being tracked under PI number G000005480 for Site 114 (the location of the former Chromate Chemical Production Facility and MGP). Remediation of non-CCPW-related constituents and constituents not associated with the operation of the former Halladay Street Gas Works MGP is the responsibility of the property owner under the LSRP program. The CID included herein only reflects the remediated soil AOCs that PPG is responsible for associated with the ACO/JCO.

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 Remedial Investigation Work Plans (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).
- September 2006 *Remedial Investigation Work Plan – Sites 132, 133, 135, 137 and 143* (ENSR, 2006c).
- 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, 2011a).
- November 2011 *Draft Remedial Investigation Report – Soil Garfield Avenue Group Non-Residential CCPW Sites 114, 132, 133, 135, 137, 143 and 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, 2018a).

The 2012 RIR provides a detailed summary of the previous RI investigations throughout the GA Group Sites. No additional data specific to Halladay Street South was collected as part of the August 2018 SSRIR. The following is a summary of the information provided in the 2012 RIR with respect to Halladay Street South.

RI activities were conducted at Halladay Street South as part of investigation activities at Site 114 and the southern GA Group Sites (Sites 132, 133, 135, 137 and 143) 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).

Halladay Street South was initially targeted for RI activities by PPG because of its proximity to former waste stockpile areas located on Site 137 associated with the former chromite ore processing facility. 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 Site 114. The compounds present included volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), metals, and hexavalent chromium (Cr⁺⁶), as well as CCPW.

The RI activities identified the presence of Cr⁺⁶ in soil at Halladay Street South 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 Halladay Street South were limited to depths shallower than 20 feet (ft) below ground surface (bgs).

The RI activities identified the presence of CCPW metals in soil at Halladay Street South at concentrations greater than the most stringent NJDEP Soil Remediation Standards (SRS) and the NJDEP Default Impact to Groundwater Soil Screening Levels (DIGWSSLs). In general, CCPW metals exceedances, particularly antimony and vanadium, were coincident with Cr⁺⁶. Thallium 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 PSEG RI activities identified visible MGP-related materials in the northern portion of Halladay Street South. An emanating from Site 114 evaluation was conducted in September 2015 and it was determined that MGP-related compounds including benzene, ethylbenzene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno (1,2,3-c,d)pyrene, naphthalene, and 2-methylnaphthalene were likely emanating from Site 114 onto the northern portion of Halladay Street South (AECOM, 2015k; AECOM, 2017d).

2.2 Physical Setting of the Site

The GA Group Sites, including Halladay Street South, 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 Halladay Street South, 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 Upper New York Bay. Due to highly compacted surface soil 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. Halladay Street South has little topographic relief, with ground surface ranging from El. 11 to 12.5 ft NAVD88. However, just to the west of Garfield Avenue, the topography rises approximately 30 to 40 ft in elevation within several hundred yards of the Project Area, and to about El. 100 ft NAVD88 about a half-mile west of the Project Area. As of May 2018, the surface elevation of the Site following soil remediation and restoration ranges from El. 10 to 12 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 Halladay Street South Geology

Halladay Street South 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 soil 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 Halladay Street South from top to bottom include:

- A non-native fill layer (the shallow zone);
- Native soil 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 Halladay Street South 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 (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. Depths of the meadow mat range from approximately 10 to 21 ft bgs (AECOM, 2012a). Shallow soil (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, soil 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 soil range in thickness from approximately 56 to 77 ft, based on borings that extended to bedrock.

Excavation of the impacted miscellaneous fill at Halladay Street South took place between May 2015 and October 2015. 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 Halladay Street South AOC HSS-1A and AOC HSS-2A. 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 Sites 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 soil; 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 soil, 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 soil; 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 and Lockatong Formations (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 Halladay Street South was estimated to be El. 6.8 ft NAVD88 based on groundwater elevation measurements from five monitoring wells located on or adjacent Halladay Street South gauged between September 2007 and May 2018. The monitoring well locations and data are included in **Appendix A**.

2.3 Recommended Remedial Action

Based on the findings of the RI, the recommended RA for soil at the Site included the excavation and removal of visible CCPW and soil with concentrations of Cr⁺⁶ greater than the CrSCC. 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.

PPG was also responsible for remediation of select MGP-related SVOCs and select VOCs emanating from Site 114 at concentrations greater than the SRS or DIGWSSLs. 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.

Following excavation, MGP-related constituents remaining in place at concentrations greater than the SRS are addressed through the placement of an engineering control (capping), institutional controls (a notice in lieu of deed notice), and a corresponding Remedial Action Permit (RAP).

3.0 Identification of Applicable Remedial Standards/Criteria

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

The RAs described in the Remedial Action Work Plan (RAWP) (see **Section 4.1** for the 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, 2012c).
- 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 Mr. Thomas 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, 2013).
- 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 presents the site-specific Impact to Groundwater Soil Remediation Standards for the Garfield Avenue Group (IGWSRS-GAG) for antimony and nickel. The August 2018 SSRIR was approved by NJDEP on October 22, 2018 (NJDEP, 2018a).

3.2 Soil Remediation Standards/Criteria

For soil at Halladay Street South, under the ACO and JCO, PPG is responsible for CCPW, CCPW-related impacts, and MGP-related impacts emanating from Site 114 only and not for any other constituents at concentrations exceeding NJDEP SRS, DIGWSSL or IGWSRS-GAG that may be present at the Site. Remediation of non-CCPW-related, non-emanating from constituents is the responsibility of the property owner under the LSRP program. This RAR addresses only the soil impacts for which PPG is responsible.

The NJDEP SRS and other criteria relevant to the remediation at Halladay Street South are presented in **Table 3-1**.

Note that, because the excavation at Halladay Street South (AOC HSS-1A and AOC HSS-2A) was extended to below the average groundwater table as described in **Section 2.2.4.2**, the analytical results were not compared to the DIGWSSLs.

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 and soil with concentrations of Cr⁶ greater than the CrSCC.

For the purposes of planning and implementing the RA, Halladay Street South was initially identified as part of GA Group Phase 4 (roadways). As part of the October 2015 Master Schedule revisions, Halladay Street South was incorporated into Phase 3C, which included Site 133 East and Site 135 North. Excavation in Halladay Street South was conducted concurrently with excavation in Site 133 East. Documentation of the RA for soil at Site 133 East and Site 135 North is provided in a separate document.

4.1 Summary of the Remedial Action Work Plan (Soil)

Following the preparation and submittal of the RIR (AECOM, 2012a), AECOM (on behalf of PPG) prepared a RAWP. A summary of the RAWP submittal/approval history is as follows:

- 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 RAWP) (AECOM, 2012d).
- On May 11, 2012, NJDEP found the 2012 RAWP to be administratively complete and issued a Conditional Approval in a letter from Thomas J. Cozzi to M. 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, 2012b).
- 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 RAWP) (AECOM, 2014g), documenting compliance with the conditions of NJDEP's Conditional Approval.
- On February 28, 2018, Weston Solutions, Inc. (Weston), on behalf of NJDEP, issued an email that requested minor editorial changes to the Draft 2014 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 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 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 were 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 RAWP Rev. 4) (AECOM, 2018c).

- On October 10, 2018, on behalf of the City of Jersey City, ERFs provided concurrence on the Final RAWP Rev. 4 (ERFS, 2018b).
- On November 9, 2018, NJDEP approved the Final RAWP Rev. 4 (NJDEP, 2018b).

The overall objectives for Cr⁺⁶ and CCPW-impacted soil, as stated in the RAWP 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 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 HSS-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. Excavation and treatment of soil containing Cr⁺⁶ was to meet the Chromium Policy (NJDEP, 2007) by following the Method to Determine Compliance (NJDEP, 2013). 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.

Under the ACO and JCO, PPG was also responsible for remediation of select MGP-related SVOCs and VOCs emanating from Site 114 at concentrations greater than the SRS and DIGWSSLs (AOC HSS-2A). 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.

Following excavation, MGP-related constituents remaining in place at concentrations greater than the SRS were to be addressed through the placement of an engineering control (capping), institutional controls (a notice in lieu of deed notice), and a corresponding RAP.

Excavation areas were to be backfilled with soil suitable for residential, commercial, or other potential uses. In areas where deemed necessary, a capillary break was to be installed between groundwater and the ground surface to eliminate the possibility of chromate crystallization from impacted groundwater wicking to surface. As described in the *Capillary Break Design Final Report (Revision 2)* (AECOM, 2017f), it was determined that a capillary break was not required within the Halladay Street South AOC HSS-1A.

To improve the design of the 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 road ways; to obtain geotechnical data for 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 and sidewalls or sampling in soil borings prior to excavation (i.e., pre-excavation sampling) was to be conducted in excavation areas, with analysis for Cr⁺⁶. At Halladay Street South, where the TEE in adjacent grids varied by more than two feet, sidewall samples were to be collected every 30 linear ft and at two-ft depth intervals. Where excavation grids were enclosed by shoring or where the TEEs in adjacent grids varied by less than two ft, sidewall sampling was not required.

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

4.2 Summary of the Technical Execution Plan and Related Activities

4.2.1 Proposed Terminal Excavation Elevations and Pre-Design Investigation

Proposed TEEs for the Halladay Street South excavation were provided in a series of memoranda from AECOM to NJDEP/Weston and responses to comments from AECOM. The memoranda typically included detailed information demonstrating how the final excavation depth in each grid would comply with the Cr⁺⁶ decision trees in the Method to Determine Compliance (NJDEP, 2013).

As part of the pre-RA activities, and in an effort to better define the TEEs and planned excavation, Pre-Design Investigation (PDI) activities were implemented.

The proposed TEEs for Halladay Street South were primarily included in the Phase 4 Halladay Street South Terminal Excavation Elevation submittals. Grids along the eastern boundary of Halladay Street South were split between Halladay Street South and Phase 3C. Grids along the western boundary of Halladay Street South were split between Halladay Street South and Phase 3B. Due to the split nature of the grids, the proposed TEEs for some grids in Halladay Street South were included with the Phase 3B and Phase 3C TEE submittals.

The following is a listing of the deliverables and correspondence that detailed the proposed TEEs and PDI investigation activities in Halladay Street South:

- AECOM memorandum, on behalf of PPG, entitled *Phase 4 Halladay Street South Terminal Excavation Elevation (TEE) Submittal (Revision 0)*, dated December 15, 2014 (AECOM, 2014i).
- AECOM memorandum, on behalf of PPG, entitled *Phase 4 Halladay Street South Terminal Excavation Elevation (TEE) Submittal (Revision 1)*, dated December 18, 2014 (AECOM, 2014j).
- Weston email of February 23, 2015 (Weston, 2015a) providing comments on AECOM's December 15, 2014 and December 18, 2014 memoranda (AECOM, 2014i; AECOM, 2014j).
- AECOM memorandum, on behalf of PPG, entitled *Phase 4 Halladay Street South Terminal Excavation Elevation Submittal (Revision 2)*, dated March 10, 2015 (AECOM, 2015c).
- Weston email of March 26, 2015 (Weston, 2015d) providing comments on AECOM's March 10, 2015 memorandum (AECOM, 2015c).

- AECOM memorandum, on behalf of PPG, entitled *Phase 4 Halladay Street South Terminal Excavation Elevation Submittal (Revision 3)*, dated April 13, 2015 (AECOM, 2015d).
- Weston email of April 28, 2015 (Weston, 2015g) providing comments on AECOM's April 13, 2015 memorandum (AECOM, 2015d).
- AECOM memorandum, on behalf of PPG, entitled *Phase 4 Halladay Street South Terminal Excavation Elevation Submittal (Revision 4)*, dated July 31, 2015 (AECOM, 2015g).
- Weston email of August 13, 2015 (Weston, 2015i) providing comments on AECOM's July 31, 2015 memorandum (AECOM, 2015g).
- AECOM email of August 19, 2015 (AECOM, 2015i) providing responses to Weston's August 13, 2015 comments (Weston, 2015i).
- Weston email of September 4, 2015 (Weston, 2015k) providing conditional concurrence on AECOM's August 19, 2015 email (AECOM, 2015i).
- AECOM email of October 19, 2015 (AECOM, 2015n) providing responses to Weston's September 4, 2015 conditional concurrence (Weston, 2015l).
- Weston email of November 12, 2015 (Weston, 2015o) providing concurrence on AECOM's August 19, 2015 email (AECOM, 2015n).

The following is a listing of the deliverables and correspondence that detailed the proposed TEEs and PDI investigation activities in Phase 3B and 3C (which includes some partial Halladay Street South grids):

Submittal 1

- AECOM memorandum, on behalf of PPG, entitled *PPG Target Excavation Depths in Phase 3B & 3C*, dated August 19, 2013 (AECOM, 2013).
- Weston email of September 4, 2013 (Weston, 2013) providing comments on AECOM's August 19, 2013 memorandum (AECOM, 2013).
- AECOM memorandum, on behalf of PPG, entitled *Response to Weston's 9/4/13 Comments on "PPG Target Excavation Depths in Phase 3B & 3C,"* dated January 22, 2014 (AECOM, 2014a).
- Weston email of February 12, 2014 (Weston, 2014a) providing comments on AECOM's January 22, 2014 memorandum (AECOM, 2014a).

Submittal 2

- AECOM memorandum, on behalf of PPG, entitled *PPG Supplemental Terminal Excavation Elevations in Phase 3B & 3C*, dated January 22, 2014 (AECOM, 2014b).
- Weston email of February 12, 2014 (Weston, 2014a) providing comments on AECOM's January 22, 2014 memorandum (AECOM, 2014b).
- AECOM memorandum, on behalf of PPG, entitled *Response to Weston's 9/4/13 comments on "PPG Target Excavation Depths in Phase 3B & 3C,"* dated April 10, 2014 (AECOM, 2014c), which provided responses to NJDEP's February 12, 2014 comments on Submittal 1 and Submittal 2.

- Weston email of April 28, 2014 providing a final round of comments wherein all of the responses were deemed adequate (Weston, 2014b).

Submittal 3

- AECOM memorandum, on behalf of PPG, entitled *Phase 3C Terminal Excavation Elevation Supplemental Submittal*, dated August 1, 2014 (distributed by AECOM on August 4, 2014) (AECOM, 2014d).
- AECOM memorandum, on behalf of PPG, entitled *Phase 3C Terminal Excavation Elevation Supplemental Submittal (Revision 1)*, dated August 15, 2014 (AECOM, 2014e), with minor corrections issued on August 28, 2014 (AECOM, 2014f).
- Weston email of August 19, 2014 (Weston, 2014c) providing high-level comments on AECOM's August 15, 2014 memorandum (AECOM, 2014e).
- Weston email of October 10, 2014 (Weston, 2014d) providing comments on AECOM's August 15, 2014 memorandum (AECOM, 2014e).
- AECOM memorandum, on behalf of PPG, entitled *Phase 3C Terminal Excavation Elevation – Submittal 3 (Revision 2)*, dated January 23, 2015 (AECOM, 2015a).
- Weston email of March 6, 2015 (Weston, 2015c) providing comments on AECOM's January 23, 2015 memorandum (AECOM, 2015a).
- AECOM memorandum, on behalf of PPG, entitled *Phase 3C Terminal Excavation Elevation – Submittal 3 (Revision 3)*, dated April 13, 2015 (AECOM, 2015e).
- Weston email of April 28, 2015 (Weston, 2015h) providing comments on AECOM's April 13, 2015 memorandum (AECOM, 2015e).
- AECOM memorandum, on behalf of PPG, entitled *Phase 3C Terminal Excavation Elevation – Submittal 3 (Revision 4)*, dated August 10, 2015 (AECOM, 2015h).
- Weston email of August 25, 2015 (Weston, 2015j) providing comments on AECOM's August 10, 2015 memorandum (AECOM, 2015h).
- AECOM memorandum, on behalf of PPG, entitled *Phase 3C Terminal Excavation Elevation – Submittal 3 (Revision 5)*, dated October 19, 2015 (AECOM, 2015m).
- Weston email of November 11, 2015 (Weston, 2015m) providing conditional concurrence on AECOM's October 19, 2015 memorandum (AECOM, 2015m).

4.2.2 Technical Execution Plan

The TEPs for Halladay Street South 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 submittal history for Halladay Street South is provided below.

Southwestern (SW) Area TEP

- On March 9, 2012, PPG/AECOM issued the *Technical Execution Plan, Southwestern Area Soil Excavation; PPG Site 114 – 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, 2012a).

- In April 2012, PPG/AECOM submitted the *Final Technical Execution Plan, Southwestern Area Soil Excavation, PPG Site 114 – Garfield Avenue, Jersey City, New Jersey* (AECOM, 2012e).

Halladay Street South TEP

- On December 12, 2014, PPG/AECOM issued the *Technical Execution Plan, Southwest TEP Addendum (Halladay Street South Soil Excavation), PPG Phase 4 – Halladay Street South Area, Jersey City, New Jersey* (HSS TEP) (AECOM, 2014h).
- On February 23, 2015, Weston Solutions, Inc. (Weston), on behalf of NJDEP, provided comments on the HSS TEP (Weston, 2015b).
- On February 24, 2015, Environmental Remediation and Financial Services, LLC (ERFS) provided comments on the HSS TEP (ERFS, 2015).
- On March 10, 2015, PPG/AECOM submitted the *Technical Execution Plan (Revision 1), Southwest TEP Addendum (Halladay Street South Soil Excavation), PPG Phase 4 – Halladay Street South Area, Jersey City, New Jersey* (HSS TEP – Revision 1) (AECOM, 2015b).
- On March 26, 2015, Weston, on behalf of NJDEP, provided comments on the HSS TEP – Revision 1 (Weston, 2015e).
- On April 13, 2015, PPG/AECOM submitted the *Technical Execution Plan (Revision 2), Southwest TEP Addendum (Halladay Street South Soil Excavation), PPG Phase 4 – Halladay Street South Area, Jersey City, New Jersey* (HSS TEP – Revision 2) (AECOM, 2015f).
- On April 24, 2015, Weston, on behalf of NJDEP, provided comments on the HSS TEP – Revision 2 (Weston, 2015f).
- On August 21, 2015, PPG/AECOM submitted the revised *Technical Execution Plan (Revision 2), Southwest TEP Addendum (Halladay Street South Soil Excavation), PPG Phase 4 – Halladay Street South Area, Jersey City, New Jersey* (Revised HSS-TEP Revision 2) (AECOM, 2015j).
- On September 4, 2015, Weston, on behalf of NJDEP, provided comments on the Revised HSS TEP - Revision 2 (Weston, 2015l).
- On October 19, 2015, PPG/AECOM submitted a memorandum entitled *Response to Comments on the Halladay Street South Technical Execution Plan (Revisions 0, 1, and 2)* (AECOM, 2015l).
- On November 12, 2015, Weston, on behalf of NJDEP, provided concurrence on the October 19, 2015 response to comments (Weston, 2015n).
- On April 8, 2016, PPG/AECOM submitted the *Technical Execution Plan (Revision 3), Southwest TEP Addendum (Halladay Street South Soil Excavation), PPG Phase 3C – Halladay Street South Area, Jersey City, New Jersey* (HSS TEP – Revision 3) (AECOM, 2016a).
- On April 22, 2016 on behalf of Jersey City, ERFS provided comments on the HSS TEP – Revision 3 (ERFS, 2016).
- On May 13, 2016, Weston on behalf of NJDEP, provided comments on the Revised HSS TEP – Revision 3 (Weston, 2016a).

- On June 8, 2016, PPG/AECOM issued a response to Weston/NJDEP's comments on the Revised HSS TEP – Revision 3 in the memorandum entitled *Response to Comments on the Halladay Street South Technical Execution Plan (Revision 3)* (AECOM, 2016b).
- On June 24, 2016, Weston/NJDEP issued an evaluation of the response to comments (Weston, 2016b).

5.0 Description of the Remedial Action

The RA at AOC HSS-1A (CCPW-impacted soil in Halladay Street South Grid Columns 20A through 41A) included the excavation of CCPW and visible CCPW-impacted soil, off-site transport and disposal of affected soil, backfilling of the excavations, and restoration of the affected areas. It was anticipated that the presence of CCPW metals (antimony, total chromium, nickel, thallium, and vanadium) at concentrations greater than the CrSCC, SRS or DIGWSSLs would be resolved as a result of the excavation being driven by the presence of Cr⁺⁶ and visible CCPW.

The RA at AOC HSS-2A (MGP-impacted soil in Halladay Street South Grid Columns 20A through 41A) included two parts. The first portion consisted of the excavation of CCPW and CCPW-impacted soil which also resulted in removal of some MGP-impacted soil. MGP-related SVOCs, including 2-methylnaphthalene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-c,d)pyrene, and naphthalene, and select MGP-related VOCs (benzene and ethylbenzene) were evaluated to determine if these compounds were remaining in place at concentrations greater than the NJDEP SRS or DIGWSSLs. The second portion of the RA consisted of the placement of an engineering control, a notice in lieu of deed notice, and a corresponding RAP to minimize exposure to naphthalene emanating from Site 114, remaining in place at concentrations greater than the SRS.

The RA was performed in accordance with the RAWP (AECOM, 2012d) as described in **Section 4.1**, and TEPs and TEE submittals, as described in **Section 4.2**.

Benzo(a)pyrene and dibenzo(a,h)anthracene remain in place at the southern end of Halladay Street South (refer to **Figure 5-4A** and **Figure 5-4B**). These exceedances of benzo(a)pyrene and dibenzo(a,h)anthracene remaining in place in Halladay Street South are attributed to historic fill and not MGP or site operations because: 1) the soil boring logs and NJDEP Historic Fill Map for the Jersey City Quadrangle (NJDEP, 2015) establish that Halladay Street South is within an area of historic fill; 2) the samples were collected within historic fill; 3) concentrations of these compounds fall within the range of concentrations presented in the NJDEP historic fill database (NJDEP, 2015); 4) no visible MGP material was encountered during sample collection; 5) the exceedances of PAHs are not co-located with elevated concentrations of naphthalene or benzene; and 6) the concentrations of benzo(a)pyrene and dibenzo(a,h)anthracene at sample locations between the area of known MGP impacts at the northern end of Halladay Street South and the exceedances located in Grids S39A, S40A, T33A, T37A, and U30A are less than the RDCSRS and NRDCSRS. As these exceedances are associated with historic fill and not MGP operations, they do not fall under the purview of the ACO (NJDEP, 1990) and JCO (Superior Court of New Jersey Law Division – Hudson County, 2009). Therefore, PPG is not responsible for the remedy for historic fill impacts, which are the responsibility of the City of Jersey City since the historic fill impacts are within the public right-of-way and are not emanating from Site 114.

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 RA. Mobilization and preparation for RA of the GA Group of Sites began in June 2010.

AECOM served as the remediation engineer. Mueser Rutledge Consulting Engineers served as the geotechnical/structural engineer.

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.

AECOM performed the air monitoring at the Site during excavation activities, in accordance with the December 2010 Revision of the Air Monitoring Plan (AMP) and applicable AMP Amendments (15 and 24) (AECOM, 2010b).

ENTACT Environmental Services of Latrobe, Pennsylvania (ENTACT) performed the remedial construction activities at the Site. These services consisted of coordination and disconnection of utilities, excavation and backfilling, decontamination, demolition, dewatering, and Site restoration.

WTS Transportation Services, LLC coordinated transportation and disposal of the waste streams generated from the RA activities.

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:

- 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**. Necessary permits and approvals are documented in **Appendix B**.

Coordination meetings were held among PPG, AECOM, Jersey City Municipal Utilities Authority (JCMUA), ERFS, Jersey City Redevelopment Agency (JCRA), and the Site Administrator project manager (PM) during the pre-planning phase.

Pre-construction activities including mobilization and placement of jersey barriers and temporary fencing, implementation of the SESCO, establishment of work zones, and utility clearance were performed from June 17, 2014 through March 25, 2015. 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 SESCO. Hay bales were installed along the downgradient perimeter of the Site. Prior to excavation work, electric

and natural gas utilities were disconnected by PSEG and sewer and potable water service was cut and capped under the supervision of JCMUA.

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 Halladay Street South) 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.

In addition to contacting the New Jersey One-Call system, a utility survey was conducted prior to intrusive Site activities. A private utility locator, Enviroscan, Inc. of Lancaster, Pennsylvania, performed a geophysical survey to mark underground utilities (gas, sewer, water, phone, cable, electrical, etc.) that exist within the proposed excavation area. The underground water, sewer, and gas lines were abandoned prior to excavation and were removed during excavation.

Monitoring wells 114-MW-19A (permit number 2600080772), 133-P3B-MW1 (permit number E201410679), 137-P3B-MW2 (permit number E201410680), MW-9D (permit number 2600075538), and MW-9S (permit number 2600084546) were properly abandoned 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). Well abandonment documentation is included in **Appendix C**.

Equipment was delivered during the initial mobilization phase for 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 RAs. As remediation progressed, some support trailers were relocated to Site 132 and 133 East to improve logistics.

Work zones were established to exclude unauthorized personnel from entering the Site 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, Conex/intermodal storage boxes, and 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 when working in the exclusion zone.
- A Contamination Reduction Zone and a truck decontamination pad were constructed for transition from the Exclusion Zone. The Contamination 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.

Between July 28 and August 27, 2014 and between September 19 and September 24, 2014, excavation shoring was installed along the western boundary of Halladay Street South to support the Phase 3B excavation (**Figures 5-1A, 5-1B, and 5-1C**). Additional excavation shoring was installed between August 17 and August 21, 2015 at the northern limits of excavation to protect infrastructure in Carteret Avenue. Along the boundary of Halladay Street South and Site 133 East, excavation shoring was not required because the excavation of Halladay Street South was performed concurrently with the Site 133 East excavation. Shoring consisted of steel sheet piling.

5.2 Excavation

In accordance with the Halladay Street South Soil Excavation TEP (AECOM, 2016a), the soil at Halladay Street South was excavated in 30-foot-by-30-foot-grid cells. Specifically, Halladay Street South includes Rows O through Z (extending west to east) and Columns 47A through 20A (extending from south to north). During the planning phase, it was determined that, due to access to adjacent properties, the grids in Columns 45A through 47A (Rows O through Q) would be excavated at a later date in conjunction with the Phase 3B South remediation. During the 2015 RA, some excavation was conducted in Columns 42A and 43A. However, due to access issues, it was determined that Columns 42A, 43A, and 44A would also have to be excavated at a later date in conjunction with the 3B South remediation. AOC HSS-1A and AOC HSS-2A presented in this RAR include Columns 20A through 41A (extending from north to south).

Each grid was excavated to a target depth. Soil analytical results from the RI soil boring 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.

Excavation of Halladay Street South (AOC HSS-1A and AOC HSS-2A) began on May 26, 2015 and was completed on October 22, 2015.

Excavation was conducted concurrently with the excavation of Site 133 East. Excavation was performed by ENTACT utilizing an excavator.

AECOM implemented dust control measures at the Site, in accordance with the March 2011 Revision of 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 Halladay Street South 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/>) in the form of Monthly Reports and Event Documentation Reports. The concentrations and the short-duration metrics demonstrate that the dust control measures were effective at maintaining Cr⁺⁶ in dust at concentrations less than the Acceptable Ambient Concentration (AAC).

ENTACT verified vertical excavation extents using global positioning system (GPS) survey equipment to document that proposed excavation depths were achieved. 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 Method to Determine Compliance (NJDEP, 2013). **Figures 5-1A** through **5-4C** depict the grid layout of Halladay Street South and the final as-built TEEs.

Excavated materials were live-loaded into lined dump trucks where possible. Soil stockpiles were not used during this excavation. Concrete was stockpiled to be sized prior to load out in accordance with the Soil and Stockpile Management Plan for the GA Group Sites included in the 2012 RAWP (AECOM, 2012d). 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 adjacent to or within the excavation in areas that had not yet been remediated. 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).

Surface water runoff, storm water, groundwater entering the excavation, and decontamination wastewater were transferred by pump to the GA Group Sites groundwater treatment plant located on Site 114.

5.3 Post-Excavation Soil Sampling

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, 2013). Where the TEE in adjacent grids varied by more than two feet, sidewall samples were collected every 30 linear ft and at two-ft depth intervals. Where excavation grids were enclosed by shoring or where the TEE in adjacent grids varied by less than two feet, sidewall sampling was not conducted.

Where the excavation was expanded to remove visible CCPW beyond the original proposed excavation extents, either post-excavation samples or samples collected 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 the excavation bottom and sidewalls were free of visible CCPW.

The post-excavation/confirmation samples 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 method 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 RAWP [see **Section 4.1** for the RAWP submittal history] and Field Change Notification SWTEP 1 discussed in **Section 5.5**).

The other constituents for which PPG was responsible for (select SVOCs and VOCs identified as parameters emanating from Site 114) were analyzed for in the post-excavation/confirmation samples as follows:

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

Additional excavation (re-dig) was completed for post-excavation soil samples that exceeded the CrSCC (see **Section 3.0**). Typically, in these circumstances, the full 30-ft-by-30-ft grid was excavated to remove the CrSCC exceedance.

Figures 5-1A through **5-4C** and **Tables 5-1** through **5-4** present data for locations within the Halladay Street South (AOC HSS-1A and AOC HSS-2A) boundary that have samples remaining in place. In addition, locations from outside the Halladay Street South boundary and/or removed samples may be shown to demonstrate compliance with the RA objectives. Laboratory analytical reports and data validation reports for the data presented in **Tables 5-1** through **5-4** are included in **Appendices D** and **E**, respectively. The laboratory electronic data deliverables (EDDs) have been submitted to the NJDEP database, as documented in **Appendix D-2**.

5.3.1 LSRP Program Sampling

In some cases, contaminants of concern associated with impacts emanating from Site 114 are the same as contaminants associated with site operations that are being evaluated under the Licensed Site Remediation Professional (LSRP) program. Adjacent to Halladay Street South, on Site 133 East, soil sampling for non-CCPW and non-emanating-from constituents was conducted under the LSRP program concurrently with the CCPW-impacts RA. Soil samples were collected in some Halladay Street South (AOC HSS-1A and AOC HSS-2A) grids for delineation of non-CCPW-impacts on Site 133 East. The SVOC and VOC results associated with samples collected under the LSRP program (typically designated by “SI” in the Location ID) for parameters emanating from Site 114 are included in this submittal for completeness. Reporting of the Site 133 East soil samples collected during the LSRP program will be submitted separately, and have not been included in the EDD submission to the NJDEP database for this RAR.

5.4 Institutional and Engineering Controls

As shown on **Figure 5-4C** and **Table 5-4**, naphthalene remains in place at concentrations greater than the SRS in Grids X21A and Grids X25A. The remedy for naphthalene in soil at concentrations greater than the SRS consists of an engineering control (clean fill cap), a notice in lieu of deed notice, and corresponding RAP for a restricted area consisting of grids within Columns 20A through 26A.

Following remediation of soil, 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 two feet as an engineering control to restrict access to soil with naphthalene at concentrations greater than the unrestricted use standards.

The horizontal extent of the Clean Fill Soil Cap Engineering Control to address naphthalene (emanating-from Site 114) remaining in place is depicted on the as-built diagram included in **Appendix F**. The western, eastern, and northern extent of the restricted area is the property boundary. Naphthalene exceedances to the west, east, and north are being addressed as separate cases. The southern extent of the restricted area is based on the delineation of naphthalene to the south at the elevation of the naphthalene remaining in place on site (shown on **Figure 5-A**). DGA is present throughout the restricted area at a thickness greater than two feet. The soil cap engineering control only includes the first two feet of material placed above the bottom of the excavation. The approximate elevation of the soil cap engineering control throughout the restricted area is depicted on the as-built diagrams in **Appendix F**. A visible change in soil type between DGA and native materials serves as the visible demarcation between the clean fill cap and impacted material beneath it. Additional information about site restoration and documentation of clean fill is included in **Sections 7.2** and **7.5**.

The notice in lieu of deed notice is provided in **Appendix G**. Once the NJDEP approves the RAR, the notice in lieu of deed notice will be filed with the following entities: 1) each road department of each municipality in which the property is located; 2) each road department of each county in which the property is located; 3) the New Jersey Department of Transportation; and 4) each utility company with an easement on the roadway, pursuant to N.J.A.C. 7:26C-7.2. Once the notice in lieu of deed notice is filed, the RAP application for the remaining soil impacts to NJDEP will be submitted for approval.

5.5 Field Change Notifications

Field changes made during implementation of the TEP were documented in Field Change Notification forms. Field Change Notifications submitted relevant to the RA activities at Halladay Street South are listed in **Table 5-5**.

Additionally, during the 2015 RA, some excavation was conducted in Columns 42A and 43A; however, due to access issues, it was determined that Columns 42A, 43A, and 44A would be excavated at a later date in conjunction with the Phase 3B South remediation. This area is defined as AOC HSS-1B and will be addressed in a future submission.

6.0 Reliability of Data: Data Validation and Usability

6.1 Data Validation

Data validation was performed by AECOM to evaluate whether the analytical data collected to demonstrate compliance with the RA objectives were scientifically defensible, properly documented, of known quality, and met RA objectives. Data validation included the review of analytical procedures, quality control (QC) results, calibration procedures, data reduction, and completeness of the laboratory data packages as specified in the soil RIWP (AECOM, 2011a) and Field Sampling Plan – Quality Assurance Project Plan (FSP-QAPP) (AECOM, 2010a). 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.

The laboratory analytical data packages (**Appendix D**) were reviewed in accordance with the FSP-QAPP (AECOM, 2010a), the NJDEP validation Standard Operating Procedures (SOPs) for Cr⁺⁶ and inorganic data, and USEPA Region 2 metals, VOC, and SVOC validation guidelines. 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 (September 2009), 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 (NJDEP, 2009); and
- NJDEP Office of Data Quality SOP 5.A.16, Rev 1 (May 2002), Quality Assurance Data Validation of Analytical Deliverables for Inorganics (based on USEPA SW-846 Methods) (NJDEP, 2002).

Where USEPA Region 2 inorganic and organic validation guidelines were also used in assessing metals, VOCs and/or SVOCs, the most current guidance in effect at the time of validation was used; the specific revision used is listed in each validation memorandum provided in **Appendix E**. The link to 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 May 2018).

The level of 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 data received limited validation. Limited validation for metals data was based on information provided by the laboratory on their 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 on 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 E**. 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 and inorganic data. The qualifiers used in data validation consisted of the following:

- 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.

6.2 Data Usability Assessment

Soil samples collected to demonstrate compliance with the RA objectives were sent to Test America Laboratories in Edison, NJ (NJ certification 12028) or SGS-Accutest Laboratories in Dayton, NJ (NJ Certification 12129). 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 E**. 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.

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 Halladay Street South RAR data set, relative percent difference (RPD) non-conformances were observed for field and laboratory duplicates associated with SVOC and Cr⁺⁶ and field duplicates associated with VOC and CCPW metals.

Field precision was assessed through the collection and analysis of field duplicates and was expressed as the RPD of the sample and field duplicate pair results. Overall, 7.6% of the RAR data were qualified as estimated (J) on the basis of field duplicate precision; this includes two VOC results, 20 SVOC results, 17 CCPW metals results, and 53 Cr⁺⁶ 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. Overall, 2.9% of the Halladay South RAR data (33 Cr⁺⁶ and two SVOC results) were qualified as estimated (J) on the basis of laboratory precision.

Duplicate injections used in Method 7199, for the determination of Cr⁺⁶ by ion chromatography, are required to agree within 20%. Four reported Cr⁺⁶ results were qualified due to failure to meet the required criteria.

6.2.2 Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference or true value. The results of LCS data, surrogate recoveries, method blanks, and MS/MSDs were used as the primary indicators of accuracy; information such as sample container type, preservation, and holding time was also considered as 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 laboratory blank contamination, LCS results, MS results, holding time exceedances, and percent solids. Overall, 43% of the RAR data were qualified based on one or more accuracy-related issues. A summary of the validation findings are presented by QC parameter type below.

The presence of target analytes in laboratory blanks and blanks related to field activities (i.e., field and trip blanks) or negative drift in blanks was cited as a reason for qualification of results for antimony (2.2% of reported values), thallium (1.1% of reported values), and Cr⁺⁶ (2.5% of reported values) in the RAR data set. For those blanks in which contaminants or negative drift were detected, action levels were established in accordance with the NJDEP or USEPA Region 2 validation guidance documents. Associated sample results were qualified accordingly.

LCS recovery criteria were not met for 19 results (5.6%) of the SVOC data reported in this data set. The LCS percent recovery for these compounds was less than the established criteria indicating a potential for a low bias in these results. The impacted results are naphthalene in 133-SI-R41A-PB-6.5-7.0; indeno(1,2,3-c,d)pyrene, benzo(b)fluoranthene, benzo(a)pyrene, dibenzo(a,h)anthracene, benzo(a)anthracene, naphthalene, and 2-methylnaphthalene in 133-SI-S40A-PB-7.0-7.5; indeno(1,2,3-c,d)pyrene, benzo(b)fluoranthene, benzo(a)pyrene, benzo(a)anthracene, naphthalene, and 2-methylnaphthalene in 133-SI-S39A-PB-8.5-9.0; naphthalene and 2-methylnaphthalene in 133-SI-V31A-PB-14.1-14.6; and indeno(1,2,3-c,d)pyrene, dibenzo(a,h)anthracene, and naphthalene in 133-SI-W26A-PB-14.5-15.0.

MS and/or MSD recoveries associated with the RAR data set did not meet the required quality control criteria for two results in the VOC fraction (2.3% of the VOC results reported); the ethylbenzene and benzene values for 133-X24A-PB-15.2-15.7 were qualified as estimated on the basis of matrix spike recoveries. In the SVOC fraction, 12 results (3.5 %) of the data were qualified on the basis of matrix spike and/or matrix spike duplicate recoveries. The results for indeno(1,2,3-c,d)pyrene, benzo(b)fluoranthene, benzo(a)pyrene, and benzo(a)anthracene in 133-SI-S39A-PB-8.5-9.0; indeno(1,2,3-c,d)pyrene, benzo(b)fluoranthene, benzo(a)pyrene, dibenzo(a,h)anthracene, benzo(a)anthracene, naphthalene, and 2-methylnaphthalene in 133-SI-V31A-PB-14.1-14.6; and naphthalene in 133-X21A-PB-16.7-17.2 were estimated based on matrix spike recovery.

In the metals fraction, 30 results (6.6%) of the reported metals data were qualified as estimated on the basis of MS or MSD recoveries. Of the total metals results qualified for MS/MSD recoveries, the majority (22 results) was antimony values; in addition, five chromium and three vanadium values were qualified on the basis of matrix spike recoveries.

Approximately 75% (243 results) of the Cr⁺⁶ results were qualified based on the results of matrix spike recoveries. Of these, 187 results (57%) were qualified as estimated due to soluble or insoluble spike results outside the range of 75-125% but within the limits of 50-150%; 54 results were qualified as "RA" due to soluble and insoluble spike recoveries which were below 50% but the supporting data indicated the sample matrix was reducing and unlikely to support the presence of Cr⁺⁶; and two sample results, 133B20C(2.9-3.4) and 133B20D(3.5-4.0), were rejected based on low matrix spike recoveries. In addition, two sample results in data package JB77366, P4-HAL-W26A-15.0-15.5 and P4-HAL-W26A-15.0-15.5X were rejected because the validation guidance in place at the time required matching the matrix of the sample used for spiking to that of the samples. Both samples chosen for use as matrix spikes were peat samples that produced very low spike recoveries; the other samples in this data package were clean fill samples. Although both samples appeared reducing

based on the Eh/pH plot, rejection of these results was based on the decision that neither of the samples used for spiking was appropriate for use in assessing the recovery of Cr⁺⁶ in the fill samples and, in the absence of a matrix spike, NJDEP rules require that all associated results be rejected.

Data points impacted by MS and/or MSD recoveries but deemed usable were qualified as estimated (flagged as J or UJ); individual validation memoranda address the potential for high or low bias to sample results based on matrix interferences. Results qualified as RA may be useful for informational purposes but the user is cautioned that the associated spike recoveries do not meet the criteria of 50-150%. Rejected values should not be used for site decisions.

Other QC issues related to sample preservation procedures or high moisture content resulted in selected data points being qualified as estimated (flagged as J or UJ). Cr⁺⁶ results for samples 133-U35A-SW-W-14.8-15.3 and 133-U35A-SW-W-16.8-17.3 were qualified as estimated due to a temperature outside of the acceptable range of $4 \pm 2^{\circ}\text{C}$ when received at the laboratory. Approximately 16% of the RAR data set was qualified on the basis of low percent solids.

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, 2011a) and FSP-QAPP (AECOM, 2010a), 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 container. 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. This requirement resulted in qualification of 18 VOC results, 70 SVOC results, 45 CCPW metals results, and 64 Cr⁺⁶ results as estimated.

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 RAR data set, 1,207 individual data points were generated. Four Cr⁺⁶ results, or 0.33% of the total data points, were rejected and 54 data points (4.5%) were qualified as "RA" to indicate that, although QC exceedances were identified, the results still had value for understanding conditions at the RA area. The remaining 1,149 data points (95%) are considered usable for project decisions. The goal of 95% completeness, which is a typical goal for large programs, has been met for this dataset.

6.2.6 Sensitivity

Analytical dilutions can be necessary 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. None of the data associated with the RAR required dilutions that resulted in reporting of non-detect values that exceeded the Residential Direct Contact Soil Remediation Standards (RDCSRS).

6.2.7 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:

- The Cr⁺⁶ results in four samples were rejected due to soluble/insoluble spike recoveries outside the 50-150% control limit or data regarding spike recovery in the specific sample matrix was unavailable.
- Results qualified as “RA” may provide useful information for RA decisions but should be used with an understanding of the data limitations.
- Remaining results are considered usable for site decisions with an understanding of the limitations, if any, identified during validation.

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 E**.

7.0 Documentation of the Protectiveness of the Remedial Action

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

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 5.3**, the locations of samples used to demonstrate compliance with the remediation goals are depicted on **Figures 5-1A** through **5-4C**. **Tables 5-1** through **5-4** 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 D** and **E**, respectively. As discussed in **Section 6**, 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 H** presents the available boring logs from the locations of samples that were used to demonstrate compliance with the remediation goals.

AOC HSS-1A and HSS-2A have been remediated as follows:

- Excavation of soil containing Cr⁺⁶ met the requirements specified in the Chromium Policy (NJDEP, 2007) in accordance with the Method to Determine Compliance (NJDEP, 2013)..
- Soil concentrations for CCPW metals are in compliance with the SRS.
- Soil concentrations of MGP-related SVOCs (2-methylnaphthalene, benzo(a)anthracene, benzo(b)fluoranthene, and indeno(1,2,3-c,d)pyrene) and select MGP-related VOCs (benzene and ethylbenzene) are in compliance with the SRS.
- Benzo(a)pyrene and dibenzo(a,h)anthracene remain in place at the southern end of the Site. It has been determined that these exceedances are associated with the presence of historic fill and not MGP operations (as explained in Section 5.0 and **Table 5-4**) and, therefore, do not fall under the purview of the ACO (NJDEP, 1990) and the JCO (Superior Court of New Jersey Law Division – Hudson County, 2009). Therefore, PPG is not responsible for the remedy for historic fill impacts, which is the responsibility of the City of Jersey City since the historic fill impacts are within the public right-of-way.
- Naphthalene, emanating from Site 114, remains in place at concentrations greater than the SRS. The remedy for naphthalene in soil at concentrations greater than the SRS consists of an engineering control, a notice in lieu of deed notice, and corresponding RAP as described in **Section 5**.

Waste manifests for soil and other materials that were loaded for off-site disposal are presented in **Appendices I** and **J**.

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

7.1 As-Built Diagrams

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

- An as-built diagram depicting the final extents of the excavation for Halladay Street South, as well as Site 133 East, Site 135, and Al Smith Moving;
- As-built diagrams depicting the horizontal extent and typical section of the Clean Fill Soil Cap Engineering Control to address naphthalene remaining in place; and
- An as-built diagram of the final Site grades following restoration for Halladay Street South, as well as Site 133 East, Site 135, and Al Smith Moving.

7.2 Description of Site Restoration Activities

After completion of the excavation activities at each grid cell, 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 Halladay Street South was completed in stages, keeping pace with the excavation. Restoration activities were completed across the GA Group Sites, including Halladay Street South, between August 8, 2017 and January 31, 2018.

Clean fill for site restoration consisted of ¾-inch stone and DGA backfill material supplied by Tilcon. Information regarding the source and quality of the backfill material is provided in **Section 7.5** below. Based on the compaction goal of 90% standard proctor, specified in the Halladay Street South TEP, ENTACT satisfactorily completed compaction of the backfill placed within the limits of Halladay Street South. Final compaction results ranged from 96.4% to 99.5%, exceeding the 90% compaction goal.

Halladay Street South were backfilled and restored in accordance with the *Restoration Technical Execution Plan, Garfield Avenue Group (Revision 1)* (Restoration TEP), dated August 2017 (AECOM, 2017c) 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, 2017e).

Per the Restoration TEP, PPG committed to restoring the storm drains that were removed during the remediation of Halladay Street South. Restoration of these storm drains is being addressed as part of an infrastructure restoration agreement between PPG and the City of Jersey City.

As part of the restoration activities, a portion of the western shoring adjacent to Site 137 North was removed between October 2 and October 6, 2017. Sheet pile that is in place at the time of the preparation of this RAR will stay in place at least until soil remediation of the adjacent area, Phase 3B South, takes place. At that point, the decision to keep or remove the sheet pile will be evaluated.

7.3 Total Remedial Action Cost

PPG's total remediation cost for implementation of the RA at Halladay Street South AOC HSS-1A and AOC HSS-2A was approximately \$12 million. This includes costs for RI, engineering, excavation and backfilling, air monitoring, construction management, groundwater management and treatment, waste transportation and disposal, and overall project management and reporting.

7.4 Documentation of Waste Generation and Disposal

The approximate in-place volume of soil excavated from the Halladay Street South AOC HSS-1A and disposed of off site is estimated at 20,000 cubic yards (approximately 30,000 tons assuming a soil density of 1.5 tons per cubic yard), based on the limits of excavation.

Waste manifests and bills of lading (BOLs) for the time period during which Halladay Street South was excavated (May 26, 2015 to October 23, 2015) are included in **Appendix I** (Hazardous Waste Disposal Documentation) and **Appendix J** (Non-Hazardous Waste Disposal Documentation).

Halladay Street South AOCs HSS-1A and HSS-2A were excavated concurrently with Site 133 East and a small portion of Halladay Street South AOC HSS-1B. Because of the concurrent excavation, the disposal weight tickets for the time period of May 26, 2015 to October 23, 2015 could not be separated and are included in both this RAR and the Site 133 East RAR for completeness; as such, the total mass of the weight tickets (60,402 tons) exceeds the mass estimated from the limits of excavation from Halladay Street South AOC HSS-1A.

Other materials generated as a result of the RA activities at Halladay Street South included contaminated debris and groundwater treatment plant sludge.

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

Hazardous Waste Materials

- Stablex, Canada Inc., Blainville, Québec, Canada;
- Environmental Quality Company (EQ) Detroit Inc., Detroit, Michigan;
- EQ - Michigan Disposal Waste Treatment Plant, Belleville, Michigan; and/or
- EQ Envirite of Pennsylvania, Inc., York, Pennsylvania.

Non-Hazardous Waste Materials

- Cumberland County Improvements Authority Landfill, Deerfield Township, New Jersey.

Water

- 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 Passaic Valley Sewerage Commission (PVSC) Wastewater Treatment Plant, Newark, NJ (under the 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 are presented in the following appendices:

- **Appendix I** – Hazardous Waste Disposal Documentation. This appendix includes fully executed manifests and certificates of disposal (if provided) documenting the off-site transport of hazardous soil, concrete, sludge, and other debris, such as scrap metal.
- **Appendix J** – Non-Hazardous Waste Disposal Documentation. This appendix includes BOLs documenting the off-site transport of non-hazardous soil.

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

Licensed quarry material was utilized for backfill and restoration, and consisted of ¾-inch open grade stone and DGA supplied by Tilcon from their mine facilities at 625 Mt. Hope Road, Wharton, NJ and Broad Street, Pompton Lakes, NJ, licensed quarry facilities permitted to operate as commercial quarries by NJDEP.

To meet the minimum requirements of the NJDEP TRSR (NJDEP, 1993b) at the time of the Halladay Street South activities, the sources of imported fill were certified by the supplier as clean from a virgin source, based on their knowledge of the place of origin and history.

In accordance with Field Change Notification #16A dated July 24, 2015, each quarry was required to provide, on an annual basis, its License (mining certificate) and annual certification that the imported 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* (NJDEP, 2015).

The concentrations of the analytes in samples collected from the quarry material were less than the NJDEP RDCSRS and the quarry material did not pose a potential impact to groundwater (per NJDEP's *Fill Material Guidance for SRP Sites Version 3.0* [NJDEP, 2015]), indicating that the material was acceptable for on-site use.

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

A list of the quarry material load reports is provided in **Appendix K-1** and the analytical reports, mine certificates, and annual certifications are provided in **Appendix K-2**.

7.6 Identification of Required Permits and Authorizations

The permits and approvals needed for the RA at Halladay Street South are listed below.

- SESCO 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.
- Flood Hazard Area Individual Permit for GA Group, NJDEP, Division of Land Use Regulation.
- Water Use Registration, NJDEP, Division of Water Supply.
- Permit-By-Rule Discharge Authorization for Site-wide FerroBlack®-H Backfill Amendment, NJDEP, Site Remediation Program.
- Community Right-to-Know Survey for 2017, NJDEP.
- PVSC Sewer Use Permit #31630010 (Site 114 groundwater treatment plant).

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**.

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 Halladay Street South AOC HSS-1A and AOC HSS-2A is effective in protecting public health and safety and the environment and remedial objectives have been achieved as follows:

- Excavation of soil containing Cr⁺⁶ met the requirements specified in the Chromium Policy per the Method to Determine Compliance.
- Soil concentrations for CCPW metals are in compliance with the SRS.
- Soil concentrations of select MGP-related SVOCs [2-methylnaphthalene, benzo(a)anthracene, benzo(b)fluoranthene, and indeno(1,2,3-c,d)pyrene] and select MGP-related VOCs (benzene and ethylbenzene) are in compliance with the SRS.
- Benzo(a)pyrene and dibenzo(a,h)anthracene remain in place at the southern end of the site. It has been determined that these exceedances are associated with the presence of historic fill and not MGP operations and, therefore, do not fall under the purview of the ACO (NJDEP, 1990) and the JCO (Superior Court of New Jersey Law Division – Hudson County, 2009). Therefore, PPG is not responsible for the remedy for historic fill impacts, which are the responsibility of the City of Jersey City since the historic fill impacts are within the public right-of-way.
- Naphthalene, emanating from Site 114, remains in place at concentrations greater than the SRS and is addressed by institutional controls (notice in lieu of deed notice) and an engineering control (clean fill cap).
- Soil in the unsaturated zone has been removed throughout AOC HSS-1A and AOC HSS-2A; therefore, DIGWSSLs do not apply.

On this basis, PPG, the responsible party has demonstrated compliance with the applicable remediation requirements for the soil on Halladay Street South AOC HSS-1A and AOC HSS-2A, and no further action with regard to AOC HSS-1A and AOC HSS-2A soil is needed (other than filing the notice in lieu of deed notice and implementing of the RAP). PPG requests the closure of AOC HSS-1A and AOC HSS-2A by the NJDEP through the issuance of a Consent Judgment Compliance Letter.

9.2 Groundwater

This RAR only addresses the RA of soil at Halladay Street South AOC HSS-1A and AOC HSS-2A. CCPW and MGP-impacted groundwater within the GA Group Sites is being tracked under the Site 114 PI Number G000005480. The status of the 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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