

5.0 Subsurface Environmental Observations and RI Analytical Results

This section presents a summary of subsurface field observations and the results of the laboratory analyses performed for the RI samples. A discussion of the results of the analyses, and a comparison to applicable NYSDEC Standards, Criteria and Guidance Values are grouped according to environmental media in the sections following the description of observed subsurface conditions. NYSDEC ASP Category B (NYSDEC, 2001) data packages were prepared by the laboratory for all samples collected during the RI and are included in Appendix I.

5.1 Subsurface Visible Impacts

Visible impacts of residual materials observed in the subsurface are summarized in Tables 5-1 and 5-2, shown on the cross-sections (Figures 4-2 through 4-5), and illustrated in plan-view by elevation intervals on Figures 5-1 through 5-5. Table 5-1 summarizes the visible and olfactory impacts noted during drilling and test pit activities during the RI. Table 5-2 provides a summary of the locations and elevations where tar saturation was noted during previous investigations and remedial efforts performed by F. C. Gowanus on the Lowe's property. Data from these tables were used to generate Figures 5-1 through 5-5 which illustrate the distribution of visible and olfactory impacts noted during the RI and tar impacts noted during previous investigations by elevation ranges between the ground surface (the average ground surface elevation at the Current Site is approximately 10 ft NAVD88) and -72 ft NAVD88. Additionally, visible impacts were grouped into color categories for illustration on the geologic cross sections. The color coded visible impact areas represent where impacts were observed in individual borings at specific depths. Zones of tar saturation represent areas where the entirety of the pore space of the soil matrix appears to be filled with NAPL. In summary, the plan view figures (5-1 through 5-5) and the cross sections (Figures 4-1 through 4-5) provide a generalization of the subsurface visible impacts observed in the RI Study Area.

Visible impacts were observed during the RI in the subsurface to the west of the Previously Remediated Area, as illustrated on cross section A-A' (Figure 4-2) and cross section C-C' (Figure 4-4). The Previously Remediated Area included former MGP Holders No. 1 through 3, former MGP tar tanks/tar pits, and former MGP oil storage tanks and was remediated by excavation and dense non-aqueous phase liquid (DNAPL) removal via recovery wells by F. C. Gowanus. Shallow, visible impacts consisting of sheen, blebs, and slight tar coating were observed between 4 and 15 ft bgs in borings between the Previously Remediated Area and Holder No. 5. Deeper visible impacts including a limited amount of tar saturation and tar saturated lenses were also noted in this area in borings SB-3, SB-13, SB-15, and SB-18 at depths ranging between 20 and 45 ft bgs [approximately -11 to -36 ft NAVD88] as illustrated on Figures 5-2 through 5-4. Odors, staining, sheen, and blebs/coatings were observed within, above, and below the interval containing tar lenses or saturation as illustrated on Figures 5-1 through 5-5. It appears from these figures and Figures 4-2 and 4-4 that the deeper visible impacts near the Previously Remediated Area may extend westward predominantly as lenses of material. It does not appear that these deeper impacts are associated with former Holder No. 5 (Block 1025, Lots 100 and 20) which was a slab on grade holder. These visible impacts diminish with distance and have been delineated to the west by borings SB-6 and SB-11, to the south by boring SB-7 and to the east by SB-14 and SB-2.

As outlined in cross section B-B (Figure 4-3), visible impacts were also noted along the western boundary of the Current Site adjacent to the Gowanus Canal. These impacts extend southwest towards SB-4 (located

on the former BAAC property) and northeast towards MW-6 and PB-5. A limited amount of tar saturation was noted within the southern portion of this area at a depth of 31.5 to 34 ft bgs in the SB-4 vicinity and in the northern portion of this area at depths of 30 to 32 ft bgs in MW-6/DP-12 (Figure 4-5). Impacts noted as petroleum saturation and odors were noted in the 70 to 77 ft bgs interval at geotechnical boring PB-6 and impacts noted as "petroleum in sample" were noted in the 50 to 85 ft bgs interval at geotechnical boring PB-5 (Figure 4-5). It should be noted that these geotechnical borings were sampled at standard 5-foot intervals instead of the continuous sampling conducted in the RI. The visible impacts are evident as tar odors, staining, sheen, and blebs/coatings between 7 and -15 ft NAVD88 and below -30 ft NAVD88 (Figures 5-1, 5-2, 5-4, and 5-5) and include tar saturation in the SB-4 and MW-6/DP-12 vicinities in elevation range -15 to -30 ft NAVD88 (Figure 5-3). It appears that this visibly impacted area is separate from the Previously Remediated Area and is possibly associated with the former tar tanks adjacent to the canal based on the lack of visible impacts in borings situated between these two potential sources as illustrated on sections A-A' and C-C' (Figures 4-2 and 4-4). However, it is possible that impacts from the Previously Remediated Area or other former structures beneath the Pathmark building contributed to the visible impacts observed along the western portion of the Current Site and that the data distribution (i.e., lack of data between the two areas) results in the appearance that the areas are separate. Drilling and subsurface investigations could not be performed in this area due to the hours of operation for the Pathmark supermarket and the retail nature of the business.

The visible impacts observed in the SB-9 area (Figures 4-3 and 4-4) are at an elevation slightly above the elevation of the bottom of the canal and were observed to approximately 30 feet below the top of the existing canal bed. Based on these elevations, the SB-9 area impacts could originate from former MGP structures but impacts observed beneath the canal sediment elevation may also originate from canal impacts. The visible impacts north of the SB-9 area at PB-5 are at an elevation below the bottom of the 11th Street Basin and the Gowanus Canal. These impacts do not extend as far northeast as monitoring wells GCMW-44, MW-23D, GCMW-46 or boring PB-3. The visible impacts noted from 70 to 75 ft bgs in geotechnical boring PB-6 to the east of SB-9 appear limited as they were not noted in adjacent boring/well SB-22/MW22.

The visible impacts observed south of SB-9 in SB-4, MW-4D1, and MW-4D2 are also illustrated on cross section A-A' (Figure 4-2). These impacts may originate from, the former tar tanks near SB-9 and/or other former structures beneath the Pathmark building, the former Brooklyn Alcatraz Asphalt operations, and/or from impacts within the Gowanus Canal. As illustrated on cross section A-A', visible tar impacts were noted in borings in sediment beneath the canal and northwest of the canal at SB-19 at an elevation consistent with visible impacts noted in SB-4. Visible impacts other than stained soil were not noted in boring SB-20 to the north of SB-19.

A third, seemingly separate area of visible impacts, was also noted beneath the parking lot adjacent to the canal in the northern corner of the RI Study Area in borings PB-1, GCMW-45, and GCMW-47 as illustrated on cross section B-B' (Figure 4-3) and Figures 5-3 and 5-4. This part of the RI Study Area is adjacent to the former Cranford Asphalt Manufacturing Company site and the Gowanus Canal. Visible impacts in this area of the RI Study Area were noted beneath the meadow mat and do not extend to the south and west in borings PB-3, GCMW-46, SB-23, and SB-25 suggesting that they are possibly separate from impacts noted in the Previously Remediated Area and from impacts adjacent to the Pathmark Building.

5.2 Soil Analytical Results

A list of the surface soil and subsurface soil samples collected, and the analyses performed, is included in Table 3-1. The surface soil results included in Table 5-3 and the subsurface soil results presented in Table 5-4 have been compared to the Unrestricted Use Soil Cleanup Objectives (SCOs) and Restricted

Commercial Use SCOs provided in the document entitled “*NYSDEC Rules and Regulations, 6 NYCRR Subpart 375-6, Remedial Program Soil Cleanup Objectives*”, dated December 14, 2006 [NYSDEC, 2006]. These Commercial SCOs were selected for comparison in accordance with NYSDEC Subpart 375-6 and CP-51 Soil Cleanup Guidance (NYSDEC, 2010b) and are consistent with the current and anticipated future Current Site zoning and use. Where a result is greater than the method detection limit (MDL), the result is shown with a bold font. If a result is greater than the respective Unrestricted Use SCO it has been shaded gray and if a result is greater than the respective Commercial Use SCO it has been shaded yellow on Tables 5-3 and 5-4.

5.2.1 Surface Soils

The results of the surface soil samples are summarized in Table 5-3. Per the work plan, three surface soil samples (SS-1, SS-2, and SS-3) were collected along the western boundary of the Current Site (see Figure 3-1) with surface soil sample SS-1 being collected at the SB-9 boring location. Sample analytical results indicate that VOCs, including benzene, ethylbenzene, toluene, and xylenes (BTEX), were not detected in the surface soil samples except for an estimated concentration of 1,1-dichloroethene in SS-2 that was not above the Unrestricted Use or Commercial Use SCOs. Two PAHs (benzo(a)pyrene at 1.1 milligram per kilogram (mg/kg) and indeno(1,2,3-cd)pyrene at 0.52 mg/kg) were detected at concentrations above the Unrestricted Use SCOs in sample SS-02. All other detected PAH concentrations were below Unrestricted Use and Commercial Use SCOs in each surface soil sample. Total PAH concentrations ranged between 4.9 and 8.2 mg/kg in the surface soil samples. A few other SVOCs were detected at concentrations below the Unrestricted Use and Commercial Use SCOs as summarized in Table 5-3. Several metals were detected in each surface soil sample at concentrations above the Unrestricted Use SCOs but below the Commercial Use SCOs. Total cyanide was detected at concentrations below both the Unrestricted Use and Commercial Use SCOs in each surface soil sample. Surface soil sample SS-1 was also analyzed for pesticides, herbicides, and PCBs. One pesticide (4,4-DDT) was detected at an estimated concentration of 0.014 mg/kg which are above the Unrestricted Use SCO of 0.0033 µg/kg. One pesticide and two PCB aroclors were detected in sample SS-1 at concentrations below the Commercial Use SCOs (if listed), however the total estimated PCB concentration (1.13 mg/kg) is above both the Unrestricted Use SCO (0.1 mg/kg) and the Commercial Use SCO (1.0 mg/kg). PCBs and pesticides are not associated with MGPs and are interpreted to be related to the presence of urban fill.

5.2.2 Subsurface Soils

The results of the subsurface soil samples are summarized in Table 5-4. The subsurface soil sample analytical results that are above the Commercial Use SCOs are illustrated on Figure 5-6. A total of 80 subsurface soil samples (77 samples and three duplicate samples) were collected from the borings and test pits advanced as part of the RI. The intervals sampled and visible impacts observed at each RI boring location are shown on the soil boring logs in Appendix C and are summarized in Tables 3-1 and 5-1.

5.2.2.1 Volatile Organic Compounds

BTEX compounds were detected in many of the 80 subsurface soil samples collected during the RI. Individual BTEX compounds were detected at concentrations above the Unrestricted Use SCOs in 29 subsurface soil samples however concentrations of individual BTEX compounds were only detected above the Commercial Use SCOs in four of the 80 subsurface samples collected. As illustrated on Figure 5-6, these four samples were collected from borings SB-13, SB-15, and SB-18 immediately west of former Holders No. 1 through No. 3. The samples that contained concentrations of one or more of the BTEX compounds above the Commercial Use SCOs were collected at depths coincident with tar saturated visible impacts. The vertical extent of the BTEX analytical impacts was delineated by deeper samples at each boring location and the horizontal extent of the BTEX analytical impacts was delineated by borings to the

north (SB-16), west (SB-11, SB-6), south (SB-7) and east (SB-14). Five VOCs, other than BTEX compounds, were detected in four of the subsurface soil samples at concentrations above the Unrestricted Use SCOs. These VOCs include acetone, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, n-propylbenzene, and 1,2, dichloroethane. None of these other detected VOC concentrations are above the Commercial Use SCOs, as summarized in Table 5-4.

5.2.2.2 Semivolatile Organic Compounds

PAHs were detected in many of the subsurface soil samples collected during the RI. Twenty-two of the 80 samples contained concentrations of one or more PAH that are above the respective Commercial Use SCOs as summarized in Table 5-4 and illustrated on Figure 5-6. Six additional subsurface soil samples collected from five locations contained concentrations of one or more PAHs that are above the respective Unrestricted Use SCOs but are not above the respective Commercial Use SCOs. Thirteen of the 22 samples that contained PAH concentrations above Commercial Use SCOs collected from ten locations, contained total PAH concentrations that are above the NYSDEC CP-51 Soil Cleanup Guidance (NYSDEC, 2010b) total PAH alternative criterion of 500 mg/kg(illustrated with green highlighting on Figure 5-6 and Table 5-4). Total PAH concentrations ranged from not detected to 14,106.2 mg/kg in the 35 to 40 ft bgs sample collected from SB-13 (downgradient of the Previously Remediated Area). All of these thirteen samples, except SB-6(4-5), were collected from soils visibly impacted with tar and/or soils with a strong hydrocarbon or naphthalene-like odor (Table 5-1).

The vertical extent of the PAH concentrations that are above the Unrestricted Use and Commercial Use SCOs and the CP-51 total PAH criterion was delineated at each location. PAHs were not detected in RI subsurface soil samples at concentrations above the Unrestricted Use SCOs, the Commercial Use SCOs, or the NYSDEC CP-51 total PAH alternative criterion of 500 mg/kg to the north of the former MGP in the Lowes parking lot. The horizontal extent of soils containing PAHs at concentrations above Commercial Use SCOs and the CP-51 total PAH alternative criterion was not delineated to the west along the Gowanus Canal at SB-9 or to the west-southwest near 13th Street at SB-6 and SB-7. The ratio of the concentrations of the individual PAHs detected in sample SB-6(4-5 ft bgs), vary from those detected in the deeper samples collected from tar impacted soils closer to former MGP structures. This distribution of PAHs is also similar in sample SB-7(4-5), collected from 4 to 5 ft bgs in SB-7, also along the southwestern Current Site boundary to the east of SB-6. Based on this information, the PAHs detected in the 4 to 5 ft bgs interval at SB-6 and SB-7 may originate from a different non-MGP source located upgradient from the SB-6 and SB-7 area or represent more weathered MGP impacts.

PAH concentrations detected in soil sample SB-19 (37-37.5 ft bgs), on the west side of the Gowanus Canal, are above the Unrestricted Use and Commercial Use SCOs and CP-51 alternate total PAH criterion. This sample was collected from soils described as tar coated and tar saturated. Soil samples were collected from boring SB-20 and SB-26 to the west and southwest of SB-19 from shallower and deeper zones than the impacted interval sampled in SB-19 and did not contain PAHs at concentrations above the Commercial Use SCOs. Black stained soils were observed during drilling at SB-20 and visibly impacted soils were not observed during drilling at SB-26, therefore the general extent of the impacts in SB-19 has been delineated. It should be noted that LNAPL was collected from MW-20S (SB-20) for forensic analysis (see Section 5. 3 below) and is not tar related.

Other SVOCs analyzed in the subsurface soil samples were either not detected or were detected at levels below the Commercial SCOs as summarized in Table 5-4. Dibenzofuran was detected at concentrations above the Unrestricted Use SCO in three subsurface soil samples including SB-3(30-35), SB-13(35-40), and SB-18(28-30); all of these samples also contained total PAH concentrations that are above the CP-51

alternative criterion of 500 mg/kg. No other SVOCs were detected in RI subsurface soil samples at concentrations above the Unrestricted Use SCOs.

5.2.2.3 Metals

Metals were detected in all of the 80 subsurface soil samples collected and analyzed during the RI as summarized in Table 5-4. Arsenic was detected at concentrations above the Commercial Use SCO in three samples, (SB-3(59-60), SB-7(4-5), and SB-8(34-35), as illustrated on Figure 5-6 and Table 5-4. Barium and lead were detected at concentrations above Commercial Use SCOs in one sample, SB-13(4-5). Several samples contained concentrations of lead and mercury at concentrations above the Unrestricted Use SCOs. All of these samples were collected from depths shallower than 13 ft bgs, and the majority was collected from depths shallower than 5 ft bgs. Copper, chromium, selenium and zinc were detected at concentrations above Unrestricted Use SCOs in three or fewer subsurface soil samples. These detections are not considered related to the operation of the former MGP and are more likely related to the presence of urban fill. PCBs

Thirteen of the 80 subsurface soil samples were analyzed for PCBs during the RI. PCBs were not detected above the reporting limit in any of the 13 samples analyzed except for an estimated concentration (0. 022 mg/kg) of Aroclor 1254 in the subsurface soil sample collected from 142 to 144 ft bgs in MW-4D2. No Unrestricted Use or Commercial Use SCOs are listed for individual aroclors; however the total PCB Unrestricted Use SCO is 0.1 mg/kg and the total PCB Commercial Use SCO is 1. 0 mg/kg.

5.2.2.4 Pesticides and Herbicides

Thirteen of the 80 subsurface soil samples were analyzed for pesticides and herbicides during the RI. Pesticides and herbicides were not detected above the reporting limit in any of the 13 samples analyzed.

5.2.2.5 Free Cyanide

Free cyanide was detected in eight of the 80 subsurface soil samples collected during the RI, as summarized in Table 5-4. All but one of the detected concentrations were estimated and ranged between 0. 395 in SB-3(30-35) to 7.36 mg/kg in SB-7(10-12). Part 375-6 does not include SCOs for free cyanide however the detected free cyanide concentrations are below the Unrestricted Use and Commercial Use SCOs for total cyanide which are both 27 mg/kg.

5.3 Forensic Analytical Results

One forensic sample of LNAPL was collected at the water table from well MW-20S at the Greco Brothers property during the RI. Results of the forensic analysis indicate that this sample contained a petrogenic material that had experienced substantial environmentally induced degradation or weathering and contained a complex mixture of blended fuels such as No. 4 or No. 6 fuel oil. The forensic analysis does not indicate that the LNAPL is related to MGP tar. Although the MGP water gas process utilized fuel oils, it is unlikely that the LNAPL collected from MW-20S is associated with former water gas fuel oil feedstock since LNAPL at the water table originating from the Historic MGP Site would likely be blocked by the bulkhead along the canal and/or discharge to the Gowanus Canal rather than migrate beneath it and LNAPL was not encountered in any of the wells on the east side of the canal during the RI. Based on the property and equipment use, these impacts may be related to current site operations (concrete plant and equipment storage/usage) or adjacent operations, including the scrap yard or the Bayside Coal and Fuel Oil Company property which are both north of the Greco Brothers property.

5.4 Groundwater Analytical Results

Thirty-two monitoring wells were installed and sampled during the RI. A total of 36 samples, including four duplicate samples, were collected and analyzed. A list of the groundwater samples collected (not inclusive of duplicate samples), and the analyses performed is included in Table 3-1. The groundwater analytical results are summarized in Table 5-5. The evaluation of the groundwater results in the following sections is based on a comparison to the Ambient Water Quality Standards and Guidance Values (AWQSGVs) provided in the NYSDEC - Division of Water – Technical Operation Guidance Series (TOGS) (1.1.1) [NYSDEC, 1998, with addendums]. In Table 5-5, where a result is greater than the MDL, the result is shown with a bold font. Where a result is greater than the respective AWQSGV, the result is shaded on Table 5-5. A summary of the results of the RI groundwater sampling performed during October 2010 and March 2012 is illustrated by depth on Figures 5-7 (shallow wells), 5-8 (intermediate wells), and 5-9 (deep wells). These figures illustrate results that are above the AWQSGVs.

5.4.1 Shallow Well Groundwater Samples

Eleven shallow monitoring wells were installed during the RI. These wells have 10 foot screened sections between 3 and 22 ft bgs as summarized on Table 3-2. The analyses performed for each well are summarized in Table 3-1. Twelve shallow well groundwater samples (including one duplicate sample) were collected and analyzed. A summary of the analytical results are illustrated on Figure 5-7 and tabulated in Table 5-5.

5.4.1.1 Volatile Organic Compounds

Seven of the twelve shallow well groundwater samples contained one or more of the BTEX compounds at concentrations above the AWQSGVs. Where detected, total BTEX concentrations ranged from 0.11 micrograms per liter ($\mu\text{g}/\text{L}$) (MW-19S) to 9,110 $\mu\text{g}/\text{L}$ in MW-3S. As illustrated on Figure 5-7, the greatest BTEX concentrations were detected in the vicinity of the former Holders No. 1 through No. 3 (MW-3S), along the southwestern Current Site boundary (MW-6S), and upgradient of the Current Site at MW-1S. Groundwater collected from MW-1S also contained MTBE, a gasoline additive, demonstrating an additional VOC source in the Current Site vicinity. The NYCDOS UST NYSDEC Spill site located east of 2nd Avenue may contribute to impacts detected in the sample collected from MW-1S. Other VOCs detected at concentrations above the AWQSGVs include 1,4-dichlorobenzene, chlorobenzene, isopropylbenzene, MTBE, and styrene. VOCs were not detected at concentrations above AWQSGVs in groundwater samples collected from shallow RI wells adjacent to the Gowanus Canal (MW-4S, MW-9S, and MW-19S).

5.4.1.2 Semivolatile Organic Compounds

Several PAHs were detected in the shallow groundwater samples, however only three PAHs, acenaphthene, benzo(a)anthracene, and naphthalene were detected at concentrations above AWQSGVs in one or more of the twelve shallow well groundwater samples. Naphthalene was the most frequently detected PAH in shallow groundwater and was detected at the greatest concentration in the sample collected from MW-3S (2,100 $\mu\text{g}/\text{L}$). Naphthalene was detected at concentrations above the AWQSGV in groundwater collected from upgradient shallow monitoring well MW-1S, shallow monitoring well MW-8S situated downgradient of the Previously Remediated Area around Holder No. 1 through 3, and along the southwestern Current Site boundary in shallow monitoring wells MW-6S and MW-7S. Benzo(a)anthracene was only detected in one sample (MW-20S at 0. 53 $\mu\text{g}/\text{L}$) and is above the AWQSGV of 0. 002 $\mu\text{g}/\text{L}$. Acenaphthene was detected at concentrations above the AWQSGV in groundwater samples collected from two wells (MW-3S at 21 $\mu\text{g}/\text{L}$ and MW-7S at 26 $\mu\text{g}/\text{L}$). PAHs were not detected at concentrations above the AWQSGVs in groundwater samples collected from shallow wells adjacent to the Gowanus Canal, including

MW-4S, MW-5S, MW-9S, MW-19S, and MW-20S or from MW-25S in the northern corner of the Lowes parking lot.

Phenol was the only other SVOC detected at concentrations above the AWQSGVs in the shallow groundwater samples collected during the RI. The detected phenol concentrations ranged from 2.4 to 69 µg/L. Phenol was detected in five of the twelve shallow groundwater samples including upgradient well MW-1S, monitoring well MW-3S near the former holders No. 1 through No. 3, MW-6S along the southwestern Current Site boundary, MW-8S downgradient of the MGP remediated area, and in MW-20S on the western side of the Gowanus Canal.

5.4.1.3 Metals

Several metals were detected at concentrations above the AWQSGVs as summarized in Table 5-5 and illustrated on Figure 5-7. The metals detected at concentrations above AWQSGVs most frequently include iron, magnesium, manganese, and sodium and were detected in monitoring wells MW-5S, MW-6S, and MW-8S. These metals are not related to MGP operations. Antimony, arsenic, and barium were each detected at concentrations above AWQSGVs in two shallow groundwater samples. Antimony is above AWQSGVs in the groundwater samples collected from MW-6S and MW-8S. Arsenic was detected at concentrations above AWQSGVs in the groundwater samples collected from MW-1S and MW-25S and barium was detected at concentrations above AWQSGVs in groundwater samples collected from MW-1S and MW-4S.

5.4.1.4 Total Cyanide

Total cyanide was detected in 10 of the 12 shallow groundwater samples and ranged in concentration from 8.7 to 279 µg/L. Total cyanide was detected at concentrations above the AWQSGV of 200 µg/L in two of the 10 samples, those collected from MW-4S and MW-7S.

5.4.1.5 Polychlorinated Biphenyls

Four of the 12 shallow groundwater samples were analyzed for PCBs during the RI. PCBs were not detected above the reporting limit in any of the four samples analyzed.

5.4.1.6 Pesticides and Herbicides

Four of the 12 shallow groundwater samples were analyzed for pesticides and herbicides during the RI. Three pesticides (Beta BHC [0.51 µg/L], Delta BHC [0.078 µg/L], and Gamma-BHC [0.072 µg/L]) were detected above the reporting limit in one (MW-6S) of the four samples analyzed. AWQSGVs are not listed for these compounds.

5.4.1.7 Monitored Natural Attenuation Parameters

Primary field parameters used to document the potential for natural biodegradation of dissolved organic compounds in groundwater under a monitored natural attenuation (MNA) approach include DO and ORP. DO and ORP parameters are included in the groundwater collection records in Appendix F. DO concentrations in shallow wells ranged from 0 milligrams per liter (mg/L) at MW-5S, MW-7S, and MW-8S to 6.23 mg/L at MW-9S. ORP readings ranged from 8 millivolts (mV) at MW-19S to -288 mV at MW-7S.

5.4.2 Intermediate Well Groundwater Samples

Twelve intermediate monitoring wells were installed during the RI. These wells have 10 foot long screens located between 25 and 50 ft bgs, as summarized on Table 3-2. The analyses performed for each well are

summarized in Table 3-1. Thirteen intermediate well groundwater samples (including one duplicate sample) were collected and analyzed. A summary of the analytical results are illustrated on Figure 5-8 and tabulated in Table 5-5.

5.4.2.1 Volatile Organic Compounds

Twelve of the 13 intermediate well groundwater samples contained one or more of the BTEX compounds at concentrations above the AWQSGVs. The detected total BTEX concentrations ranged from 4.0 µg/L (MW-20I) to 15,100 µg/L in MW-3I. As illustrated on Figure 5-8, upgradient well MW-1I was the only intermediate well that did not contain groundwater with concentrations of at least one BTEX compound above the AWQSGVs. BTEX is more prevalent and present at higher concentrations in the intermediate zone groundwater than in the shallow zone groundwater beneath the Current Site, consistent with the observation of visible subsurface impacts and locations where soil detections were above Commercial Use SCOs. Groundwater collected from MW-20I on the west side of the canal also contained MTBE, a gasoline additive, demonstrating an additional non-MGP VOC source. Other VOCs detected at concentrations above the AWQSGVs are summarized in Table 5-8. Isopropylbenzene was detected at concentrations above the AWQSGV in eight of the thirteen intermediate zone groundwater samples. Chlorinated VOCs were detected at concentrations above the AWQSGVs in groundwater samples collected from MW-6I and MW-7I along the southwestern boundary of the Current Site and in groundwater samples collected from wells near the Gowanus Canal including MW-5I, MW-9I, and MW-20I. Chlorinated VOCs are not associated with former MGP operations.

5.4.2.2 Semivolatile Organic Compounds

Several PAHs were detected in nine of the 13 intermediate groundwater samples, however only four PAHs (acenaphthene, fluorene, naphthalene, and phenanthrene) were detected at concentrations above AWQSGVs in one or more of the samples. Naphthalene and acenaphthene were the most frequently detected PAHs in intermediate groundwater and were detected at the greatest concentrations in the sample collected from MW-4I and MW-9I near the Gowanus Canal and in MW-3I near former Holders No. 1 through No. 3. Fluorene and phenanthrene were only detected at concentrations above the AWQSGVs in one groundwater sample collected from MW-9I. PAHs were not detected in groundwater samples collected from upgradient monitoring well MW-1I, monitoring well MW-20I across the Gowanus Canal, or monitoring well MW25I in the northern corner of the parking lot (Block 1007 Lot 1).

Phenol and 1,1 biphenyl were the only other SVOCs detected at concentrations above the AWQSGVs in the intermediate groundwater samples collected during the RI. 1,1-Biphenyl was only detected in the groundwater sample collected from MW-6I. The detected phenol concentrations ranged from 5.7 to 86 µg/L. Phenol was detected in six of the 13 intermediate groundwater samples including the samples collected from monitoring well MW-3I near former holders No. 1 through No. 3, MW-6I along the southwestern Current Site boundary, MW-8I downgradient of the Previously Remediated Area, and MW-4I, MW-5I, and MW-9I near the Gowanus Canal.

5.4.2.3 Metals

Several metals were detected at concentrations above the AWQSGVs as summarized in Table 5-5 and illustrated on Figure 5-8. The metals detected at concentrations exceeding AWQSGVs most frequently include arsenic, iron, magnesium, manganese, and sodium. Antimony was detected in two groundwater samples and barium was detected in one intermediate groundwater sample, at concentrations above the AWQSGVs. Arsenic was detected at concentrations above AWQSGVs in five intermediate groundwater samples and ranged in concentration from 26.7 to 110 µg/L.

5.4.2.4 Total Cyanide

Total cyanide was detected in eight of the 13 intermediate groundwater samples and ranged in concentration from 9.9 to 156 µg/L. None of the intermediate groundwater samples contained concentrations of total cyanide above the AWQSGVs of 200 µg/L.

5.4.2.5 Polychlorinated Biphenyls

PCBs were analyzed in three of the 13 intermediate groundwater samples collected during the RI. PCBs were not detected above the reporting limit in any of the 3 samples analyzed.

5.4.2.6 Pesticides and Herbicides

Pesticides and herbicides were analyzed in three of the 13 intermediate groundwater samples collected during the RI. One pesticide (Beta-BHC, at an estimated concentration of 0.072 µg/L) and one herbicide (2,4-DB, at a concentration of 1.4 µg/l) were detected above the reporting limit in one (MW-5I) of the 3 samples analyzed. AWQSGVs are not listed for these compounds.

5.4.2.7 MNA Parameters

Primary field parameters used to document the potential for natural biodegradation of dissolved organic compounds in groundwater under a MNA approach include DO and ORP. The groundwater collection records in Appendix F include the DO and ORP parameters. DO concentrations in intermediate wells ranged from 0 mg/L at MW-4I and MW-5I to 3.35 mg/L at MW-1I. ORP readings ranged from 20 mV at MW-1I to -198 mV at MW-4I.

5.4.3 Deep Well Groundwater Samples

Nine deep monitoring wells were installed during the RI. The deep wells have 10 foot screened sections between 50 and 70 ft bgs. Two deeper wells (MW-4D1 and MW-4D2) located adjacent to the Gowanus Canal, have 5 foot screened sections extending from 115 to 120 ft bgs and 142 to 147 ft bgs as summarized on Table 3-2. The analyses performed for each well are summarized in Table 3-1. Eleven deep well groundwater samples (including two duplicate samples) were collected and analyzed. A summary of the analytical results are illustrated on Figure 5-9 and tabulated in Table 5-5.

5.4.3.1 Volatile Organic Compounds

Five of the 11 deep well groundwater samples contained benzene at concentrations above the AWQSGV. Four of these samples did not contain any of the other BTEX compounds and the benzene concentration ranged from 1.3 to 1.9 µg/L. One of the groundwater samples (MW-9D) contained all of the BTEX compounds at concentrations above the AWQSGVs (total BTEX concentration of 1,653 µg/L). As illustrated on Figure 5-9, the sample with the greatest BTEX concentrations was collected from the monitoring well adjacent to the Gowanus Canal and in the vicinity of former tar tanks (MW-9D). Low, yet above AWQSGV, concentrations of benzene were also detected in monitoring wells MW-21D through MW-23D to the north-northeast of the Historic MGP Site in the parking lot in Block 1007 Lot 1). BTEX is less prevalent and generally present at lower concentrations in the deep zone groundwater than in the intermediate zone groundwater beneath the Current Site.

Deep zone groundwater samples also contained chlorinated VOCs at concentrations above AWQSGVs. As illustrated on Figure 5-9 and in Table 5-5, chlorinated VOC concentrations above AWQSGVs were detected in every deep zone well (screened between 50 and 70 ft bgs) except monitoring well MW-21D. Chlorinated compounds are not associated with former MGP operations.

5.4.3.2 Semivolatile Organic Compounds

Only one deep zone groundwater sample contained PAHs at concentrations above AWQSGVs. Acenaphthene and naphthalene were detected at concentrations of 61 and 2,100 µg/L, respectively, in the groundwater sample collected from MW-9D near the former tar tanks adjacent to the Gowanus Canal. Only two other SVOCs (carbazole and dibenzofuran) were detected in one groundwater sample (MW-9D). These SVOCs do not have AWQSGVs.

5.4.3.3 Metals

A few metals were detected in the majority of the deep groundwater samples. Only one deep groundwater sample (MW-5D) contained concentrations of metals above AWQSGVs. These metals include iron, magnesium, manganese, and sodium as summarized in Table 5-5 and illustrated on Figure 5-9. These metals are not typically associated with MGPs.

5.4.3.4 Total Cyanide

Total cyanide was detected in six of the 11 deep groundwater samples and ranged in concentration from 6.4 to 29 µg/L. None of the deep groundwater samples contained concentrations of total cyanide above the AWQSGVs of 200 µg/L.

5.4.3.5 Polychlorinated Biphenyls

One sample of the 11 deep groundwater samples was analyzed for PCBs during the RI. PCBs were not detected above the reporting limits in the sample analyzed.

5.4.3.6 Pesticides and Herbicides

One of the 11 deep groundwater samples was analyzed for pesticides and herbicides during the RI. Pesticides and herbicides were not detected above the reporting limits in the sample analyzed.

5.4.3.7 MNA Parameters

Primary field parameters used to document the potential for natural biodegradation of dissolved organic compounds in groundwater under a MNA approach include DO and ORP. The groundwater collection records in Appendix F include the DO and ORP parameters. DO concentrations in deep wells ranged from 0.63 mg/L at MW-21D to 7.89 mg/L at MW-1D. ORP readings ranged from -81 mV at MW-2D to -178 mV at MW-1D.

5.5 Vapor Intrusion Evaluation Sample Results

Samples of sub-slab vapor were collected from four locations at the Current Site. Two of the samples (SV-1 and SV-2) were collected immediately below the concrete slab of the occupied structure currently used for commercial-retail purposes located at 137 12th Street (Block 1007, Lot 172) in March 2010. The remaining samples (SV-3 through SV-4) were collected immediately below the slab in two separate retail spaces of the occupied structure currently used for commercial purposes at 60 12th Street and 64 12th Street, respectively (Block 1025, Lot 26). Results from three ambient air samples (AMB-1, AMB-2, and AMB-3) collected during the three phases of soil gas sampling are also presented on Table 5-6.

A list of the sub-slab soil vapor, indoor air, and ambient air samples collected, and the analyses performed, is included in Table 3-3. The results of the soil vapor and indoor air evaluation samples collected during the RI are summarized in Table 5-6 and illustrated on Figure 5-10. The compounds are divided into two

categories in the table. The first category includes compounds that could possibly be related to MGP sources, but may also be related to non-MGP sources. The second category includes compounds that are not related to MGP sources, including: ethanol, chlorinated hydrocarbons, and MTBE.

5.5.1 Block 1007, Lot 172

5.5.1.1 Sub-slab Vapor

As indicated on Table 5-6 and illustrated on Figure 5-10, compounds were detected in sub-slab vapor samples SV-1 and SV-2, but only two were above the NYSDOH background indoor air concentration levels for non-residential buildings. Carbon disulfide was the only MGP-related constituent detected in sub-slab vapor (SV-1: 2010 sampling event) above NYSDOH's background indoor air values. However, carbon disulfide was not detected in the paired indoor air sample. Chloroform was detected above the NYSDOH background indoor air concentration levels for non-residential buildings in samples SV-1 and SV-2. Chloroform was detected in the paired indoor air samples as discussed below. Chloroform is a non-MGP-related compound.

5.5.1.2 Ambient Air

There were detections of various constituents in the ambient air samples during the sampling event, consistent with urban background concentrations.

5.5.1.3 Indoor Air

1,4-Dichlorobenzene was detected in indoor air only slightly above the background concentration in sample IA-1. It was not detected in the sub-slab vapor samples. 1,4-Dichlorobenzene is an ingredient in various products including air fresheners, mothballs, and toilet-deodorizer blocks, which may be used/located at the facility.

Chloroform was detected in indoor air only slightly above the background concentration in sample IA-1 of the two sample locations and equal to background at the other (IA-2). Chloroform was also detected in soil vapor concentrations above the NYSDOH background concentration levels for non-residential buildings in samples SV-1 and SV-2. Chloroform is frequently employed as a solvent and is an ingredient in various products including air fresheners, adhesive removers, and glass wipes, all of which are present in the building. Chloroform is not associated with former MGPs.

Freon 11 was detected in indoor air only slightly above the background concentration at one of the two sample locations (IA-2) and below background at the other (IA-1). Freon 11 was also detected in sub-slab vapor at a concentration slightly above the NYSDOH background indoor air concentration levels for non-residential buildings. Freon 11 is a widely used halocarbon aerosol propellant and refrigerant, all of which are likely present at the facility.

5.5.2 Block 1025, Lot 26

5.5.2.1 Sub-slab Vapor

As indicated on Table 5-6 and illustrated on Figure 5-10, compounds were detected in sub-slab vapor samples SV-3 and SV-4, but only chloroform is slightly above the NYSDOH background indoor air concentration levels for non-residential buildings. Chloroform was detected in the paired indoor air samples (IA-3 and IA-4) at concentrations below the background levels.

5.5.2.2 Ambient Air

There were detections of various constituents in the ambient air samples during the sampling event, consistent with urban background concentrations.

5.5.2.3 Indoor Air

1,2-Dichloropropane was detected in indoor air above the background concentration at one sample location (IA-3). It was not detected in sub-slab soil vapor samples. 1,2-Dichloropropane is used in the production of tetrachloroethylene (PCE). In the past it was used as a soil fumigant and an industrial solvent and found in paint strippers, varnish, and furniture finish remover.