FINAL
FIELD SAMPLING PLAN
REV. 2

NORWOOD LANDFILL
NORWOOD, DELAWARE COUNTY, PENNSYLVANIA

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FINAL

FIELD SAMPLING PLAN REV. 1
NORWOOD LANDFILL
NORWOOD, DELAWARE COUNTY, PENNSYLVANIA

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LIST OF ACRONYMS

ºC	degrees Celsius
bgs	below ground surface
BTAG	Biological Technical Assistance Group
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
CVAA	cold vapor atomic absorption
DO	dissolved oxygen
DPT	Direct Push Technology
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
ERT	EPA Environmental Response Team
ESAT	Environmental Services Assistance Team
ESI	Expanded Site Inspection
FSP	Field Sampling Plan
gpm	gallons per minute
GPR	Ground-Penetrating Radar
GPS	Global Positioning System
HRS	Hazard Ranking System
IATA	International Air Transport Association
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectroscopy
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry
IDW	investigation-derived waste
L	liter
L/min	liters per minute
LTSB	EPA Region III Laboratory and Technical Services Branch
MCL	Maximum Contaminant Level
mL	milliliter
MS/MSD	matrix spike/matrix spike duplicate
mV	millivolt
NPL	National Priorities List
OLEM	Office of Land and Emergency Waste
ORP	Oxidation-Reduction Potential
OSWER	Office of Solid Waste and Emergency Response
PAH	polycyclic aromatic hydrocarbon

LIST OF ACRONYMS, CONTINUED

PCB	polychlorinated biphenyl
pdf	portable document file
pH	hydrogen ion concentration
PID	photoionization detector
PMC	Program Management Company
PPE	personal protective equipment
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
RBC	Risk-Based Concentration
RSL	Regional Screening Level
S/D	matrix spike/duplicate
SIM	selected ion monitoring
SOP	Standard Operating Procedure
SOW	Statement of Work
START	Superfund Technical Assessment and Response Team
SVOC	semivolatile organic compound
TAL	target analyte list
TCL	target compound list
TDD	Technical Direction Document
TDS	total dissolved solids
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
USFWS	U.S. Fish and Wildlife Service
VOA	volatile organic analysis
VOC	volatile organic compound
WAM	Work Assignment Manager
WESTON®	Weston Solutions, Inc.
WWTP	Wastewater Treatment Plant

1.0 INTRODUCTION

Under the Eastern Area Superfund Technical Assessment and Response Team (START) Contract No. EP-S3-15-02, Technical Direction Document (TDD) No. W503-17-03-001, the U.S. Environmental Protection Agency (EPA) Region III tasked Weston Solutions, Inc. (WESTON®) to conduct a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Expanded Site Inspection (ESI) of the Norwood Landfill Site (the Site) located in Norwood, Delaware County, Pennsylvania.

The Norwood Landfill ESI is being conducted in accordance with EPA *Guidance for Performing Site Inspections Under the Comprehensive Environmental Response, Compensation, and Liability Act* (EPA, 1992). The purpose of this ESI is to collect sufficient information concerning the conditions at the Site to assess the relative threat posed to human health and the environmental with respect to the actual or potential release of hazardous substances attributable to the Site, and to determine the need for additional action under CERCLA based on criteria set forth in EPA's Hazard Ranking System (HRS) Final Rule (EPA, 1990). The HRS model is a screening tool used to determine whether a site meets the criteria required to be considered for the National Priorities List (NPL), which is EPA's list of sites warranting federal interest. The scope of the ESI includes multi-media sampling and analysis.

The sampling strategy for the ESI presented in this Field Sampling Plan (FSP) emphasizes the collection of samples intended to meet analytical data requirements presented in the *Guidance for Performing Site Inspections Under the Comprehensive Environmental Response, Compensation, and Liability Act* (EPA, 1992). WESTON developed the FSP in accordance with the provisions of the EPA Region III START 5 Program-Wide *Uniform Federal Policy-Quality Assurance Project Plan* (UFP-QAPP) (WESTON, 2015).

2.0 BACKGROUND

This section describes the site location, presents a description of the Site, and summarizes the previous investigation activities associated with the Site.

2.1 SITE LOCATION AND DESCRIPTION

The Norwood Landfill site consists of the Lower Norwood Neighborhood, known as Winona Homes, which was constructed during the 1950s, the surrounding wooded area, and the adjacent Muckinipattis and Darby Creeks (Figure 1). The geographic coordinates of the approximate center of the neighborhood are 39°52'55.76" north latitude and 75°17'29.04" west longitude (Figure 1). Norwood Park borders the neighborhood and wooded area to the north-northeast and the Norwood Elementary School borders the neighborhood to the northwest. Additional residential areas are located west of the Lower Norwood neighborhood (Figure 1).

2.2 SITE HISTORY

Based on a review of available information and historical aerial photos, approximately 10 acres of land directly south of Norwood Park was used as the Norwood Dump from approximately 1950 to 1959. From 1960 to 1963, those 10 acres and an additional 15 acres of land located south of the Lower Norwood Neighborhood along Darby Creek were used as a sanitary landfill by a landfill operator who had a contract with Norwood Borough (the land owner) to dispose of municipal solid waste collected in the City of Philadelphia. In August 2016, EPA learned that several current and former residents of Norwood Borough who are concerned about reports of cancer and auto-immune diseases in their community had sought assistance from state environmental and health agencies to investigate whether those illnesses were caused by contamination resulting from the landfill. Additionally, residents are also concerned with the potential for material originating from the nearby Glenolden Laboratories (and subsequently Merck, Sharp, and Dohme Pharmaceutical Laboratories) to have been disposed in the landfill, as well as other unregulated and unpermitted dumping on the landfill over time.

Another concern reported by a resident is that the Winona Homes section of Lower Norwood was constructed on fill soil, brought to the site from an unknown source on or near the Walt Whitman Bridge in Philadelphia, PA, while it was under construction. Because the origin of soil or fill material is an unknown source, there is a potential for it to contain hazardous substances.

Finally, an additional area of concern to residents is the former Muckinipates Wastewater Treatment Plant (WWTP) that was located to the northwest of the dump and operated from some time prior to 1957 until it was demolished in the early 1980s. Residents are concerned that raw sewage was deposited in a flat field adjacent to the plant. Historic aerial photos and an archival newspaper article confirm that sludge was stored in this area, which is now the site of a sewage pumping station that directs waste water to a treatment facility in Southwest Philadelphia. Areas of concern are shown on Figure 2.

2.3 PREVIOUS INVESTIGATIONS

In 1993, the U.S. Fish and Wildlife Service (USFWS) conducted a Level I Contamination Survey of two tracts of land, Tract 24 and Tract 35, located between the Lower Norwood neighborhood and Darby Creek (see Figure 2). The Level I Contamination Survey noted that the Borough of Norwood historically had used Tract 35 as a municipal landfill and that debris was scattered across the property at the time of the survey. Observed debris included glass jars and bottles, automobile frames and parts, aluminum siding, asphalt, concrete, and tires (Program Management Company [PMC], 1999).

In 1999, PMC conducted a Level II Survey of Tracts 24 and 35 for USFWS, during which test pits were excavated and samples of soil (21 shallow and 17 deep), sediment (7), surface water (6), and groundwater (10) were collected. The samples were analyzed for target compound list (TCL) volatile organic compounds (VOCs), TCL semivolatile organic compounds (SVOCs), TCL pesticides, polychlorinated biphenyls (PCBs), chlorinated herbicides, target analyte list (TAL) metals (total and dissolved for groundwater samples), and cyanide. Analytical results were compared to the EPA Region III Risk-Based Concentrations (RBCs) (now known as Regional Screening Levels [RSLs]) residential and industrial soil screening levels for the surface soil and sediment samples and to the EPA RBCs for tap water for the surface water and groundwater samples, where applicable (PMC, 1999).

VOCs were not detected in any of the soil, sediment, or surface water samples above RBCs, and only chloroform was detected above the RBC in one groundwater sample. Several SVOCs were detected above RBCs in the soil, sediment, and groundwater samples, and in one surface water sample. Pesticides were not detected above RBCs in the surface water or sediment samples; however, one pesticide, chlordane, was detected above the RBC in one of the soil samples. Concentrations of PCBs were detected above RBCs in several soil samples, but did not exceed RBCs in the sediment, surface water, or groundwater samples. Manganese was the only inorganic analyte that exceeded RBCs in the surface water samples; however, several inorganic analytes were detected above RBCs in the soil, sediment, and groundwater samples. Additional details on analytical results and sample locations are provided in the *Final Preliminary Assessment Report for the Norwood Landfill* (WESTON, 2017).

Although constituents were detected in samples collected as part of the Level II Survey, the concentrations of the constituents were attributed to natural conditions in the area, impacts from surface water runoff from adjacent properties and streets, and non-hazardous materials previously disposed on the property (PMC, 1999).

In August 2016, EPA received complaints from concerned citizens regarding the historical use of the surrounding area as a waste dump for landfill material and laboratory equipment, as well as the use of potentially contaminated fill material during construction of the housing development, and requested that EPA conduct an investigation to determine whether hazardous substances may be present on the Site.

In September 2017, EPA collected 20 surface (0 to 6 inches below ground surface [bgs]) soil and 9 subsurface (24 to 48 inches bgs) soil samples, including 1 duplicate surface soil sample, 2 background surface soil samples, and 1 background subsurface soil sample. Soil samples were collected in the wooded right-of-way between the homes along E. Winona Avenue and W. Martin Lane and throughout the wooded area south of the neighborhood adjacent to Darby Creek. Surface soil samples were collected directly behind the homes to determine whether fill material used during the construction of the Lower Norwood neighborhood may have contained contaminants at concentrations that may pose a risk to human health. The subsurface soil samples were collected to determine whether landfill material was present below the surface. Debris and/or landfill material was generally not observed in the subsurface soil samples, with the exception of glass debris at one location.

Analytical results of soil samples indicated detected VOCs did not exceed applicable EPA Regional Screening Levels (RSLs [previously known as RBCs]) for residential soil. Low levels of SVOCs were detected in the majority of the soil samples; however, with the exception of the concentrations of benzo(a)anthracene in two surface soil samples and the concentrations of benzo(b)fluoranthene, benzo(a)pyrene, and indeno(1,2,3 cd)pyrene in one surface soil sample, detected concentrations of SVOCs in surface soil samples did not exceed applicable EPA RSLs. Additionally, concentrations of benzo(a)pyrene in five subsurface soil samples and the concentrations of dibenzo(a,h)anthracene in three subsurface soil samples met or exceeded the EPA RSL for residential soil. Concentrations of PCBs in two surface soil samples exceeded the EPA RSL for residential soil. PCBs were not detected at elevated concentrations in the subsurface soil samples. Low levels of pesticides were detected in the majority of the soil samples; however, with the exception of the concentration of dieldrin in one soil sample and the concentrations of dieldrin and aldrin in one subsurface soil sample, detected concentrations did not exceed EPA RSLs. Concentrations of detected inorganics did not exceed applicable EPA RSLs with the exception of the concentrations of cobalt in one surface soil sample and the concentrations of manganese in one surface and one subsurface soil sample. Additionally, two subsurface soil samples contained elevated concentrations of lead exceeding the EPA residential lead screening level. Additional details on analytical results and sample locations are provided in the Final Preliminary Assessment Report for the Norwood Landfill (WESTON, 2017).

In spring of 2018, EPA mailed letters to approximately 37 residences along E. Winona Avenue, as well as to residents living along Essex Road, Love Lane, Martin Lane, and Mohawk Avenue who expressed interest in having their property sampled. EPA gained access to 21 residential properties to collect soil samples. In May 2018, EPA collected 23 surface soil (0 to 12 inches bgs) samples from the 21 residential properties, including two duplicate soil samples.

Analytical results of the residential surface soil samples indicated that VOCs were not detected in the soil samples exceeding EPA RSLs for residential soil; three surface soil samples contained concentrations of the SVOCs benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, and indeno(1,2,3-cd)pyrene exceeding EPA RSLs; one soil sample contained a concentration of PCBs above the EPA residential RSL; two soil samples contained concentrations of dieldrin above the EPA RSL for residential soil; and one soil sample contained concentrations of antimony and lead above applicable EPA RSLs. Additional details on analytical results and sample locations are provided in the *Final Site Inspection Report for the Norwood Landfill*, *Revision 1* (WESTON, 2018).

3.0 OBJECTIVE AND DATA USE

The objective of this sampling event is to collect samples and analytical data to determine whether hazardous substances are present in the soil, groundwater, surface water, and sediment at levels that may pose a risk to human health and/or the environment. The data will be used to provide EPA with adequate information to determine whether the Site is eligible for placement on the NPL. Analytical data will be compared to EPA RSLs for residential soil for the soil and sediment samples (EPA, 2019), EPA Maximum Contaminant Levels (MCLs) and EPA RSLs for tap water for groundwater samples (EPA, 2009 and 2019), and EPA Biological Technical Assistance Group (BTAG) Benchmarks for Freshwater and Freshwater Sediments (EPA, 2006). The data will be used to prepare an ESI report and calculate a preliminary HRS score.

4.0 PROPOSED ACTIVITIES

This section describes the scope of work, including proposed sampling activities and field measurements; summarizes samples for the project; explains how samples will be collected and handled; and describes equipment decontamination procedures and the disposal of investigation-derived waste (IDW) generated during sampling.

4.1 SCOPE OF WORK

As part of the sampling event for the Site, WESTON will perform the following tasks:

- Identify sampling locations in the field by physically marking sampling locations with pin flags and record sampling locations using Global Positioning System (GPS) technology.
- Provide clearance of boring locations through a private underground utility clearance contractor using geophysics/ground-penetrating radar (GPR) and/or other technology to locate potential underground utilities and other underground features.
- Advance 27 soil borings throughout the Site using Direct Push Technology (DPT). Soil borings will be field screened with a photoionization (PID) detector and a radiation meter such as a Ludlum Model 19, Micro R and logged.
- Collect up to 40 soil samples, one surface and one subsurface, from 19 borings advanced at the Site, including 4 soil samples from boreholes beyond the known landfill area to document background, and 2 duplicates for Quality Assurance/Quality Control (QA/QC). Up to five additional 5 soil samples may be collected from any of the 27 boreholes based on field observations.
- Convert up to six boreholes into temporary well points if groundwater is encountered. Borehole locations for conversion to monitoring wells will be selected to maximize triangulation to determine groundwater flow direction. Temporary well points will be surveyed in to determine ground elevation and used to determine groundwater elevations.

- Develop temporary well points to remove sediment and turbidity. Collect groundwater samples from the installed temporary well points. Abandon temporary well points.
- Collect up to 11 soil samples, one surface and one subsurface plus a duplicate sample for QA/QC, from 5 borings advanced at the southern end of the Norwood Landfill between Darby Creek and residential properties located along W. Martin Lane using a hand auger.
- Collect up to 6 co-located surface water and sediment samples along the Muckinipattis Creek upstream, adjacent to, and downstream of the Old Norwood Dump.
- Photo document sampling activities and sampling locations.
- Record all sampling locations using GPS technology.
- Package and ship all samples collected to the assigned EPA Contract Laboratory Program (CLP) laboratory for the following analyses: TAL VOCs, SVOCs, polycyclic aromatic hydrocarbons (PAHs) by selected ion monitoring (SIM), PCBs, pesticides, and TAL metals including mercury. Additionally, select soil samples will be analyzed for dioxins and furans if ash is observed in boreholes.

4.2 SAMPLE COLLECTION

This section describes the proposed sampling activities and general locations for each sample to be collected as part of the field activities. Proposed sampling locations are shown on Figure 3, Proposed Sampling Location Map, and summarized in Table 1, Proposed Sampling. Table 2 summarizes the matrices, analyses, analytical methods, containers, preservatives, detection limits, and maximum holding times for all the samples proposed to be collected during the sampling event.

4.2.1 SOIL SAMPLE COLLECTION

4.2.1.1 DPT Soil Boring

Up to 27 soil borings will be advanced with DPT using a Geoprobe® type drill rig. Prior to boring installation, an underground utility specialist will use GPR and/or electromagnetic instruments and other methods to locate potential underground utilities, in addition to contacting the underground utility locator service 811 hotline and completing a mark-out request ticket. The exact location of the proposed borings may be altered based on the results of the subsurface utility investigation and utility mark-outs. WESTON will collect soil samples in accordance with WESTON SOP No. 304, Subsurface Soil Sampling (WESTON, 2019a).

Eight borings will be advanced in and along the suspected boundary of the Old Norwood Dump, three borings will be advanced in the Norwood neighborhood, two borings will be advanced in the athletic fields in the southern portion of Norwood Park, and two borings will be advanced at background locations to document soil conditions not believed to have been impacted by landfill or fill material: one boring on a parcel of land owned by the borough northwest of the landfill area and one in the northern corner of Norwood Park. Two samples, one surface soil and one subsurface soil, will be collected from each of these boreholes. Additionally, nine borings, three transects of three borings, will be advanced along the boundary of the southern end of the Norwood Neighborhood and the suspected northern boundary of the Norwood Landfill in an effort to identify the extent of the landfill closest to residences and three borings, one transect of three borings, will be advanced within the landfill area . Of the four transects consisting of three borings, a total of three borings will be made no less than 10 feet apart from each other. Two samples, a surface soil and a subsurface soil, will be collected from at least one of the three borings; however, additional samples from the other two borings may be collected based on field observations and/or instrument detection. If spacing does not permit up to three borings at least 10 feet apart, then the number of borings will be reduced to two. Three additional soil samples will be collected as field duplicates for field quality assurance/quality control (QA/QC).

Soil borings will be advanced with a standard 2-inch probing rod and 5-foot MacroCore® sampler. Soils will be collected in acetate sleeves and continuously collected, logged, and screened for volatile organic vapors. Borings will be advanced to the prescribed depth or refusal at each of the soil sampling locations. WESTON proposes to advance DPT soil borings to a depth of approximately 15 to 20 feet bgs, the groundwater table, or refusal, whichever is encountered first. Surface soil samples collected for laboratory analysis will be collected from 0 – 1 foot bgs, and subsurface soil samples collected for laboratory analysis will be biased towards the soil interval (1-foot increment) containing the highest field evidence of impacts, based on field screenings with a PID and radiation meter and/or observation of staining and odors. The exact depth of each sample will be documented in the site logbook. In the event that no obvious signs of impacts are observed in the borings, the samples will be collected from the deepest interval achieved or at the water table interface. The Geoprobe® MacroCore® sampler and other sampling equipment will be decontaminated before use and between boring locations. All decontamination fluids will be containerized for later disposal.

At each soil sampling location, WESTON will first collect sample volume for VOC analysis using an Encore® sampling device. The sample will be collected directly from the soil core in the acetate sleeve. Following the collection of soil for VOC analysis, WESTON will collect additional soil volume from the boring sleeve using a dedicated, disposable polyethylene scoop in a disposable aluminum foil pan for homogenization prior to placement into appropriate sample containers for analysis of SVOCs, PAHs by SIM, PCBs, pesticides, and metals (including mercury). Additionally, up to five soil samples, including one duplicate sample, will be analyzed for dioxins/furans; two samples from the transect borings along along the access road between the southern boundary of the Winona Homes neighborhood and the northern boundary of the Norwood Landfill two samples from borings within the Old Dump. Sample locations for dioxin analysis will be biased towards locations where incinerator ash is observed. If no ash is observed, samples will be collected from randomly selected locations and depths at the discretion of the WAM.

4.2.1.2 Hand Auger Boring

An additional 5 soil borings will be advanced using a stainless steel hand auger in the southwestern portion of the landfill. At each location, WESTON will first collect a surface soil sample from 0 to 6 inches bgs in accordance with WESTON SOP No. 302, Surface Soil Sampling (WESTON, 2019b). Prior to sampling, any vegetation or debris will be removed with a stainless steel trowel and/or shovel in preparation for sample collection. Soil will first be placed into an aluminum pan, and all sticks, leaves, and stones will be removed. Soil to be analyzed for VOCs will then be collected from the bottom of the hole directly into an EnCore® sampler. The soil in the aluminum pan will be thoroughly homogenized prior to being placed into appropriate sample containers for analysis of SVOCs, PCBs, pesticides, TAL metals, and mercury. WESTON will then continue the advancement of the hand auger to a depth between 24 and 36 inches bgs for the collection of a subsurface soil sample in accordance with WESTON SOP No. 304, Subsurface Soil Sampling (WESTON, 2019a). Soil that is removed from 6 to 24 inches bgs will be staged in a pile next to the borehole, soil that is removed from 24 to 36 inches bgs will be placed into a dedicated, disposable aluminum pan. When the desired depth is reached, soil to be analyzed for VOCs will be collected immediately from the auger directly into an EnCore® sampler. The soil in the aluminum pan will be thoroughly homogenized prior to being placed into appropriate sample containers for analysis of SVOCs, PCBs, pesticides, and TAL metals including mercury. Additionally, two samples will be collected for dioxin/furan analysis. Sample locations for dioxin analysis will be biased towards locations where incinerator ash is observed. If no ash is observed, samples will be collected from randomly selected locations and depths at the discretion of the WAM. The stainless steel hand auger will be decontaminated between each sampling location using water and Liquinox®. An additional sample will be collected as a field duplicate for field QA/QC.

4.2.2 GROUNDWATER SAMPLING

Temporary groundwater monitoring points will be installed at as many as six borehole locations as follows: one in the approximate center of the Old Norwood Dump, one in the athletic fields, one in the central portion of the Norwood neighborhood, one along the southern boundary of the Norwood neighborhood adjacent to Norwood Landfill, one in the Norwood Landfill, and one on a parcel of land owned by the township northwest of the landfill area as a background location to document upgradient conditions not believed to have been impacted by landfill or fill material. An additional sample will be collected as duplicates for field QA/QC.

As stated previously, soil borings will be advanced to approximately 15 feet to 20 feet bgs. If saturated soils indicative of groundwater are encountered, borings will be advanced approximately an additional 5 feet below the depth of saturation to ensure that the collection of representative groundwater samples is feasible. Once groundwater is encountered and the zone of saturation is sufficiently penetrated (as noted above), pre-packed a 1-inch-diameter, polyvinyl chloride (PVC) screened monitoring well will be installed to the base of the boring. The wells will be screened entirely within the saturated interval of the boring with 5 to 10 feet of 0.01 slotted PVC screen and 0-graded sand. The temporary wells will be developed to reduce sediment and turbidity. WESTON and its subcontractor will conduct temporary monitoring well installation activities in general accordance with EPA Environmental Response Team (ERT) SOP No. 2050, Operation of the Model 6620 DT Geoprobe (EPA ERT, 2015), as modified for the specific Geoprobe® rig to be used. The final depth and screening intervals for each boring will be documented in the site logbook. Bentonite chips will be used during abandonment of the wells at the conclusion of groundwater sampling.

WESTON will collect up to seven groundwater samples from the six temporary wells, assuming that an adequate amount of water is produced. Groundwater samples will be collected to document whether a release of hazardous substances associated with possible sources has occurred to the groundwater.

Following installation and prior to commencing purging and sampling activities, WESTON will collect a round of static water levels from all of the wells in accordance with WESTON SOP No. 204, Water Level Measurements (WESTON, 2019c). All wells will be purged in accordance with WESTON SOP No. 201, Groundwater Well Sampling (WESTON, 2019d), using low-flow groundwater sampling techniques utilizing a peristaltic pump with dedicated tubing in order to minimize agitation of samples. Water quality parameters, including pH, turbidity, specific conductance, dissolved oxygen (DO), Eh/oxidation reduction potential (ORP), total dissolved solids (TDS) and temperature will be measured in accordance with WESTON SOP No. 210, Field pH, Conductivity, and Temperature Measurement (WESTON, 2019e) using a field-calibrated YSI meter or equivalent. The wells will be purged until three well volumes have been removed and general water quality parameters have stabilized as follows:

- pH: ±0.1 unit
- Specific conductance: ±3%
- ORP (Eh): ±10 millivolts (mV)
- DO: ±10%
- Temperature ±0.1 degrees Celsius (°C)

Typically, the discharge rate will be less than 0.5 liter per minute (L/min) (0.13 gallon per minute [gpm]). The maximum purge rate shall not exceed 1 L/min (0.25 gpm) and will be adjusted to achieve minimal drawdown. Water quality parameters will be measured and recorded at 5-minute intervals until the well has stabilized. Parameters will be considered stable when three consecutive readings collected 5 minutes apart using a field water quality instrument (YSI or equivalent) meet the criteria listed above. Once three well volumes have been removed and stabilization has occurred, samples will be collected for analysis of VOCs, SVOCs, PAHs by SIM, PCBs, pesticides, and TAL metals (including mercury). WESTON will collect groundwater samples directly from the sample/purging tubing after disconnecting the tubing from the flow-through cell. The groundwater samples will be immediately collected from the tubing into the appropriate certified-clean sample containers identified for each analysis. All well purge data and water level measurements will be recorded by WESTON personnel in the site field logbook

4.2.3 SURFACE WATER AND SEDIMENT SAMPLING

WESTON will collect co-located surface water and sediment samples along Muckinipattis Creek in accordance with WESTON SOPs No. 203 Surface Water Sampling and No. 303, Sediment Sampling (WESTON, 2019f and 2019g). Surface water and sediment samples will be collected along Muckinipattis Creek and will be used to determine the presence of off-site migration of contaminants from possible source areas (i.e., alleged fill, dump/landfill, and WWTP sludge beds). A surface water and sediment sample will be collected upstream of the former WWTP sludge beds to document background conditions. WESTON will begin sample collection at the most downstream location and work upstream in an effort to minimize sediment disturbance. Darby Creek and Muckinipattis Creek are tidal. Surface water and sediment samples will be collected during an out-going tide to ensure there is no influence of contaminants migrating from downstream sources. Five additional sediment samples will be collected from mapped wetland areas; two from wetland area along Muckinipattis Creek near the Delcora pumping stations and three from wetland area south of landfill.

At each sample location, WESTON will first collect the surface water samples. Samples for VOC analysis will be collected by submerging a dedicated 1 liter (L) glass sample jar and transferring water directly into three pre-preserved 40- milliliter (mL) volatile organic analysis (VOA) vials. The samples for VOC analysis will be preserved with hydrochloric acid to a hydrogen ion concentration (pH) of less than 2. The sample bottles for the remaining surface water parameters will be filled, and the dedicated 1-L sampling container will be discarded in the IDW waste stream. The samples for TAL metals and mercury analysis will be preserved with nitric acid to a pH less than 2 immediately following sample collection.

Following the collection of the surface water samples, the sediment will be collected using a Ogeechee Corer and a dedicated, disposable plastic scoop. Sediment for nonvolatile analyses will be homogenized in a dedicated disposable aluminum pan prior to being placed into appropriate sample containers. The sediment for VOC analysis will be collected prior to homogenization using Terra Core® samplers to extract approximately 5 grams of sediment. The sediment will be extruded into three glass amber 40-mL VOA vials, each containing a miniature magnetic Teflon®-coated stir bar. The VOA vials must be pre-weighed with the tare weight written on the bottle label. It is important that the field sampler does not add a label to the VOA vial to alter the vial's tare weight or to obscure the recorded tare weight on the original label. An additional 60-mL glass VOA vial will be provided for percent solids for the VOC soil sample.

Surface water and sediment samples will be analyzed for VOCs, SVOCs, PAHs by SIM, PCBs, pesticides, and TAL metals including mercury.

4.3 SAMPLE IDENTIFICATION

The Sample Identifier will be listed on the chain-of-custody document for each sample and will provide the date and sample location as follows:

NL-MMDDYY-XX-##

The "NL" prefix refers to the Site name – Norwood Landfill. The YYYY refers to the date of sample collection (i.e., 2020 for samples collected in the year 2020). The XX portion of the Sample Identifier refers to the sample type ("SS" for surface soil, "SB" for subsurface soil, "GW" groundwater, "SW" for surface water, "SD" for sediment, "RB" for rinsate blank, "FB" for ambient field blank, and "TB" for trip blank). The "##" portion of the suffix refers to the unique sequential sample number assigned to a specific sampling location. Field duplicate samples will be identified with a -01 suffix following the sequential sample number.

In addition to the Sample Identifier, samples to be shipped to CLP laboratories for analysis will be assigned unique CLP sample numbers. Organics samples will be identified in the format C#### (where the # may represent a number or letter), and the corresponding inorganics sample ID will be in the format MC####. The CLP sample number and the Sample Identifier will be included on the chain-of-custody, the bottle labels, and the sample tags attached to each bottle.

4.4 SAMPLE MANAGEMENT

WESTON will document field activities using logbooks, photographic records, and chain-of-custody documentation. Documentation, record keeping, and data management activities will be conducted in accordance with the WESTON UFP-QAPP (WESTON, 2015) and in accordance with the *Contract Laboratory Program Guidance for Field Samplers* (EPA, 2014a), unless otherwise specified. Each sampling location will be noted in the field logbook in accordance with WESTON SOP No. 101, Logbook Documentation (WESTON, 2019h). Scribe software will be used for sample documentation and data management.

Sample handling, packaging, and shipment procedures will be in accordance with the *Contract Laboratory Program Guidance for Field Samplers* (EPA, 2014a) for samples shipped to CLP laboratories. Sample labels and tags will be affixed to each sample jar shipped to the CLP laboratory. Samples will be placed in plastic zipper bags. Bagged containers will be placed in coolers with ice and packed with appropriate absorbent material. All sample documents will be sealed in a plastic zipper bag and affixed to the underside of each cooler lid. The lid will be sealed with shipping tape, and custody seals will be affixed to the cooler. Coolers will be labeled with the origin and destination locations.

Chain-of-custody documents will be completed using Scribe software and will accompany field samples to the laboratory in accordance with WESTON SOP No. 103, Chain-of-Custody Documentation (WESTON, 2019i). Samples will be shipped to the designated CLP laboratories via Federal Express. Regulations for packaging, marking, labeling, and shipping hazardous materials and wastes are promulgated by the U.S. Department of Transportation. Air carriers that transport hazardous materials require compliance with the current International Air Transport Association (IATA) regulations, which apply to shipment and transport of hazardous materials by air carrier. WESTON will follow all applicable IATA regulations.

4.5 DECONTAMINATION AND INVESTIGATION-DERIVED WASTE

Dedicated, disposable sampling equipment and personal protective equipment (PPE) will be used wherever applicable. Disposable sampling equipment and PPE will be double-bagged and disposed of as dry industrial waste. Non-dedicated sampling equipment, such as a stainless steel trowel or hand auger, petite ponar, and Geoprobe® equipment will undergo a gross decontamination between each sampling point with Liquinox, followed by a double rinse with distilled water, in accordance with WESTON SOP No. 301, Decontamination Procedures (WESTON, 2019j). IDW is defined as any byproduct of the field activities that is suspected or known to be contaminated with hazardous substances. IDW, soil cuttings and purge water, will be consolidated and containerized in 55-gallon drums and stored onsite awaiting analytical results, which will determine the appropriate disposal method for the IDW in accordance with Office of Land and Emergency Waste (OLEM), formerly known as Office of Solid Waste and Emergency Response (OSWER) 9345.3-02 (EPA, 1991) and WESTON SOP No. 019, Investigative Derived Waste Compliance Plan (WESTON, 2019k).

5.0 ANALYTICAL PARAMETERS AND METHODS

Samples will be analyzed for TAL VOCs, SVOCs, PAHs by SIM, PCBs, pesticides and TAL metals in accordance with EPA CLP Methods SOM02.4 and ISM02.4 for organics and inorganics, respectively (EPA, 2016a and EPA, 2016b). Select samples will also be analyzed for dioxins/furans in accordance with EPA CLP High Resolution Superfund Methods HRSM01.2 (EPA, 2014b). Surface water and groundwater samples will be analyzed using the Trace VOC method. Equipment rinsate blanks and trip blanks associated with soil and sediment samples will be analyzed by the low level VOC method.

Metals for groundwater and surface water will be analyzed by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) and mercury will be analyzed by cold vapor atomic absorption (CVAA). Metals for soil and sediment will be analyzed for aluminum, calcium, iron, magnesium, potassium, and sodium by Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES) with the remaining metals analyzed by ICP-MS and mercury analyzed by CVAA. The equipment rinsate blanks associated with soil or sediment samples will be analyzed by the same methods as the soil and sediment samples. Table 2, Analytical Parameters, summarizes the matrices, analyses, analytical methods, containers, preservatives, QA/QC samples, and technical holding times for the samples proposed for collection during the sampling event.

6.0 QUALITY ASSURANCE AND QUALITY CONTROL PROCEDURES

This section describes the QA and QC procedures for personnel during the site sampling event, including responsibilities, field QC, laboratory QC, data evaluation, and data management.

6.1 FIELD QUALITY CONTROL

Field QA/QC measures will consist of collecting field duplicates and field blanks (e.g., trip blank samples, ambient field blank samples, and equipment rinsate blank samples). These measures will be applied in accordance with the WESTON EPA Region III START 5 Program-Wide UFP-QAPP (WESTON, 2015). The numbers and types of QC samples to be collected are summarized in Table 2.

Field duplicate samples will be collected at a rate of one per 20 samples per sample matrix and will be used to test the reproducibility of sampling procedures and analytical results.

Trip blank samples will be collected and provided in each cooler containing samples for VOC analysis. Trip blank samples will be used to assess whether samples may have become cross-contaminated with VOCs during storage and shipment. Trip blanks associated with groundwater and surface water samples will be analyzed by the Trace VOC method. Trip blanks associated with soil and sediment samples will be analyzed by the low-level VOC method.

Ambient field blanks will be collected at a frequency of one per day or one per 20 groundwater or surface water field samples, whichever is greater, for Trace VOC analysis. Ambient field blanks are generated in the field by pouring laboratory-grade deionized water into the sampling container and preserving the sample according to method requirements. The ambient field blank results will be used to assess whether contaminants were introduced during sample collection, storage, and shipment or sample handling by the laboratory.

Equipment rinsate blanks will be collected from non-dedicated sampling equipment at a frequency of 1 rinsate per day for each parameter to be analyzed to demonstrate equipment decontamination. An equipment rinsate blank will be collected from the Geoprobe® equipment, hand auger, and the petite ponar following decontamination to document that the nondedicated sampling equipment were properly decontaminated between locations. Equipment blank results will be used to verify proper decontamination of non-dedicated sampling equipment. Equipment blank samples associated with soil and sediment samples will be collected for low-level VOCs, SVOCs, PAHs by SIM, pesticides, PCBs, TAL metals including mercury, and dioxins/furans (as appropriate).

Temperature blanks will be placed in each sample cooler and used to determine whether samples have been adequately cooled during shipment and storage. The temperature blank will be prepared using tap water placed in a VOA vial without preservative.

6.2 LABORATORY QUALITY CONTROL

Samples will be shipped to the CLP laboratory assigned through the EPA Region III Laboratory and Technical Services Branch (LTSB) Laboratory Section. Laboratory QC measures will consist of all QC elements identified in the analytical method or CLP Statement of Work (SOW) as required by EPA Region III policy, and will incorporate all reportable QC (including forms and deliverables) required by the SOW and this FSP.

For samples that are shipped to EPA CLP laboratories, analysis of matrix spike/matrix spike duplicate (MS/MSD) samples are required for PCBs and pesticides and matrix spike/duplicate (S/D) samples are required for inorganic analyses. EPA Region III does not require analysis of MS/MSD samples for CLP VOCs, SVOCs, PAHs, or dioxins/furans.

MS/MSD and S/D sample results are used to assess analytical precision and accuracy in a specific sample matrix. WESTON field personnel will collect a minimum of one MS/MSD and one S/D sample per 20 samples of the same matrix. For water samples, the MS/MSD sample will require collection of a triple volume of sample for PCBs and pesticides and a double volume of sample for TAL metals. For soil and sediment samples, a double volume of sample required for the PCB and pesticide MS/MSD but no additional sample volume is required for the TAL metals S/D sample. See Table 2, Analytical Parameters, for a summary of QA/QC samples being collected.

6.3 DATA VALIDATION

Validation of all analytical data will be performed by the Environmental Services Assistance Team (ESAT) contractor under the direction of the LTSB Laboratory Section. Organic and inorganic data will be validated at EPA Region III Organic Level 2 and Inorganic Level 2, respectively, in accordance with the EPA CLP *National Functional Guidelines for Superfund Organic Methods Data Review*, EPA-540-R-2017-002 (EPA, 2017a), and the EPA CLP *National Functional Guidelines for Inorganic Superfund Methods Data Review*, EPA-540-R-2017-001 (EPA, 2017b).

6.4 DATA EVALUATION AND MANAGEMENT

This section describes how WESTON will evaluate data generated from the sampling event, determine whether data are representative of the Site, and ensure that data are secure and retrievable.

6.4.1 DATA EVALUATION

WESTON will review the data validation reports to determine whether any major or minor deficiencies were encountered during sampling and analysis. These deficiencies may include major deficiencies (such as unusable or rejected data) or minor deficiencies affecting data, including data that were estimated or qualified as a result of failure to meet project-specific or National Functional Guideline QC acceptance limits.

To assess the effectiveness of field sampling procedures and implement corrective actions as needed, WESTON will evaluate field blank results. Trip blank contamination not attributed to laboratory sources may be due to contamination in the field or during shipment. Rinsate blank contamination not otherwise attributed to laboratory sources may be due to inadequate decontamination procedures or contamination in source water used for the rinsate blank. Ambient field blank contamination not attributed to laboratory sources suggests contaminants from either airborne sources that may have been entrained in the analytical sample during collection or from the source water used to generate the ambient field blank. Failure of the temperature blank to meet the temperature acceptance criteria indicates the need to better ice down the samples.

6.4.2 DATA REPRESENTATIVENESS AND COMPLETENESS

The intent of this FSP is to obtain a complete data set that is representative of site conditions. Data will be reviewed for completeness. If not all samples are collected or received/analyzed by the laboratory, resulting in less than 100% completeness, the reason for the data gaps will be identified in the ESI Report. If any data are rejected, the reason for the data rejection will be discussed in the ESI Report. If sampling activities or procedures vary significantly from this FSP as a result of unexpected conditions in the field or other unforeseeable factors, WESTON will discuss in the ESI Report these deviations from the FSP and whether the changes affect data representativeness.

6.4.3 DATA MANAGEMENT

EPA Region III will provide WESTON with a validation report for the analytical data in portable document file (pdf) format along with an importable Excel electronic data deliverable (EDD). WESTON will upload the EDD data to the Scribe® database and compare the EDD results to the sample results received in pdf format in conjunction with the data validation report to ensure their consistency. All electronic data will be stored in a Scribe® database for future retrieval and reference, based on the requirements of the Work Assignment Manager (WAM).

7.0 SCHEDULE AND DELIVERABLES

WESTON anticipates that sample collection will be conducted in March 2020. WESTON will ship samples to the assigned laboratory for analysis. WESTON expects to receive validated analytical data from EPA Region III LTSB approximately 60 to 90 days after the Region receives the unvalidated data from the assigned CLP laboratory. WESTON will provide EPA with the ESI Report within 60 days after all site activities have been completed and validated data are available.

Information obtained during the sampling event will be compiled in an ESI Report. The ESI Report will include a discussion of data collection methods; document sampling locations; and present data summary tables, figures, maps, and site photographic documentation.

8.0 REFERENCES

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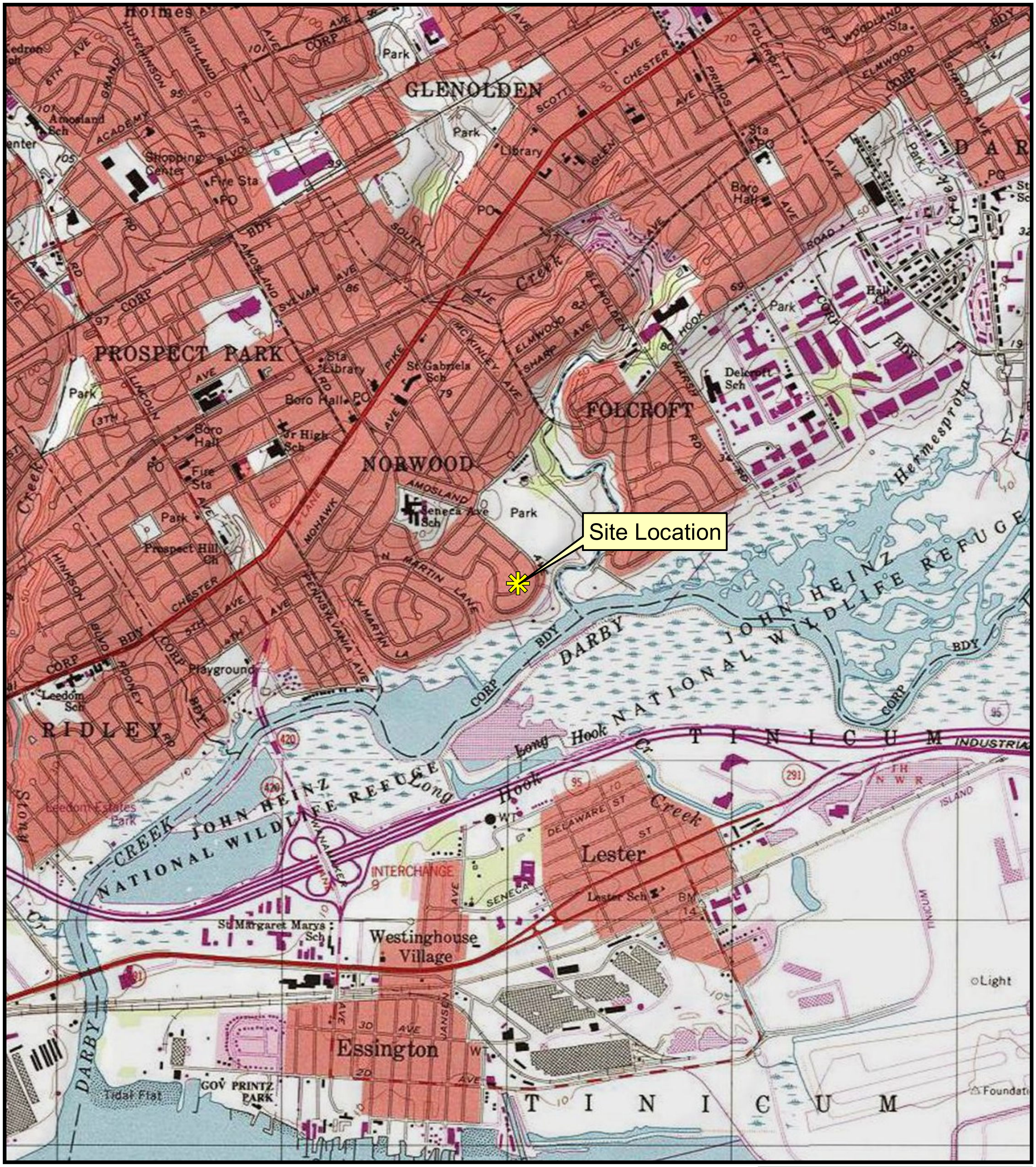
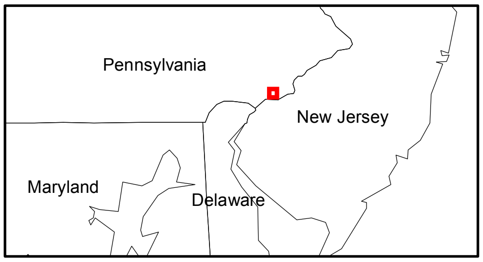
FIGURES





USGS 7.5 Minute Quadrangle
Landsdowne, Pa. 1974.

The source of this map image is Esri, used by the EPA with Esri's permission

Coordinate System:
WGS84 UTM Zone 18N Feet

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Norwood Landfill Site
Norwood, Delaware County, PA

Figure 1
Site Location Map

TDD#: W503-17-03-001
Contract: EP-S3-15-02
Prepared: 11/13/2017

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Legend

Muckinipattis Creek

Areas of Concern

- Former Muckinipates WWTP
- Lower Norwood Neighborhood
- Norwood Sanitary Landfill
- Old Norwood Dump

Data Sources
Imagery: ESRI, Bing Mapping Service
The source of this map image is Esri, used by the EPA with Esri's permission

Shapefiles: US Fish and Wildlife Service

Coordinate System:
WGS 1984 UTM Zone 18N
Linear Unit: Foot US

Datum: WGS 1984

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Feet

Norwood Landfill Site
Norwood, Delaware County, PA

Figure 2
Areas of Concern

TDD#: W503-17-03-001
Contract: EP-S3-15-02
Prepared: 12/10/2019

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Legend

- Muckinipattis Creek
- NWI Wetlands

Areas of Concern

- Former Muckinipattis WWTP
- Lower Norwood Neighborhood
- Norwood Sanitary Landfill
- Old Norwood Dump
- Surface Soil/Soil Boring Sample Location
- Surface Water/Sediment Sample Location
- Groundater Sample Location
- Sediment Sample Location

Data Sources
Imagery: ESRI, Bing Mapping Service
The source of this map image is Esri, used by the EPA with Esri's permission

Shapefiles: US Fish and Wildlife Service

Coordinate System:
WGS 1984 UTM Zone 18N
Linear Unit: Foot US

Datum: WGS 1984

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0 175 350
Feet

Norwood Landfill Site
Norwood, Delaware County, PA

Figure 3
Proposed
Sample Location Map

TDD#: W503-17-03-001
Contract: EP-S3-15-02
Prepared: 3/5/2020

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TABLES

Table 1 Proposed Sampling

DPT Soil Borings			
Sample Identifier	**Sample Matrix**	**Sampling Location Description**	**Rationale**
NL-2020-SS-21	Surface Soil	Borough property, northwest of Norwood neighborhood	Background
NL-2020-SB-21	Subsurface Soil	Borough property, northwest of Norwood neighborhood	Background
NL-2020-SS-22	Surface Soil	Northwestern portion of Norwood Park	Background
NL-2020-SB-22	Subsurface Soil	Northwestern portion of Norwood Park	Background
NL-2020-SS-23	Surface Soil	Southwestern portion of Norwood Park	Source characterization
NL-2020-SB-23	Subsurface Soil	Southeastern portion of Norwood Park	Source characterization
NL-2020-SS-24	Surface Soil	Southeastern portion of Norwood Park	Source characterization
NL-2020-SB-24	Subsurface Soil	Southeastern portion of Norwood Park	Source characterization
NL-2020-SS-25	Surface Soil	Central portion of Norwood Neighborhood	Source characterization
NL-2020-SB-25	Subsurface Soil	Central portion of Norwood Neighborhood	Source characterization
NL-2020-SS-26	Surface Soil	West-central portion of Norwood Neighborhood	Source characterization
NL-2020-SB-26	Subsurface Soil	West-central of Norwood Neighborhood	Source characterization
NL-2020-SS-27	Surface Soil	Southern portion of Norwood Neighborhood	Source characterization
NL-2020-SB-27	Subsurface Soil	Southern portion of Norwood Neighborhood	Source characterization
NL-2020-SS-28	Surface Soil	Central portion of Old Dump	Source characterization
NL-2020-SB-28	Subsurface Soil	Central portion of Old Dump	Source characterization
NL-2020-SS-29	Surface Soil	Central portion of Old Dump	Source characterization
NL-2020-SB-29	Subsurface Soil	Central portion of Old Dump	Source characterization
NL-2020-SS-30	Surface Soil	Central portion of Old Dump	Source characterization
NL-2020-SB-30	Subsurface Soil	Central portion of Old Dump	Source characterization
NL-2020-SS-31	Surface Soil	Central portion of Old Dump	Source characterization/Extent of landfill
NL-2020-SB-31	Subsurface Soil	Central portion of Old Dump	Source characterization/Extent of landfill
NL-2020-SS-32	Surface Soil	Northern boundary of Old Dump	Source characterization/Extent of landfill
NL-2020-SB-32	Subsurface Soil	Northern boundary of Old Dump	Source characterization/Extent of landfill

Table 1 Proposed Sampling (Continued)

DPT Soil Borings			
Sample Identifier	**Sample Matrix**	**Sampling Location Description**	**Rationale**
NL-2020-SS-33	Surface Soil	Northern boundary of Old Dump	Source characterization/Extent of landfill
NL-2020-SB-33	Subsurface Soil	Northern boundary of Old Dump	Source characterization/Extent of landfill
NL-2020-SS-34	Surface Soil	Northern boundary of Old Dump	Source characterization/Extent of landfill
NL-2020-SB-34	Subsurface Soil	Northern boundary of Old Dump	Source characterization/Extent of landfill
NL-2020-SS-35	Surface Soil	Southern boundary of Old Dump	Source characterization/Extent of landfill
NL-2020-SB-35	Subsurface Soil	Southern boundary of Old Dump	Source characterization/Extent of landfill
NL-2020-SS-36	Surface Soil	Transect along Norwood Landfill at boundary between neighborhood and landfill	Source characterization/Extent of landfill
NL-2020-SB-36	Subsurface Soil	Transect along Norwood Landfill at boundary between neighborhood and landfill	Source characterization/Extent of landfill
NL-2020-SS-37	Surface Soil	Transect along Norwood Landfill at boundary between neighborhood and landfill	Source characterization/Extent of landfill
NL-2020-SB-37	Subsurface Soil	Transect along Norwood Landfill at boundary between neighborhood and landfill	Source characterization/Extent of landfill
NL-2020-SS-38	Surface Soil	Transect along Norwood Landfill at boundary between neighborhood and landfill	Source characterization/Extent of landfill
NL-2020-SB-38	Subsurface Soil	Transect along Norwood Landfill at boundary between neighborhood and landfill	Source characterization/Extent of landfill
NL-2020-SS-39	Surface Soil	Transect within Norwood Landfill	Source characterization/Extent of landfill
NL-2020-SB-39	Subsurface Soil	Transect within Norwood Landfill	Source characterization/Extent of landfill
NL-2020-XX-XX	TBD	Additional samples as needed based on field observations	Source characterization/
NL-2020-XX-XX	TBD	Additional samples as needed based on field observations	Source characterization
NL-2020-XX-XX	TBD	Additional samples as needed based on field observations	Source characterization
NL-2020-XX-XX	TBD	Additional samples as needed based on field observations	Source characterization
NL-2020-XX-XX	TBD	Additional samples as needed based on field observations	Source characterization

Table 1 Proposed Sampling (Continued)

DPT Soil Borings			
Sample Identifier	**Sample Matrix**	**Sampling Location Description**	**Rationale**
NL-2020-SS-XX-01	Surface Soil	Duplicate soil sample	QA/QC
NL-2020-SB-XX-01	Subsurface Soil	Duplicate soil sample	QC/QC
Temporary Wells			
Sample Identifier	**Sample Matrix**	**Sampling Location Description**	**Rationale**
NL-2020-GW-01	Groundwater	Temporary well converted from soil boring at Borough property (SB-21)	Background
NL-2020-GW-02	Groundwater	Temporary well converted from soil boring at northern portion of Norwood Park (SB-22)	Background
NL-2020-GW-03	Groundwater	Temporary well converted from soil boring in central portion of Norwood neighborhood (SB-25)	Assess groundwater conditions
NL-2020-GW-04	Groundwater	Temporary well converted from soil boring in central portion at Old Dump (SB-31)	Assess groundwater conditions
NL-2020-GW-05	Groundwater	Temporary well converted from soil boring boundary between neighborhood and Norwood Landfill (SB-37a)	Assess groundwater conditions
NL-2020-GW-06	Groundwater	Temporary well converted from soil boring boundary between neighborhood and Norwood Landfill (SB-40a)	Assess groundwater conditions
NL-2020-GW-XX-01	Groundwater	Duplicate groundwater sample	QA/QC
Hand Auger Samples			
Sample Identifier	**Sample Matrix**	**Sampling Location Description**	**Rationale**
NL-2020-SS-40	Surface Soil	Southwestern portion of Norwood Landfill	Source characterization
NL-2020-SB-40	Subsurface Soil	Southwestern portion of Norwood Landfill	Source characterization
NL-2020-SS-41	Surface Soil	Southwestern portion of Norwood Landfill	Source characterization
NL-2020-SB-41	Subsurface Soil	Southwestern portion of Norwood Landfill	Source characterization
NL-2020-SS-42	Surface Soil	Southwestern portion of Norwood Landfill	Source characterization
NL-2020-SB-42	Subsurface Soil	Southwestern portion of Norwood Landfill	Source characterization
NL-2020-SS-43	Surface Soil	Southwestern portion of Norwood Landfill	Source characterization
NL-2020-SB-43	Subsurface Soil	Southwestern portion of Norwood Landfill	Source characterization
NL-2020-SS-44	Surface Soil	Southwestern portion of Norwood Landfill	Source characterization

Table 1 Proposed Sampling (Continued)

Hand Auger Samples			
Sample Identifier	**Sample Matrix**	**Sampling Location Description**	**Rationale**
NL-2020-SB-44	Subsurface Soil	Southwestern portion of Norwood Landfill	Source characterization
NL-2020-SS-XX-01	Surface Soil	Duplicate soil sample	QA/QC
Surface Water and Sediment Samples			
Sample Identifier	**Sample Matrix**	**Sampling Location Description**	**Rationale**
NL-2020-SW-13	Surface water	Muckinipattis Creek, upstream of former WWTP sludge beds	Background
NL-2020-SD-13	Sediment	Muckinipattis Creek, upstream of former WWTP sludge beds	Background
NL-2020-SW-14	Surface water	Muckinipattis Creek; approximately 1,000 feet downstream of SW/SD-13 adjacent to northern end of former WWTP sludge beds	Assess surface water migration pathway
NL-2020-SD-14	Sediment	Muckinipattis Creek; approximately 1,000 feet downstream of SW/SD-13 adjacent to northern end of former WWTP sludge beds	Assess surface water migration pathway
NL-2020-SW-15	Surface water	Muckinipattis Creek; approximately 500 feet downstream of SW/SD-14 adjacent to southern end of former WWTP sludge beds	Assess surface water migration pathway
NL-2020-SD-15	Sediment	Muckinipattis Creek; approximately 500 feet downstream of SW/SD-14 adjacent to southern end of former WWTP sludge beds	Assess surface water migration pathway
NL-2020-SW-16	Surface water	Muckinipattis Creek; approximately 500 feet downstream of SW/SD-15 adjacent to northern end of former Old Dump	Assess surface water migration pathway
NL-2020-SD-16	Sediment	Muckinipattis Creek; approximately 500 feet downstream of SW/SD-15 adjacent to northern end of former Old Dump	Assess surface water migration pathway
NL-2020-SW-17	Surface water	Muckinipattis Creek; approximately 500 feet downstream of SW/SD-16 adjacent to southern end of former Old Dump	Assess surface water migration pathway
NL-2020-SD-17	Sediment	Muckinipattis Creek; approximately 500 feet downstream of SW/SD-16 adjacent to southern end of former Old Dump	Assess surface water migration pathway
NL-2020-SW-18	Surface water	Muckinipattis Creek; approximately 500 feet downstream of SW/SD-17 just upstream of confluence with Darby Creek	Assess surface water migration pathway
NL-2020-SD-18	Sediment	Muckinipattis Creek; approximately 500 feet downstream of SW/SD-17 just upstream of confluence with Darby Creek	Assess surface water migration pathway
NL-2020-SW-XX-01	Surface water	Duplicate surface water sample	QA/QC
NL-2020-SD-XX-01	Sediment	Duplicate sediment sample	QA/QC

Table 1 Proposed Sampling (Continued)

Surface Water and Sediment Samples			
Sample Identifier	**Sample Matrix**	**Sampling Location Description**	**Rationale**
NL-2020-SD-19	Sediment	Wetlands along Muckinipattis Creek	Assess surface water migration pathway; actual contamiantion of wetlands
NL-2020-SD-20	Sediment	Wetlands along Muckinipattis Creek	Assess surface water migration pathway; actual contamiantion of wetlands
NL-2020 SD-21	Sediment	Wetlands along Darby Creek	Assess surface water migration pathway; actual contamiantion of wetlands
NL-2020-SD-22	Sediment	Wetlands along Darby Creek	Assess surface water migration pathway; actual contamiantion of wetlands
NL-202-SD-23	Sediment	Wetlands along Darby Creek	Assess surface water migration pathway; actual contamiantion of wetlands
Blank Samples			
Sample Identifier	**Sample Matrix**	**Sampling Location Description**	**Rationale**
NL-2020-TB-01	Aqueous	Trip blank for water samples – **trace analysis**	QA/QC
NL-2020-TB-02	Aqueous	Trip blank for water samples – **trace analysis**	QA/QC
NL-2020-TB-03	Aqueous	Trip blank for soil/sediment samples – **low level analysis**	QA/QC
NL-2020-TB-04	Aqueous	Trip blank for soil/sediment samples – **low level analysis**	QA/QC
NL-2020-TB-05	Aqueous	Trip blank for soil/sediment samples – **low level analysis**	QA/QC
NL-2020-TB-06	Aqueous	Trip blank for soil/sediment samples – **low level analysis**	QA/QC
NL-2020-TB-07	Aqueous	Trip blank for soil/sediment samples – **low level analysis**	QA/QC
NL-2020-TB-08	Aqueous	Trip blank for soil/sediment samples – **low level analysis**	QA/QC
NL-2020-AB-01	Aqueous	Ambient field blank for groundwater samples – **trace analysis**	QA/QC
NL-2020-AB-02	Aqueous	Ambient field blank – for surface water samples – **trace analysis**	QA/QC
NL-2020-RB-01	Aqueous	Rinsate blank for Geoprobe® soil samples – **low level VOC analysis**	QA/QC
NL-2020-RB-02	Aqueous	Rinsate blank for Geoprobe® soil samples – **low level VOC analysis**	QA/QC

Table 1 Proposed Sampling (Continued)

NL-2020-RB-03	Aqueous	Rinsate blank for Geoprobe® soil samples – **low level VOC analysis**	QA/QC
NL-2020-RB-04	Aqueous	Rinsate blank for Auger soil samples – **low level VOC analysis**	QA/QC
NL-2020-RB-05	Aqueous	Rinsate blank for sediment samples – **low level VOC analysis**	QA/QC

Notes:
AB = ambient field blank
DPT = direct push technology
GW = groundwater
NL = Norwood Landfill
QA/QC = Quality Assurance/Quality Control
RB = rinse blank
SB = subsurface soil
SD = sediment
SS = surface soil
SW = surface water
TB = trip blank
VOC = volatile organic compound
WWTP = wastewater treatment plant

Table 2 Analytical Parameters

Matrix	Parameter	Analytical Method[1]	Container Type	Preservative	Detection Limit	Technical Holding Time	No. of Field Samples	No. of Field Duplicates	No. of Lab QC Samples[2]	No. of Blanks[3]
Soil	Low/medium VOCs	CLP SOW SOM02.4	Three 5-g Encores	Ice	CRQL	2 days (unpreserved)	55	3	0	5 TB 4 RB
	TAL SVOCs and PAHs by SIM	CLP SOW SOM02.4	One 8-oz CWM jar	Ice	CRQL	14 days (extract) 40 days (analysis)	55	3	0	4 RB
	Pesticides and PCBs	CLP SOW SOM02.4	One 8-oz CWM jar	Ice	CRQL	14 days (extract) 40 days (analysis)	55	3	4 MS/MSD	4 RB
	TAL Metals and Hg	CLP SOW ISM02.4	One 8-oz CWM jar	Ice	CRQL[1]	180 days (except 28 days for Hg)	55	3	4 S/D	4 RB
	Dioxins/furans	CLP SOW HRSM01.2	One 8-oz CWM jar	Ice	CRQL	1 year (extraction) 40 days (analysis)	6	1	0	1RB
Groundwater	Trace VOCs	CLP SOW SOM02.4	3 x 40-mL amber VOA vials	HCl to pH<2, Ice	Trace CRQL	14 days (analysis)	6	1	0	1 TB 1 AB
	TAL SVOCs	CLP SOW SOM02.4	Two 1-L amber bottles	Ice	CRQL	7 days (extraction) 40 days (analysis)	6	1	0	0
	PAHs by SIM	CLP SOW SOM02.4	Two 1-L amber glass	Ice	CRQL	7 days (extraction) 40 days (analysis)	6	1	0	0
	PCBs	CLP SOW SOM02.4	Two 1-L amber bottles	Ice	CRQL	7 days (extraction) 40 days (analysis)	6	1	1 MS/MSD	0
	Pesticides	CLP SOW SOM02.4	Two 1-L amber bottles	Ice	CRQL	7 days (extraction) 40 days (analysis)	6	1	1 MS/MSD	0
	TAL Metals and Hg	CLP SOW ISM02.4	1-L high-density polyethylene	Ice, HNO_3 to pH <2	CRQL[1]	180 days (except 28 days for Hg)	6	1	1 MS/MSD	0
Surface Water	Trace VOCs	CLP SOW SOM02.4	3 x 40-mL amber VOA vials	HCl to pH<2, Ice	Trace CRQL	14 days (analysis)	6	1	0	1 TB 1 AB
	TAL SVOCs	CLP SOW SOM02.4	Two 1-L amber bottles	Ice	CRQL	7 days (extraction) 40 days (analysis)	6	1	0	0

Matrix	Parameter	Analytical Method[1]	Container Type	Preservative	Detection Limit	Technical Holding Time	No. of Field Samples	No. of Field Duplicates	No. of Lab QC Samples[2]	No. of Blanks[3]
	PAHs by SIM	CLP SOW SOM02.4	Two 1-L amber glass	Ice	CRQL	7 days (extraction) 40 days (analysis)	6	1	0	0
Surface Water	PCBs	CLP SOW SOM02.4	Two 1-L amber bottles	Ice	CRQL	7 days (extraction) 40 days (analysis)	6	1	1 MS/MSD	0
	Pesticides	CLP SOW SOM02.4	Two 1-L amber bottles	Ice	CRQL	7 days (extraction) 40 days (analysis)	6	1	1 MS/MSD	0
	TAL Metals and Hg	CLP SOW ISM02.4	1-L high-density polyethylene	Ice, HNO_3 to pH <2	CRQL[1]	180 days for metals (except 28 days for Hg)	6	1	1 S/D	0
Sediment	Low/medium VOCs	CLP SOW SOM02.4	Three 40-mL VOA vials with stir bar and one 60-mL vial for % solids	Ice	CRQL	2 days (unpreserved)	11	1	0	1 TB 1 RB
	TAL SVOCs and PAHs by SIM	CLP SOW SOM02.4	One 8-oz CWM jar	Ice	CRQL	14 days (extract), 40 days (analysis)	11	1	0	1 RB
	Pesticides/PCBs	CLP SOW SOM02.4	One 8-oz CWM jar	Ice	CRQL	14 days (extract), 40 days (analysis)	11	1	1 MS/MSD	1 RB
	TAL Metals and Hg	CLP SOW ISM02.4	One 8-oz CWM jar	Ice	CRQL[1]	180 days for metals (except 28 days for Hg)	11	1	1 S/D	1 RB

Notes:

[1] Metals for soil and sediment samples will be analyzed by ICP-AES for aluminum, calcium, iron, magnesium, potassium, and sodium; remaining metals will be analyzed by ICP-MS. Hg will be analyzed by CVAA. Metals for groundwater and surface water samples will be analyzed by ICP-MS and CVAA.
[2] Designate 1 sample per 20 samples for laboratory QC (i.e., MS/MSD for PCB and pesticide analysis and S/D for inorganic analysis). For groundwater and surface water, a triple volume is required for the PCB and pesticide sample designated for MS/MSD analysis and a double volume is required for the inorganic sample designated for S/D analysis. For soil and sediment samples, double volume is required for the PCB and pesticide MS/MSD sample but no additional volume is required for the metals sample designated for S/D analysis.
[3] Trip blanks, equipment rinsate blanks, and ambient field blanks will be collected in the same bottleware and preservatives as groundwater samples and be analyzed by the same method as the associated field samples.

AB = Ambient blank
CLP = Contract Laboratory Program
CRQL = Contract-required quantitation limit
CVAA = Cold vapor atomic absorption
CWM = clear wide mouth
g = gram
HCl = Hydrochloric acid
Hg = Mercury
HNO_3 = Nitric acid
ICP-AES = Inductively coupled plasma-atomic emission spectroscopy
ICP-MS = Inductively coupled plasma-mass spectroscopy
ISM02.4 = Inorganic Superfund Method version 2.4
L = Liter
mL = Milliliter
MS/MSD = matrix spike/matrix spike duplicate
oz = ounce
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyl
pH = hydrogen ion concentration
QC = Quality control
RB = Rinsate blank
S/D = matrix spike/duplicate
SIM = selected ion monitoring
SOM02.4 = Superfund Organic Method version 2.4
SOW = Statement of work
SVOC = Semivolatile organic compound
TAL = Target analyte list
TB = Trip blank
VOA = Volatile organic analysis
VOC = Volatile organic compound