

Removal Site Evaluation Work Plan – Surface and Shallow Soil Assessment

Former Houston Wood Preserving Works Site (HWPW Site)

Prepared for

**Union Pacific Railroad Company
1400 Douglas Street
Omaha, Nebraska 68179**

Prepared by

*Geosyntec Consultants, Inc.
10777 Westheimer Road, Suite 900
Houston, Texas 77042*

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ACRONYMS AND ABBREVIATIONS

2,4-DNT	2,4-Dinitrotoluene
A-CZ	A-Cohesive Zone
AOC	Area of Concern
APAR	Affected Property Assessment Report
ASAO	Administrative Settlement Agreement and Order on Consent
A-TZ	A-Transmissive Zone
B-CZ	B-Cohesive Zone
BRA	Background Reference Areas
BTV	Background Threshold Values
B-TZ	B-Transmissive Zone
C-CZ	C-Cohesive Zone
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Contaminants of Concern
CPT	Cone-Penetrometer Testing
CSM	Conceptual Site Model
C-TZ	C-Transmissive Zone
D-CZ	D-Cohesive Zone
DMP	Data Management Plan
DSHS	Texas Department of State Health Services
D-TZ	D-Transmissive Zone
ft	feet
ft bgs	feet below ground surface
FSP	Field Sampling Plan
GWBU	Groundwater Bearing Units
HASP	Health and Safety Plan
HCA	Hierarchical clustering analysis
HCPCS	Harris County Pollution Control Services
HHD	Houston Health Department

ACRONYMS AND ABBREVIATIONS (CONT'D)

HWPW	Houston Wood Preserving Works
in	inches
in bgs	inches below ground surface
μm	micrometer
NAPL	Non-Aqueous Phase Liquid
ng/kg	nanograms per kilogram
PAH	Polyaromatic Hydrocarbons
PBW	Pastor, Behling & Wheeler, LLC
PCDD/Fs	Polychlorinated Dibenzo-P-Dioxins and Dibenzofurans
PCL	Protective Concentration Levels
PCLE	Protective Concentration Level Exceedance
PCOC	Potential Contaminants of Concern
PCP	Pentachlorophenol
QAPP	Quality Assurance Project Plan
RAP	Response Action Plan
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RKI	Raba Kistner, Inc.
ROST	Rapid Optical Screening Tool
RSE	Removal Site Evaluation
SDD	South Drainage Ditch
SOW	Statement of Work
SVOC	Semi-Volatile Organic Compounds
SWMU	Solid Waste Management Units
TarGOST®	Tar-specific Green Optical Screening Tool
TCDD	2,3,7,8-tetrachlorodibenzo- <i>p</i> -dioxin
TCEQ	Texas Commission on Environmental Quality
TEF	Toxic Equivalence Factors
TEQ	Toxic Equivalence

ACRONYMS AND ABBREVIATIONS (CONT'D)

TNOD	Technical Notice of Deficiency
TPH	Total Petroleum Hydrocarbon
TRRP	Texas Risk Reduction Program
UPRR	Union Pacific Railroad Company
USEPA/EPA	U.S. Environmental Protection Agency
UTL	Upper Tolerance Limit
VOC	Volatile Organic Compounds
WSP	WSP Golder Associates

1. INTRODUCTION

This document was prepared in accordance with Paragraph 17 of the February 27, 2023, Administrative Settlement Agreement and Order on Consent (ASAOC) for Removal Site Evaluation (RSE), between the U.S. Environmental Protection Agency (USEPA/EPA) and Union Pacific Railroad Company (UPRR), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Docket No. 06-02-03. Section 3.1 of Appendix C to this ASAOC, the EPA Region 6 Statement of Work (SOW), calls for UPRR to prepare and submit a RSE Work Plan to EPA for the Houston Wood Preserving Works Site (HWPW, “Site”) located at 4910 Liberty Road, Houston, Texas, (**Figure 1**), which is owned by UPRR. This document constitutes one part of the RSE Work Plan, which is specific to the assessment of the extent of dioxins/furans (i.e., total toxicity equivalence [TEQ]), semi-volatile organic compounds (SVOCs), and volatile organic compounds (VOCs) in surface (0 to 2 inches below ground surface [in bgs]) and shallow (2-24 in bgs) soils in the community (including neighborhoods, schools, churches, parks, and recreation center) adjacent to the HWPW Site, and evaluate these same compounds within the HWPW property (surface soil, shallow soil and materials beneath the soil cap) to support human health risk evaluation by EPA (to include direct contact exposure evaluation and risk characterization) and forensic analysis by UPRR of data both adjacent to and at the HWPW Site¹. In addition, the approach for the Background Study (or Background Reference Area investigation [BRA]), as described in Section 4.3 of the SOW, is included herein. This RSE Work Plan was prepared by Geosyntec Consultants, Inc. with support from RSJ Consulting, LLC, ToxStrategies LLC, and WSP Golder Associates (WSP) at the request of UPRR. This RSE Work Plan is intended to address comments related to the soil investigation received from the EPA, the Texas Commission on Environmental Quality (TCEQ), the City of Houston and Harris County and subsequent discussions.

This RSE Work Plan will provide details to:

1. Collect data needed to characterize anthropogenic background soil representative of current and historical activities not impacted by the historic wood preserving activities at the HWPW Site for use in establishing background threshold values (BTVs).
2. Collect data needed to characterize the nature and extent of the presence of dioxins/furans (i.e., TEQ), SVOCs, and VOCs in surface soils in the community (including neighborhoods, schools, parks, and recreation center) adjacent to the HWPW Site to support human health risk evaluation (direct contact exposure evaluation and risk characterization) and forensic analysis.

¹ A direct exposure evaluation provides quantitative estimates of receptor exposures to potential compounds of concern (PCOCs) based on the PCOC analytical data and site-specific exposure parameter assumptions (e.g., daily soil ingestion, dermal contact and incidental inhalation of soil particulates; frequency of dermal contact; duration of exposure; etc.). The resulting PCOC exposure estimates will be used along with relevant PCOC toxicity criteria to derive quantitative estimates of cancer risk and/or noncancer hazard to characterize potential risks and hazards.

3. Collect additional on-site soil data to further evaluate dioxin/furans, SVOCs, and VOCs for attribution purposes.

This RSE Work Plan addresses the activities required by Paragraphs 14.a of the ASAOC (and subsection A of Section 1.2 of the SOW), as well as relevant portions of SOW Sections 4.1 (Existing Data and Data Gap Analysis; Conceptual Site Model [CSM]), 4.3 (Background Study) and 4.4 (on-site and off-site Shallow Soil Investigation). In addition, this RSE Work Plan describes the analytical database required under ASAOC Paragraph 14.d and SOW Sections 1.2(D) and Section 4.1.

The Initial Focus Area for the investigation has been identified through discussions with EPA and TCEQ, as well as representatives of the City of Houston and Harris County. UPRR and its consultants have had meetings with EPA and these other stakeholders to discuss the scope of work presented in this RSE Work Plan and the information collected is intended to provide necessary and sufficient data to assess potential health risks described above, and the data will be interpreted to assess any potential data gaps that may warrant additional assessment in subsequent stages. If contaminants attributed to the HWPW Site are found at the boundary of the Initial Focus Area for the investigation, the results will be discussed with EPA to evaluate if further investigation is recommended.

The final *RSE Work Plan – Vapor Intrusion Assessment* was submitted to EPA on October 27, 2023 (Geosyntec, 2023). UPRR is in the process of preparing a plan to evaluate impacts to the off-site storm sewer system and drainage areas and connections to on-site storm sewers as required under SOW Sections 1.2(C) and 4.4.

1.1 Site Specific Plans

The status of Site-Specific plans required by Section 3.2 of the SOW are as follows:

- Field Sampling Plans (FSPs)
 - Surface and Shallow Soils, On-Site and Background Reference Areas
 - Final submitted to EPA February 8, 2024
 - Surface and Shallow Soils, Off-Site Areas,
 - Final Submitted to EPA March 21, 2024
 - Vapor Intrusion Investigation
 - Final submitted to EPA September 8, 2023
- Health and Safety Plan (HASP)
 - Final submitted to EPA July 14, 2023
- Data Management Plan (DMP)

- Final submitted to EPA July 14, 2023
- Quality Assurance Project Plans (QAPP)
 - Final VI QAPP submitted to EPA December 1, 2023
 - Final Soil QAPP submitted to EPA on January 23, 2024

1.2 Document Organization

This document contains several elements, collectively comprising the RSE work plan:

- Background (Section 2)
- Soil Investigation (Section 3)
 - Summary of existing data (Section 3.1)
 - Data gap analysis (Section 3.2)
 - Review of potential compounds of concern (Section 3.3)
 - Review of the Conceptual Site Model (CSM) of the nature, extent, fate, and transport of chemicals (Section 3.4)
 - Proposed Sampling approach and evaluation (Section 3.5)
 - Data quality objectives (Section 3.6)
- Schedule (Section 4)
- References (Section 5)

2. BACKGROUND

The former HWPW Site is described in many documents that are available at the public website (<https://www.houstonwoodpreservingworks.com>). The contents of this section are drawn primarily from the Response Action Plan (RAP) of August 2020 by Golder Associates, Inc. (Golder, 2020a).

UPRR inherited the Site in 1997 after its merger with Southern Pacific Transportation Company. Since then and over the past 30 years, UPRR has conducted investigative and cleanup work under the oversight and approval of the TCEQ to address the historic groundwater and soil contamination and to prevent exposure pathways.

Chemicals used in the past wood preserving activities by Southern Pacific Railroad Company include coal tar creosote and extenders that were hydrocarbon mixtures miscible with creosote. Associated chemicals of potential health concern include VOCs, SVOCs, and polycyclic aromatic hydrocarbons (PAHs) that may be present as non-aqueous phase liquid (NAPL), dissolved constituents in groundwater or as vapors in soil gas, depending on the volatility and solubility, which vary for individual chemicals. Dioxins and furans have been found at some sites to be associated with former wood preservation activities and can also result from numerous other sources such as waste incineration, backyard and household trash burning, vehicle exhaust, and cigarette smoke.

2.1 Site Description

The HWPW Facility at 4910 Liberty Road, Houston, Harris County, Texas (the Site) is located within industrial land and includes the former HWPW facility and UPRR Englewood Intermodal Yard, which is to the south of the former HWPW facilities. The Englewood Intermodal Yard is currently vacant, but formerly used for the transfer of box containers from rail cars to truck trailers and vice-versa. UPRR mainline rail and siding rails separate the former HWPW and the Englewood Intermodal Yard areas. The Site will remain as a commercial/industrial land use for the foreseeable future.

2.2 Operational History

The Site was first developed for creosoting operations in 1899 and operated until 1984 when all wood treating activities operations ceased. The facility was dismantled in the early 1990s. The history and previous operations at the Site have been discussed in detail in the previously submitted Affected Property Assessment Report (APAR) (ERM, 2000) and Revised APAR (ERM, 2004), as well as the Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) Report (PRC, 1993). Former operation and process areas are shown in **Figure 2**.

2.3 Previous Investigations/Regulatory Involvement

The initial APAR prepared for the Site was submitted to the TCEQ dated June 10, 2000 (ERM, 2000). A revised APAR was submitted to the TCEQ dated June 10, 2004. Pastor, Behling & Wheeler, LLC (PBW) prepared an APAR Addendum dated July 2009 (PBW, 2009). Following comments from the TCEQ, PBW submitted an Updated APAR Addendum dated October 15, 2010, with response to TCEQ comments dated March 29, 2011. The TCEQ approved the APAR in a letter dated April 13, 2011.

As detailed in the APARs and subsequent submittals, the Affected Property consists of surface soils, subsurface soils, and groundwater affected by contaminants of concern (COC). The soil and groundwater exposure pathways were evaluated as part of the Site assessments.

In response to the TCEQ Technical Notice of Deficiency (TNOD) dated April 11, 2019, on the RCRA Permit Renewal with Major Amendments (including the RAP), UPRR conducted pre-design investigations in 2019 and 2020 to supplement the CSM for development of response actions at the Site that were detailed in Worksheet 2.0 of the Conceptual Response Action Plan – Revision No. 4 dated July 9, 2019. Results from additional pre-design assessments were submitted to the TCEQ in multiple reports including the following:

- Pentachlorophenol Soil Assessment Interim Report dated March 30, 2020 (Golder, 2020b)
- Updated Pentachlorophenol Soil Assessment Interim Report dated July 14, 2020 (Golder, 2020c)
- Soil Vapor Intrusion Assessment Interim Report dated March 31, 2020 (Golder, 2020d)
- Updated Soil Vapor Intrusion Assessment Interim Report dated August 4, 2020 (Golder, 2020e)
- Interim Groundwater Monitoring Report (2019-2020) dated April 30, 2020 (Golder, 2020f)
- Interim NAPL and Total Petroleum Hydrocarbon (TPH)-NAPL Assessment Report dated May 29, 2020 (Golder, 2020g)

The above interim reports are included in Appendix 3 of the RAP (Golder, 2020a).

2.3.1 Other Reports

Other documents that have been reviewed in the development of this RSE Work Plan include:

- Environmental Sampling and Analysis of Soil, Surface Water, Storm Water, and Storm Sewer Sediment, Raba Kistner, Inc., November 2022 (RKI, 2022)
- Shallow Soils Investigation of Dioxins and Furans, Neighborhood Near Former Union Pacific Railroad, Houston Wood Preserving Works, 4910 Liberty Road, Houston, TX., Epperson Environmental Group, LLC. September 21, 2022 (Epperson, 2022)

- Attic Dust Wipe Sampling Report, Neighborhood Near Former Union Pacific Railroad, Houston Wood Preserving Works, 4910 Liberty Road, Houston, TX. Epperson Environmental Group, LLC. March 15, 2023 (Epperson, 2023)
- Site-Specific Risk Based Screening Level for Dioxin in Residential Soil at the Former Houston Wood Preserving Works Site, Houston, Texas, September 2023 (EPA, 2023)
- Health Consultation for the Houston Health Department – Evaluation of soil data collected in the neighborhood adjacent to the former Union Pacific Railroad Houston Wood Preserving Works, January 30, 2023 (TX DSHS, 2023)

2.4 Geological Information

The generalized interpreted site stratigraphy from the ground surface to a depth of approximately 135 feet (ft) is as follows: Fill Material (0 to 5 ft thick); A-Cohesive Zone (A-CZ) (8 to 15 ft thick); A-Transmissive Zone (A-TZ) (4 to 21 ft thick); B-Cohesive Zone (B-CZ) (6 to 19 ft thick); B-Transmissive Zone (B-TZ) (discontinuous, where present, 3 to 10 ft thick); C-Cohesive Zone (C-CZ) (8 to 20 ft thick); C-Transmissive Zone (C-TZ) (10 to 13 ft thick); D-Cohesive Zone (D-CZ) (17 to 36 ft thick); and D-Transmissive Zone (D-TZ). It should be noted that these units and depths should be considered as only a general summary for the purposes of describing the overarching CSM and that much more complete and comprehensive lithologic characterizations, including specific hydrogeologic cross-sections and detailed discussions relative to individual investigative locations, are provided in the APARs and are supplemented in Attachment 1A of the 2020 RAP (Golder, 2020a).

2.5 Non-Aqueous Phase Liquids

Creosote NAPL, which is denser than water, has been detected in the groundwater bearing units (GWBU)s A-TZ, B-CZ, B-TZ, and C-TZ as noted in soil borings and monitoring wells. The sources of NAPL are likely from former wood treating operations. The wood treating facility was shut down in 1984 and dismantled in the early 1990s; thus, the NAPL sources were removed over 30 years ago. Over the past 25 years, UPRR has conducted numerous NAPL investigations, including cone-penetrometer testing (CPT) with rapid optical screening tool (ROST) borings and NAPL recoverability testing. In response to the TCEQ April 2019 TNOD, UPRR conducted an additional NAPL assessment using the Tar-specific Green Optical Screening Tool (TarGOST®), which was developed to target heavier end petroleum hydrocarbons including creosote and coal tar. For the off-site assessment, there was no evidence of off-site NAPL present within the vadose zone or the A-TZ. For the B-CZ/B-TZ, elevated TarGOST® signals off-site generally corresponded with observations of NAPL in existing wells, boring logs, and previously collected data.

Based on the additional NAPL assessment activities, the extent of NAPL in the B-CZ/B-TZ off-site is within generally discontinuous, isolated zones of thin carbonate seams and sand-lined fractures in the B-CZ occurring at depths of 24 ft or more below the ground surface. These zones have been

delineated laterally to occur within approximately 500 ft north of the Site. Elevated TarGOST® signals were observed on-site along the northern perimeter of the Site, and within the Englewood Intermodal Yard, indicating NAPL within the A-CZ, A-TZ, and B-CZ/B-TZ on-site. The NAPL impacts were delineated to the west, south, and east within the Site (delineated to the north off-site). A description of the additional assessment activities and an evaluation of the data collected were submitted to the TCEQ in the Interim NAPL and TPH-NAPL Assessment Report dated May 29, 2020 (Golder, 2020g), which is included in Appendix 3 of the 2020 RAP (Golder, 2020a).

2.6 Contaminants of Concern

As detailed in the APARs, the following COCs had measured concentrations in soil samples above their respective critical TCEQ Texas Risk Reduction Program (TRRP) Protective Concentration Levels (PCLs):

- Surface Soils
 - 1,2-Diphenylhydrazine
 - 2,4-Dinitrotoluene (2,4-DNT)
 - 2-Methylnaphthalene
 - Benzene
 - Benzo(a)anthracene
 - Benzo(a)pyrene
 - Dibenzofuran
 - Naphthalene
 - Pentachlorophenol (PCP)
 - Arsenic
 - Lead
 - TPH
- Subsurface Soils
 - 2-Methylnaphthalene
 - Benzene
 - Naphthalene
 - PCP

Regarding human exposure to COC concentrations in the off-site groundwater Protective Concentration Level Exceedance (PCLE) Zones, there is no potential for exposures to the off-site groundwater PCLE Zones. Drinking water in the area is provided by a municipal water supply (City of Houston) and a water well survey completed in 2014 confirmed no potable use within a one-mile radius of the HWPW Site (RCRA Permit Renewal, Part B, Section VI – Geology, July 15, 2014). In addition, the shallow GWBUs (A-TZ, B-CZ/B-TZ, C-TZ and D-TZ) do not have a reasonably anticipated future beneficial use in the area (as defined in TRRP [30 TAC §350.37(l)(3)(C)]).

Section 3.3 provides a more detailed discussion of the potential compounds of concerns (PCOCs), which includes the COCs identified in the APAR, to be included in the surface and shallow soils in the community (including neighborhoods, schools, parks, child day care locations and recreation center) adjacent to the HWPW Site to support human health risk evaluation (direct contact exposure evaluation and risk characterization) and forensic analysis.

2.7 Summary of Existing Data

The existing data for the HWPW Site and nearby areas investigated by UPRR and Southern Pacific Railroad Company from 1984 to present, data from 2022 surface soil sampling conducted by RKI on behalf of Harris County Pollution Control Services (HCPCS), and data from the 2022 Houston Health Department (HHD) shallow soil sampling event for dioxins and furans and 2022 attic dust wipe sampling at residential structures have been compiled in electronic format into an interactive database with a geographic information system that is searchable and is available at (<https://geocortex1.geosyntec.com/Html5Viewer/Index.html?viewer=HWPW.Site#>). EPA and TCEQ representatives were given access to this database on March 20, 2023, in accordance with Paragraph 14.d of the ASAO. A summary of the location (on-site vs. off-site), year, number of locations, number of samples, soil sample depths, and laboratory analysis completed is provided in **Table 1**.

3. SOIL

3.1 Summary of Soil Data

3.1.1 On-Site

3.1.1.1 Dioxins and Furans

Historical investigations at HWPW Site have generally not targeted dioxins and furans. Review of the past data identified analytical results for two on-site soil samples reported to TCEQ in 2009. Dioxins and furans were not detected in one sample (sample ID TW-01 collected in an area designated “former process area 1”, or solid waste management unit [SWMU] #5), while the other sample (sample ID MW-52A collected in a northeast area of the HWPW Site designated “former process area 2”, or SWMU #4) was comprised of hexa- and octa chlorinated dioxins and furans for a Total TEQ of 230 nanograms per kilogram soil (ng/kg), based on current toxic equivalency factors. Currently available data do not indicate whether the HWPW Site could be a source of dioxins or furans, and the TCEQ has not identified dioxins or furans as COCs. Commercial PCP formulations are known to have been contaminated with trace (parts per million) levels of polychlorinated dibenzo-*p*-dioxins and dibenzofurans (PCDD/Fs) (Johnson et al., 2017). In recent comments to TCEQ regarding the HWPW Site, the EPA noted that it is likely that PCP was used at some point during the facility’s wood treatment operations (USEPA, 2022). In 2020 UPRR submitted a PCP Soil Assessment Interim Report dated March 30, 2020 (Golder, 2020b), and an Updated Pentachlorophenol Soil Assessment Interim Report dated July 14, 2020 (Golder, 2020c), which provided PCP test results for soil sampled in February 2020 across the former HWPW area north of the main line tracks, as well as in June 2020 along the northern and western HWPW property boundary and immediately adjacent offsite areas. In an August 5, 2020 letter, TCEQ stated “the extent of PCP [in] soil has been delineated and concurred that UPRR had completed its assessment of PCP in soil in accordance with Texas rules”.

3.1.1.2 VOCs and SVOCs

Extensive testing at the HWPW Site for VOCs and SVOCs in soil has been conducted as summarized in **Table 1** and compiled in electronic format into an interactive database with a geographic information system that is searchable and is available at (<https://geocortex1.geosyntec.com/Html5Viewer/Index.html?viewer=HWPW.Site#>).

The surface soil PCLE zone extends from the northeast portion of the HWPW Site including the Original Process Area (SWMU 5) and Recent Process Area (SWMU 4), to the southwest along the South Drainage Ditch (SDD) (SWMU 2), and across the Former Inactive Wastewater Lagoon (Area of Concern [AOC] 6) (prior to conducting the soil consolidation as part of the soil response action). The PCLE zone was primarily defined by the concentrations of benzo(a)anthracene, benzo(a)pyrene, naphthalene, and PCP in surface soils. Additional soil sampling conducted in 2013 indicated that the surface soil PCLE Zone extends south into the Englewood Intermodal Yard where a former lagoon and large above-ground storage tanks were located (added as a new AOC).

Additional soil sampling in 2014 indicated that the surface soil PCLE Zone (benzo(a)pyrene and PCP) extended north beyond the northern Site fence to the edge of Liberty Road but was delineated along the northeast side of the HWPW Site.

3.1.2 Off-Site

3.1.2.1 Dioxins and Furans

Soil sampling for laboratory analysis of dioxins and furans was commissioned by the City of Houston in July 2022 and focused on the fence line and neighborhood around the HWPW Site (Epperson, 2022). The HHD soil sampling event included varying depths off-site that ranged from 4- to 20-in bgs in 4- to 6-inch (in) intervals. Specifically, the HHD soil sampling report included dioxin/furan data at a depth of 4-8 in bgs and below 8 in bgs (varying depth intervals) at 30 and 17 sample locations, respectively. The data were inconclusive regarding an association between depth and dioxin/furan concentration. With one exception along the western HWPW Site fence line (i.e., not on a residential property), the soil dioxin/furan Total TEQ levels reported in the HHD's soil sampling investigation were within the background range of urban soil dioxin/furan Total TEQ levels reported across the U.S. (Urban et al., 2014).

3.1.2.2 VOCs and SVOCs

Soil testing for VOCs and SVOCs has been primarily conducted to the north of the HWPW Site, along Liberty Road. In general, most shallow soil sample results have been low or not detected above the laboratories reporting limits. A sample summary is provided in **Table 1** and compiled in electronic format into an interactive database with a geographic information system that is searchable and is available at (<https://geocortex1.geosyntec.com/Html5Viewer/Index.html?viewer=HWPW.Site#>).

At the request of HCPCS, RKI collected 38 surface soil samples that were collected from 0-1 feet below ground surface (ft bgs) and 7 soil samples were collected from 4-5 ft bgs from separate locations within a ½-mile radius of the HWPW Site for laboratory analysis of potential contaminants (VOCs, SVOCS, metals and total petroleum hydrocarbons [TPH]) from creosote related chemicals. The purpose of this sampling effort was to determine whether creosote-related chemicals were contaminating the neighborhoods surrounding the HWPW Site from air dispersion, surface water, or stormwater runoff. None of the creosote-related chemicals were found in any of the soil samples at levels above the PCL protection standards (RKI, 2022).

3.2 Summary of Data Gaps

3.2.1 Dioxins and Furans

The existing data identified the following data gaps related to the shallow soils:

- On-Site

The historical on-site soil sampling (two samples) is inadequate to characterize dioxins/furans to determine if the HWPW Site is a potential source of off-site soil dioxins/furans. Therefore, on-site dioxin/furan soil sampling is needed to characterize on-site Total TEQ as well as to establish onsite dioxin/furan congener profiles for potential source attribution analysis.

- Off-Site

- The HHD dioxin/furan soil sample data are inadequate for evaluating potential human health risks from off-site soils. For example, the sample depths represented in the HHD dioxin/furan soil sample data do not inform potential soil surface exposures. Additionally, the HHD sampling plan only characterized dioxin/furan soil concentrations in select off-site areas, mostly focused on public by-ways and residential properties along the north, northwest and west HWPW Site boundary. Thus, there is a need to collect surface and shallow surface soil data across a more comprehensive off-site area to evaluate nature and extent of dioxins and furans in soils to evaluate potential human health risks.
- Lack of background soil data in the area surrounding the HWPW Site.

3.2.2 SVOCs and VOCs

The existing data identified the following data gaps related to SVOCs and VOCs in the shallow soils:

- On-Site

Extensive soil sampling has been completed on-site for VOCs and SVOCs; however, there is limited data for a few of specific SVOCs (e.g., atrazine, 1,1'-biphenyl, and pyridine).

- Off-Site

Limited soil data for laboratory analysis of VOCs and SVOCs is available surrounding the Site since previous investigations confined the limits of Site impacts to shallow soils to the interior of the property and along the northern boundary along Liberty Road.

- Lack of background soil data in the area surrounding the HWPW Site.

3.3 Potential Contaminants of Concern

The EPA SOW (2023) defined the primary “PCOC” for soils as “the analytes identified in EPA Methods 8260 and 8270 associated with wood preserving and polychlorinated dibenzo-*p*-dioxins, polychlorinated dibenzofurans. The analysis for these contaminants shall include the actual concentration of each PCOC and toxicity equivalent factor for polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans.” Based on previous HWPW Site investigations, the current PCOCs include the following analytes identified in EPA Methods 8260 and 8270:

- 1,2-Diphenylhydrazine
- 2,4-DNT
- 2-Methylnaphthalene
- Benzene
- Benz(a)anthracene
- Benzo(a)pyrene
- Dibenzofuran
- Naphthalene
- PCP

After a review of historic data, recent NAPL analysis, the use of potential extenders during the wood preserving process, and common constituents of coal tar creosote, the following analytes were conservatively added to the PCOC list:

- Acenaphthene
- Anthracene
- Atrazine
- 1,1'-Biphenyl
- Carbazole
- Chrysene
- 2,4-Dimethylphenol
- Fluoranthene
- Fluorene
- 2-Methylphenol
- 3-Methylphenol
- 4-Methylphenol

- Phenanthrene
- Phenol
- Pyrene
- Pyridine

The specific dioxin and furan PCOCs will be limited to the 17 congeners identified in the EPA SOW that have 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD)-based toxic equivalence factors (TEFs). These congeners are the dioxin and furan analytes listed in EPA analytical Method 1613B; the dioxin and furan congeners and their TEFs are provided in **Table 2**.

Table 3A summarizes the Proposed PCOCs for soil and **Table 3B** presents the chemical constituents for analysis of soil collected under the SOW.

3.4 Conceptual Site Model

The preliminary human health exposure CSM (**Figure 3**) summarizes information on sources of PCOCs, affected environmental media, PCOC release and transport mechanisms, potentially exposed receptors, and potential exposure pathways for each receptor. Because the analytical database for on-site and off-site soil PCOCs is incomplete, and because some of these pathways are based on hypothetical-future exposure, they are considered potentially complete, but may not actually be complete for all receptors in the future. Exposure routes for residents (child and adult), recreators (child and adult), students and staff at relevant schools, members of churches, and site workers associated with the potentially complete exposure pathways are described in the following sections. The hypothetical release and transport mechanisms (stormwater runoff and wind erosion and atmospheric dispersion) are shown in **Figure 4**.

3.4.1 Dioxins and Furans

The EPA identified dioxins and furans as PCOCs in off-site soils in Section 2.2 of the SOW. This decision was based on historical documentation that indicates PCP was used on-site as a wood preservative for a limited period of time, a class of preservative mixtures known to contain dioxins and furans as impurities. The historical records indicate that for a limited period of time the HWPW Site had an active incinerator (also referred to as a burner) that was installed between 1955-1965 and dismantled before 1976, but it was used to dispose of only untreated lumber remnants generated from the raw wood framing mill and adzing plant. The former incinerator area was designated as AOC 4 in the 1993 RFA (PRC, 1993). The RFA also indicates that an uncontrolled fire occurred on April 28, 1979, at the southwest border of the HWPW Site in a low-lying area designated as AOC 6. No cause for the fire was identified, but the Houston Fire Department and Southern Pacific Railroad Company determined that the area surrounding the fire contained creosote-contaminated soil and debris, apparently resulting from historical surface runoff and discharges from an unlined ditch bordering the main rail lines. This area was investigated and remediated under the supervision of TCEQ. In 1979, the uppermost layer of soils in AOC 6 was removed via excavation (5,065 cubic yards). In 2016, an additional 2,736 cubic yards of surface

soil were removed from portions of AOC 6 and adjacent areas. Additionally, an off-site soils sampling event commissioned by the HHD reported the detection of dioxins and furans in a September 2022 report (Epperson, 2022).

Currently available data do not indicate whether the HWPW Site could be a source of dioxins or furans, and the TCEQ has not identified dioxins or furans as HWPW COCs. Dioxins and furans are byproducts of combustion and are commonly detected in urban environments as a result of automobile exhaust, waste incineration (e.g., municipal, industrial, backyard burning), and sewage sludge, among other sources.^{2,3} The lipophilic nature of dioxins and furans, their strong affinity for soil organic materials, and long environmental half-lives makes this class of compounds relatively immobile and persistent once bound to soils in the environment. If the historical on-site activities are related to off-site soil dioxins and furans, it is expected the primary mechanisms of transport would be aerial dispersion from prior incineration/airborne soil particulates (dictated by prevailing wind directions and velocities) as well as storm water runoff.

It is expected that the on- and off-site soil data collected as a part of this investigation will help provide insight on potential sources and, if attributable to the HWPW Site, help further refine the CSM to explain the off-site soil dioxin and furans. The potential release mechanisms, migration pathways, and potential exposure pathways for human receptors are as follows:

- Releases from on-site creosote and PCP treatment activities and/or spills, emissions from burning/incineration of wood waste materials, airborne dust and process emissions, and contaminated storm water runoff potentially impacting surface soils on and off the HWPW Site.
- Contaminated surface soils pose potential noncancer and/or cancer health risks through incidental ingestion, direct dermal contact and incidental soil particulate inhalation by nearby residents, recreation center and park recreators, students and staff at schools within Zone 1a, members of churches within the study area, and site workers.
- Contaminated surface soils could become airborne particulates and pose a risk through inhalation.

3.4.2 VOCs and SVOCs

The EPA identified VOCs/SVOCs associated with wood preserving as PCOCs in off-site soils in the ASAOC. As previously stated, extensive data has been collected defining the nature and extent of VOCs/SVOCs from HWPW Site operations. Out of an abundance of caution and to confirm the existing conceptual site model developed and refined throughout the APAR/RAP process for surface soils, the investigation activities defined in this plan will also occur.

It is expected that the on- and off-site soil data collected as a part of this investigation will help provide insight on potential sources and, if attributable to the HWPW Site, help refine the CSM

² <https://www.epa.gov/dioxin/inventory-dioxin-sources-and-environmental-releases>

³ <https://www.epa.gov/dioxin/dioxin-exposure-initiative>

that can explain off-site soil VOCs and SVOCs, if present. The potential release mechanisms, migration pathways, and potential exposure pathways for human receptors are as follows:

- Releases from on-site activities and contaminated storm water runoff potentially impacting surface soils on and off the HWPW Site.
- Contaminated surface soils pose potential noncancer and/or cancer health risks through incidental ingestion, direct dermal contact, and incidental soil particulate inhalation by nearby residents, recreation center and park recreators, students and staff at schools within Zone 1a, members of churches within the study area, and site workers.

3.5 Proposed Sampling Approach and Evaluation

3.5.1 Off-Site Background Reference Area Surface and Shallow Soil Sampling

The objective of the off-site BRA surface and shallow soil sampling is to collect data needed to characterize anthropogenic background soil representative of current and historical activities not impacted by the historic wood preserving activities at the HWPW Site for use in establishing BTVs.

The objective of the BRA location selection is to identify areas with soils that reflect the current and historic anthropogenic activities (“anthropogenic background”) at the off-site sample areas unrelated to the historic on-site activities (EPA, 2002a). The selection of BRA sampling locations was informed by several factors:

- a. Proximity to (≥ 0.5 miles) and circumscribing of the HWPW Site.
- b. Public parcels (parks and public byways owned by the city, county, or state).
- c. Historical research to determine if currently exposed soils had been remediated, excavated/filled, capped, or otherwise directly disturbed by notable activities for the last three to four decades.
- d. Geological, soil type, and ecological characteristics (as defined by the United States Geological Survey, United States Department of Agriculture, Texas Parks and Wildlife Department, respectively) comparable to HWPW off-site study area.
- e. Cross-referenced publicly available environmental records to avoid locations where use and possible release of pollutants have been documented.
- f. Presence of at least two locations in census tracts that did not have elevated cancer rates as determined by the Texas Department of State Health Services (per email communication from Casey Luckett of USEPA Region 6 on May 23, 2023).
- g. In proximity to areas heavily influenced by vehicle traffic (e.g., bus stops, road medians and parcels within one block of a major highway) and those to a lesser extent.

The selection of BRA locations followed the EPA policy presented in the Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites (EPA, 2002) such that the locations are not influenced by releases from the site and described as naturally occurring or anthropogenic background. The site-specific background information will be addressed at the end of the risk assessment in the risk characterization per the EPA Frequently Asked Questions About the Development and Use of Background Concentrations at Superfund Site: Part One, General Comments (EPA, 2018). The twenty BRA locations will provide a 95%-95% Upper Tolerance Limit (UTL) which is designed to represent the concentration value below which 95% of the population concentration values are expected to fall with 95% confidence.

Soil samples will be obtained from each of the twenty BRAs identified on **Figure 5**. Eighteen of the BRAs cover an approximate 500 square meter (5,400 square foot) area for a five-point composite sample, with the remaining two BRAs being smaller due to the limited available sample area. Additional information on each BRA and the sample locations are provided in the *Field Sampling Plan – Surface and Shallow Soils, On-Site and BRA Field Sampling Plan* (Geosyntec, 2024a).

At each BRA, a five-point composite soil sample will be collected at three depth intervals; surface soils will be collected at the 0-2 in bgs interval, and shallow soils will be collected from the 2-6 in bgs and 6-12 in bgs intervals. In addition, at one of the five-point composite soil sample increment locations that is randomly selected, one discrete sample will be collected at the same depth intervals as the composite sample (i.e., 0-2, 2-6 and 6-12 in bgs) to support the off-site soil forensic attribution analysis by UPRR. A duplicate soil sample will be collected at each of the composite and discrete sample locations for use in the sieving trial described in the following subsection (3.5.1.1). Composite and discrete soil samples will be analyzed by the laboratory for all analytes under the analytical methods for dioxins and furans, and SVOCs specified in the QAPP. The discrete samples will also be analyzed by the laboratory for VOC analytes under the analytical methods described in the QAPP, but only for the shallow soil samples (2-6 and 6-12 in bgs). The laboratory results will be utilized to establish BTVs for each of the PCOCs.

BRA samples will be both discrete and composite which will allow for comparison with existing data, proposed on- and off-site data, and future background data.

The BRA soils investigation is summarized in **Table 4**.

3.5.1.1 Sieving Trial

EPA has directed UPRR to sieve the soil samples to <150 micrometer (µm) particle size fraction if feasible. Data collected from soil samples sieved down to this size are preferred by EPA for the risk assessment because particles of this size are more adherent to the skin than larger particles, potentially leading to greater hand-to-mouth exposures, and thus greater hazard and risk estimates. For comparability, all soil samples (i.e., background and off-site) should be handled the same, including sieved to obtain the <150 µm particle size fraction for analysis of dioxins/furans and SVOCs. As detailed in the *Field Sampling Plan – Surface and Shallow Soils, On-Site and Background Reference Areas, Former Houston Wood Preserving Works Site* (Geosyntec, 2024a),

UPRR will conduct a trial with the BRA soil samples to determine the feasibility of sieving soil samples at <150 µm particle size. Sieving will not be completed in the field and will be completed in the laboratory, if feasible, and details are provided in the QAPP.

Preliminary results from the soil samples in the sieving trial indicated less than 50% (range: 6%-44%, median: 18%) of the total volume of the sample passed through the 150 µm sieve; therefore, as specified in the FSP (Geosyntec, 2024a), UPRR relayed the issue to EPA and did not proceed with the analysis of the dioxins and furans because it did not meet the 50% volume threshold through the sieve. Subsequently, EPA requested that UPRR proceed with the analysis of the soil samples as there was sufficient sample mass collected from the sieved soil samples to complete the dioxin and furan analysis.

Despite UPRR reservations regarding the soil sample representativeness and the additional uncertainty inherent to analytical data collected from these highly variable sieved soil samples, UPRR agreed to perform testing on the sieved samples as requested by EPA. UPRR will consult with EPA on the most appropriate path forward for off-Site sampling based on the sieved vs. non-sieved results as outlined in the FSP.

If EPA and UPRR determine that soil sieving must be performed for the off-Site soil samples based on the results of that trial, then sieving for off-Site and on-Site soil samples will be performed using the methods described in the QAPP. The EPA site-specific screening level for dioxins and furans of 48 ng TEQ/kg is applicable for bulk soil samples and fine particle samples (i.e. sieved samples).

3.5.2 On-Site Soil Sampling

On-site soil samples are being collected for attribution purposes. The locations have been selected to provide spatial coverage and samples will be collected and analyzed for the PCOCs listed in Section 3.3 (**Table 3A**) and other compounds included in the laboratories standard reporting lists (**Table 3B**). Soil samples will be collected to provide spatial coverage, focused on historic operational areas, and within areas that contained SWMUs or AOCs if not previously capped. At 42 on-site locations, a five-point composite soil sample and a discrete soil sample from two depth intervals will be collected as follows: surface soils will be collected at the 0-2 in bgs, and shallow soils will be collected from the 2-6 in bgs. At 10 of 42 on-site locations (25%), an additional five-point composite soil sample and a discrete soil sample will be collected at 6-12 in bgs shallow soil interval. These 10 locations will be randomly selected. Each five-point composite sample will be collected from an area of approximately 500 square meters (5,400 square feet), which is an equivalent size to the BRA composite sample collection area. In addition, at one of the five-point composite soil sample increment locations that is randomly selected, one discrete sample will be collected at the same depth intervals as the composite sample (i.e., 0-2, 2-6 and 6-12 in bgs) to support the off-site soil forensic attribution analysis by UPRR.

Soil samples collected from all 42 on-site locations shown in **Figure 6** will be sent to the laboratory for analysis of the dioxins and furans listed in the **Table 3B**. Soil samples collected from 21 of the 42 on-site locations shown in **Figure 6** will be analyzed for the SVOCs and VOCs listed in

Table 3B. Fewer locations for sampling of SVOCs and VOCs are proposed as there is an extensive set of data for these analytes available as described in Section 3.1.

Previously excavated areas, areas covered with a protective cap, and areas covered in concrete were not included except at 10 additional locations beneath the existing protective soil cap (**Figure 6**). At each of these 10 locations, one discrete soil sample will be obtained once the liner is penetrated (approximately 18 in bgs) and will continue for a depth of about 6 in. Soil samples collected beneath the soil cap will be submitted to laboratory for analysis of dioxins, furans, SVOCs and VOCs listed in **Table 3B**.

The on-site soils investigation is summarized in **Table 4**.

3.5.3 Off-Site Soil Sampling

The off-site surface and shallow soil investigation is intended to characterize the nature and extent of the presence of dioxin, furan, SVOC and VOC analytes targeted by the analytical methods described in the QAPP in surface and shallow soils in the community (i.e., neighborhoods, schools, parks, child day care locations and recreation center) around the HWPW Site to support a human health risk assessment. The EPA's Initial Focus Area for the Investigation is identified on **Figure 7** and is based on discussions with the EPA and TCEQ during meetings on scoping subsequent to the issuance of the SOW. Initial sample locations and sequencing (Zones 1a and Zones 1 through 4) were selected based on relative perceived risk and historic site data, with the sampling approach prioritizing the properties closest to the site. The zones were sized based on operational and logistical considerations, particularly available laboratory capacity and estimated turnaround times for analytical results. Zone 1a parcels are located at a greater distance from the HWPW Site and were identified as a priority by the EPA during project scoping. Zone 1a will be sampled in the first phase of the field program along with Zone 1. Zone 1a includes Dogan Elementary School, Atherton Elementary School, the Julia C. Hester House, Catherine Adams Park, Boyce-Dorian Park, and Barbara Jordan Family Park.

Zone 1a and 1 sampling activities will be completed first and then UPRR will move to Zone 2, then 3, then 4.

The off-site soil investigation is summarized in **Table 5**.

3.5.3.1 Dioxin, Furan, and SVOC Surface and Shallow Soil Sampling

Composite soil samples will be obtained from 0-2 and 2-6 in bgs at the off-site parcels adjacent to the HWPW Site perimeter for laboratory analysis of dioxins, furans, and SVOCs (**Figure 7**). At 25% of the parcels, an additional composite soil sample will be collected at a depth of 6-12 in bgs. These sample locations will be randomly selected except at locations adjacent to HHD soil sample exceedances of dioxins and furans (HHD-21, HHD-34, and HHD-35). Composite soil samples will be collected at parcels that contain less than or equal to a 1/8th acre (≤ 0.125 acres) area not covered by a hard surface following the approach as shown in **Figure 8**. Composite samples will be collected at parcels that contain greater than a 1/8th acre (> 0.125 acres) area not covered by a

hard surface following the approach as shown in **Figure 9**. In addition, at one of the five-point composite soil sample increment locations that is randomly selected, one discrete sample will be collected at the same depth intervals as the composite sample (i.e., 0-2, 2-6 and 6-12 in bgs) to support the off-site soil forensic attribution analysis by UPRR.

3.5.3.2 VOC Shallow Soil Sampling

Discrete shallow soil samples will be collected at 2-6 in bgs and 6-12 in bgs at the off-site parcels immediately adjacent to the HWPW Site perimeter for laboratory analysis of VOCs (**Figure 10**). At 25% of the parcels, an additional discrete soil sample will be collected at a depth of 6-12 in bgs. These sample locations will be randomly selected except at locations adjacent to HHD soil sample exceedances of dioxins and furans (HHD-21, HHD-34 and HHD-35). Discrete soil samples will be collected at parcels that contain less than or equal to a 1/8th acre (≤ 0.125 acres) of area not covered by a hard surface following the approach shown in **Figure 11**. Discrete soil samples will be collected at parcels that contain greater than a 1/8th acre (> 0.125 acres) area not covered by a hard surface following the approach shown in **Figure 12**.

3.5.3.3 Surface and Shallow Soil Sampling Results Evaluation

Upon receiving the soil analytical results for a zone, the analyte data for each set of parcel soil samples will be evaluated according to their respective screening levels (refer to thresholds listed in **Table 3B**). If no exceedances of the analyte screening levels are reported for a parcel, then it will be concluded that the soil analytical data do not represent unacceptable hazards or risks for the parcel and no further action will be required. For parcels with soil screening level exceedances, those analytes in exceedance will be carried forward to a site-specific human health risk assessment to characterize potential hazards/risks related to the soil analyte data.

After the validation and evaluation of laboratory results from the composite soil samples collected from Zone 1a, Zones 1 – 4, and the BRA samples, UPRR and EPA will evaluate the need for soil samples at the 12 – 24 in bgs interval. An addendum to the QAPP will be made prior to proceeding with the sampling of 12 – 24 in bgs soil sampling depths in Zones 1a, Zones 1 – 4, and BRA areas.

Special case soil sampling investigations (e.g., property with a vegetable garden or small livestock) as required under SOW Section 4.4 and community impact mitigation activities as required under the ASAO Section 17 will be included as an addendum to the *Field Sampling Plan – Surface and Shallow Soils, Off-Site Areas* (Geosyntec, 2024b), if required.

3.6 Data Quality Objectives

The data quality objectives for the on-site, BRA and off-site investigation areas are provided in Appendix A as presented in the QAPP which was approved by EPA on January 23, 2024.

4. SCHEDULE

A high-level Gantt chart is provided in **Appendix B**. The proposed schedule has been prepared in consideration of the expected process for obtaining access to residential parcels, laboratory procurement lead times, and laboratory turn-around-time, etc. Some flexibility in fieldwork to accommodate delays or stakeholder requirements has been built into schedule. Schedule updates will be provided in the weekly progress reports. The schedule assumes approval by the dates provided in the schedule by EPA and other stakeholders.

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Tables

Table 1
Sample Summary
Union Pacific Railroad
Houston Wood Preserving Works

Geosyntec Consultants

Media	Location	Year	Number of Locations	Number of Samples	Soil Sample Depth (in bgs)	Analyte Groups
Air	Off-site	2020	4	4	-	SVOC,VOC
DNAPL	Off-site	2020	1	1	-	Physical Parameter
Groundwater	Off-site	2000	6	11	-	Phenol,Phthalate,SVOC,VOC
		2001	12	24	-	Phenol,Phthalate,SVOC,VOC
		2002	12	22	-	Phenol,Phthalate,SVOC,VOC
		2004	8	8	-	Phenol,Phthalate,SVOC,VOC
		2007	27	27	-	Phenol,Phthalate,SVOC,VOC
		2008	33	70	-	Field parameter,Phenol,Phthalate,SVOC,VOC
		2009	25	28	-	Field parameter,Phenol,Phthalate,SVOC,VOC
		2010	33	69	-	Field parameter,Phenol,Phthalate,SVOC,VOC
		2011	34	75	-	Field parameter,Phenol,Phthalate,SVOC,VOC
		2012	40	81	-	Field parameter,Phenol,Phthalate,SVOC,VOC
		2013	38	97	-	Field parameter,Phenol,Phthalate,SVOC,VOC
		2014	36	93	-	Field parameter,Phenol,Phthalate,SVOC,VOC
		2018	41	141	-	Field parameter,Metal,Phenol,Phthalate,SVOC,VOC
		2019	42	90	-	Field parameter,Metal,Phenol,Phthalate,SVOC,VOC
		2020	72	168	-	Field parameter,General Chemistry,Metal,Phenol,Phthalate,Physical Parameter,SVOC,VOC
		2021	60	135	-	Field parameter,General Chemistry,Metal,Phenol,Phthalate,SVOC,SVOC TIC,VOC
		2022	63	138	-	Field parameter,General Chemistry,Metal,PHC,Phenol,Phthalate,SVOC,VOC
	On-site	1984	3	6	-	Phenol,Phthalate,SVOC,VOC
		1985	3	12	-	Phenol,Phthalate,SVOC,VOC
		1986	3	12	-	Phenol,Phthalate,SVOC,VOC
		1987	3	12	-	Phenol,Phthalate,SVOC,VOC
		1988	3	12	-	Phenol,Phthalate,SVOC,VOC
		1989	3	12	-	Phenol,SVOC,VOC
		1990	4	14	-	Phenol,Phthalate,SVOC,VOC
		1991	6	15	-	Phenol,Phthalate,SVOC,VOC
		1992	6	18	-	Pesticide,Phenol,Phthalate,SVOC,VOC
		1993	11	40	-	Phenol,Phthalate,SVOC,VOC
		1994	15	30	-	Phenol,Phthalate,SVOC,VOC
		1995	30	63	-	General Chemistry,Phenol,Phthalate,SVOC,VOC
		1996	15	31	-	General Chemistry,Phenol,Phthalate,SVOC,VOC
		1997	26	41	-	General Chemistry,Phenol,Phthalate,SVOC,VOC
		1998	15	15	-	Phenol,Phthalate,SVOC,VOC
		1999	32	48	-	Phenol,Phthalate,SVOC,VOC
		2000	29	44	-	Phenol,Phthalate,SVOC,VOC
Groundwater	On-site	2001	29	58	-	Phenol,Phthalate,SVOC,VOC
		2002	29	55	-	Phenol,Phthalate,SVOC,VOC
		2003	1	1	-	Phenol,Phthalate,SVOC,VOC
		2004	21	21	-	Phenol,Phthalate,SVOC,VOC
		2005	15	27	-	Phenol,Phthalate,SVOC,VOC
		2006	10	20	-	Phenol,Phthalate,SVOC
		2007	43	43	-	Phenol,Phthalate,SVOC,VOC
		2008	44	102	-	Field parameter,Phenol,Phthalate,SVOC,VOC
		2009	40	57	-	Field parameter,Phenol,Phthalate,SVOC,VOC
		2010	44	99	-	Field parameter,Phenol,Phthalate,SVOC,VOC
		2011	49	97	-	Field parameter,Phenol,Phthalate,SVOC,VOC
		2012	56	124	-	Field parameter,Phenol,Phthalate,SVOC,VOC
		2013	62	135	-	Field parameter,Phenol,Phthalate,SVOC,VOC
		2014	56	132	-	Field parameter,Phenol,Phthalate,SVOC,VOC
		2015	10	25	-	Field parameter,Phenol,Phthalate,SVOC
		2016	10	24	-	Field parameter,Phenol,Phthalate,SVOC
		2017	10	24	-	Field parameter,Phenol,Phthalate,SVOC
		2018	55	169	-	Field parameter,Metal,Phenol,Phthalate,SVOC,VOC
		2019	56	120	-	Field parameter,Metal,Phenol,Phthalate,SVOC,VOC
		2020	72	160	-	Field parameter,General Chemistry,Metal,PHC,Phenol,Phthalate,SVOC,VOC
NAPL	On-site	2018	4	4	-	Field parameter,General Chemistry,PHC,Phenol,Phthalate,Physical Parameter,SVOC,VOC
Sanitary Sewer	Off-site	2010	2	2	-	Phenol,Phthalate,SVOC,VOC
		2010	1	1	-	Phenol,Phthalate,SVOC,VOC
Soil	Off-site	1995	2	2	Unknown	Phenol,Phthalate,SVOC,VOC
		2000	4	9	Unknown	General Chemistry,Phenol,Phthalate,Physical Parameter,SVOC,VOC
		2003	2	7	>24	Phenol,Phthalate,Physical Parameter,SVOC,VOC
		2004	3	3	Unknown	Phenol,Phthalate,Physical Parameter,SVOC,VOC
		2004	1	1	>24	Phenol,Phthalate,Physical Parameter,SVOC,VOC
		2006	4	4	0-24	Phenol,Physical Parameter,SVOC,VOC
		2006	1	1	>24	Physical Parameter,SVOC
		2009	4	7	0-24	Phenol,Physical Parameter,SVOC,VOC
		2010	7	7	0-24	Phenol,Phthalate,Physical Parameter,SVOC,VOC
		2010	8	10	>24	Phenol,Phthalate,Physical Parameter,SVOC,VOC
		2014	8	8	0-24	Phenol,Phthalate,SVOC,VOC
		2015	5	5	0-24	Metal,Phenol,Phthalate,Physical Parameter,SVOC
		2020	63	92	0-24	Field parameter,General Chemistry,PHC,Phenol,Physical Parameter,SVOC,VOC
		2020	32	32	>24	Physical Parameter,SVOC,VOC
		2021	33	34	Unknown	Metal,PHC,Phenol,Phthalate,SVOC,VOC
		2021	7	7	0-24	Metal,PHC,Phenol,Phthalate,SVOC,VOC
		2021	6	6	>24	Metal,PHC,Phenol,Phthalate,SVOC,VOC
		2022	3	3	0-24	Metal,PHC,Phenol,Phthalate,Physical Parameter,SVOC,VOC
	On-site	1900	2	2	Unknown	Phthalate,SVOC
		1995	3	3	Unknown	Phenol,Phthalate,SVOC
		1995	1	4	>24	Phenol,Phthalate,SVOC,VOC
		2003	7	7	0-24	Phenol,Phthalate,Physical Parameter,SVOC,VOC
		2003	3	3	>24	Phenol,Phthalate,Physical Parameter,SVOC,VOC
		2007	3	3	>24	Phenol,Physical Parameter,SVOC,VOC
		2008	5	8	0-24	General Chemistry,Phenol,Physical Parameter,SVOC
		2009	24	34	0-24	Phenol,Physical Parameter,SVOC,VOC
		2010	1	1	0-24	Phenol,Phthalate,Physical Parameter,SVOC,VOC
		2010	2	3	>24	Phenol,Phthalate,Physical Parameter,SVOC,VOC
Soil Gas	Off-site	2016	2	2	-	Metal,Phenol,Phthalate,SVOC,VOC
		2017	1	1	-	Phenol,Phthalate,SVOC,VOC
Surface Water	On-site	2019	2	2	-	PHC,SVOC,VOC
		2016	1	1	-	Phenol,Phthalate,SVOC,VOC

Notes:
DNAPL - dense non-aqueous phase liquid
NAPL - non-aqueous phase liquid
PHCs - petroleum hydrocarbons
SVOCs - semi-volatile organic compounds
TICs - tentativeily identified compound
VOCs - volatile organic compounds
- - information not available or applicable
in bgs - inches below ground surface

Table 2
Dioxin and Furan Congeners and their Toxic Equivalency Factors
Union Pacific Railroad
Houston Wood Preserving Works

Compound	2005 WHO TEF
<i>Polychlorinated dibenzo-p-dioxins (PCDDs)</i>	
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	1
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	0.1
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	0.1
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	0.1
1,2,3,7,8,9-Heptachlorodibenzo-p-dioxin (HpCDD)	0.01
Octachlorodibenzo-p-dioxin (OCDD)	0.0003
<i>Polychlorinated dibenzofurans (PCDFs)</i>	
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	0.1
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	0.03
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	0.3
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	0.1
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	0.1
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	0.1
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	0.1
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	0.01
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	0.01
Octachlorodibenzofuran (OCDF)	0.0003

Notes:

TEF - toxic equivalency factor (van den Berg et al., 2006)

Table 3A
Proposed Potential Contaminants of Concern - Soil
Former Houston Wood Preserving Works, Houston, Texas

Analyte	CAS Number	US EPA Analytical Method or Method Number	Method Detection Limit (MDL) ¹	Reporting Limit (RL) ¹	EPA Regional Screening Level ² Residential	Toxic Equivalency Factor (TEF) ³
<i>Dioxins and Furans (ng/kg)</i>						
2,3,7,8-TCDF	51207-31-9	1613B	0.196	1	--	0.1
2,3,7,8-TCDD*	1746-01-6	1613B	0.204	1	4.8	1
1,2,3,7,8-PeCDF	57117-41-6	1613B	0.216	5	--	0.03
2,3,4,7,8-PeCDF	57117-31-4	1613B	0.241	5	--	0.3
1,2,3,7,8-PeCDD	40321-76-4	1613B	0.205	5	--	1
1,2,3,4,7,8-HxCDF	70648-26-9	1613B	0.43	5	--	0.1
1,2,3,6,7,8-HxCDF	57117-44-9	1613B	0.411	5	--	0.1
2,3,4,6,7,8-HxCDF	60851-34-5	1613B	0.387	5	--	0.1
1,2,3,7,8,9-HxCDF	72918-21-9	1613B	0.382	5	--	0.1
1,2,3,4,7,8-HxCDD	39227-28-6	1613B	0.406	5	--	0.1
1,2,3,6,7,8-HxCDD	57653-85-7	1613B	0.556	5	--	0.1
1,2,3,7,8,9-HxCDD	19408-74-3	1613B	0.478	5	--	0.1
1,2,3,4,6,7,8-HpCDF	67562-39-4	1613B	0.596	5	--	0.01
1,2,3,4,7,8,9-HpCDF	55673-89-7	1613B	0.446	5	--	0.01
1,2,3,4,6,7,8-HpCDD	35822-46-9	1613B	0.433	5	--	0.01
OCDF	39001-02-0	1613B	1.23	10	--	0.0003
OCDD	3268-87-9	1613B	4.14	10	--	0.0003
<i>Volatile Organic Compounds (mg/kg)</i>						
benzene	71-43-2	8260D+5035	0.000467	0.001	1.2	--
naphthalene	91-20-3	8260D+5035	0.00488	0.0125	2.0	--
<i>Semi-Volatile Organic Compounds (mg/kg)</i>						
2,4-dimethylphenol	105-67-9	8270E	0.0087	0.333	130	--
2,4-dinitrotoluene	121-14-2	8270E	0.00955	0.333	1.7	--
acenaphthene	83-32-9	8270E	0.00539	0.0333	360	--
anthracene	120-12-7	8270E	0.00593	0.0333	1,800	--
benzo(a)anthracene	56-55-3	8270E	0.00587	0.0333	1.1	--
benzo(a)pyrene	50-32-8	8270E	0.00619	0.0333	0.11	--
chrysene	218-01-9	8270E	0.00662	0.0333	110	--
fluoranthene	206-44-0	8270E	0.00601	0.0333	240	--
fluorene	86-73-7	8270E	0.00542	0.0333	240	--
naphthalene	91-20-3	8270E	0.00836	0.0333	2.0	--
pentachlorophenol	87-86-5	8270E	0.00896	0.333	1.0	--
phenanthrene	85-01-8	8270E	0.00661	0.0333	--	--
phenol	108-95-2	8270E	0.0134	0.333	1,900	--
pyrene	129-00-0	8270E	0.00648	0.0333	180	--
2-methylnaphthalene	91-57-6	8270E + PAH by SIM	0.00427	0.02	24	--
<i>Volatile and Semivolatile Organic Compounds Requested as Tentatively Identified Compounds (not quantified)</i>						
1,1'-Biphenyl	92-52-4	--	--	--	4.7	--
1,2-Diphenylhydrazine	122-66-7	--	--	--	0.68	--
2-Methylphenol	95-48-7	--	--	--	320	--
3-Methylphenol	108-39-4	--	--	--	320	--
4-Methylphenol	106-44-5	--	--	--	130	--
Atrazine	1912-24-9	--	--	--	2.4	--
Carbazole	86-74-8	--	--	--	--	--
Dibenzofuran	132-64-9	--	--	--	7.8	--
Pyridine	110-86-1	--	--	--	7.8	--

Notes:***Bold italic*** - indicates that the RSL is less than the RL

1 - Laboratory method detection limits and analytical reporting limits are presented in the individual laboratory SOPs in Appendix D of the Soil QAPP.

2 - US EPA Regional Screening Levels (November 2023), based on a target cancer risk of 1×10^{-6} or a target hazard quotient of 0.1.

3 - Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8- Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds, EPA 2010 - Table 2.

4 - Site-Specific Risk-Based Screening Level for Dioxin in Residential Soil at the Former Houston Wood Preserving Works Site = 48 ng/kg, US EPA, September 2023

5 - Regional Screening Level for 1,3-dichloropropene applied.

-- - not applicable

CAS - Chemical Abstracts Service

mg/kg - milligram per kilogram

ng/kg - nanogram per kilogram

MDL - method detection limit

PAH by SIM - Polycyclic Aromatic Hydrocarbons by Selective Ion Monitoring

RL - reporting limit

RSL - Regional Screening Level

Table 3B
Analytical Methods and Reporting Limits - Soil
Former Houston Wood Preserving Works, Houston, Texas

Analyte	CAS Number	US EPA Analytical Method or Method Number	Method Detection Limit (MDL) ¹	Reporting Limit (RL) ¹	EPA Regional Screening Level ² Residential	Toxic Equivalency Factor (TEF) ³
Dioxins and Furans (ng/kg)						
2,3,7,8-TCDF	51207-31-9	1613B	0.196	1	--	0.1
2,3,7,8-TCDD*	1746-01-6	1613B	0.204	1	4.8	1
1,2,3,7,8-PeCDF	57117-41-6	1613B	0.216	5	--	0.03
2,3,4,7,8-PeCDF	57117-31-4	1613B	0.241	5	--	0.3
1,2,3,7,8-PeCDD	40321-76-4	1613B	0.205	5	--	1
1,2,3,4,7,8-HxCDF	70648-26-9	1613B	0.43	5	--	0.1
1,2,3,6,7,8-HxCDF	57117-44-9	1613B	0.411	5	--	0.1
2,3,4,6,7,8-HxCDF	60851-34-5	1613B	0.387	5	--	0.1
1,2,3,7,8,9-HxCDF	72918-21-9	1613B	0.382	5	--	0.1
1,2,3,4,7,8-HxCDD	39227-28-6	1613B	0.406	5	--	0.1
1,2,3,6,7,8-HxCDD	57653-85-7	1613B	0.556	5	--	0.1
1,2,3,7,8,9-HxCDD	19408-74-3	1613B	0.478	5	--	0.1
1,2,3,4,6,7,8-HpCDF	67562-39-4	1613B	0.596	5	--	0.01
1,2,3,4,7,8,9-HpCDF	55673-89-7	1613B	0.446	5	--	0.01
1,2,3,4,6,7,8-HpCDD	35822-46-9	1613B	0.433	5	--	0.01
OCDF	39001-02-0	1613B	1.23	10	--	0.0003
OCDD	3268-87-9	1613B	4.14	10	--	0.0003
Volatile Organic Compounds (mg/kg)						
1,1,1,2-tetrachloroethane	630-20-6	8260D+5035	0.000948	0.0025	2.0	--
1,1,1-trichloroethane	71-55-6	8260D+5035	0.000923	0.0025	810	--
1,1,2,2-tetrachloroethane	79-34-5	8260D+5035	0.000695	0.0025	0.6	--
1,1,2-trichloroethane	79-00-5	8260D+5035	0.000597	0.0025	0.15	--
1,1,2-trichlorotrifluoroethane	76-13-1	8260D+5035	0.000754	0.0025	670	--
1,1-dichloroethane	75-34-3	8260D+5035	0.000491	0.0025	3.6	--
1,1-dichloroethene	75-35-4	8260D+5035	0.000606	0.0025	23	--
1,1-dichloropropene	563-58-6	8260D+5035	0.000809	0.0025	--	--
1,2,3-trichlorobenzene	87-61-6	8260D+5035	0.00733	0.0125	6.3	--
1,2,3-trichloropropane	96-18-4	8260D+5035	0.00162	0.0125	0.0051	--
1,2,3-trimethylbenzene	526-73-8	8260D+5035	0.00158	0.005	34	--
1,2,4-trichlorobenzene	120-82-1	8260D+5035	0.0044	0.0125	5.8	--
1,2,4-trimethylbenzene	95-63-6	8260D+5035	0.00158	0.005	30	--
1,2-dibromo-3-chloropropane	96-12-8	8260D+5035	0.0039	0.025	0.0053	--
1,2-dibromoethane	106-93-4	8260D+5035	0.000648	0.0025	0.036	--
1,2-dichlorobenzene	95-50-1	8260D+5035	0.000425	0.005	180	--
1,2-dichloroethane	107-06-2	8260D+5035	0.000649	0.0025	0.46	--
1,2-dichloropropane	78-87-5	8260D+5035	0.00142	0.005	1.6	--
1,3,5-trimethylbenzene	108-67-8	8260D+5035	0.002	0.005	27	--
1,3-dichlorobenzene	541-73-1	8260D+5035	0.0006	0.005	--	--
1,3-dichloropropane	142-28-9	8260D+5035	0.000501	0.005	160	--
1,4-dichlorobenzene	106-46-7	8260D+5035	0.0007	0.005	2.6	--
2,2-dichloropropane	594-20-7	8260D+5035	0.00138	0.0025	--	--
2-butanone (mek)	78-93-3	8260D+5035	0.0635	0.1	2,700	--
2-chlorotoluene	95-49-8	8260D+5035	0.000865	0.0025	160	--
4-chlorotoluene	106-43-4	8260D+5035	0.00045	0.005	160	--
4-methyl-2-pentanone (MIBK)	108-10-1	8260D+5035	0.00228	0.025	3,300	--
acetone	67-64-1	8260D+5035	0.0365	0.05	7,000	--
acrylonitrile	107-13-1	8260D+5035	0.00361	0.0125	0.25	--
benzene	71-43-2	8260D+5035	0.000467	0.001	1.2	--
bromobenzene	108-86-1	8260D+5035	0.0009	0.0125	29	--
bromodichloromethane	75-27-4	8260D+5035	0.000725	0.0025	0.29	--
bromoform	75-25-2	8260D+5035	0.00117	0.025	19	--
bromomethane	74-83-9	8260D+5035	0.00197	0.0125	0.68	--
carbon tetrachloride	56-23-5	8260D+5035	0.000898	0.005	0.65	--
chlorobenzene	108-90-7	8260D+5035	0.00021	0.0025	28	--
chlorodibromomethane	124-48-1	8260D+5035	0.000612	0.0025	8.3	--
chloroethane	75-00-3	8260D+5035	0.0017	0.005	540	--

Table 3B
Analytical Methods and Reporting Limits - Soil
Former Houston Wood Preserving Works, Houston, Texas

Analyte	CAS Number	US EPA Analytical Method or Method Number	Method Detection Limit (MDL) ¹	Reporting Limit (RL) ¹	EPA Regional Screening Level ² Residential	Toxic Equivalency Factor (TEF) ³
chloroform	67-66-3	8260D+5035	0.00103	0.0025	0.32	--
chloromethane	74-87-3	8260D+5035	0.00435	0.0125	11	--
cis-1,2-dichloroethene	156-59-2	8260D+5035	0.000734	0.0025	6.3	--
cis-1,3-dichloropropene ²	10061-01-5	8260D+5035	0.000757	0.0025	1.8	--
dibromomethane	74-95-3	8260D+5035	0.00075	0.005	2.4	--
dichlorodifluoromethane	75-71-8	8260D+5035	0.00161	0.0025	8.7	--
di-isopropyl ether	108-20-3	8260D+5035	0.00041	0.001	220	--
ethylbenzene	100-41-4	8260D+5035	0.000737	0.0025	5.8	--
hexachloro-1,3-butadiene	87-68-3	8260D+5035	0.006	0.025	1.2	--
isopropylbenzene	98-82-8	8260D+5035	0.000425	0.0025	190	--
methyl tert-butyl ether	1634-04-4	8260D+5035	0.00035	0.001	47	--
methylene chloride	75-09-2	8260D+5035	0.00664	0.025	35	--
naphthalene	91-20-3	8260D+5035	0.00488	0.0125	2.0	--
n-butylbenzene	104-51-8	8260D+5035	0.00525	0.0125	390	--
n-propylbenzene	103-65-1	8260D+5035	0.00095	0.005	380	--
p-isopropyltoluene	99-87-6	8260D+5035	0.00255	0.005	--	--
sec-butylbenzene	135-98-8	8260D+5035	0.00288	0.0125	780	--
styrene	100-42-5	8260D+5035	0.000229	0.0125	600	--
tert-butylbenzene	98-06-6	8260D+5035	0.00195	0.005	780	--
tetrachloroethene	127-18-4	8260D+5035	0.000896	0.0025	8.1	--
toluene	108-88-3	8260D+5035	0.0013	0.005	490	--
trans-1,2-dichloroethene	156-60-5	8260D+5035	0.00104	0.005	7	--
trans-1,3-dichloropropene ⁵	10061-02-6	8260D+5035	0.00114	0.005	1.8	--
trichloroethene	79-01-6	8260D+5035	0.000584	0.001	0.41	--
trichlorofluoromethane	75-69-4	8260D+5035	0.000827	0.0025	2,300	--
vinyl chloride	75-01-4	8260D+5035	0.00116	0.0025	0.059	--
xylenes, total	1330-20-7	8260D+5035	0.00088	0.0065	58	--
Semi-Volatile Organic Compounds (mg/kg)						
1,2,4-trichlorobenzene	120-82-1	8270E	0.0104	0.333	5.8	--
1,2-dichlorobenzene	95-50-1	8270E	0.00987	0.333	180	--
1,3-dichlorobenzene	541-73-1	8270E	0.0101	0.333	--	--
1,4-dichlorobenzene	106-46-7	8270E	0.00991	0.333	2.6	--
2,2-oxybis(1-chloropropane)	108-60-1	8270E	0.0144	0.333	310	--
2,4,6-trichlorophenol	88-06-2	8270E	0.0107	0.333	6.3	--
2,4-dichlorophenol	120-83-2	8270E	0.0097	0.333	19	--
2,4-dimethylphenol	105-67-9	8270E	0.0087	0.333	130	--
2,4-dinitrophenol	51-28-5	8270E	0.0779	0.333	13	--
2,4-dinitrotoluene	121-14-2	8270E	0.00955	0.333	1.7	--
acenaphthene	83-32-9	8270E	0.00539	0.0333	360	--
acenaphthylene	208-96-8	8270E	0.00469	0.0333	--	--
anthracene	120-12-7	8270E	0.00593	0.0333	1,800	--
benzidine	92-87-5	8270E	0.0626	1.67	0.00053	--
benzo(a)anthracene	56-55-3	8270E	0.00587	0.0333	1.1	--
benzo(a)pyrene	50-32-8	8270E	0.00619	0.0333	0.11	--
benzo(b)fluoranthene	205-99-2	8270E	0.00621	0.0333	1.1	--
benzo(g,h,i)perylene	191-24-2	8270E	0.00609	0.0333	--	--
benzo(k)fluoranthene	207-08-9	8270E	0.00592	0.0333	11	--
benzylbutyl phthalate	85-68-7	8270E	0.0104	0.333	290	--
bis(2-chlorethoxy)methane	111-91-1	8270E	0.01	0.333	19	--
bis(2-chloroethyl)ether	111-44-4	8270E	0.011	0.333	0.23	--
bis(2-ethylhexyl)phthalate	117-81-7	8270E	0.0422	0.333	39	--
chrysene	218-01-9	8270E	0.00662	0.0333	110	--
dibenz(a,h)anthracene	53-70-3	8270E	0.00923	0.0333	0.11	--
diethyl phthalate	84-66-2	8270E	0.011	0.333	5,100	--
dimethyl phthalate	131-11-3	8270E	0.0706	0.333	--	--
di-n-butyl phthalate	84-74-2	8270E	0.0114	0.333	630	--
di-n-octyl phthalate	117-84-0	8270E	0.0225	0.333	63	--
fluoranthene	206-44-0	8270E	0.00601	0.0333	240	--

Table 3B
Analytical Methods and Reporting Limits - Soil
Former Houston Wood Preserving Works, Houston, Texas

Analyte	CAS Number	US EPA Analytical Method or Method Number	Method Detection Limit (MDL) ¹	Reporting Limit (RL) ¹	EPA Regional Screening Level ² Residential	Toxic Equivalency Factor (TEF) ³
fluorene	86-73-7	8270E	0.00542	0.0333	240	--
hexachloro-1,3-butadiene	87-68-3	8270E	0.0112	0.333	1.2	--
hexachlorobenzene	118-74-1	8270E	0.0118	0.333	0.078	--
hexachlorocyclopentadiene	77-47-4	8270E	0.0175	0.333	0.18	--
hexachloroethane	67-72-1	8270E	0.0131	0.333	1.8	--
indeno(1,2,3-cd)pyrene	193-39-5	8270E	0.00941	0.333	1.1	--
isophorone	78-59-1	8270E	0.0102	0.333	570	--
naphthalene	91-20-3	8270E	0.00836	0.0333	2.0	--
nitrobenzene	98-95-3	8270E	0.0116	0.333	5.1	--
n-nitrosodimethylamine	62-75-9	8270E	0.0494	0.333	0.002	--
n-nitrosodi-n-propylamine	621-64-7	8270E	0.0111	0.333	0.078	--
n-nitrosodiphenylamine	86-30-6	8270E	0.0252	0.333	110	--
pentachlorophenol	87-86-5	8270E	0.00896	0.333	1.0	--
phenanthrene	85-01-8	8270E	0.00661	0.0333	--	--
phenol	108-95-2	8270E	0.0134	0.333	1,900	--
pyrene	129-00-0	8270E	0.00648	0.0333	180	--
1-methylnaphthalene	90-12-0	8270E + PAH by SIM	0.00449	0.02	18	--
2-chloronaphthalene	91-58-7	8270E + PAH by SIM	0.00466	0.02	480	--
2-methylnaphthalene	91-57-6	8270E + PAH by SIM	0.00427	0.02	24	--
acenaphthene	83-32-9	8270E + PAH by SIM	0.00209	0.006	360	--
acenaphthylene	208-96-8	8270E + PAH by SIM	0.00216	0.006	--	--
anthracene	120-12-7	8270E + PAH by SIM	0.0023	0.006	1,800	--
benzo(a)anthracene	56-55-3	8270E + PAH by SIM	0.00173	0.006	1.1	--
benzo(a)pyrene	50-32-8	8270E + PAH by SIM	0.00179	0.006	0.11	--
benzo(b)fluoranthene	205-99-2	8270E + PAH by SIM	0.00153	0.006	1.1	--
benzo(g,h,i)perylene	191-24-2	8270E + PAH by SIM	0.00177	0.006	--	--
benzo(k)fluoranthene	207-08-9	8270E + PAH by SIM	0.00215	0.006	11	--
chrysene	218-01-9	8270E + PAH by SIM	0.00232	0.006	110	--
dibenz(a,h)anthracene	53-70-3	8270E + PAH by SIM	0.00172	0.006	0.11	--
fluoranthene	206-44-0	8270E + PAH by SIM	0.00227	0.006	240	--
fluorene	86-73-7	8270E + PAH by SIM	0.00205	0.006	240	--
indeno(1,2,3-cd)pyrene	193-39-5	8270E + PAH by SIM	0.00181	0.006	1.1	--
naphthalene	91-20-3	8270E + PAH by SIM	0.00408	0.02	2.0	--
phenanthrene	85-01-8	8270E + PAH by SIM	0.00231	0.006	--	--
pyrene	129-00-0	8270E + PAH by SIM	0.002	0.006	180	--
<i>Volatile and Semivolatile Organic Compounds Requested as Tentatively Identified Compounds (not quantified)</i>						
1,1'-Biphenyl	92-52-4	--	--	--	4.7	--
1,2-Diphenylhydrazine	122-66-7	--	--	--	0.68	--
2-Methylphenol	95-48-7	--	--	--	320	--
3-Methylphenol	108-39-4	--	--	--	320	--
4-Methylphenol	106-44-5	--	--	--	130	--
Atrazine	1912-24-9	--	--	--	2.4	--
Carbazole	86-74-8	--	--	--	--	--
Dibenzofuran	132-64-9	--	--	--	7.8	--
Pyridine	110-86-1	--	--	--	7.8	--

Notes:

Bold italic - indicates that the RSL is less than the RL

1 - Laboratory method detection limits and analytical reporting limits are presented in the individual laboratory SOPs in Appendix D of the Soil QAPP.

2 - US EPA Regional Screening Levels (November 2023), based on a target cancer risk of 1×10^{-6} or a target hazard quotient of 0.1.

3 - Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8-Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds, EPA 2010 - Table 2.

4 - Site-Specific Risk-Based Screening Level for Dioxin in Residential Soil at the Former Houston Wood Preserving Works Site = 48 ng/kg, US EPA, September 2023

5 - Regional Screening Level for 1,3-dichloropropene applied.

-- not applicable

CAS - Chemical Abstracts Service

mg/kg - milligram per kilogram

ng/kg - nanogram per kilogram

MDL - method detection limit

PAH by SIM - Polycyclic Aromatic Hydrocarbons by Selective Ion Monitoring

RL - reporting limit

RSL - Regional Screening Level

TABLE 4
On-Site and Background Reference Areas Surface and Shallow Soil Sampling Scope of Work
Union Pacific Railroad
Houston Wood Preserving Works

Sample Location		Number of Sample Locations	Sample Depth (inches below ground surface) ¹	Sample Type (Discrete/Composite)	Analytes		
					Dioxins and Furans	VOCs ³	SVOCs
					Number of Investigative Samples for Each Analysis		
On-Site	Surface Soils	42	0 - 2	Composite	<u>42</u>	0	<u>21</u>
				Discrete	42	0	21
	Shallow Soils		2 - 6	Composite	<u>42</u>	0	<u>21</u>
				Discrete	42	<u>21</u>	21
			6 - 12	Composite	<u>10</u>	0	<u>5</u>
				Discrete	10	<u>5</u>	5
	Soil Beneath Cap	10	~18 - 24	Discrete	<u>10</u>	<u>10</u>	<u>10</u>
Background Reference Areas ²	Surface Soils	20	0 - 2	Composite	<u>40</u>	0	<u>20</u>
				Discrete	40	0	20
	Shallow Soils		2 - 6	Composite	<u>40</u>	0	<u>20</u>
				Discrete	40	<u>20</u>	20
			6 - 12	Composite	<u>40</u>	0	<u>20</u>
				Discrete	40	<u>20</u>	20

Notes:

VOCs - volatile organic compounds

SVOCs - semi-volatile organic compounds

Underline indicates an EPA required soil sample. Samples not underlined are for UPRR forensic source attribution purposes.¹ Samples at different depths to be collected at the same location.² Refer to Section 3.5.1.1 Sieving Trial for further details on the number of soil samples collected at each depth interval for sieving and non-sieving.³ VOC soil samples will be collected as discrete samples and will only be collected from the 2-6 and 6-12 inch below ground surface soil intervals.

Table 5
Off-Site Surface and Shallow Soil Sampling Scope of Work
Union Pacific Railroad
Houston Wood Preserving Works

Sample Type	Area of Investigation		Number of Soil Sample Locations ¹	Soil Sample Depth (inches below ground surface) ²	Soil Sample Type (Discrete/Composite)	Soil Laboratory Analysis		
						Dioxins and Furans	VOCs ⁴	SVOCs
						Number of Investigative Samples for Each Analysis		
Surface and Shallow Soils	Off-Site	Zone 1a ³	6	0 - 2	Composite	<u>30</u>	0	<u>30</u>
					Discrete	30	0	30
				2 - 6	Composite	<u>30</u>	0	<u>30</u>
					Discrete	30	<u>30</u>	30
				6 - 12	Composite	<u>8</u>	0	8
					Discrete	8	8	8
		Zone 1	57	0 - 2	Composite	<u>57</u>	0	<u>23</u>
					Discrete	57	0	23
				2 - 6	Composite	<u>57</u>	0	<u>23</u>
					Discrete	57	23	23
				6 - 12	Composite	<u>15</u>	0	<u>6</u>
					Discrete	15	<u>6</u>	6
		Zone 2	83	0 - 2	Composite	83	0	<u>22</u>
					Discrete	83	0	22
				2 - 6	Composite	<u>83</u>	0	<u>22</u>
					Discrete	83	<u>22</u>	22
				6 - 12	Composite	<u>21</u>	0	<u>6</u>
					Discrete	21	<u>6</u>	6
		Zone 3	123	0 - 2	Composite	<u>123</u>	0	<u>53</u>
					Discrete	123	0	53
				2 - 6	Composite	<u>123</u>	0	<u>53</u>
					Discrete	123	<u>53</u>	53
				6 - 12	Composite	<u>31</u>	0	<u>14</u>
					Discrete	31	14	14
		Zone 4	73	0 - 2	Composite	<u>73</u>	0	<u>18</u>
					Discrete	73	0	18
				2 - 6	Composite	<u>73</u>	0	<u>18</u>
					Discrete	73	<u>18</u>	18
				6 - 12	Composite	<u>19</u>	0	<u>5</u>
					Discrete	19	<u>5</u>	5

Notes:

VOCs - volatile organic compounds

SVOCs - semi-volatile organic compounds

Underline indicates an EPA required soil sample. Samples not underlined are for UPRR forensic source attribution purposes.

¹ Sample locations for VOC and SVOC sampling will be parcels within Zone 1a through Zone 4 which are closest to HWPW property

² Samples at different depths to be collected at the same location or co-located for sample volume

³ Five composite soil samples are proposed at each parcel in Zone 1a for both the 0-2 and 2 - 6 inches below ground surface depths.

⁴ VOC soil samples will be collected as discrete samples and will only be collected from the 2-6 and 6-12 inch below ground surface soil intervals.

Figures



Legend

Approximate UPRR Property Boundary as defined in Appendix B of ASAOC For Removal Action Site Evaluation

Notes:
ASAOC - Administrative Settlement Agreement and Order on Consent
UPRR - Union Pacific Railroad

1. Aerial Imagery provided by ESRI Basemaps 2022.

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500

250

0

500 Feet

Site Location
Union Pacific Railroad
Houston Wood Preserving Works

Geosyntec

consultants

Guelph

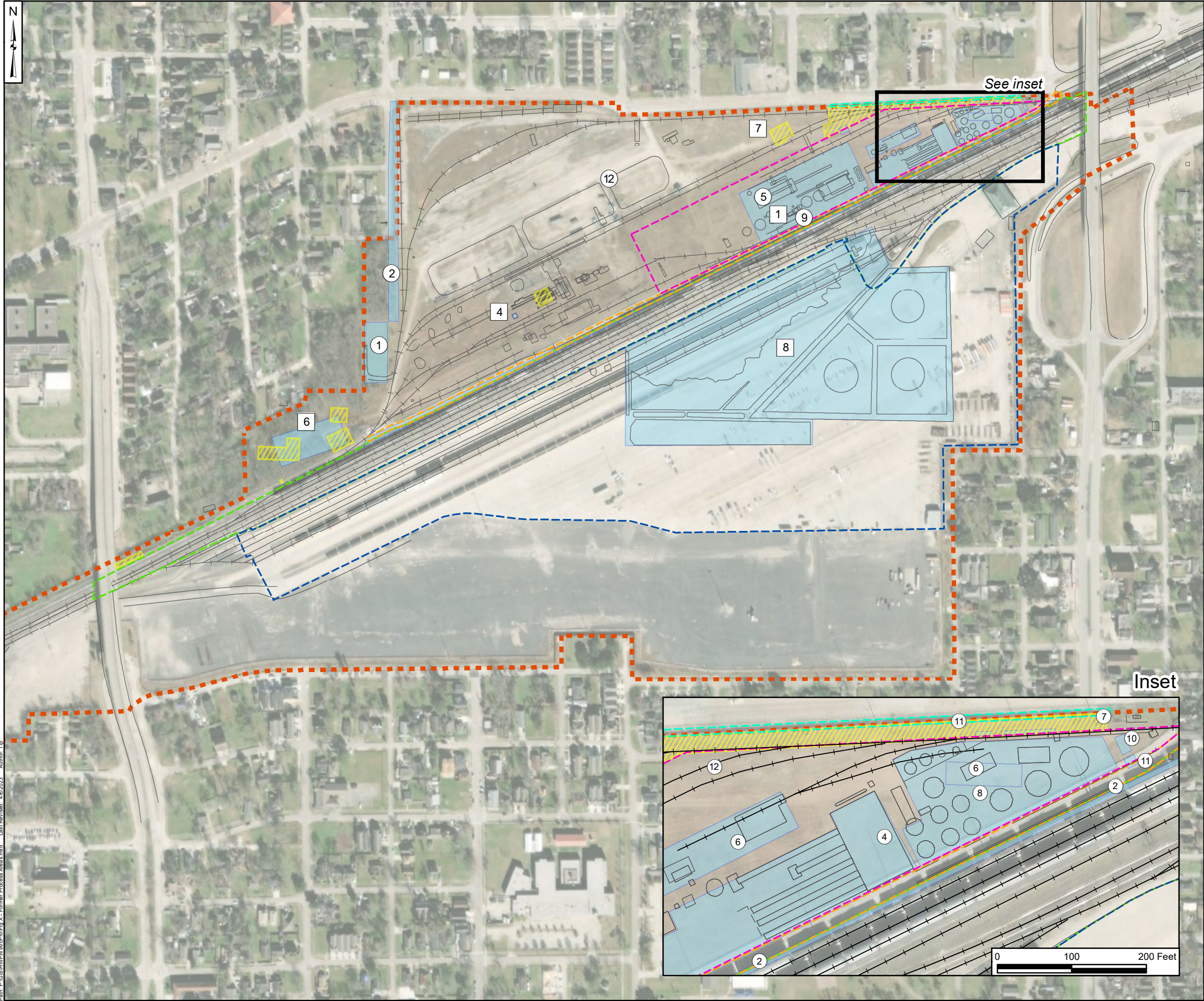
April 2024

Figure

1

Path: P:\GIS\102\Mapa\Evaluation\Wood_aux\Site_Location.dwg Version: 1 Last Revised: 7/26/2023 Author: T

Projection: GCS WGS 1984; Units in Degree



Legend

- On-site AOCs or SWMUs
- Excavated Area
- Soil Cap Area
- Concrete Sidewalk Cap Area
- Asphalt Cap Area
- Concrete Cap Area
- Railroad Ballast Cap Area
- Site Boundary (EPA, Approximate)
- Railroad
- Site Features

SWMU No.	Description
1	Inactive Surface Impoundment
2	Northern and Southern Drainage Ditches
4	Former Process Area 2
5	Former Process Area 1
6	Water Treatment and Boiler System
7	Tank Car Storage Area
8	Above Ground Storage Tank Area
9	Location of Former UST No. 44-023-05
10	Location of Former Sap Water Treatment Tank
11	Oil/Water Separators
12	Railroad Tie Storage Area

AOC No.	Description
1	Diesel Storage Tank
3	Contaminated Portion of City Water Line (Not Shown)
4	Location of Former Incinerator
5	City Storm Sewer (Not Shown)
6	Inactive Wastewater Lagoon
7	Location of Former UST No. 44-023-21
8	Former Fueling ASTs and Wastewater Lagoons

Notes:

AOC - Areas of Concern
VOC - volatile organic compounds
SVOC - semi-volatile organic compounds
SWMU - Solid Waste Management Units

1. Locations of SWMU 9 and AOCs 1, 3, 5, and 7 are approximate.
2. Basemap Aerial Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

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400 200 0 400 Feet

Former Process Areas

Union Pacific Railroad
Houston Wood Preserving Works

Geosyntec
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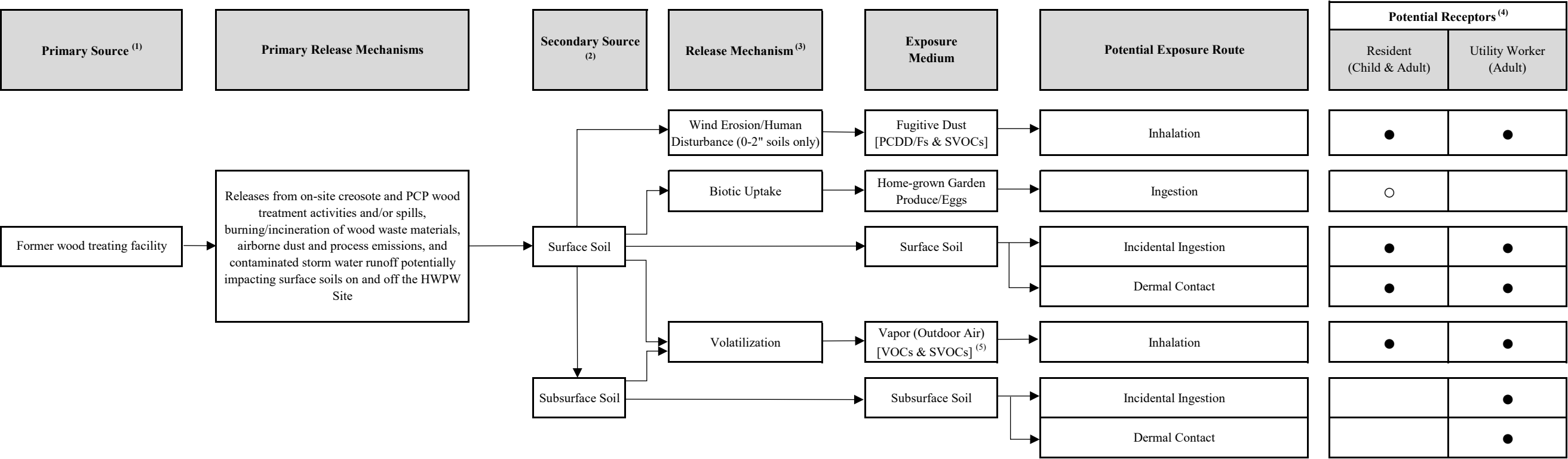
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April 2024

Figure

2

Figure 3. Preliminary Human Health Exposure Conceptual Site Model for Soils



Legend

●	Potentially complete exposure pathway
○	Incomplete or potentially negligible exposure pathway
	Pathway is not complete; no evaluation required

Notes

PCDD/Fs - Polychlorinated Dibenzo-P-Dioxins and Dibenzofurans

PCP - Pentachlorophenol

SVOCs - Semi-Volatile Organic Compounds

VOCs - Volatile Organic Compounds

⁽¹⁾ Onsite soil characterization and analysis is part of the SOW and has not been completed, therefore potential releases from the former wood treatment facility are considered preliminary. UPRR will account for background sources as a part of risk characterization per EPA CERCLA guidance.

⁽²⁾ Surface soil will be considered the top twelve inches of soil below ground surface (0-12"). Subsurface soil will be considered any depth below 12".

⁽³⁾ Residents are expected to primarily be exposed to the top two inches of soil (0-2"), but may also be exposed to the 2-12" depth during activities such as gardening and children digging while playing. To account for potential differences in contamination at depth and varying exposure scenarios, soils will be evaluated for the 0-2", 2-6" and 6-12" depth horizons. Exposures to VOCs will be evaluated for the 2-6" and 6-12" depth intervals, but not the 0-2" depth interval.

⁽⁴⁾ The work plan recognizes that there are other off-site receptors for Zone 1a (school students and staff, church leaders and congregants, and park recreators), but residents and utility workers are expected to have higher exposures given assumed daily activities. The other off-site receptors will be addressed qualitatively in the risk assessment.

⁽⁵⁾ VOCs and SVOCs must be both sufficiently volatile and sufficiently toxic. For the purposes of the risk assessment, a chemical is considered to be sufficiently volatile if it has a Henry's Law constant greater than 1×10^{-5} atm-m³/mole or a vapor pressure greater than 1 mm Hg, and sufficiently toxic if the vapor concentration of the pure component exceeds the indoor air target risk level (U.S. EPA 2015 *OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air*).



Legend

Approximate UPRR Property Boundary as defined in Appendix B of ASAOC For Removal Action Site Evaluation

Potential Migration Pathways to Surface and Subsurface Soil

Predominant Direction of Stormwater Runoff (sediment transport)

Prevailing Wind Direction (wind erosion and atmospheric dispersion)

Notes:

*Prevailing Wind: TCEQ Houston Kirkpatrick monitor annual average 2020-2021

ASAOC - Administrative Settlement Agreement and Order on Consent

UPRR - Union Pacific Railroad

1. Aerial Imagery provided by ESRI Basemaps 2022.

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5002500500 Feet

Preliminary Conceptual Site Model – Release and Transport Mechanisms

Union Pacific Railroad
Houston Wood Preserving Works

Geosyntec

consultants

Guelph

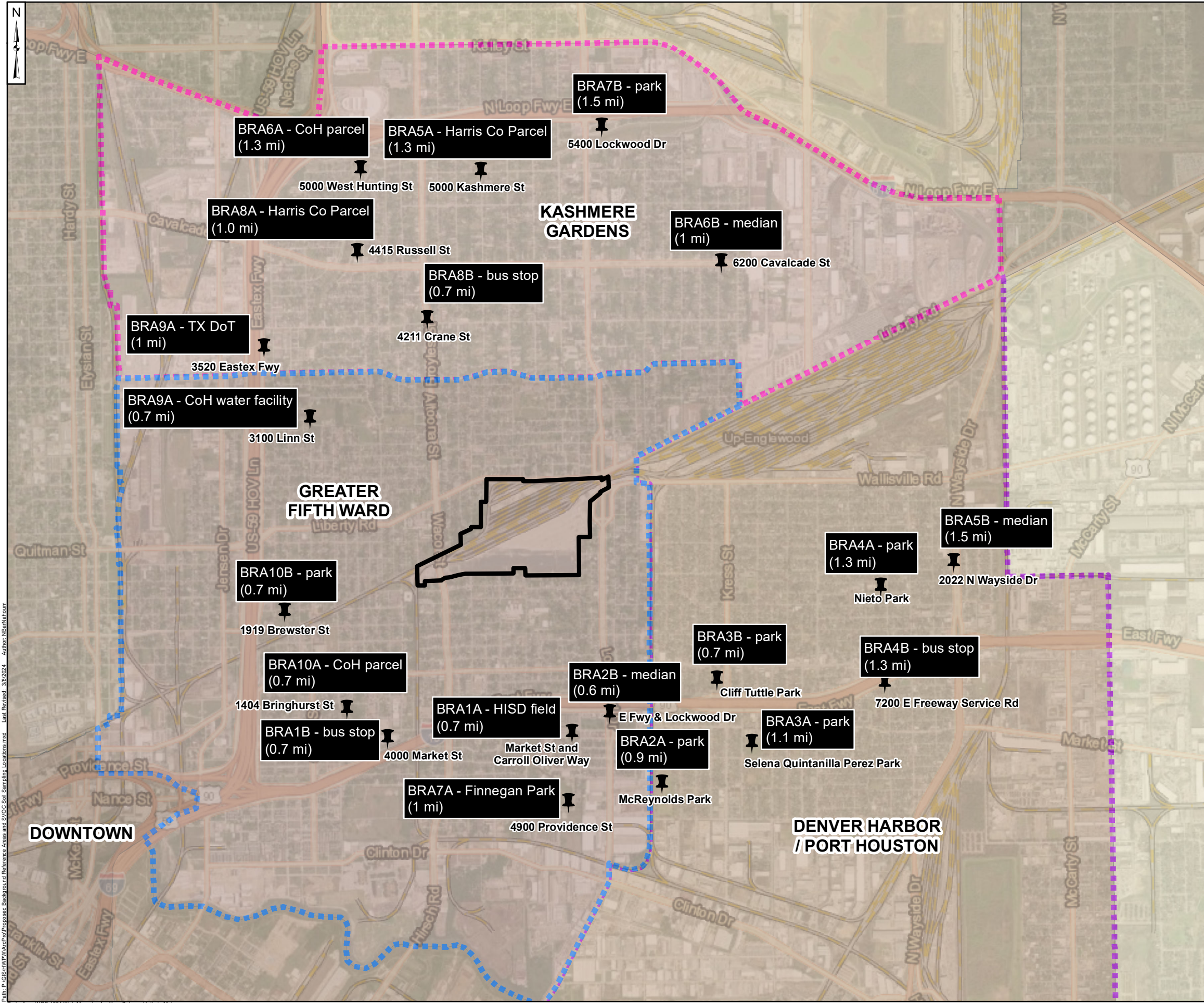
April 2024

Figure

4

Path: P:\GIS\102\PM\CA\ReleaseTransportWood\and\Basemaps\Conceptual Site Model - Last Revised: 2/20/2024 Author: Kresante

Projection: GCS WGS 1984; Units in Degree



Legend

PROPOSED BACKGROUND REFERENCE AREAS

Approximate UPRR Property Boundary as defined in Appendix B of ASAOC For Removal Action Site Evaluation

DENVER HARBOR / PORT HOUSTON

DOWNTOWN

EASTEX - JENSEN AREA

EL DORADO / OATES PRAIRIE

GREATER FIFTH WARD

KASHMERE GARDENS

NEAR NORTHSIDE

PLEASANTVILLE AREA

SECOND WARD

SETTEGAST

TRINITY / HOUSTON GARDENS

Prevailing Wind*



Notes:
*TCEQ Houston Kirkpatrick CAMS 0404 monitor annual average 2020-2021, arrow displays prevailing wind direction.

1. All proposed addresses are approximate
2. The selection of background reference area (BRA) locations followed the EPA policy presented in the Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites (EPA, 2002).
3. Basemap Aerial Imagery: Esri, HERE, Garmin, (c) OpenStreetMap contributors
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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0.5 0.25 0 0.5 Kilometers

Proposed Background Reference Areas for PCDD/F, VOC, and SVOC Soil Sampling

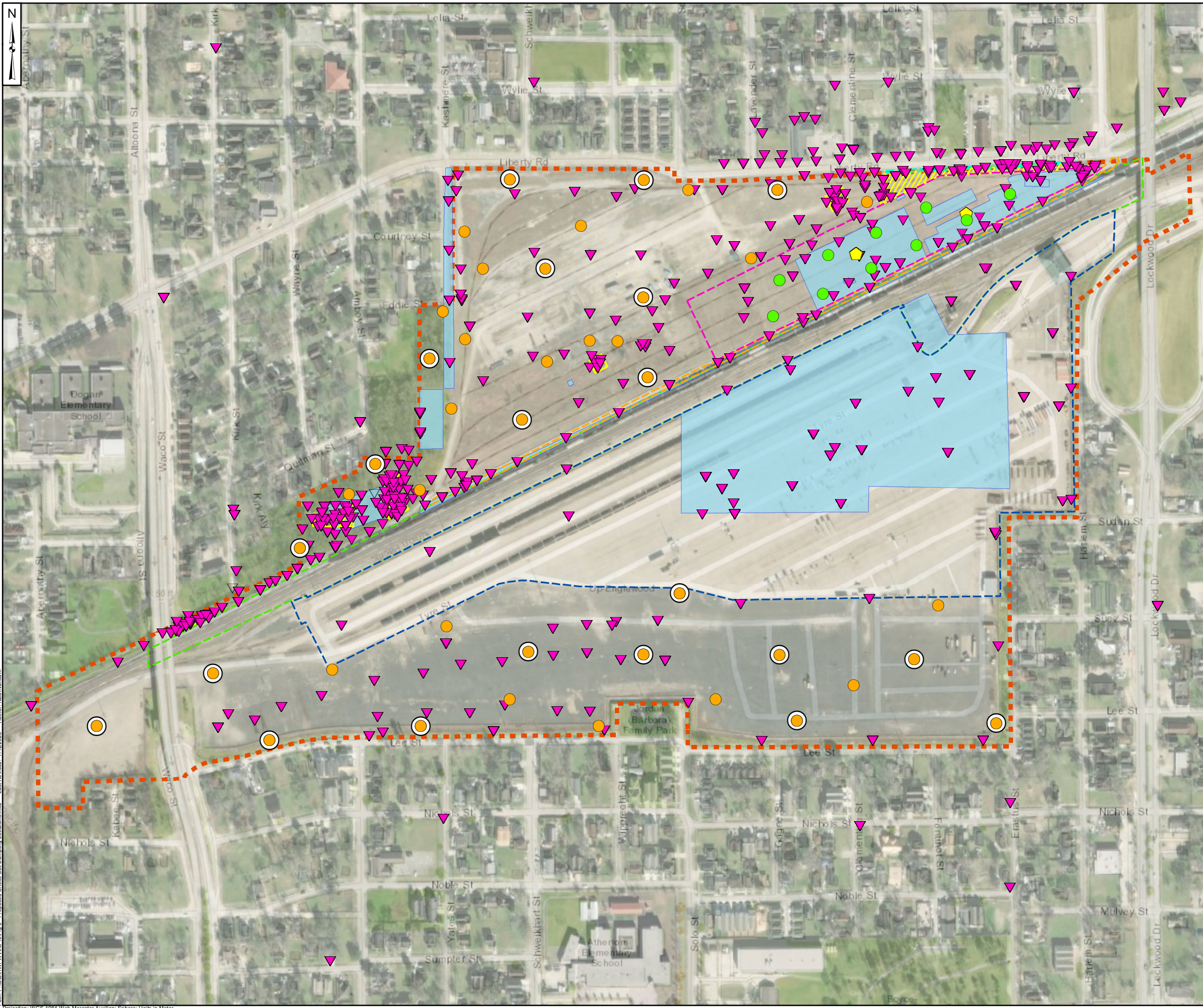
Union Pacific Railroad
Houston Wood Preserving Works

Figure

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April 2024

5



Legend

- Proposed On-Site Soil Sample Locations (42 Locations at 2 depth intervals)
- Proposed On-Site Soil Sample Locations for VOC/SVOC Analysis (21 Locations at 2 Depth Intervals = 42 Samples)
- Proposed On-Site Sample Locations Within Soil Cap Area (10 Locations at one depth interval)
- Previous Soil Sampling Locations analyzed for VOC\SVOC
- Previous Soil Sampling Locations analyzed for Dioxin/Furans
- AOCs or SWMUs
- Excavated Area
- Soil Cap Area
- Concrete Sidewalk Cap Area
- Asphalt Cap Area
- Concrete Cap Area
- Railroad Ballast Cap Area
- Approximate UPRR Property Boundary as defined in Appendix B of ASAO

Notes:

ASAO - Administrative Settlement Agreement and Order on Consent
SVOC - semi-volatile organic compounds
UPRR - Union Pacific Railroad
VOC - volatile organic compounds

1. Basemap Aerial Imagery: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

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4002000400 Feet

Proposed On-Site Soil Sample Locations

Union Pacific Railroad
Houston Wood Preserving Works

Geosyntec

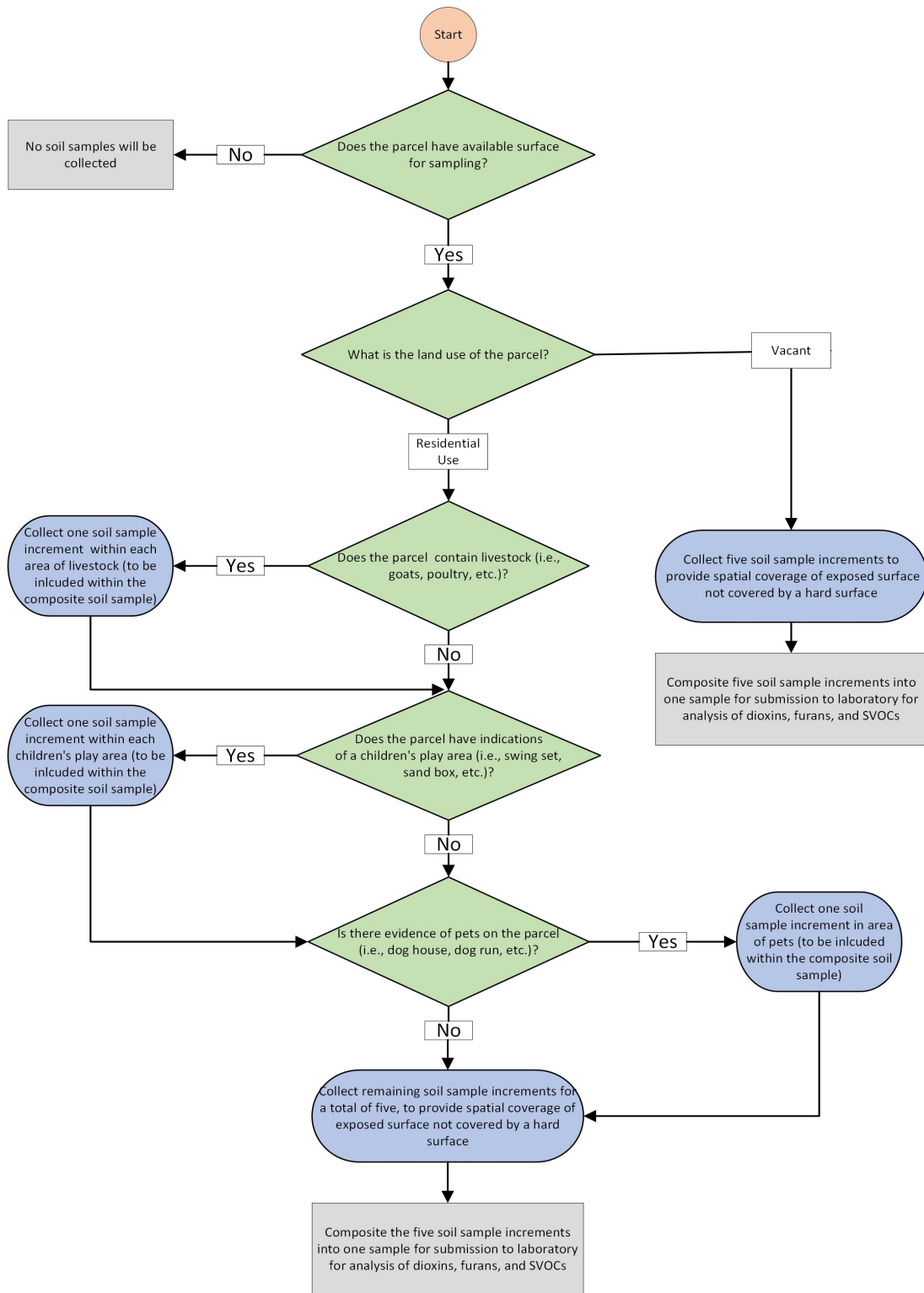
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Figure

6

April 2024



Decision Points: Dioxins, Furans and SVOCs Soil Sample Selection (Parcels ≤ 1/8 acre)¹

Union Pacific Railroad
Houston Wood Preserving Works

Geosyntec
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Figure

8

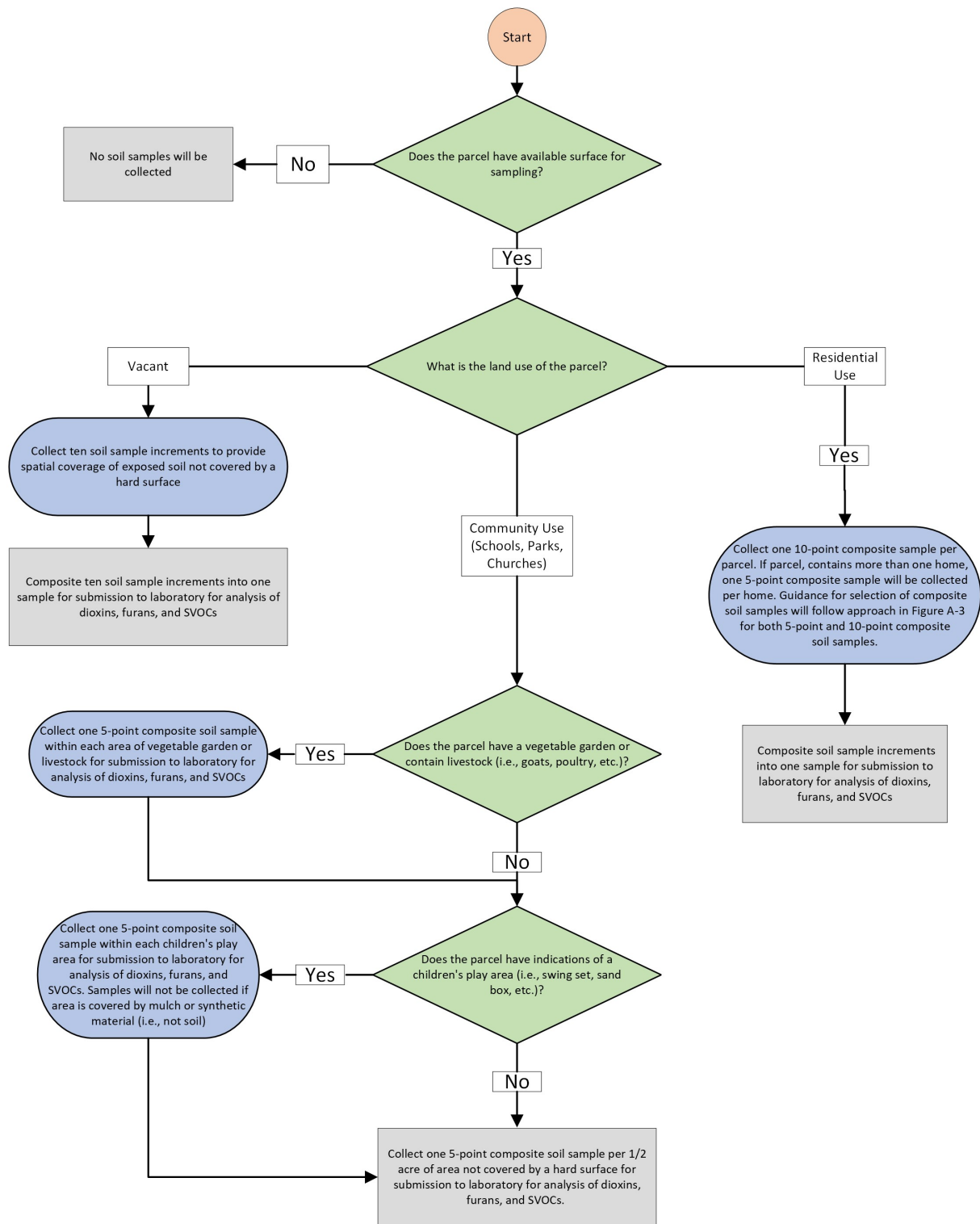
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April 2024

Notes:

¹ Parcels that contain less than or equal to 1/8 acre of area not covered by a hard surface

SVOCs - Semi-Volatile Organic Compounds



Decision Points: Dioxins, Furans and SVOCs Soil Sample Selection (Parcels > 1/8 acre)¹

Union Pacific Railroad
Houston Wood Preserving Works

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Figure

9

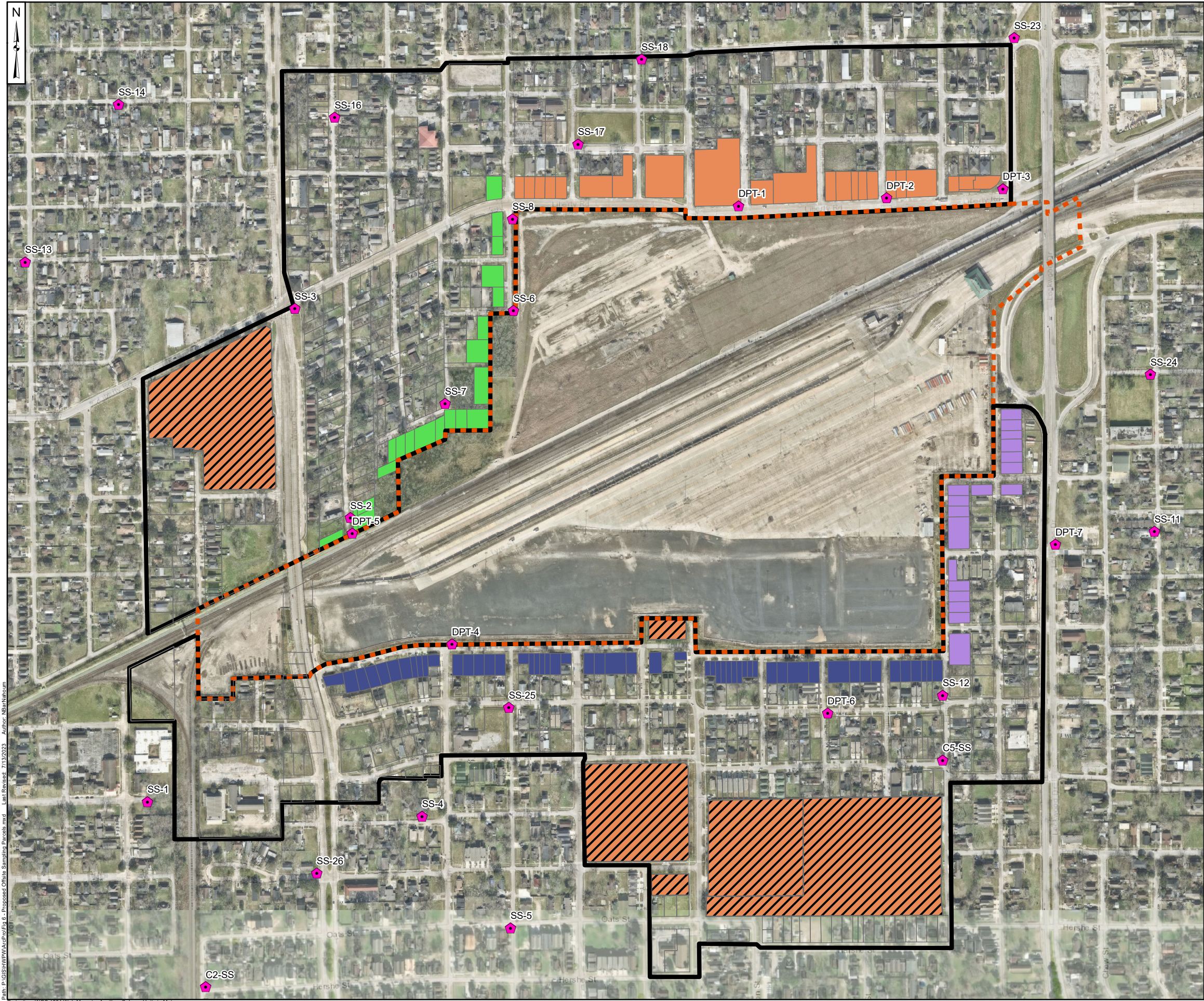
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April 2024

Notes:

¹ Parcels that contain greater than 1/8 acre of area not covered by a hard surface

SVOCs - Semi-Volatile Organic Compounds



Legend

Proposed Off-Site Sampling Parcels by Zone

- Zone 1a (6 parcels with 5 samples per parcel = 30 samples)
- Zone 1 (23 parcels with 1 sample per parcel = 23 samples)
- Zone 2 (22 parcels with 1 sample per parcel = 22 samples)
- Zone 3 (53 parcels with 1 sample per parcel = 53 samples)
- Zone 4 (18 parcels with 1 sample per parcel = 18 samples)

EPA Proposed Off-Site Area

Approximate UPRR Property Boundary as defined in Appendix B of ASAOB For Removal Action Site Evaluation

County Soil Sampling Locations

- Historical samples with VOC/SVOC concentrations below TRRP Tier 1 Residential Protective Concentration Levels

Notes:

*TCEQ Houston Kirkpatrick CAMS 0404 monitor annual average 2020-2021, arrow displays prevailing wind direction.
VOC - volatile organic compounds
SVOC - semi-volatile organic compounds

1. Basemap Aerial Imagery: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

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400 200 0 400 Feet

Proposed Off-Site Sampling Parcels - VOC/SVOC

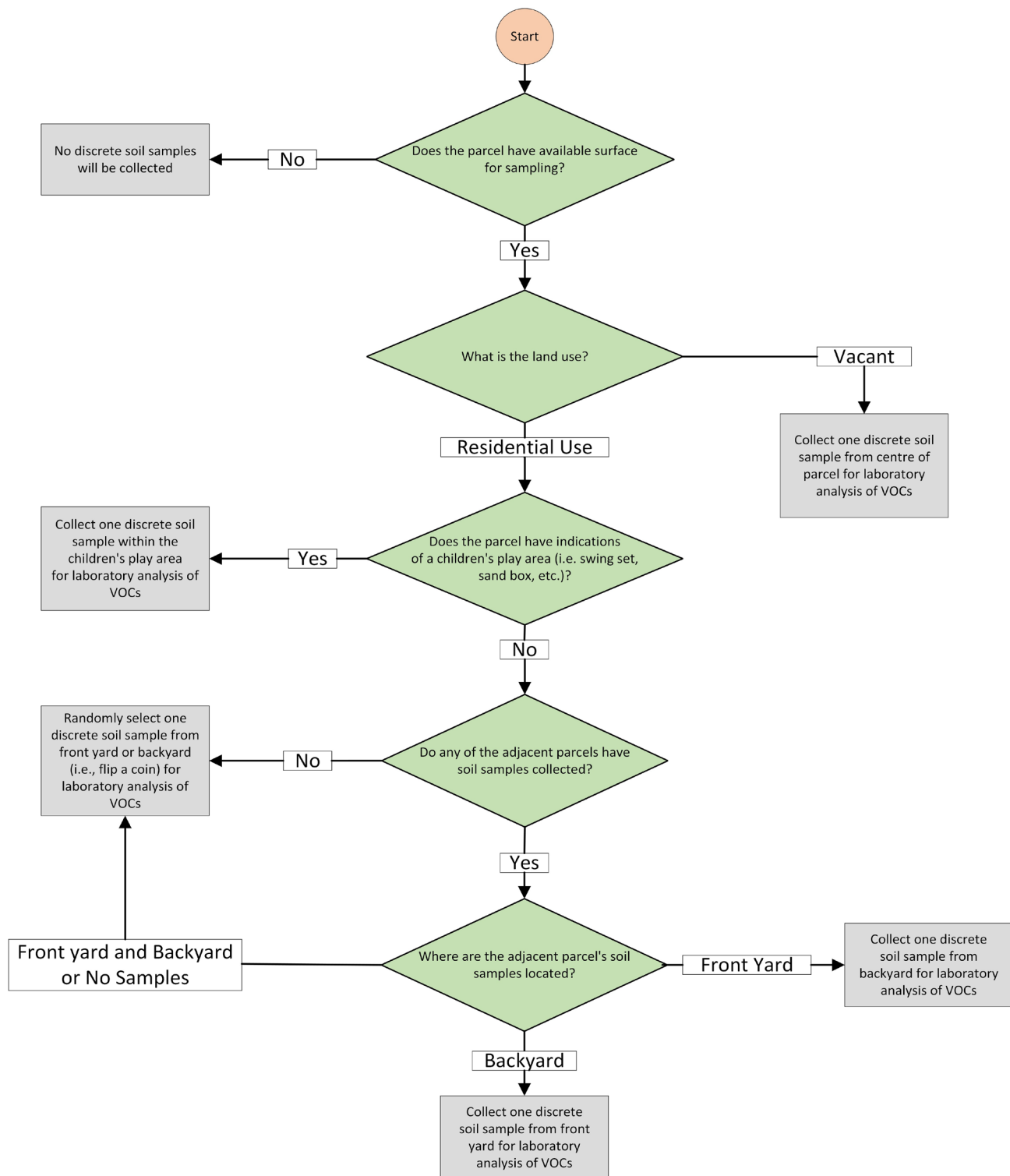
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Houston Wood Preserving Works

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April 2024

Figure
10



Decision Points: VOCs Soil Sample Selection (Parcels ≤ 1/8 acre)¹

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Houston Wood Preserving Works

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Figure

11

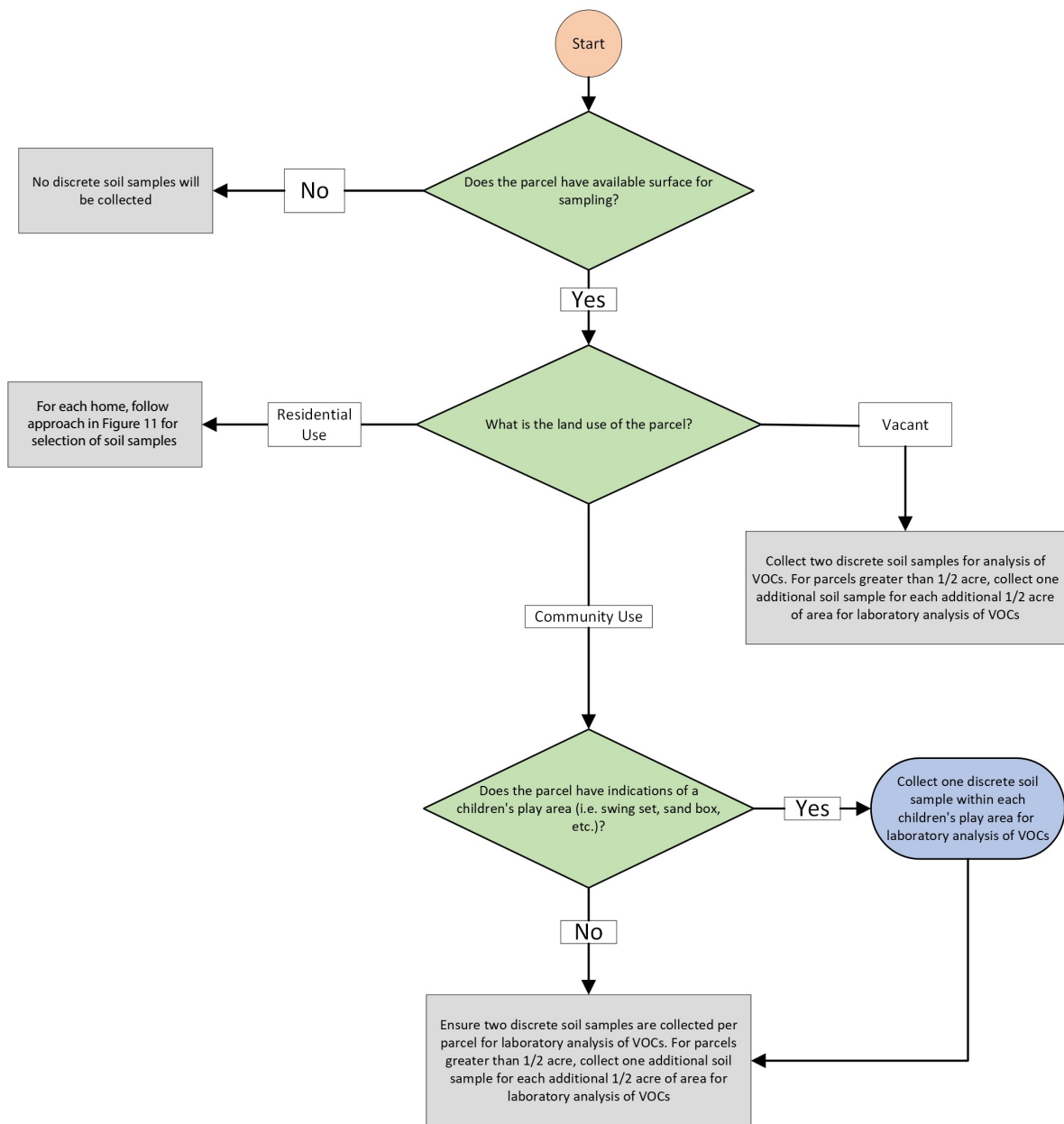
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April 2024

Notes:

¹ Parcels that contain less than or equal to 1/8 acre of area not covered by a hard surface

VOCs - Volatile Organic Compounds



**Decision Points: VOCs
Soil Sample Selection (Parcels > 1/8 acre)¹**

Union Pacific Railroad
Houston Wood Preserving Works

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Figure

12

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April 2024

Notes:

¹ Parcels that contain greater than 1/8 acre of area not covered by a hard surface

VOCs - Volatile Organic Compounds

Appendix A

Soil Data Quality Objectives

DATA QUALITY OBJECTIVES SURFACE AND SHALLOW SOIL ASSESSMENT

The following Data Quality Objectives (DQO) were presented in the Geosyntec *Removal Site Evaluation Work Plan – Surface and Shallow Soil Assessment*, dated July 2023. Updates have been made per the U.S. Environmental Protection Agency (EPA) request in the Quality Assurance Project Plan (QAPP).

Step 1. State the Problem

Sample the surface and shallow soils in the community (including neighborhoods, schools, parks, child day care locations, and recreation center) adjacent to the HWPW Site to characterize the nature and extent of dioxins/furans (i.e., TEQ), SVOCs, and VOCs – both those related and unrelated to the Houston Wood Preserving Works (HWPW) Site – to support human health risk assessment, and forensic analysis by Union Pacific Railroad Company (UPRR). Sample the surface and shallow soils of background reference areas (BRAs) around the HWPW Site to characterize the nature and extent of background concentrations of dioxin/furans, SVOCs, and VOCs in the area and to inform risk characterization and to support risk management. UPRR will also characterize analytes from BRAs and on-site soils to support off-site soil forensic source attribution analysis.

Step 2. Identify the Goals of the Study

- i. **Question 1.** What is the nature and extent (if any) of the analyte soil concentrations above thresholds in **QAPP Table 2** measured in the samples according to the specified sampling depths from off-site soils within Parcels in Zone 1a and Zones 1-4? *Note: QAPP Table 2 meets the requirements of Uniform Federal Policy (UFP) Worksheet #15: Reference Limits and Evaluation Table.*
- ii. **Question 2.** For soil samples that exceed the soil concentration thresholds (**QAPP Table 2**), what are the cancer and non-cancer risks to the human receptor populations in neighboring off-site residential areas from exposure to these soils?
- iii. **Question 3.** What are the background threshold values (BTVs), calculated as 95% - 95% upper tolerance limit (UTL), for the analytes measured in the surface and shallow composite soil samples, respectively, across the BRA locations according to the specified sampling depths?
- iv. **Question 4.** What are the 95% upper confidence limits (UCLs) of the soil concentration means for the analytes measured in off-site soils for each of the off-site Zones relative to their respective thresholds according to the specified sampling depths (**QAPP Table 2**)?
- v. **Question 5.** For soil samples that exceed the soil concentration thresholds (**QAPP Table 2**), what is the distribution of the analytes in the off-site soils according to the

specified sampling depths? UPRR will evaluate the on-site soils to support an off-site soil forensic source attribution analysis.

Step 3. Identify Information Inputs

- i. Five-point composite soil samples will be obtained for dioxin, furan and SVOC laboratory analysis from soils (0-2 and 2-6 inches [in] below ground surface [bgs]) at the off-site parcels properties within Zones 1a and 1-4 (as illustrated in **Figure A1** for dioxins and furans and **Figure A2** for SVOCs directly adjacent to the HWPW Site fence line) for human health risk assessment. At approximately 25% of the five-point composite sample locations, an additional 6-12 in bgs shallow soil interval will be collected. These sample locations will be randomly selected except at locations adjacent to HHD soil sample exceedances of dioxins and furans (HHD-21, HHD 34 and HHD-35). For laboratory analysis of VOCs, at one of the five-point composite soil sample locations that is randomly selected, one discrete sample will be collected at two of the same depth intervals as the composite sample (i.e., 2-6, and 6-12 in bgs) (**Figure A2**). At approximately 25% of the discrete sample locations, an additional 6-12 in bgs shallow soil interval will be collected. These sample locations will be randomly selected except at locations adjacent to HHD soil sample exceedances of dioxins and furans (HHD-21, HHD 34 and HHD-35). The samples will be collected at properties that contain less than or equal to a 1/8th acre (≤ 0.125 acres) area not covered by a hard surface following the approach shown in **Figure A3** (dioxins, furans and SVOCs) and **Figure A4** (VOCs). The samples will be collected at properties that contain greater than a 1/8th acre (> 0.125 acres) area not covered by a hard surface following the approach as shown in **Figure A5** (dioxins, furans and SVOCs) and **Figure A6** (VOCs). The numbers of surface and shallow soil samples to be collected in these Zones are listed in **Table A1**. As described in the QAPP, soil samples will be analyzed for dioxin and furan congeners according to EPA Method 1613B, SVOC analytes according to EPA Method 8270E, and VOC analytes according to EPA Method 8260D (listed in **QAPP Table 2**).
- ii. Discrete soil samples will be obtained for dioxin, furan and SVOC laboratory analysis from soils (0-2 and 2-6 in bgs) at the off-site parcels within Zones 1a and 1-4 (as illustrated in **Figure A1** for dioxins and furans and **Figure A2** for SVOCs directly adjacent to the HWPW Site fence line) for off-site soil forensic source attribution analysis by UPRR. At approximately 25% of the discrete sample locations, an additional 6-12 in bgs shallow soil interval will be collected. These sample locations will be randomly selected except at locations adjacent to HHD soil sample exceedances of dioxins and furans (HHD-21, HHD 34 and HHD-35). For laboratory analysis of VOCs, one discrete sample will be collected at two of the same depth intervals (i.e., 2-6, and 6-12 in bgs) (**Figure A2**). The samples will be collected at properties that contain less than or equal to a 1/8th acre (≤ 0.125 acres) area not covered by a hard

surface following the approach shown in **Figure A3** (dioxins, furans and SVOCs) and **Figure A4** (VOCs). The samples will be collected at properties that contain greater than a 1/8th acre (> 0.125 acres) area not covered by a hard surface following the approach as shown in **Figure A5** (dioxins, furans and SVOCs) and **Figure A6** (VOCs). The number of surface and shallow soil samples to be collected in these Zones are listed in **Table A1**. As described in the QAPP, soil samples will be analyzed for dioxin and furan congeners according to EPA Method 1613B, SVOC analytes according to EPA Method 8270E, and VOC analytes according to EPA Method 8260D (listed in **QAPP Table 2**). BRA soil sample locations were selected to characterize analyte concentrations in soils around the off-site and on-site areas (**Figure A7**). The objective of the BRA locations is to identify soils that reflect the anthropogenic activities (“anthropogenic background”) in this urban environment and that are not expected to have been impacted by the HWPW Site. BRA locations ($n=20$) were identified to support the derivation of the 95%-95% UTL. At each BRA location, a five-sample composite soil sample will be collected at three depth intervals (0-2, 2-6, and 6-12 in bgs) and analyzed for dioxins and furans (according to EPA Method 1613B) and SVOCs (according to EPA Method 8270E) as described in the QAPP. In addition, at one of the five-point composite soil sample locations that is randomly selected, one discrete sample will be collected at two of the same depth intervals as the composite sample (i.e., 0-2, 2-6, and 6-12 in bgs). The numbers of composite surface and shallow soil samples to be collected are listed in **Table A2**. For the laboratory analysis of VOCs, discrete soil samples at each of the 20 BRA locations will be collected at two depth intervals (2-6 in bgs and 6-12 in bgs) and analyzed using EPA Method 8270D as described in the QAPP.

- iii. On-site soil sample locations for dioxin and furan analysis have been selected to provide spatial coverage, focused on historic operational areas, and within areas that contained solid waste management units (SWMUs) or Areas of Concern (AOCs) if not previously capped (**Figure A8**). While there already exist sufficient on-site soil concentration data for most of the SVOC and VOC analytes, there are some analytes that either lack on-site data or have only a small number of data points. Fifty percent of on-site soil sample locations have been selected to analyze for a subset of SVOC/VOC analytes. These on-site soil samples will be coincident with a subset of the on-site soil sample locations for dioxin and furan soil analysis (**Figure A8**). Samples from the on-site locations will be collected as composite and discrete samples and analyzed for the dioxin and furan congeners according to EPA Method 1613B and for SVOCs according to EPA Method 8270E as described in the QAPP. On-site soil samples will be collected and analyzed for dioxins, furans and SVOCs at three depths: 0-2 in bgs, 2-6 in bgs, and 6-12 in bgs (only for 25% of the locations selected at random). For laboratory analysis of VOCs, discrete soil samples from 2-6 in bgs and 6-12 in bgs will be collected according to EPA Method 8270D as described in the QAPP. Previously excavated areas, areas covered with a protective cap, and areas

- covered in concrete were not included except at 10 additional locations beneath the existing protective soil cap. At the 10 locations beneath the cap, one discrete soil sample will be obtained for dioxin, furan, SVOC, and VOC laboratory analysis using the appropriate EPA Method described in the QAPP once the liner is penetrated (approximately 18 in bgs) and will continue for a depth of 6 in. The number of composite and discrete soil samples to be collected on-site are listed in **Table A2**.
- iv. UPRR will use soil dioxin, furan, SVOC and VOC profiles from the discrete samples collected from on-site and BRA locations to characterize potential sources/source activities of the off-site parcels with surface and shallow composite soil samples that exceed the thresholds (**QAPP Table 2**).
 - v. After the evaluation and validation of laboratory results from the composite soil samples at available Zone 1a, and Zones 1 through 4 parcels (as illustrated in **Figure A1** for dioxins and furans and **Figure A2** for SVOCs directly adjacent to the HWPW Site fence line) and the BRA samples, UPRR and EPA will evaluate the need for soil samples at the 12 – 24 in bgs interval. An addendum to the QAPP will be made prior to proceeding with the sampling of 12 – 24 in bgs soil sampling depths in Zones 1a, Zones 1 – 4 and BRA areas.

Step 4. Define the Boundaries of the Study

- i. The boundary for the soil study area is identified in **Figure A1**. It covers the previous Houston Health Department (HHD) sample locations and extends further out (away from the HWPW Site) in all directions. As **Figure A1** illustrates, the northern boundary is defined by Lucille Street, while Cushing Street (north of the HWPW Site) and Lockwood Drive (east and south of the HWPW Site) define the Eastern boundary. The Southern and Western study boundaries are more variable as they include sensitive receptor areas (e.g., schools, day cares, a recreation center, and parks): portions of the Southern study boundary are bounded by Mulvey Street, Herche Street, Rawley Street, and Noble Street, whereas the Western Boundary includes Altoona Street (north of HWPW Site), Leffingwell Street and Benson Street (west and south of the HWPW Site).
- ii. Initial off-site sampling will occur within Zone 1a and Zones 1-4 as defined in **Figure A1**. Zone 1a includes Dogan Elementary School, Liberty Road Head Start Center, Atherton Elementary School, Gulf Coast Community Services Association (GCCSA) Early Headstart, the Julia C. Chesterhouse Inc. Community Center, and the Catherine Adams, Boyce-Dorian and Barbara Jordan Family Parks. Zones 1-4 represent the parcels closest to the HWPW Site and/or those parcels on/around which the HHD soil sampling indicated an exceedance of the EPA residential soil non-carcinogenic (nc)-Regional Screening Level (RSL) for dioxins/furans

- (i.e., 51 nanograms [ng] toxic equivalence [TEQ]/kilogram [kg]). Each parcel represents a decision unit.
- iii. The BRA locations surround the HWPW Site and range from approximately 0.5-1.5 miles from the closest HWPW Site boundary for each designated BRA location. While local meteorological data indicate the prevailing winds for the area are generally from the southeast, the winds across Houston are known to be variable throughout the year. Therefore, BRA locations were identified in all directions from the HWPW Site.
 - iv. On-site soil sampling will occur within the HWPW Site property line defined in **Figure A8** and as defined in the Administrative Settlement Agreement and Order on Consent (ASAOC).
 - v. Timing of sample collection will depend on sample plan approval, property access agreements and field sampling logistics.

Step 5. Develop the Analytical Approach

- i. Statistics will be used to characterize the off-site, background, and on-site analyte soil concentrations at each depth sampled. For the off-site sample areas, the 95% UCL of the mean soil concentration for each analyte with measurements in exceedance of their respective threshold will be calculated from the composite (dioxins, furans, and SVOCs) or discrete (VOCs) sample analytical data for each soil depth (i.e., 0-2, 2-6, 6-12 in bgs, and 12-24 in bgs, if warranted) using EPA's ProUCL tool. A minimum of 8-10 samples are required to calculate the 95% UCL of the mean, so 95% UCLs will be calculated for each Zone. For the BRA samples, the 95%-95% UTL analyte soil concentrations will be calculated from the composite (dioxins, furans, and SVOCs) or discrete (VOCs) sample analytical data for each soil depth (i.e., 0-2, 2-6, 6-12 in bgs, and 12-24 in bgs, if warranted), also using EPA's ProUCL tool. For dioxins and furans, Total TEQ concentrations will be calculated using 2005 World Health Organization (WHO) toxic equivalence factors (TEFs) for dioxin and furan congeners measured according to EPA Method 1613B.
- ii. For background, summary statistics on the composite (dioxins, furans, and SVOCs) or discrete (VOCs) samples will be derived for each of the depth intervals for the two background categories (A and B) and statistical analysis conducted to determine if there is a significant difference in analyte soil concentrations between the two categories. For each soil analyte, if no statistical difference is found between categories (e.g., it is determined that there is no statistically significant difference in the Total TEQ soil concentrations between the soil samples from high vehicle traffic areas vs. lower vehicle traffic areas), the analyte soil concentration data for samples collected at all 20 BRAs will be combined into a larger background data set and a single BTV will be computed for that analyte. If there is a statistically significant difference in soil concentrations for an analyte between the two datasets, then EPA and UPRR will have

follow-up discussions to determine if it is appropriate to combine the datasets into a single background dataset for the computation of BTVs.

- iii. The extent and distribution of soil analyte concentrations will be characterized by UPRR as follows:
 - a. By comparing the analyte concentrations measured in each of the individual off-site composite or discrete soil samples with their respective thresholds (**QAPP Table 2**).
 - i. If off-site analyte soil concentration measurements do not exceed their respective thresholds at a sampled parcel, no further risk assessment activities will be pursued for these soil analytes on this parcel.
 - ii. If the off-site analyte soil concentration measurements do exceed their respective thresholds at a sampled parcel, then this parcel will be included in a site-specific human health risk assessment to determine the extent of potential hazards and/or risks.
 - b. For analytes that exceed their respective thresholds in individual off-site composite or discrete soil samples, by comparing the 95% UCL of the mean analyte soil concentration (calculated from the individual off-site composite [SVOC/Dioxin/Furans] or discrete soil samples [VOCs] for each relevant off-site Zone) with their respective thresholds (**QAPP Table 2**).
 - i. If an analyte soil concentration measured at any off-site parcel exceeds their respective threshold, then the 95% UCL of the mean soil concentration (calculated using the individual off-site composite [SVOC/Dioxin/Furans] or discrete soil samples [VOCs] for the Zone relevant to that parcel) will be derived for that analyte.
 - ii. If all of the off-site soil concentration measurements for an analyte are less than its respective threshold, then it will be unnecessary to calculate a 95% UCL of the mean because this analyte will not be carried forward to a site-specific risk assessment.
 - c. By comparing the analyte concentrations measured in each of the individual off-site composite or discrete soil samples with the analyte BTV (95%-95% UTL) calculated from the BRA soil measurements.
 - i. If off-site analyte soil concentration measurements do not exceed their respective BTV, the role of this analyte will be considering in the risk characterization section of the site-specific risk assessment, as well as inform future risk management decisions.

- iv. For off-site parcels with analyte soil concentrations exceeding their respective threshold and BTVs, the distribution and analyte profiles from the respective discrete samples collected for that parcel will be used by UPRR in a forensic analysis (comparing the analyte concentration profile data with that from the BRA and on-site soil samples, as well as published soil analyte profiles, using appropriate statistical methods [e.g., principal component analysis (PCA), hierarchical clustering analysis (HCA), polytopic vector analysis (PVA), etc.]) to characterize potential source patterns and attribution.
- v. Only dioxin and furan soil sampling data collected according to this work plan will be considered for characterizing off-site and on-site dioxin and furan soil contamination. Previous dioxin and furan soil sampling efforts by HHD (2022) generated soil concentration data that were not collected using the same sampling design or methods described in this work plan and QAPP, and therefore are not comparable to the measurements that will be generated using this sampling plan.

Step 6. Specify Performance or Acceptance Criteria

Acceptance criteria for field sampling and analytical results includes:

- i. Sample collection will follow standard operating procedures (SOPs) and the methodology(ies) and collection of quality control samples specified by the project specific Off-Site Surface and Shallow Soil Field Sampling Plan (FSP) and QAPP.
- ii. Samples will be submitted to an accredited laboratory. Validation of laboratory results per the requirements of the QAPP will be implemented on 100% of the data to determine any limitations of data usability. Reporting limits for each of the dioxin, furan, SVOC, and VOC analytes are provided in **QAPP Table 2**.
- iii. The use of analyte soil concentration data reported as below detection limit (i.e., “non-detect” results) will be considered according to the statistical recommendations outlined in the current ProUCL technical guide.

Performance Criteria for Human Health Risk Evaluation:

- i. The EPA site specific level (SSL) (48 ng TEQ/kg) for dioxins and furans is purposefully protective using default and site-specific conservative exposure parameters and a conservative toxicity value (Reference Dose [RfD]) at a hazard quotient (HQ) of 1. This is a screening level that is protective of human health; off-site composite samples found to exceed this SSL are not indicative of health hazard but suggest that the soil dioxin and furan concentrations should be included in a site-specific human health risk assessment along with other SVOC and VOC analytes that exceed their respective screening levels. Although there is no Tier I cancer slope factor for dioxins/furans, screening levels developed based on the dioxin RfD will be within EPA’s lifetime excess cancer risk range. EPA’s September 2023 SSL Technical

memorandum and Superfund guidance on dioxin assert that their Integrated Risk Information System (IRIS) RfD is protective of cancer risk.

- ii. The EPA RSLs for VOCs and SVOCs are purposefully protective, as they are based on default conservative exposure parameters and conservative toxicity values. The lower of the 10^{-6} cancer risk level or $HQ = 0.1$ will be used as the initial screening level for soils. Noncancer screening levels based on $HQ=0.1$ represent a conservative approach for assessing potential cumulative hazards, and per EPA guidance on cumulative hazards is relevant for potential contaminants of concern (PCOCs) with common critical toxicity endpoints (i.e., target organs). These are screening levels and exceedances are not indicative of health hazard from potential exposure but indicate a site-specific risk assessment should be conducted to better characterize potential hazards and risks to area receptors.
- iii. For noncancer risk characterization, HQs and hazard indices (HIs) will be calculated for analytes that exceeded their respective screening values (PCOCs). In cases where $HI > 1$, PCOCs will be evaluated for cumulative hazard based on common target organs. For cancer risk characterization, potential cumulative cancer risk estimates (total cancer risk) will be derived by adding together the PCOC cancer risk estimates.
- iv. Given that the goal of the AOC SOW is to characterize the nature and extent of dioxins/furans (i.e., TEQ), SVOCs, and VOCs (both those related and unrelated to the Houston Wood Preserving Works (HWPW) Site), BTVs will be considered in risk characterization section of the site-specific risk assessment, and will inform future risk management decisions, particularly for those analytes with BTVs that exceed their respective thresholds (**QAPP Table 2**).
- v. If it is deemed necessary to develop a site-specific health-based preliminary remediation goals, toxicity values for the relevant PCOCs representing the state of the science will be identified, accounting for the US EPA (2013) toxicity value hierarchy.

Performance Criteria for Attribution and Potential Follow-up Sampling Decisions:

- i. Forensic analyses will also be conducted by UPRR using the analyte profiles from discrete samples collected on parcels where off-site composite soil analyte soil concentrations exceeded their respective thresholds and on-site, BRA, as well as published analyte profiles of potential sources/source activities (e.g., see Johnson [2017] for dioxins/furans and Murphy and Brown [2005] for SVOCs and VOCs) using appropriate multivariate statistical methods. These methods provide insight on potential source patterns and could support estimating the amount of each of the contributing sources.

Step 7. Develop the Plan for Obtaining Data

To meet the soil sampling objectives, UPRR proposes the work documented in the RSE Work Plan – Surface and Shallow Soil Assessment.

References

Johnson GW, 2017. Chlorinated dioxin and furan congener profiles from pentachlorophenol sources. J Environ Protection. 8:663-677.

Murphy BL and Brown J, 2005. Environmental forensics aspects of PAHs from wood treatment with creosote compounds. Environ Forensics. 6:151–159.

US EPA, 2013. Tier 3 Toxicity Value White Paper. OSWER Publication 9285.7-86. May 16.

Tables

TABLE A1
Off-Site Surface and Shallow Soil Sampling Scope of Work
Union Pacific Railroad
Houston Wood Preserving Works

Sample Type	Area of Investigation		Number of Soil Sample Locations ¹	Soil Sample Depth (inches below ground surface) ²	Soil Sample Type (Discrete/Composite)	Soil Laboratory Analysis		
						Dioxins and Furans	VOCs	SVOCs
						Number of Investigative Samples for Each Analysis		
Surface and Shallow Soils	Off-Site	Zone 1a ³	6	0 - 2	Composite	30	0	30
					Discrete	30	0	30
				2 - 6	Composite	30	0	30
					Discrete	30	30	30
				6 - 12	Composite	8	0	8
					Discrete	8	8	8
		Zone 1	57	0 - 2	Composite	57	0	23
					Discrete	57	0	23
				2 - 6	Composite	57	0	23
					Discrete	57	23	23
				6 - 12	Composite	14	0	6
					Discrete	14	6	6
		Zone 2	83	0 - 2	Composite	83	0	22
					Discrete	83	0	22
				2 - 6	Composite	83	0	22
					Discrete	83	22	22
				6 - 12	Composite	21	0	6
					Discrete	21	6	6
		Zone 3	123	0 - 2	Composite	123	0	53
					Discrete	123	0	53
				2 - 6	Composite	123	0	53
					Discrete	123	53	53
				6 - 12	Composite	31	0	13
					Discrete	31	13	13
		Zone 4	73	0 - 2	Composite	73	0	18
					Discrete	73	0	18
				2 - 6	Composite	73	0	18
					Discrete	73	18	18
				6 - 12	Composite	18	0	5
					Discrete	18	5	5

Notes:

¹ Sample locations for VOC and SVOC sampling will be parcels within Zone 1a through Zone 4 which are closest to HWPW property

² Samples at different depths to be collected at the same location or co-located for sample volume

³ Five composite soil samples are proposed at each parcel in Zone 1a for both the 0-2 and 2 - 6 inches below ground surface depths.

VOCs - volatile organic compounds

SVOCs - semi-volatile organic compounds

TABLE A2
Soil Sampling Scope of Work - On-Site and Background Reference Areas
Union Pacific Railroad
Houston Wood Preserving Works

Geosyntec Consultants

Sample Location		Number of Sample Locations	Sample Depth (inches below ground surface) ¹	Sample Type (Discrete/Composite)	Analytes			
					Dioxins and Furans	VOCs	SVOCs	
					Number of Investigative Samples for Each Analysis			
On-Site	Surface Soils	42	0 - 2	Composite	42	0	21	
	Shallow Soils			Discrete	42	0	21	
			2 - 6	Composite	42	0	21	
				Discrete	42	21	21	
				6 - 12	Composite	10	0	5
					Discrete	10	5	5
	Soil Beneath Cap	10	~18 - 24	Discrete	10	10	10	
Background Reference Areas ²	Surface Soils	20	0 - 2	Composite	40	0	20	
	Discrete			40	0	20		
	Shallow Soils		2 - 6	Composite	40	0	20	
				Discrete	40	20	20	
			6 - 12	Composite	40	0	20	
				Discrete	40	20	20	

Notes:

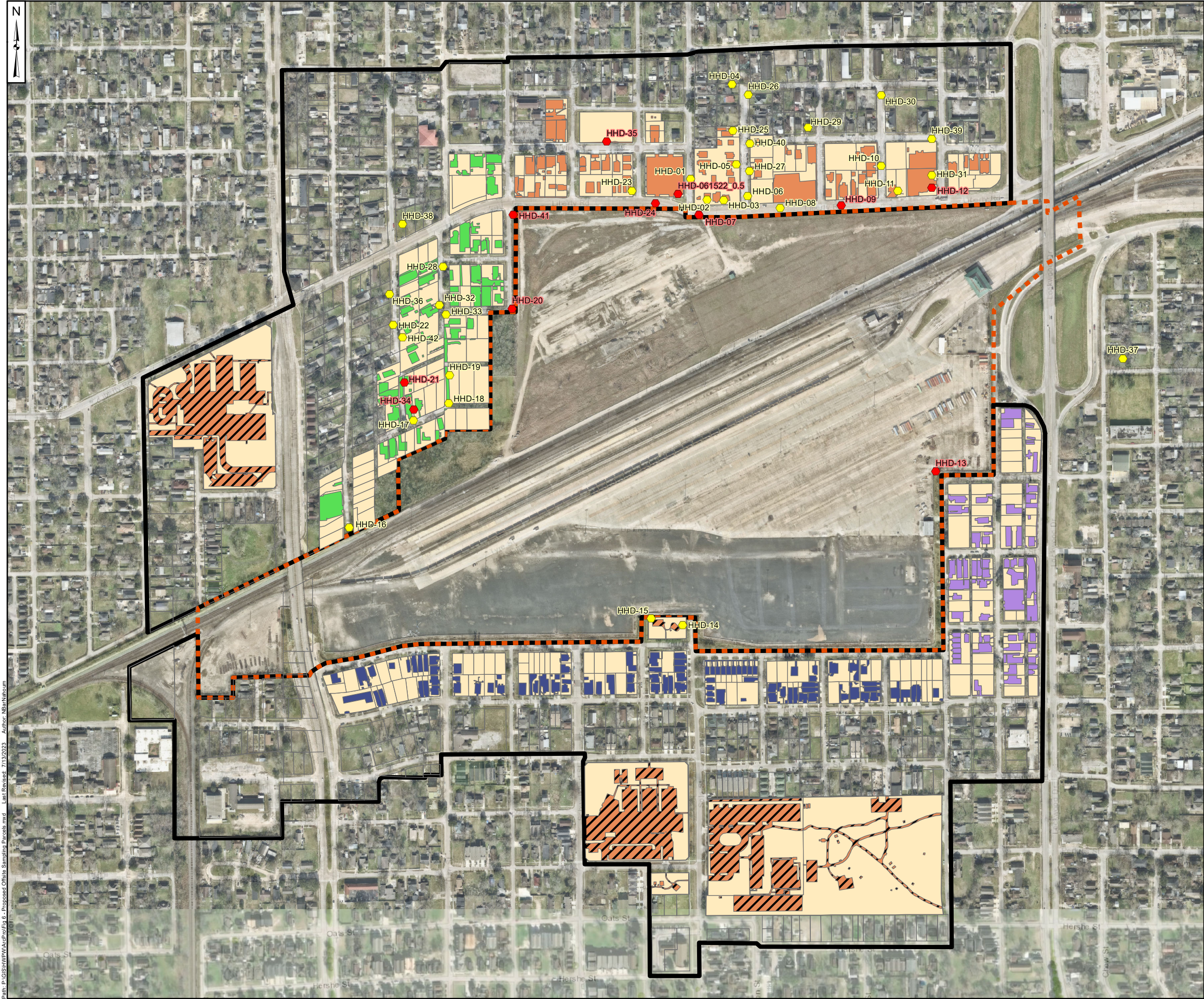
VOCs - volatile organic compounds

SVOCs - semi-volatile organic compounds

¹ Samples at different depths to be collected at the same location.

² Refer to Section 3.5.1.1 Sieving Trial for further details on the number of soil samples collected at each depth interval for sieving and non-sieving.

Figures



- Legend
- Proposed Off-Site Soil Sampling Parcels by
- Zone 1a (6 parcels with 5 samples per parcel = 30 samples)
 - Zone 1 (57 parcels with 1 sample per parcel = 57 samples)
 - Zone 2 (83 parcels with 1 sample per parcel = 83 samples)
 - Zone 3 (123 parcels with 1 sample per parcel = 123 samples)
 - Zone 4 (73 parcels with 1 sample per parcel = 73 samples)
 - Zones 1 - 4 (Without Hard Surfaces)
 - EPA Proposed Off-Site Area
 - Approximate UPRR Property Boundary as defined in Appendix B of ASAOC For Removal Action Site Evaluation
- Houston Health Department (HHD) Off-site Sample Locations
- Samples Result >RSL
 - Samples Result <RSL

Prevailing Wind*



Notes:

*TCEQ Houston Kirkpatrick monitor annual average 2020-2021

ASAOC - Administrative Settlement Agreement and Order on Consent

UPRR - Union Pacific Railroad

1. Basemap Aerial Imagery: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

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**Proposed Off-Site Soil Sampling Parcels - Dioxan/
Furans**

Union Pacific Railroad
Houston Wood Preserving Works

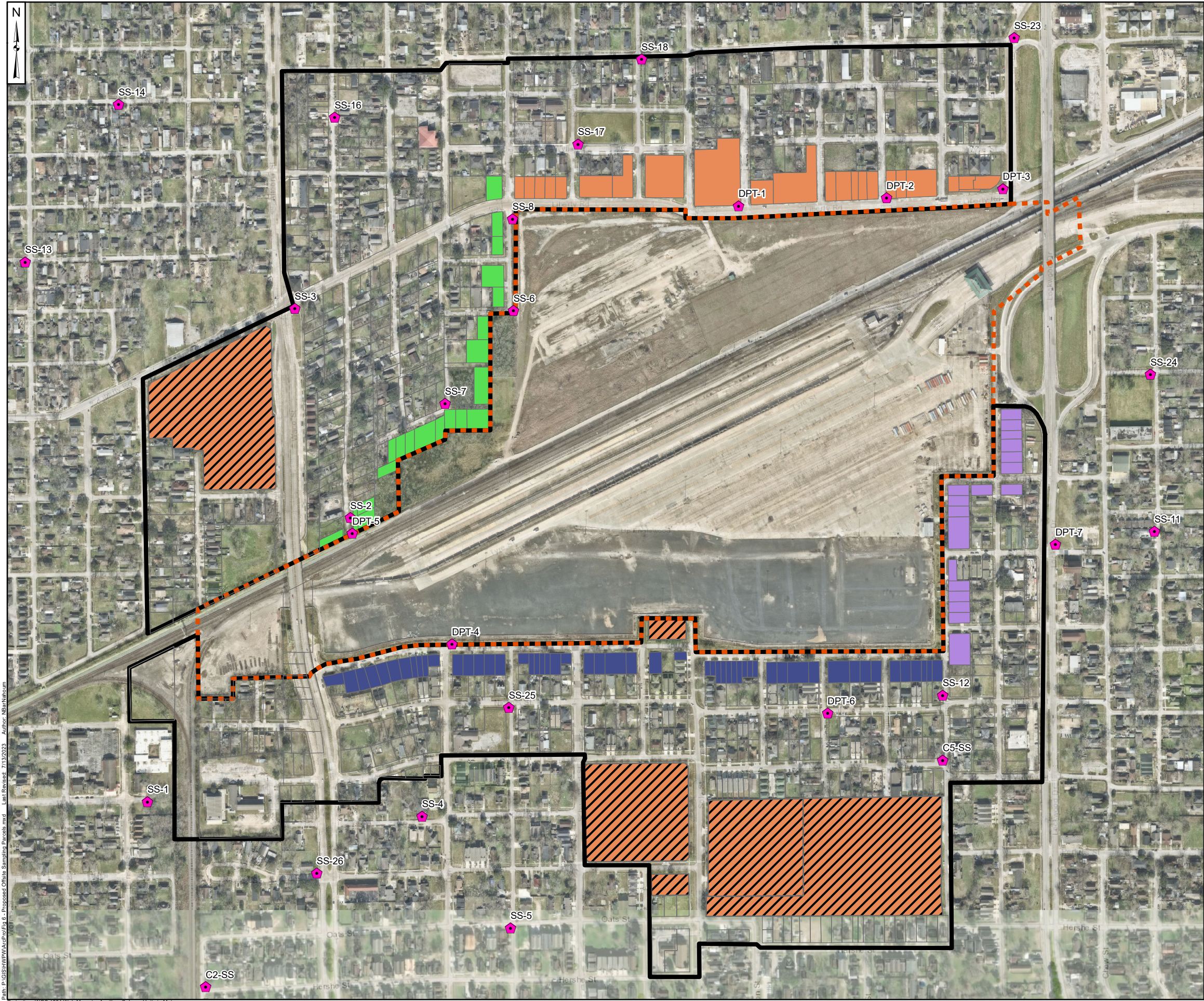


Guelph January 2024

Figure
A-1

Path: P:\GIS\HWP\Map\Profile B - Proposed Offsite Sampling Parcels.mxd Last Revised: 7/13/2023 Author: NBlankenship

Projection: WGS 1984 Web Mercator Auxiliary Sphere; Units in Meter



Legend

Proposed Off-Site Sampling Parcels by Zone

- Zone 1a (6 parcels with 5 samples per parcel = 30 samples)
- Zone 1 (23 parcels with 1 sample per parcel = 23 samples)
- Zone 2 (22 parcels with 1 sample per parcel = 22 samples)
- Zone 3 (53 parcels with 1 sample per parcel = 53 samples)
- Zone 4 (18 parcels with 1 sample per parcel = 18 samples)

EPA Proposed Off-Site Area

Approximate UPRR Property Boundary as defined in Appendix B of ASAOB For Removal Action Site Evaluation

County Soil Sampling Locations

- Samples with VOC/SVOC concentrations below TRRP Tier 1 Residential Protective Concentration Levels

Notes:

*TCEQ Houston Kirkpatrick CAMS 0404 monitor annual average 2020-2021, arrow displays prevailing wind direction.
VOC - volatile organic compounds
SVOC - semi-volatile organic compounds

1. Basemap Aerial Imagery: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

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400 200 0 400 Feet

Proposed Off-Site Sampling Parcels - VOC/SVOC

Union Pacific Railroad
Houston Wood Preserving Works

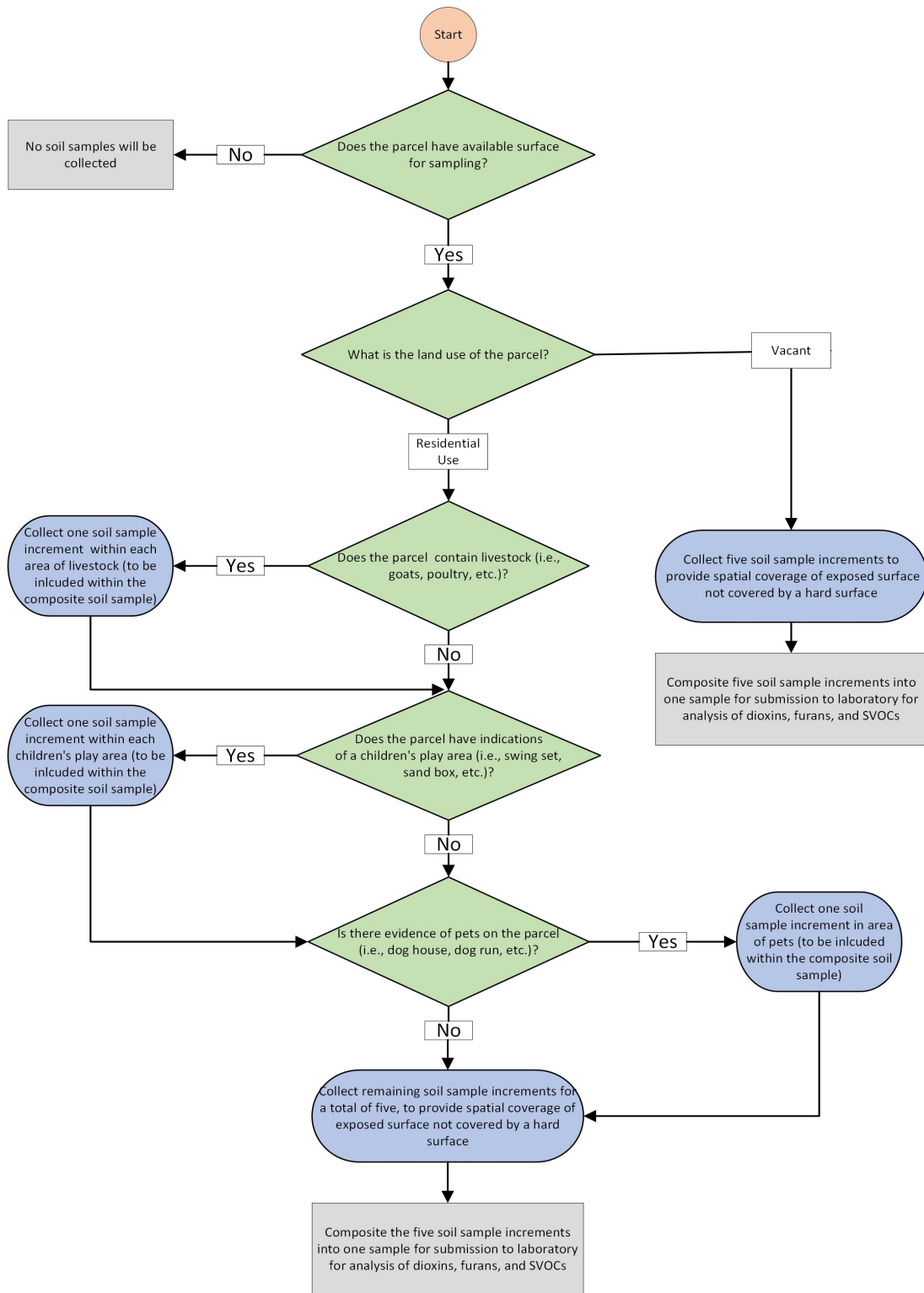
Geosyntec
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Guelph

January 2024

Figure

A-2



Decision Points: Dioxins, Furans and SVOCs Soil Sample Selection (Parcels ≤ 1/8 acre)¹

Union Pacific Railroad
Houston Wood Preserving Works

Geosyntec
consultants

Figure

A-3

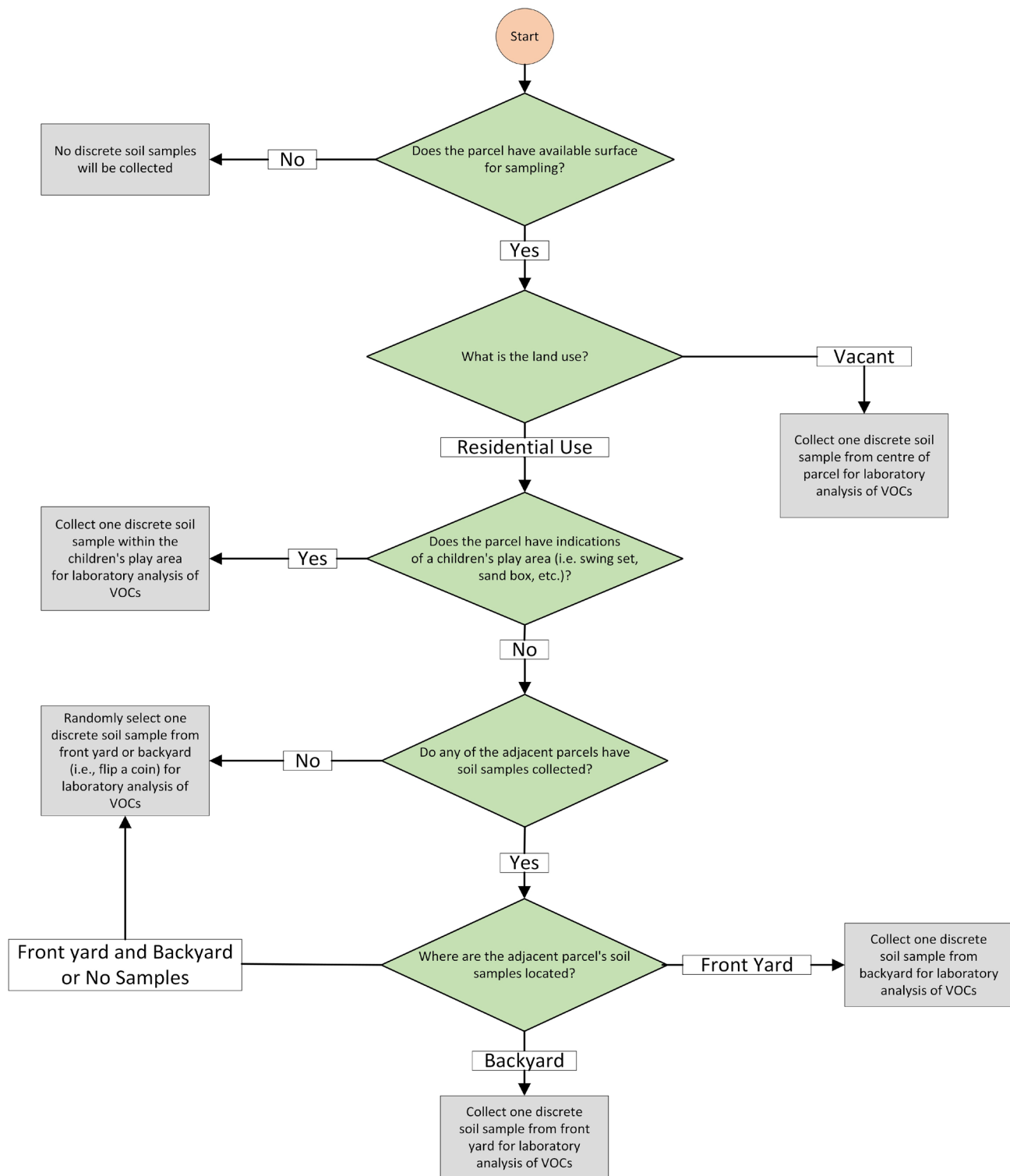
Guelph

January 2024

Notes:

¹ Parcels that contain less than or equal to 1/8 acre of area not covered by a hard surface

SVOCs - Semi-Volatile Organic Compounds



Decision Points: VOCs
Soil Sample Selection (Parcels ≤ 1/8 acre)¹

Union Pacific Railroad
Houston Wood Preserving Works

Geosyntec
consultants

Figure

A-4

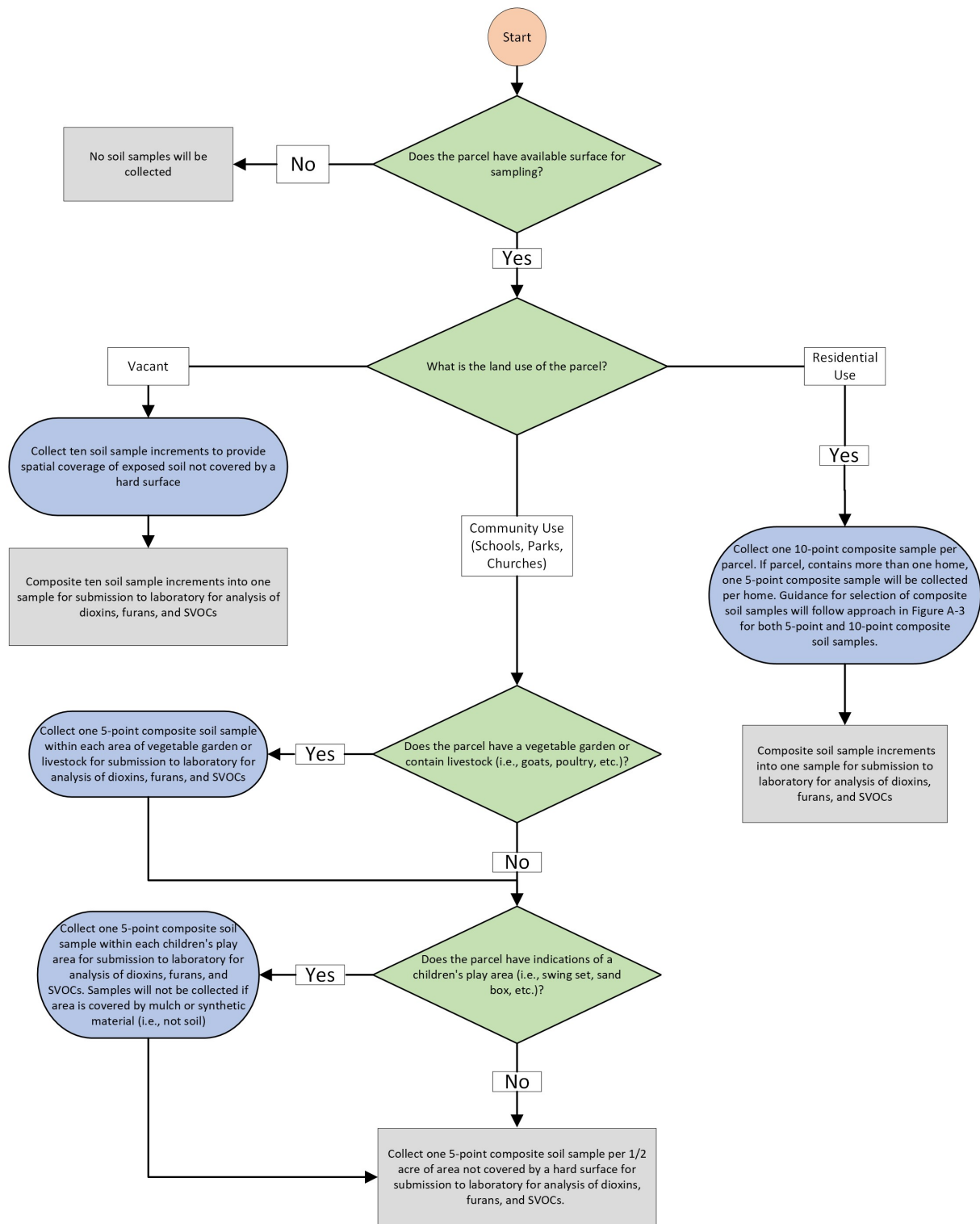
Guelph

January 2024

Notes:

¹ Parcels that contain less than or equal to 1/8 acre of area not covered by a hard surface

VOCs - Volatile Organic Compounds



Decision Points: Dioxins, Furans and SVOCs Soil Sample Selection (Parcels > 1/8 acre)¹

Union Pacific Railroad
Houston Wood Preserving Works

Geosyntec
consultants

Figure

A-5

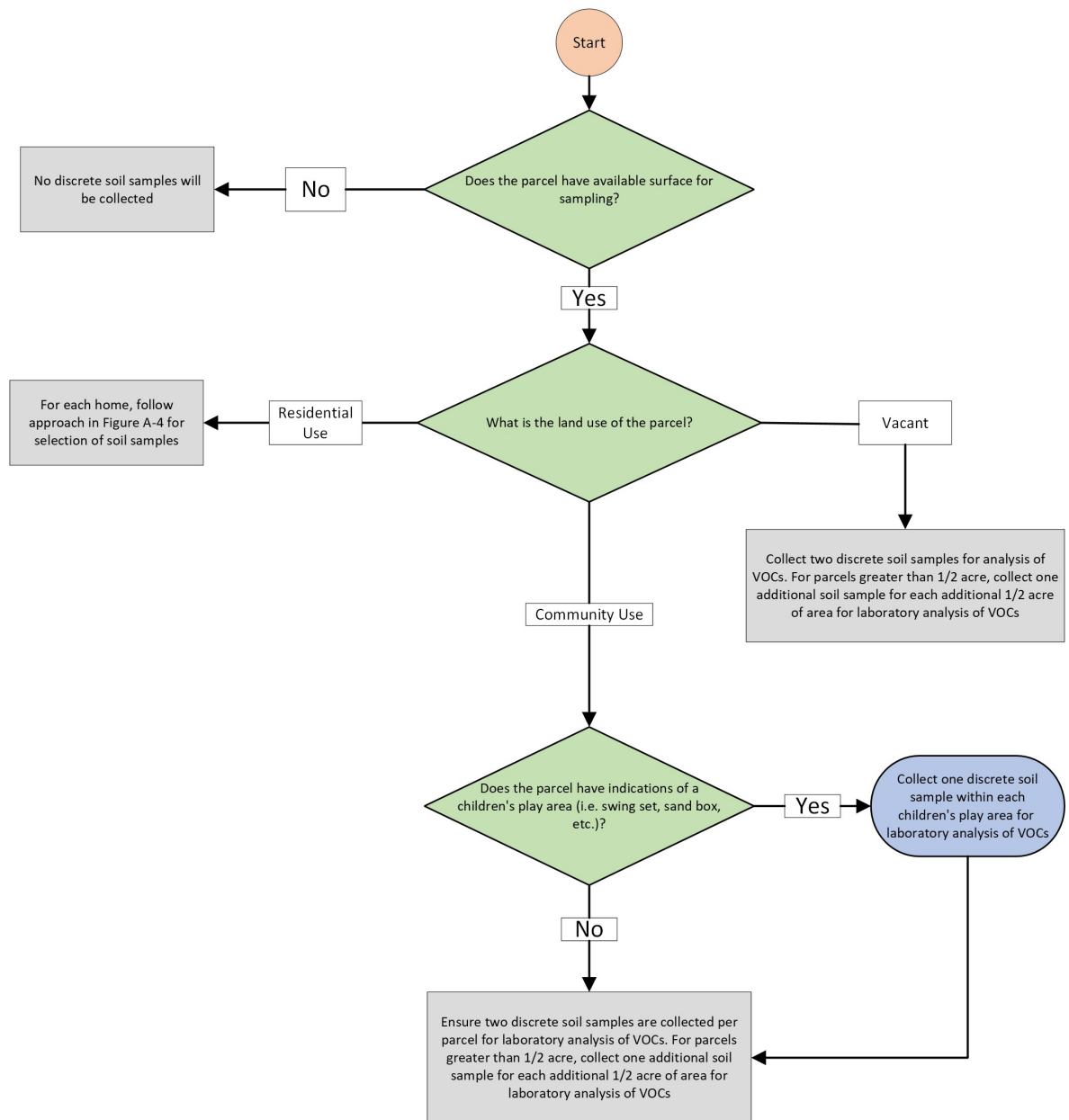
Guelph

January 2024

Notes:

¹ Parcels that contain greater than 1/8 acre of area not covered by a hard surface

SVOCs - Semi-Volatile Organic Compounds



Decision Points: VOCs
Soil Sample Selection (Parcels > 1/8 acre)¹
 Union Pacific Railroad
 Houston Wood Preserving Works



Figure
A-6

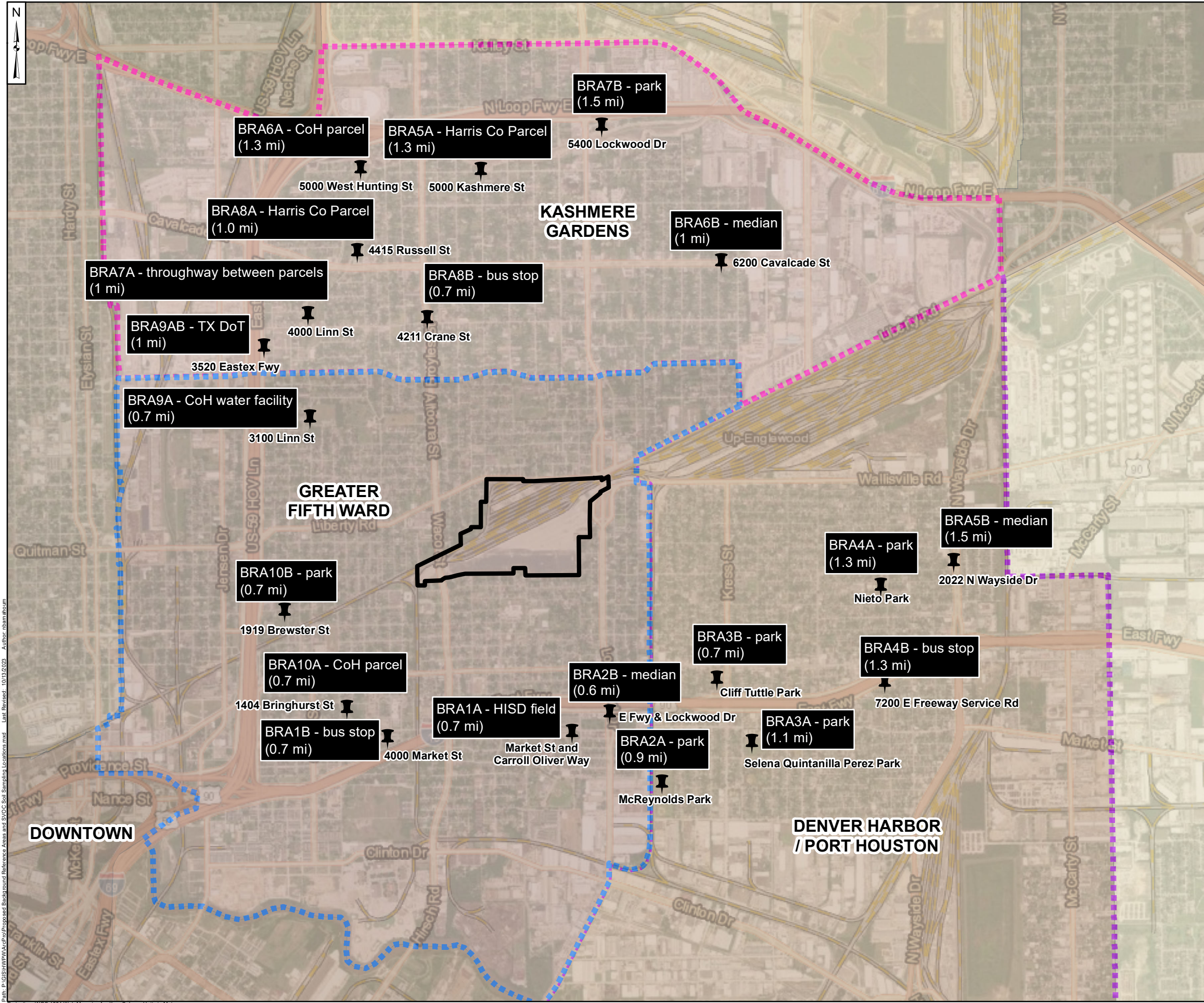
Guelph

January 2024

Notes:

¹ Parcels that contain greater than 1/8 acre of area not covered by a hard surface

VOCs - Volatile Organic Compounds



Legend

- PROPOSED BACKGROUND REFERENCE AREAS
- Approximate UPRR Property Boundary as defined in Appendix B of ASAOC For Removal Action Site Evaluation
- DENVER HARBOR / PORT
- DOWNTOWN
- EASTEX - JENSEN AREA
- EL DORADO / OATES PRAIRIE
- GREATER FIFTH WARD
- KASHMERE GARDENS
- NEAR NORTHSIDE
- PLEASANTVILLE AREA
- SECOND WARD
- SETTEGAST
- TRINITY / HOUSTON GARDENS

Notes:

*TCEQ Houston Kirkpatrick CAMS 0404 monitor annual average 2020-2021, arrow displays prevailing wind direction.

1. All proposed addresses are approximate
2. Basemap Aerial Imagery: Esri, HERE, Garmin, (c) OpenStreetMap contributors
Source: Esri, Maxar, Earthstar Geographics, and the GIS User

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0.5 0.25 0 0.5 Kilometers

Proposed Background Reference Areas for PCDD/F, VOC, and SVOC Soil Sampling

Union Pacific Railroad
Houston Wood Preserving Works

Geosyntec
consultants

Guelph

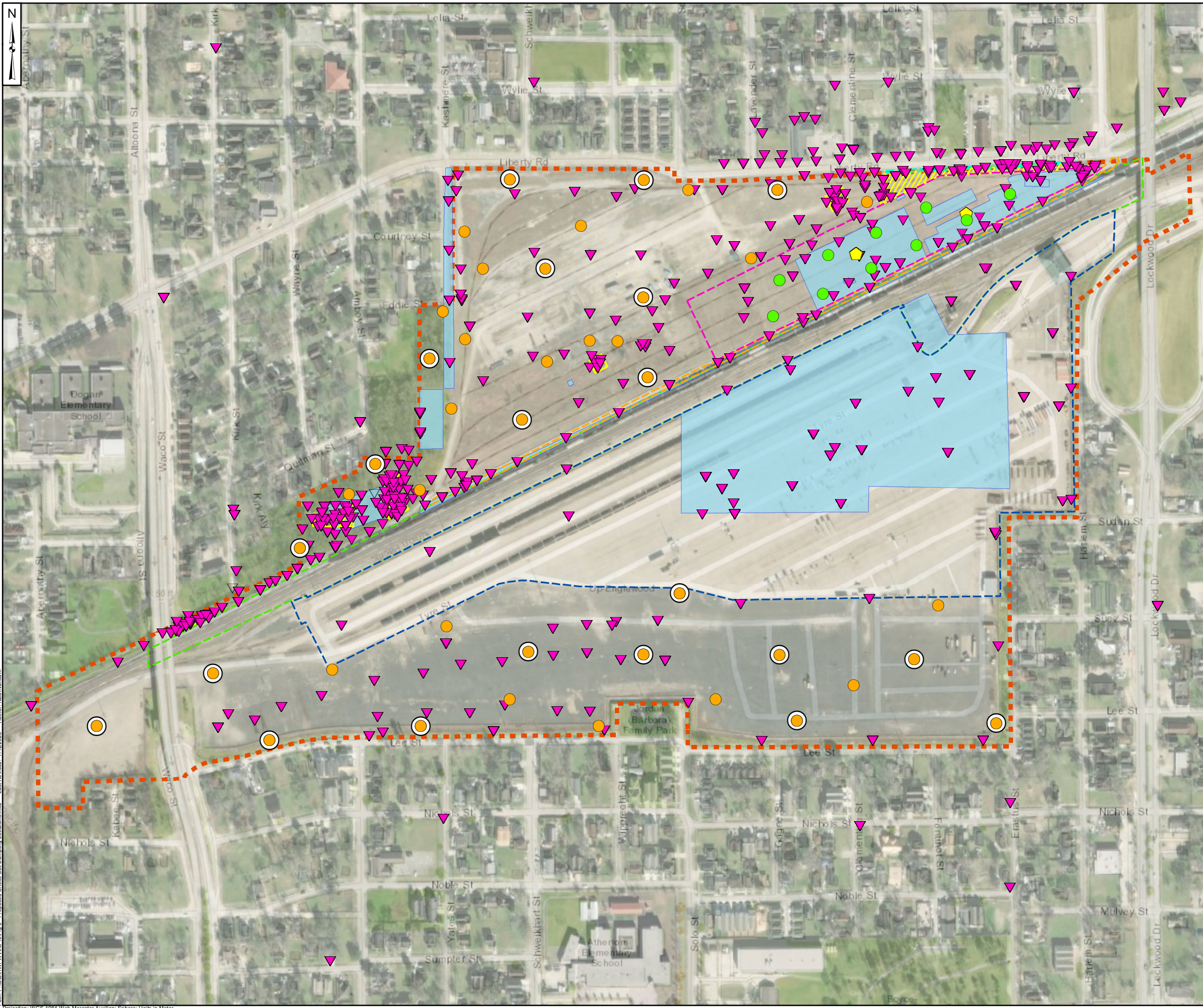
January 2024

Figure

A-7

Path: P:\GIS\HWP\MapArea\Proposed Background Reference Areas and SVOC So Sampling Locations.mxd Last Revised: 10/13/2023 Author: nhaman@um

Projection: WGS 1984 Web Mercator Auxiliary Sphere; Units in Meter



Legend

- Proposed On-Site Soil Sample Locations (42 Locations at 2 depth intervals)
- Proposed On-Site Soil Sample Locations for VOC/SVOC Analysis (21 Locations at 2 Depth Intervals = 42 Samples)
- Proposed On-Site Sample Locations Within Soil Cap Area (10 Locations at one depth interval)
- Previous Soil Sampling Locations analyzed for VOC\SVOC
- Previous Soil Sampling Locations analyzed for Dioxan/Furans
- AOCs or SWMUs
- Excavated Area
- Soil Cap Area
- Concrete Sidewalk Cap Area
- Asphalt Cap Area
- Concrete Cap Area
- Railroad Ballast Cap Area
- Approximate UPRR Property Boundary as defined in Appendix B of ASAOC For Removal Action Site Evaluation

Notes:

ASAOC - Administrative Settlement Agreement and Order on Consent
SVOC - semi-volatile organic compounds
UPRR - Union Pacific Railroad
VOC - volatile organic compounds

1. Basemap Aerial Imagery: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

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4002000400 Feet

Proposed On-Site Soil Sampling Locations

Union Pacific Railroad
Houston Wood Preserving Works

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Figure
A-8

Appendix B

Project Schedule

