Analysis of Brownfield Cleanup Alternatives (ABCA)

SLC Station Center
550 and 570 West 400 South Salt Lake City, Salt Lake County, Utah EPA ACRES Property ID #253042, 253043, 253044, 253045, 253046, 253047 and 253048

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Prepared for:

University of Utah and
University of Utah Research Foundation
Salt Lake City, Utah

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1.0 Introduction and Background

Terracon Consultants, Inc. (Terracon) has prepared this Analysis of Brownfield Cleanup Alternatives (ABCA) on behalf of The University of Utah (University) for the SLC Station Center Site, which is comprised of 1.89-acres of land currently owned by the University of Utah Research Foundation (Exhibit 1, Appendix A). The Site comprises seven parcels consisting of the addresses, Salt Lake County Assessor Parcel Numbers (APNs), and land uses listed below (the "Site"):

Address	APN	Acres	Former Use
550 W. 400 South	15-01-302-012	0.14	Storage Building/Outdoor storage yard
550 W. 400 South	15-01-302-011	0.14	Outdoor storage yard
570 W. 400 South	15-01-302-007	0.63	Former ZCMI Carriage House/Outdoor storage yard
570 W. 400 South	15-01-302-013	0.16	Outdoor storage yard
570 W. 400 South	15-01-302-010	0.18	Former auto repair shop
570 W. 400 South	15-01-302-009	0.16	Office/Warehouse building
570 W. 400 South	15-01-302-008	0.48	Office/Warehouse building

An approximately 40,000-square-foot industrial building formerly occupied the Site. Since 1911 the Site has been used for numerous industrial uses including a cleanser (soap) company, poultry processing, automobile and heavy equipment repair, a heating plant, and a paint shop. The Site was most recently occupied by WRR Industries, Inc., a landscaping and erosion control contractor. The buildings on the property were used for office space and dry storage of miscellaneous new and old stock materials such as auto parts, landscaping equipment, vehicle storage, and diesel truck repair. The buildings were demolished in 2023. The Site has remained unoccupied since WRR Industries, Inc. vacated the property on January 3, 2023. Figure 1 on the following page shows the Site parcel boundaries, Site layout, and surrounding properties with an aerial photograph.

The north-adjoining property was residential from the 1890s to at least 1911, and by 1937 a large building, depicted as 'Ice House' in 1949 was built to the northwest, and a mattress store to the northeast. The north-adjoining building was constructed by 1962 and has been occupied by several different food distribution companies, and most recently, a pallet distribution company. The 'Ice House' building was removed between 1977 and 1981, and the land has remained vacant since then. The east-adjoining properties were vacant in 1889, a corral and vacant land in 1898, residences in 1911, and then a new building followed by residences by 1937. In 1952 it appears to be used for coal storage. In 1958 the eastern property is a parking lot full of vehicles and remained as a parking lot until 2004. By 2006 the property appears to have been vacant. To the south is 400 South Street, followed by residences in 1898. Additional residences and an office were depicted in 1911, and the property appears residential through the 1960s; with one residence and storage building between 1965 to 1977. The southeast-adjoining Quality Plating facility began operations in 1955 and continues to the current day. To the west is 600 West Street, followed by vacant land in 1889. In 1898 there were railroad tracks and a platform. Over the years, the configuration of the tracks has changed, but the use has remained as a rail yard (Terracon, 2021).

FIGURE 1: SITE MAP (SALT LAKE COUNTY ASSESSOR'S WEBSITE: HTTPS://SLCO.ORG/ASSESSOR/)

The Site is adjoined by the following:

Direction	Adjoining Properties
North	A commercial pallet distribution facility (Salt Lake County Parcel No. 15-01-153-012)
East	Vacant property (Salt Lake County Parcel No. 15-02-302-017)
South	400 South Street, vacant property, and Quality Plating (Multiple Salt Lake County Parcels)
West	600 West Street, railroad tracks, associated railroad facilities (Multiple Salt Lake County Parcels)

This ABCA has been prepared to support redevelopment of the Site by the University of Utah by providing preliminary cleanup planning information. It is Terracon's understanding that the Site will be redeveloped for commercial use. The ABCA was prepared using information collected from several Site assessments, as described below.

1.1 Limited Site Investigation: December 15, 2017

In November 2017, Terracon performed a Limited Site Investigation (LSI; Terracon, 2017) on the Site for 217 Development, LC. The LSI consisted of eight soil and groundwater borings and determined that the property was impacted by the presence of dissolved-phase chlorinated solvents with tetrachloroethene (PCE) concentrations as high as 34 milligrams per liter (mg/L), compared to the United States Environmental Protection Agency (EPA) Maximum Contaminant Level (MCL) of 0.005 mg/L. Chlorinated solvents, such as PCE, trichloroethene (TCE), cis-1,2-dichloroethene (DCE), vinyl chloride (VC), trans-1,2-dichloroethene, and chloroform were identified in groundwater at the Site above EPA MCL and/or EPA Residential or Commercial Vapor Intrusion Screening Levels (VISLs) Target Groundwater Concentrations (TGCs). Benzene was reported in groundwater at concentrations above the Residential or Commercial VISL TGCs. Total petroleum hydrocarbons gasoline-range organics (TPH-GRO) was reported in groundwater at concentrations above the Utah Department of Environmental Quality (UDEQ) Division of Environmental Response and Remediation (DERR) Initial Screening Level (ISL) and Tier 1 Screening Criteria. Arsenic was reported in soil at concentrations above the EPA Residential and Industrial Regional Screening Levels (RSLs). Naphthalene was reported above the EPA Residential RSL. Concentrations of TPH-GRO were reported above the DERR ISL.

1.2 Phase I Environmental Site Assessment: January 3, 2018

In January 2018, Terracon performed a Phase I Environmental Site Assessment (ESA; Terracon, 2018) on the Site for 217 Development, LC. The Phase I ESA identified the following Recognized Environmental Condition (REC) associated with the Site.

Long-term industrial use: The Site has a long history of industrial uses by multiple tenants with multiple uses including automobile repair, heating plants, a paint shop, a landscaping and erosion control contractor and other miscellaneous industrial type operations from the early 1900s through the present. Historically, facilities of this nature have used chlorinated solvents, petroleum hydrocarbons, coal, pesticides, and herbicides, for many of the activities conducted at the Site. For much of the operational history of the Site, (until the 1980's) the uses, handling, and disposal of these hazardous chemicals were not strictly regulated, controlled, or monitored. These historical operations are poorly documented. Based on the Limited Site Investigation (Terracon, 2017) conducted at the Site, impacts from chlorinated solvents (PCE, TCE, DCE, and VC) and hydrocarbons are identified in the groundwater and soils. The concentrations in soil and groundwater exceed screening levels, as noted in Section 1.1. These known impacts to soil and groundwater and suspected impacts to soil vapor from the long-term industrial activities at the Site, constitutes a REC.

1.3 Site Investigation: October 8, 2018

Additional Site investigation was subsequently performed by Environmental Contractors Incorporated (ECI) during 2018 (ECI, 2018). ECI advanced seven soil borings (B-9 through B-15) in March 2018 and August 2018 to further assess the horizontal extent of groundwater chlorinated solvent contamination. Concentrations of PCE, TCE, DCE, VC were reported in groundwater above the EPA MCLs and EPA VISL TGCs (Commercial or Residential), benzene and ethylbenzene were reported above the EPA Residential VISL TGCs, and total petroleum hydrocarbons diesel-range organics (TPH-DRO) was reported above the UDEQ DERR ISL but was below the Tier 1 Screening Criteria. Arsenic was reported in soil at concentrations above the EPA Industrial RSL, 1,1,2,2-trichloroethane (TCA) and 1,1,2-TCA were reported above the EPA Residential RSL, and TPH-DRO was reported above the UDEQ DERR ISL but below the Tier 1 Screening Criteria.

1.4 Corrective Action: 2019 Through 2021

ECI engaged the UDEQ, Division of Waste Management and Radiation Control (DWMRC) to provide remediation oversight in September 2018. Multiple remedial corrective action work plans were prepared by ECI and submitted to DWMRC (ECI, 2018, 2019, and 2021). The following structural demolition, soil removal and groundwater remediation were conducted by ECI at the Site from 2019 to 2021 per the DWMRC-approved plans (ECI, 2020 and 2022).

- The lean-to structure (shed) located south of the former boiler room was demolished (ECI, 2020).
- The concrete floor of the former boiler room, the oil/water separator, and associated soil to a depth of approximately 12 feet below ground surface (bgs) were removed (ECI, 2020).
- A groundwater extraction trench and stacked-tray air stripper were operated in the northeast area of the Site from April 2019 through November 2019 (ECI, 2020).
- From March 2020 to July 2020, approximately 8,066 pounds of 97% remediation-grade crystalline potassium permanganate (KMnO4) ~4% solution was added to extracted groundwater and re-injected via trenches and eight soil borings (ECI, 2020).
- From June 2021 to October 2021, approximately 4,630 pounds of ~4% KMnO4 solution was added to extracted groundwater and re-injected via 14 soil borings (ECI, 2022).

Despite the corrective actions performed, PCE, TCE, VC were reported above EPA MCLs and VISL TGCs and chloroform was reported above the Residential VISL TGC in Site groundwater during ECI's final sampling event conducted in September 2021 (ECI, 2022).

1.5 Phase I Environmental Site Assessment: June 24, 2021

In June 2021, Terracon performed a Phase I ESA (Terracon, 2021) on the Site for the University of Utah. The Phase I ESA identified the following REC associated with the Site.

> **Long-term industrial use:** The Site has a long history of industrial uses by multiple tenants with multiple uses including automobile repair, heating plants, a paint shop, a landscaping and erosion control contractor and other miscellaneous industrial type clients from the early 1900s through the present. Historically, facilities of this nature have used chlorinated solvents, petroleum hydrocarbons, coal, pesticides, and herbicides, for many of the activities conducted at the Site. For much of the operational history of the Site, (until the 1980's) the uses, handling, and disposal of these hazardous chemicals were not strictly regulated, controlled, or monitored. These historical operations are poorly documented. Based the LSI (Terracon, 2017) conducted at the Site, impacts from chlorinated solvents (PCE, TCE, DCE, and VC) and hydrocarbons are present in the groundwater and soils. The concentrations in soil and groundwater exceed screening levels, as noted in Section 1.1. These known impacts to soil and groundwater and suspected impacts to soil vapor from the long-term industrial activities at the Site, constitutes a REC.

Terracon recommended conducting additional investigation to fully characterize the horizontal and vertical extent of impacts on the Site and assess if impacts have migrated off-Site above regulatory limits.

1.6 Site Characterization Reports: April and October 2023

Terracon performed a subsequent Site investigation (Phase 2 Site Characterization Report [Phase 2 SCR] and Site Characterization Report; Terracon, 2023a and 2023b) for the property with the purpose of gathering additional data to bridge the gaps identified in the

Terracon 2021 Phase I ESA, and to provide information needed to develop an ABCA for the Site. These activities were conducted in accordance with a DWMRC-approved work plan (Terracon, 2022; University of Utah, 2023) for this Site. The agency-approved work plan established a sampling process design, details regarding Site-specific sampling and analyses, and preliminary Site-specific objectives based on a risk assessment of the Site conditions at that time. Additional risk assessment will be required following the remediation activities to evaluate site-specific objectives based on the cumulative risk of residual Site impacts, in accordance with DWMRC requirements and Utah Administrative Code R315-101.

Phase 2 SCR field sampling consisted of the following data collection:

Soil Sampling:

August 2023: One sample was collected from the screen interval of each of thirteen new monitoring wells installed by Terracon for analysis of volatile organic compounds (VOCs). Two additional samples were collected from MW-14 for analysis of VOCs where elevated field photoionization detector readings were recorded.

Groundwater Sampling:

January 2023: One sample was collected from each of the five monitoring wells installed by ECI (MW-1 through MW-5) for analysis of VOCs.

August–September 2023: One sample was initially collected in mid-August from each of the thirteen new monitoring wells installed by Terracon (MW-6 through MW-15, including multiple nested well sets) for analysis of VOCs.

A second groundwater sampling event was conducted in late-August/early–September that consisted of collecting one sample from MW-1 through MW-3 and MW-6 through MW-15, including nested wells, for analysis of VOCs.

Soil Gas Sampling:

January 2023: Soil gas samples were collected from twelve locations (SV-1 through SV-12) within the previously estimated extent of the chlorinated solvent plume boundary for analysis of VOCs to assess VOC impacts in soil gas at the Site.

August 2023: Soil gas samples were collected from an additional nineteen locations (SV-13 through SV-31) for analysis of VOCs to further assess the extent of VOC impacts in soil gas at the Site.

High-Resolution Site Characterization Survey:

February 2023: A High Resolution Site Characterization (HRSC) survey was performed using Membrane Interface Probe-Hydraulic Profiling Tool (MIHPT) technology to assess the horizontal and vertical extent of chlorinated solvent contamination. Sixteen MIHPT borings were advanced at the Site (MIP-1 through MIP-16).

August 2023: A second HRSC survey was performed in mid-August 2023 to further assess the horizontal and vertical distribution of potential chlorinated solvent contamination documented during the January–February 2023 sampling events. Five additional MIHPT borings were advanced at the Site (MIP-17 through MIP-21).

Constituent concentrations in groundwater were compared to EPA MCLs and EPA VISL TGCs (target carcinogenic risk of $1x10^{-6}$, Hazard Quotient of 1). Constituent concentrations in soil samples were compared to EPA RSLs for Residential and Industrial scenarios and Utah-specific petroleum hydrocarbon screening levels (UDEQ DERR ISLs and Tier 1 Screening Criteria). Constituent concentrations in soil gas samples were compared to EPA Residential and Industrial VISLs (target carcinogenic risk of $1x10^{-6}$, Hazard Quotient of 1).

Soil Results

Sixteen soil samples and two field duplicate samples were analyzed for VOCs. One soil sample was analyzed for petroleum hydrocarbons. Soil samples did not exceed EPA Residential or Industrial RSLs or DERR ISLs.

Groundwater Results

Thirty-four groundwater samples and five field duplicate samples were analyzed for VOCs. Groundwater samples were reported at concentrations exceeding the following thresholds and screening levels:

PCE:

- January 2023:
  - Exceeded 1 mg/L at MW-1
  - Exceeded the EPA MCL and EPA VISL Commercial and Residential TGC at MW-1, MW-2, and MW-3
- Mid-August 2023:
  - Exceeded 1 mg/L at MW-8
  - Exceeded the EPA VISL Commercial and Residential TGC at MW-6 and MW-8
  - Exceeded the EPA MCL at MW-10A
- Late-August/early–September 2023:
  - Exceeded 1 mg/L at MW-2 and MW-8
  - Exceeded the EPA VISL Commercial TGC at MW-1, MW-2, and MW-8
  - Exceeded the EPA VISL Residential TGC at MW-3
  - Exceeded the EPA MCL at MW-6

TCE:

- January 2023:
  - Exceeded 1 mg/L at MW-3
  - Exceeded the EPA MCL and/or EPA VISL Commercial TGC at MW-1, MW-2, and MW-3
  - Exceeded the EPA VISL Residential TGC at MW-5
- Mid-August 2023:
  - Exceeded 5 mg/L at MW-8
  - Exceeded the EPA MCL and EPA VISL Commercial TGC at MW-6, MW-8, MW-9, and MW-14
  - Exceeded the EPA MCL at MW-6
  - Exceeded the EPA VISL Residential TGC at MW-3
- Late-August/early–September 2023:
  - Exceeded 5 mg/L at MW-8
  - Exceeded 1 mg/L at MW-2
  - Exceeded the EPA VISL Commercial TGC at MW-2, MW-6, MW-8, MW-9, and MW-14
  - Exceeded the EPA MCL at MW-7
  - Exceeded the EPA VISL Residential TGC at MW-10A

DCE:

- January 2023:
  - Exceeded 1 mg/L at MW-2 and MW-3
  - Exceeded the EPA MCL at MW-1, MW-2, and MW-3
- Mid-August 2023:
  - Exceeded 1 mg/L at MW-8
  - Exceeded the EPA MCL at MW-6, MW-8, MW-9, and MW-15
- Late-August/early-September 2023:
  - Exceeded 1 mg/L at MW-1, MW-2, and MW-8
  - Exceeded the EPA MCL at MW-1, MW-2, MW-3, and MW-8

VC:

- January 2023:
  - Exceeded the EPA MCL and/or EPA VISL Commercial TGC at MW-1, MW-2, MW-3, and MW-5
  - Exceeded the EPA VISL Residential TGC at MW-4
- Mid-August 2023:
  - Exceeded the EPA MCL and/or EPA VISL Commercial TGC at MW-8, MW-9, MW-14, and MW-15

- Late-August/early-September 2023
  - Exceeded the EPA MCL and/or EPA VISL Commercial TGC at MW-1, MW-2, MW-3, MW-8, MW-14, and MW-15
  - Exceeded the EPA VISL Residential TGC at MW-9

Chloroform:

- January 2023:
  - No exceedances
- Mid-August 2023:
  - Exceeded the EPA VISL Residential TGC at MW-10A, MW-10B, MW-10C, and MW-11
- Late-August/early-September 2023
  - Exceeded the EPA VISL Residential TGC at MW-10C

1-1-Dichloroethene:

- January 2023:
  - No exceedances
- Mid-August 2023:
  - Exceeded the EPA MCL at MW-8
- Late-August/early-September 2023
  - No exceedances

Soil Gas Results

Thirty-one soil gas samples were analyzed for VOCs. Soil gas samples exceeded the following thresholds and screening levels:

PCE:

- Exceeded the EPA VISL Commercial Target Sub-Slab and Near-source Soil Gas Concentration (TSSNSGC) at SV-5, SV-7, SV-12, SV-17, and SV-26.
- Exceeded the EPA VISL Residential TSSNSGC at SV-1, SV-2, SV-3, SV-8, SV-10, SV-14, SV-15, SV-28, and SV-31.

TCE:

- Exceeded the EPA VISL Commercial TSSNSGC by more than one order of magnitude at SV-3, SV-8, SV-23, SV-26, and SV-29.
- Exceeded the EPA VISL Commercial TSSNSGC at SV-1, SV-4, SV-5, SV-7, SV-10, SV-12, SV-17, SV-21, SV-28, and SV-30.
- Exceeded the EPA VISL Residential TSSNSGC at SV-2, SV-6, SV-9, and SV-11, SV-25, and SV-31.

Chloroform:

- Exceeded the EPA VISL Commercial TSSNSGC at SV-3, SV-8, SV-15, SV-23, SV-25, SV-26, SV-30, and SV-31.
- Exceeded the EPA VISL Residential TSSNSGC at SV-7, SV-13, SV-18, SV-20, SV-21, and SV-29.

Benzene:

- Exceeded the EPA VISL Residential TSSNSGC at SV-12, SV-13, SV-15, SV-16, SV-17, SV-18, SV-23, SV-24, SV-26, SV-28.

Bromodichloromethane:

- Exceeded the EPA VISL Residential TSSNSGC at SV-31.

Ethylbenzene:

- Exceeded the EPA VISL Residential TSSNSGC at SV-13.

Naphthalene:

- Exceeded the EPA VISL Commercial TSSNSGC at SV-13.
- Exceeded the EPA VISL Residential TSSNSGC at SV-16 and SV-17.

1.7 Supplemental Soil Gas Sampling Report: February 2024

Terracon performed supplemental off-Site soil gas sampling (Supplemental Soil Gas Sampling Report; Terracon, 2024a) at the Site. The sampling was conducted in accordance with DWMRC's Phase 2 SCR approval letter, dated October 17, 2023, which required additional off-Site soil gas sampling on the eastern-adjacent property to delineate the off-Site extent of PCE and TCE impacts in soil gas. Eight soil gas probes (SV-32 through SV-39) were installed on the east-adjoining property and sampled for analysis of VOCs to further assess the eastern extent of VOC impacts in soil gas.

Thirty-one soil gas samples were analyzed for VOCs. Soil gas samples exceeded the following thresholds and screening levels:

TCE: Exceeded the EPA VISL Commercial TSSNSGC at SV-36.

Ethylbenzene: Exceeded the EPA VISL Residential TSSNSGC at SV-32.

1.8 Corrective Action Plan: May 2024

Terracon prepared a Corrective Action Plan (CAP) for the Site (Terracon, 2024b), which was approved by DWMRC in a letter, dated May 24, 2024. Corrective actions for groundwater included a combination of biological enhanced reductive dechlorination (ERD) and abiotic in-situ chemical reduction (ISCR) for rapid reduction of chlorinated VOCs. Corrective action for soil included excavation and off-Site disposal of shallow fill soils.

1.9 Groundwater Monitoring Report: January 2026

Terracon conducted baseline groundwater sampling for analysis of VOCs using 11 existing monitoring wells in August 2025 to assess the groundwater condition.

Groundwater samples exceeded the following screening levels:

PCE:

- Exceeded the Site-specific EPA Commercial TGC VISL of 0.242 mg/L in MW-1 and MW-2 (0.312 to 6.81 mg/L), as documented in the Phase 2 Site Characterization Report (Terracon, 2023b)
- Exceeded the EPA MCL of 0.005 mg/L in MW-1, MW-2, and MW-14 (0.0737 to 6.81 mg/L)

TCE:

- Exceeded the Site-specific EPA TGC VISL of 0.0218 mg/L and EPA MCL of 0.005 mg/L in MW-1, MW-2, MW-3, MW-8, MW-9, and MW-14 (0.0259 to 0.156 mg/L)), as documented in the Phase 2 Site Characterization Report (Terracon, 2023b)

DCE:

- Exceeded the Site-specific EPA Commercial TGC VISL of 1.05 mg/L in MW-1, MW-2, and MW-8 (2.29 to 4.2 mg/L)), as documented in the Phase 2 Site Characterization Report (Terracon, 2023b)
- Exceeded the EPA MCL of 0.07 mg/L in MW-1, MW-2, MW-3, MW-8, and MW-9 (0.14 to 4.2 mg/L)

VC:

- Exceeded the EPA MCL of 0.002 mg/L in MW-9, MW-14, and MW-15 (0.00205 to 0.0619 mg/L)

1.10 Summary of Investigations Conducted to Date

Groundwater has been impacted by PCE, TCE, DCE, VC, benzene, and ethylbenzene above EPA MCLs and/or EPA Commercial or Residential VISL TGCs. Soil gas has been impacted with similar and additional VOCs above EPA VISLs. Soil has been impacted by naphthalene, 1,1,2-TCA and 1,1,2,2-TCA above Residential EPA RSLs, arsenic above the Industrial EPA RSL, and TPH-GRO and TPH-DRO above UDEQ DERR ISLs.

Groundwater concentrations have fluctuated throughout the previous sampling events. Based on the August 2025 groundwater monitoring results, the distribution of dissolved-phase chlorinated solvent impacts in groundwater was identified as follows:

Maximum dissolved-phase chlorinated solvent impacts are currently present in the southeast portion of the Site.

- The groundwater flow direction is generally to the west with variations to the northwest and southwest; however, it dips slightly to the south in the east portion of the Site.
- The lateral extents of PCE impacts appear to be defined to the north, east, and partially to the south and west.
- The lateral extents of TCE impacts appear to be defined to the north, and partially to the east and south. Due to the destruction of the westernmost monitoring wells during the building demolition activities, the west extent of the TCE impacts are no longer defined. Low concentrations of TCE are present on the eastern Site boundary at MW-9. Because the apparent groundwater flow direction is generally to the west, it is considered unlikely that the TCE impacts extend a meaningful distance east of MW-9.
- The lateral extents of DCE impacts appear to be defined to the north, and partially to the south, east, and west.
- The lateral extents of VC impacts appear to be defined to the north, but not fully defined to the south, east, and west. The southern-adjacent property is occupied by Quality Plating, which has been used for chrome plating and other industrial purposes since the 1950s. The Quality Plating property is considered a poor location for further delineation given the RCRA violations associated with chlorinated solvent use at the off-Site property, and the lack of PCE, TCE, and DCE impacts at MW-15, located south of the Site.
- The vertical extent of dissolved-phase chlorinated solvent impacts appears to be limited to a depth of less than 25 to 30 feet bgs. Subsurface lithology below this depth is dominated by low-permeability clays derived from Lake Bonneville sediments that appear to be acting as an aquitard and impeding the downward migration of dissolved-phase contamination.

Based on the historical Site investigations, soil impacts were generally limited to the shallow, imported fill depth at the Site.

Based on the soil gas sampling data, the distribution of vapor-phase chlorinated solvent impacts in soil gas is determined as follows:

- Maximum vapor-phase PCE impacts are present on the northern and southwestern portions of the Site, while maximum vapor-phase TCE impacts are present on the eastern portion of the Site.
- The lateral extents of PCE impacts appear to be defined to the west and east and partially defined to the north and south.
- The lateral extents of TCE impacts appear to be defined to the north and east and partially defined to the south and west.
- Limited soil gas impacts also exist for benzene and chloroform, bromodichloromethane, ethylbenzene, and naphthalene; however, relative to PCE and TCE, these impacts have limited distribution and low concentrations.

Based on cancer and non-cancer risk data provided by EPA's VISL Calculator, TCE (in groundwater and soil gas) represents the greatest risk to human health and would likely be the driver for corrective action at the Site, though PCE, DCE, and VC are also concerns. The primary Contaminants of Concern (COC) are listed in the following table.

Primary Contaminants of Concern

Analyte	Matrix	Exposure Scenario	Screening tool
Tetrachloroethene (PCE)	Groundwater and Soil Gas	Residential/Commercial	EPA MCL, VISL
Trichloroethene (TCE)	Groundwater and Soil Gas	Residential/Commercial	EPA MCL, VISL
Cis-1,2-dichloroethene (DCE)	Groundwater	Residential/Commercial	EPA MCL, VISL
Vinyl Chloride (VC)	Groundwater	Residential/Commercial	EPA MCL, VISL

1.11 Project Goal

The Salt Lake City Community Reinvestment Agency (SLCCRA) designated a 240-acre area from North Temple to 400 South Street and 400 West Street to Interstate 15 as a blighted redevelopment area. According to the Rio Grande District Vision and Implementation Plan, dated December 2024 (Salt Lake City Redevelopment Agency [now SLCCRA], 2024), the goals for the Rio Grande District are as follows:

- "**Development**: establish the Rio Grande District as the standard for sustainable transit-oriented development in Salt Lake City and the State of Utah.
- **Programming**: Create a new urban scale development that leverages local organizations to create a programmed and activated district for art, community health and wellness, and organic economic growth for SLC.
- **Positioning**: Foster a walkable community that takes advantage of density to create a mixed-use, mixed income, and inclusive district."

The University of Utah proposes to develop the property in conjunction with the SLCCRA Rio Grande District redevelopment strategy. The University is well-versed with Salt Lake City's development plans in the Depot District area and has been working and partnering with the SLCCRA for years. These partnering efforts included a feasibility study completed by HR&A Advisors in 2021. This joint effort between the University of Utah and the SLCCRA aims to transform the heart of the Depot District into a hub of innovation, allowing a wide range of residents and businesses to live, work, and contribute ideas necessary for an "innovation district" to thrive. The innovation district will build on Salt Lake City Mayor Erin Mendenhall's "Tech Lake City" initiative which focuses on bringing more businesses from the life sciences and medical tech fields, including pharmaceutical and medical device companies, as well as research, testing, and medical laboratories, to Salt Lake City. Cleanup and reuse of this Site is a vital component of the overall approach for revitalizing the Depot District area. Remediation of documented impacts to groundwater, soil, and soil gas will be required to support this redevelopment strategy.

2.0 Applicable Regulations and Cleanup Standards

2.1 Cleanup Oversight Responsibility

The Site is currently enrolled in the DWMRC Environmental Cleanup Program (ECP) for regulatory oversight purposes.

The goal of the regulatory program is to promote the investigation and cleanup of contaminated sites under a cooperative, regulatory-friendly framework. The purpose of the program is to encourage the investigation and cleanup of sites where there has been a suspected or confirmed contaminant release threatening public health and the environment. A successful ECP cleanup results in the issuance of a Certificate of Completion, which provides a limited release of liability to qualified applicants as specified in the ECP statute. The liability release is transferable to subsequent property owners. A successful DWMRC ECP remediation results in two possible designations depending on the level of residual risk as determined in accordance with DWMRC requirements: (a) Corrective Action Complete without Controls (CACWOCs), or (b) Corrective Action Complete with Controls (CACWCs), with controls provided by an Environmental Covenant recorded on the title of the property and a Site Management Plan (SMP).

Work plans, including sampling and analysis plans, quality assurance project plans, and remedial action plans, and reports related to environmental investigations and remediation activities conducted at the Site will be submitted to the agency for review and approval.

2.2 Cleanup Standards

Terracon understands that the University intends to redevelop the property for commercial use. With this anticipated exposure scenario, Terracon anticipates the following screening levels will be used as the Cleanup Standards for the Site.

Soil:

- EPA's most recent RSLs for industrial land use with a target cancer risk of $1x10^{-6}$ and a hazard quotient of 1.

Groundwater:

- EPA's most recent TGC VISLs for commercial exposure scenarios with a target carcinogenic risk of $\leq 1x10^{-4}$ but $\geq 1x10^{-6}$ and a hazard quotient of 1.
- EPA's most recent MCLs.

Soil Gas:

- EPA's most recent TSSNSGC VISLs for commercial exposure scenarios with a target cancer risk of $\leq 1x10^{-4}$ but $\geq 1x10^{-6}$ and a hazard quotient of 1.

A human health and ecological screening level risk assessment will be conducted following the remediation and monitoring activities to assess the applicable type of site closure. The target carcinogenic risk will be $\leq 1x10^{-4}$ but $\geq 1x10^{-6}$, with a cumulative non-carcinogenic Hazard Index of ≤1.

2.3 Laws & Regulations Applicable to the Cleanup

Laws and regulations that are applicable to this cleanup include:

- Occupational Safety and Health Act, Hazardous Waste Operations and Emergency Response Standard (40CFR1910.120) and applicable Safety and Health Regulations for Construction (29CFR1926).
- National Emissions Standards for Hazardous Air Pollutants (NESHAP) (40CFR61 – Subpart M: National Emission Standard for Asbestos).
- Department of Transportation, Hazardous Materials Regulations (49CFR Subtitle B, Chapter 1, Subchapter C).
- Resource Conservation and Recovery Act (42 U.S.C. § 6901, et. seq.).
- National Historic Preservation Act of 1966, Section 106.
- Utah Code Ann. 19-6-401 et. seq. (Underground Storage Tank [UST] Act and rules promulgated there under [Utah Administrative Code, R311]) and the Corrective Action Cleanup Standards Policy Per UST and CERCLA Acts, Utah Administrative Code, R311-211.
- Utah Code Ann. 19-6-101 et. seq. (Solid and Hazardous Waste Act and rules promulgated there under (Utah Administrative Code, R315)).
- Utah Code Ann. 19-5-101 et. seq. (Water Quality Act and rules promulgated there under (Utah Administrative Code, R317)).
- Utah Code Ann. 19-2-101 et. seq. (Air Conservation Act and rules promulgated there under (Utah Administrative Code, R307)).
- Utah Code Ann. 57-25-101 et. seq. (Uniform Environmental Covenants Act).
- Salt Lake City, Salt Lake County, and State building codes and construction requirements.
- Utah Code Ann. Title 19, Chapter 6, Part 3 et seq. (Hazardous Substances Mitigation Act).
- Utah Administrative Code R315-101 (Cleanup Action and Risk-Based Closure Standards).
- Federal Small Business Liability Relief and Brownfields Revitalization Act, if Brownfields or other Federal funding is used.
- Federal Davis-Bacon Act, if Brownfields or other Federal funding is used.
- Build America, Buy America Act, if Brownfields or other Federal funding is used.

In addition, appropriate permits, and notifications (e.g., Blue Stakes of Utah Utility Notification Center, soil disposal acceptance notification, soil transport/disposal manifests, injection permits, etc.) will be obtained prior to the cleanup activities commencing.

2.4 Extreme Weather Event Considerations

To ensure that brownfield site cleanups remain effective, EPA requires that when grant recipients prepare an ABCA, or equivalent state Brownfield program document, the ABCA must consider "the resilience of the remedial options to address potential adverse impacts caused by extreme weather events and natural hazards (e.g., sea level rise, drought, increased frequency and intensity of flooding, etc.)." Because the possibility exists that Cleanup grant funds or Revolving Loan Funds may be utilized for cleanup actions at the Site, the resilience of the remedial actions proposed for this Site has been considered in this ABCA.

2.4.1 General Considerations

In considering remedy resiliency, Terracon consulted the following resources as authoritative sources to identify observed and potential risk conditions and any existing resiliency or hazard mitigation planning.

Climate Mapping for Resilience and Adaptation (CMRA)

Resources on Data.gov

Resilience Toolkit

FEMA National Flood Hazard Layer

NOAA Sea Level Rise Viewer

NASA Sea Level Rise Scenario Tool

National Risk Index

USDA Wildfire Risk to Communities Tool

National Integrated Heat Health Information System

2.4.2 Site-Specific Considerations

According to the Climate Mapping for Resilience and Adaptation tool, Salt Lake County has risk factors including flooding, wildfire, drought, and extreme heat. As a detailed Site-specific analysis of each of these factors is not part of the scope for this ABCA, these risk factors will be considered collectively as "extreme weather" and discussed for each proposed cleanup alternative for the Site below. The impacts of these risk factors are also considered in the discussion of the long-term use of the Site. The Site does not have any additional or specific risk factors (e.g., located in a floodplain) that warrant consideration beyond what is listed above.

3.0 Analysis of Brownfield Cleanup Alternatives

A discussion of the cleanup objectives and an evaluation of remedial alternatives for the Site are provided in the following sections.

3.1 Cleanup Objectives

Chlorinated solvents in groundwater, particularly TCE, will be remediated to concentrations low enough to reduce the vapor intrusion potential to acceptable risk levels and prevent potential off-Site migration of the groundwater plume.

3.2 Cleanup Alternatives Considered

Terracon has discussed proposed redevelopment scenarios with the University and has incorporated information from those conversations into this ABCA. The assumptions behind the cleanup alternative discussions include the following:

- The Site will be redeveloped for commercial use.
- Chlorinated compounds (PCE, TCE, DCE, and VC) have been detected in groundwater above MCLs and VISLs. The chlorinated VOC plume in groundwater currently extends slightly beyond the property boundaries based on the August 2025 groundwater sampling results (Terracon, 2026).
- Chlorinated compounds (PCE, TCE, and DCE) have been detected in soil gas above VISLs. The chlorinated VOC-impacted soil gas extends beyond the property boundaries based on the August 2023 soil gas groundwater sampling results (Terracon, 2023b).
- On-Site and off-Site soil gas impacts will be addressed through remediation of the dissolved-phase source material in groundwater. Shallow impacted soil will be excavated and disposed of off-Site at an appropriate disposal facility.
- The existing on-Site building foundations will be removed as part of the Site's redevelopment and a vapor mitigation system could be included in the future building designs, if applicable.
- Because it may not be economically feasible to remediate the Site below unrestricted use criteria, an Environmental Covenant may need to be recorded on the title of the property by its Owner(s) to place institutional controls and/or engineering control requirements on the property. Due to the potential for post-remediation concentrations of chlorinated solvents in groundwater to exceed MCLs and soil gas concentrations or soil to exceed EPA Residential VISLs and RSLs, an Environmental Covenant may be required to restrict groundwater use (i.e., no potable use of groundwater), property use (i.e., commercial/industrial use only), and additional measures would be incorporated, as necessary, to address possible exposure to the contaminants of concern.

Table 1 (Appendix B) presents proposed cleanup alternatives with respect to effectiveness, long-term reliability, implementability, and cost. Advantages and disadvantages of the proposed technologies are also presented. The final solution may involve multiple technologies to achieve remedial goals. A more detailed comparison of potential costs to implement the cleanup alternatives is provided in Table 2 (Appendix B).

3.2.1 Alternative 1: No Action

The No Action alternative is included as a baseline comparison to other remedial alternatives and assumes no action is taken.

This approach would decrease long-term resiliency of the Site by inhibiting sustainable redevelopment and allowing chlorinated impacts to remain at the Site that could increase greenhouse gases.

3.2.2 Alternative 2: Vapor Mitigation System (VMS)

Alternative 2 would provide vapor mitigation from accumulating sub-slab vapors in soil gas originating from impacted groundwater. The purpose of the VMS is to protect future building occupants from potentially harmful accumulating vapors. If one or more new buildings are constructed at the Site, consideration should be given to a design that would include sub-slab soil gas collection piping and a sub-slab vapor intrusion barrier. This type of system would offer a robust engineered approach, integrating the VMS with building materials and components, installation by a certified installer, and construction oversight by a certified inspector providing an entire building solution. This alternative does not address the chlorinated compounds in groundwater or soil. The concentration of chlorinated VOC vapors in soil gas at the Site currently exceed DWMRC risk thresholds for addressing Site risks through engineering controls alone.

The Site-specific extreme weather events identified include flooding, increased weather activity, fires, drought, and extreme heat. This remedy requires operation of vapor mitigation equipment and vehicle usage for maintenance workers to travel to and from the Site. Energy use and greenhouse gas emissions are required during manufacturing of the items used during remedy implementation. Fossil fuel and other energy consumption and air pollution created by operation and maintenance activities under this alternative are significantly less than operation of an SVE system (Alternative 3). Emissions of chlorinated vapors would increase greenhouse gases, which have been linked to extreme weather events; however, air pollution created by this alternative would be decreased by source material removal if Alternative 4 (groundwater treatment and excavation) is conducted prior to installation of a vapor mitigation system. Maintenance activities are expected to be required infrequently, likely once per year, and are not expected to be a significant source of fossil fuel consumption.

Extreme heat could pose a risk to the workers conducting remediation if heat-illness safety precautions are not considered.

Site redevelopment will require approval from the City Engineer for a stormwater management plan that evaluates the development's impact on storm sewer capacity and treatment demand. If pavement alterations occur, the pavement design would require elements to attenuate the acceleration of stormwater runoff. Redevelopment will result in increased maintenance of the grounds and will enhance drainage, thus preventing potential fires from uncontrolled growth or flooding from poor drainage under the Site's current

condition. The effect of redevelopment on drought and heat is insignificant due to the small size of the Site located within an already developed large urban area.

3.2.3 Alternative 3: Soil Vapor Extraction (SVE)

Alternative 3 is Soil Vapor Extraction (SVE), a remediation technology with an objective to reduce the concentration of volatile contaminants in the source media (e.g., subsurface soil and indirectly groundwater) to levels that will reduce soil gas concentrations to levels below the EPA's TSSNSGC VISLs. SVE is not an appropriate technology for direct remediation of groundwater (though groundwater is treated indirectly through increased volatilization). The technology uses a blower coupled to vapor extraction wells installed in the source area. The blower induces a vacuum for removing soil gas and accelerating volatilization of contaminants from soil and indirectly groundwater. The difference between SVE and VMS is that SVE removes source materials and VMS prevents soil gas accumulating below the floor slab from entering the enclosed space via creation of a pressure differential. Both SVE and VMS methods may require a Notice of Intent and reporting to the UDEQ Division of Air Quality. Extracted vapors require treatment prior to discharge to the atmosphere to reduce Hazardous Air Pollutants (HAPs). The concentrations of chlorinated solvent vapors in soil gas at the Site currently exceed DWMRC risk thresholds. Installing an SVE system would not directly remediate groundwater; therefore, an additional remediation alternative would be required to remediate Site COCs in groundwater.

The SVE system's vapor extraction wells would be placed in areas where soil gas concentrations have been identified to exceed VISLs. Pilot testing would be required to determine the feasibility of using SVE and to determine Site parameters for design. SVE systems can take months to years to achieve cleanup endpoints and require ongoing operations and maintenance (O&M) and sampling to determine system effectiveness. Given the concentrations of chlorinated solvents present in groundwater, it is likely that the soil gas concentrations will increase after removal of SVE system; therefore, it is considered likely that a combination of SVE and VMS would be required.

In addition to SVE, this alternative would also include removal of shallow fill soils that are located throughout the Site. These fill soils have naphthalene, 1,1,2-TCA and 1,1,2,2-TCA above the EPA Residential RSLs, arsenic above the EPA Industrial RSL, and concentrations of TPH-GRO and TPH-DRO above UDEQ DERR ISLs. Removal of these soils will be required for installation of SVE equipment.

This alternative would allow for redevelopment; however, sustained emissions of chlorinated vapors would increase greenhouse gases, which have been linked to extreme weather events. This remedy also requires vehicle usage for maintenance workers to travel to and from the Site. Energy use and greenhouse gas emissions are required during manufacturing of the items used during remedy implementation. Fossil fuel and other energy consumption and air pollution created by operation and maintenance activities are higher for this alternative than operation of a VMS system (Alternative 2). The chlorinated VOC emissions

created by this remediation alternative are not anticipated to significantly increase extreme weather events due to greenhouse gas emissions.

Extreme heat could pose a risk to the workers conducting remediation if heat-illness safety precautions are not considered.

Similar to Alternative 2, if the Site is redeveloped, it will require approval from the City Engineer for a stormwater management plan that evaluates the development's impact on storm sewer capacity and treatment demand. If pavement alterations occur, the pavement design would require elements to attenuate the acceleration of stormwater runoff. Redevelopment will result in increased maintenance of the grounds and will enhance drainage, thus preventing potential fires from uncontrolled growth or flooding from poor drainage under the Site's current condition. The effect of redevelopment on drought and heat is insignificant due to the small size of the Site located within an already developed large urban area.

3.2.4 Alternative 4: In-Situ Biological Enhanced Reductive Dechlorination and Abiotic In-Situ Chemical Reduction

Alternative 4 directly targets chlorinated solvent contamination in groundwater and indirectly targets chlorinated solvent contamination in soil gas. This alternative proposes to use a combination of biological ERD and abiotic ISCR degradation pathways for rapid reduction of chlorinated solvent concentrations. Chlorinated solvents dissolved in groundwater will be treated by in-situ biological ERD and abiotic ISCR using a combination of an oleic acid and lactate/polylactate electron donor microemulsion (or equivalent), micro-scale zero valent iron (ZVI), and a microbial inoculum containing species of *Dehalococcoides sp.* which are known to stimulate the rapid and complete dechlorination of chlorinated solvents. This multi-component reductive dechlorination approach will rapidly degrade the PCE, TCE, DCE, and VC to concentrations that are below the cleanup standards specified in Section 2.2 and mitigate potential off-Site impacts, compared to more common in-situ remediation methods (e.g., biological ERD alone). A multi-component reductive dechlorination approach is more expensive than other potential in-situ treatment methods (e.g., chemical oxidation); however, due to the size of the impacted groundwater plume, the high concentrations of chlorinated VOCs, and the documented failure of a previous chemical oxidation approach (Section 1.4), a multi-component reductive dechlorination approach is considered to have a much higher likelihood of achieving cleanup goals. A multi-component reductive dechlorination approach also provides long-term treatment capacity with a much lower probability of rebound and the need for re-application.

The treatment solutions will be injected in a grid pattern throughout the chlorinated VOC groundwater plume via direct-push methods by a specialized remediation contractor. Several companies manufacture products that could be used. Further research and vendor coordination would be required to determine suitable products, volumes and dosages to be applied, method of delivery, and concentrations needed to achieve remedial goals. The technology can also be appropriate for destruction of other volatile organics that may be

present in groundwater and soil. Implementation would be prior to construction of a new building.

Many factors play a role in the success of the proposed in-situ treatment. Some of these factors are listed below:

- demand for electron donors and reductants from target compounds and nontarget compounds
- remedial goals
- soil properties (e.g., grain size, porosity)
- contact times
- groundwater velocity
- contaminant mass flux
- aquifer reoxygenation rates

Additional subsurface information may be required to design treatment specifications and provide an appropriate delivery system to distribute the treatment solutions in the target zones. The biggest challenge for in-situ treatment at the Site is the native, fine-grained soils observed in investigation borings, which were predominantly silts and clays in the impacted zones but also include some higher permeability sandy strata. Use of micro-scale electron-donor and ZVI products will be critical for achieving good distribution of the treatment solutions through fine-grained soils.

In addition to in-situ remediation of the chlorinated solvent plume in groundwater, this alternative would also include removal of shallow, impacted fill soils that are located throughout the Site. These fill soils have been reported to contain low levels of petroleum hydrocarbons, VOCs and PAHs at concentrations that are above the EPA Residential RSLs and arsenic above the EPA Industrial RSL. The soil removal will accelerate attenuation of chlorinated solvents in soil gas. Since the development is planned for commercial use, the target cleanup goals are commercial/industrial.

This remedy will require on-Site use of injection, excavation, landfill, and transportation equipment and production of remediation products and equipment used in the remedy implementation, resulting in fossil fuel and other energy consumption and creation of air pollution; however, removal of source material will decrease emissions of chlorinated vapors from the Site, which have been linked to extreme weather events. The VOC emissions from the existing chlorinated VOC Site impacts will be reduced; therefore, the benefits of the source removal outweigh the temporary impacts of fossil fuel consumption and air pollution. Excavated materials will consume finite landfill space for impacted material disposal. This remedy will not require ongoing operation and maintenance activities.

Similar to Alternative 2, Site redevelopment will require approval from the City Engineer for a stormwater management plan that evaluates the development's impact on storm sewer capacity and treatment demand and a parking lot design that includes elements to

attenuate the acceleration of stormwater runoff. Redevelopment will result in increased maintenance of the grounds and will enhance drainage, thus preventing potential fires from uncontrolled growth or flooding from poor drainage under the Site's current condition. The effect of redevelopment on drought and heat is insignificant due to the small size of the Site located within an already developed large urban area.

As with Alternative 2, increased temperatures pose a risk to Site workers conducting remediation if heat-illness safety precautions are not considered.

3.2.5 Recommended Cleanup Alternative

The applicable remedial alternatives for the primary analytes exceeding screening levels are summarized below.

Analyte	Remedial Alternative	Screening tool	Exposure Scenario	Matrix
Tetrachloroethene (PCE)	2, 3, 4	EPA, MCL, VISL	Commercial	Groundwater and Soil Gas
Trichloroethene (TCE)	2, 3, 4	EPA, MCL, VISL	Commercial	Groundwater and Soil Gas
Cis-1,2-dichloroethene (DCE)	2, 3, 4	EPA, MCL, VISL	Commercial	Groundwater
Vinyl Chloride (VC)	2, 3, 4	EPA MCL, VISL	Commercial	Groundwater

To achieve the Cleanup Objectives listed in Section 3.1, the Recommended Cleanup Alternative is Alternative 4. Other alternatives were rejected for the following reasons.

Alternative 1 (No Action) is not considered a viable option since it does not meet the redevelopment objectives or protect from future exposure to Site contaminants.

Alternative 2 (VMS):

- does not directly address groundwater contamination which could lead to off-Site migration of contaminants

- likely would be rejected by a regulatory agency since the concentration of chlorinated VOCs in soil gas at the Site currently exceed DWMRC risk thresholds for addressing Site risks through engineering controls alone.

Alternative 3 (SVE):

- does not directly address groundwater contamination which could lead to off-Site migration of contaminants
- poses significant engineering challenges
- requires a number of mechanical equipment that is vulnerable to breakdown and will require periodic maintenance, repair, and replacement
- requires long-term O&M and monitoring
- likely to require air abatement, which further complicates operations
- likely would need to be implemented in combination with a VMS; and
- likely would be rejected by a regulatory agency since the concentration of chlorinated VOCs in soil gas at the Site likely to rebound once SVE ceases operations due to the presence of high concentrations of VOCs in groundwater since SVE does not remediate groundwater directly

Following implementation of a remedial strategy, a cleanup completion report would be generated to document that the cleanup activities were completed, along with the final condition of the Site based on cleanup confirmation sampling. A post-remediation risk assessment will also be required to calculate the level of residual human health and ecological risk. If concentrations exceed applicable residential use standards, an SMP and Environmental Covenant would be prepared to manage the residual risks for future Site use with remaining environmental impacts.

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Appendix A

Exhibit

G:\006\61217142_SLC Station Center (WRR) - Work Plan\WRR map\Maps\ProjectNumber_ProjectName\WRR map\WRR map Sept 2023.aprx

Existing Monitoring Well

- Existing
- Not Located
- Site Boundary
- Approximate Proposed Injection Area

Feet
0 30 60 120

Project No.:	61267081
Date:	Oct 2025
Drawn By:	AST
Reviewed By:	ABA

terracon
6952 S High Tech Dr, Ste B
Midvale, UT
PH. 801-545-8500 terracon.com

Site Map

SLC Station Center
550 and 570 West 400 South
Salt Lake City, Utah

Exhibit

1

Appendix B

Tables

Table 1 Brownfield Cleanup Alternatives Balancing Factor Evaluation

Remedial Alternative	Effectiveness	Long-term reliability	Implementability	Cost Implications
1. No Action	Does not address potential risks.	Does not address potential risks.	Not applicable for no action.	No cost to implement. Potential cost implications on property value and future liabilities associated with contaminant exposure.
2. Vapor Mitigation System (VMS)	Addresses vapor intrusion from VOCs in groundwater. Does not address impacts to groundwater. VMS is not recognized as a remediation technology.	Does not address impacts to soil or groundwater. Requires the operation of a passive or active system fitted with alarm indicators in the event of system failure.	Can be incorporated in the design of any future development. Properly maintained, the system would operate for the expected life of the building.	Moderate costs are associated with vapor mitigation.

Remedial Alternative	Effectiveness	Long-term reliability	Implementability	Cost Implications
3. Soil Vapor Extraction (SVE)	Reduces soil gas VOC contaminant levels but may not eliminate the need for a VMS. Does not address impacts to groundwater.	Targets the unsaturated zone with minimal benefits to the saturated zone. Requires pilot testing to determine feasibility of technology, equipment design, and placement.	Design of an SVE system is based on subsurface lithology and expected performance. Costs will be higher than a VMS due to need for wells and mechanical equipment that will need to be operated for lengthy periods of time, potentially in perpetuity since it is unlikely that VOC concentrations in groundwater will be substantially reduced.	High implementation cost to include engineering costs, pilot testing, capital equipment, installation/construction, permitting, and O&M. Excavation: Moderate costs for excavation, transportation, and disposal fees.
4. In-Situ Biological Enhanced Reductive Dechlorination and Abiotic In-Situ Chemical Reduction with Shallow Soil Removal	Reduces source zone contaminant levels of VOCs in groundwater. Remediates low-level contamination in soils and accelerates attenuation of soil gas impacts after groundwater remediation.	Reduces the concentration of chlorinated compounds through chemical reduction and reductive dechlorination. Reduces vapor intrusion potential and reduces off-site migration of chlorinated compounds.	Chemical injection in source area for degradation of chlorinated compounds in the saturated zone. Not difficult to implement due to the demolition of the Site buildings. Minor implementation risks associated with excavation and transportation to appropriate disposal facilities. Minor risk to community due to transportation.	High short-term costs for injection chemicals, methods for application, and labor. Unlikely to require multiple treatments or long-term O&M. Excavation: Moderate costs for excavation, transportation, and disposal fees.

Table 2 Estimated Comparative Costs for Cleanup Alternatives

Cleanup Alternative	Estimated Costs	Notes	
1. No Action	$0	Not a viable option.	
2. Vapor Mitigation System (VMS)	$745,000	**VMS:**	
		$40,000	Engineering Design.
		$525,000	Installation of system (labor and materials). Assumes an approximate building envelope of~65,000 ft^2
		$100,000	Operations and Maintenance for the life of the future buildings.
		$30,000	Consultant oversight during installation,
		Oversight and Reporting:	
		$50,000	Cleanup planning document preparation, public notification of proposed cleanup, completion report.

Cleanup Alternative	Estimated Costs	Notes
3. Soil Vapor Extraction (SVE) Source zone removal of volatile compounds, excavation of shallow fill soils	$1,955,000–$2,185,000	**Soil Vapor Extraction** $40,000–$50,000 — Pilot testing. $25,000 — System design. $750,000 — Capital costs and installation. $50,000 — Consultant installation oversight. $400,000–$600,000 — Operations and maintenance for 10 years. **Oversight and Reporting**: $50,000–$70,000 — Cleanup planning document preparation; air emissions permitting and reporting; meetings with the selected regulatory agency; public notification of proposed cleanup; and cleanup completion report.

Cleanup Alternative	Estimated Costs	Notes	
		Shallow fill soil removal:	
		$620,000	Remove, transport, and disposal of fill soils (10,000 tons). Contractor rough estimate based on similar projects. Includes all labor and equipment necessary. Assumes non-hazardous waste disposal at a RCRA Subtitle D landfill.
		$20,000	Soil confirmation sampling and oversight.
4. In-Situ Biological Enhanced Reductive Dechlorination and Abiotic In-Situ Chemical Reduction with Shallow Soil Removal Remediation of groundwater VOCs, excavation of shallow fill soils	$1,853,500 - $1,893,500	**In-Situ Reductive Dechlorination:**	
		$30,000	In-situ remediation design validation study
		$270,000	Remediation contractor (design and injection field implementation)
		$700,000	Cost for chemicals (including delivery and sales tax).
		$53,500	Consultant field oversight of in-situ injections.
		$100,000-$120,000	Post-remediation monitoring (groundwater and soil gas)

Cleanup Alternative	Estimated Costs	Notes
		Oversight and Reporting:
		$60,000 - $80,000 — Cleanup planning document preparation; meetings with the selected regulatory agency; public notification of proposed cleanup; and cleanup completion report.
		Shallow fill soil removal:
		$620,000 — Remove, transport, and disposal of fill soils (10,000 tons). Contractor rough estimate based on similar projects. Includes necessary labor and equipment. Assumes non-hazardous waste disposal at a RCRA Subtitle D landfill.
		$20,000 — Soil confirmation sampling and oversight.

Estimated costs do not include regulatory oversight.