Analysis of Brownfield Cleanup Alternatives (ABCA)

Zeller Property

1307 West Baltimore Street

Defiance, Ohio

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1.0 INTRODUCTION AND BACKGROUND

The Defiance County Land Reutilization Corporation (DCLRC) and Tetra Tech, Inc. (Tetra Tech) have prepared this Analysis of Brownfield Cleanup Alternatives (ABCA) for remediation of the Zeller Site (Subject Property) located in Defiance, Ohio (see **Figure 1**). The DCLRC and the Ohio Environmental Protection Agency (Ohio EPA) will enter into a cleanup agreement under the Ohio Voluntary Action Program (VAP) to remediate and redevelop the Subject Property.

This ABCA was prepared to obtain a U.S. Environmental Protection Agency (US EPA) Brownfields cleanup grant that includes an overview of the Subject Property conditions, cleanup objectives, and a review of potential remedial alternatives. DCLRC acquired the Subject Property in 2023 with intentions to redevelop the property for light commercial and/or industrial uses.

1.1 Background

The Subject Property was first developed in 1905 by the National Box Company, which occupied the property until about 1924 and used it for the manufacture of wagon boxes. Another company occupied the eastern portion of the property for manufacture of milk cans. The Subject Property was then occupied by the Zeller Corporation and its predecessor firm, Defiance Automatic Screw Company from at least the late 1930s until about 1999. These firms manufactured universal joints, drive shafts, drive line components, and spark plugs. A firm that made similar products, Driveline Technologies, reportedly occupied the property for about a year after Zeller Corporation ceased operations. The Subject Property has been vacant since 2000 with the buildings demolished by October 2011.

The Subject Property is bound to the north by Baltimore Street and Maumee River beyond; to the east by Linden Street and a vacant lot beyond; to the south by railroad tracks and Omni Source beyond; and to the west by an automotive repair shop and commercial properties beyond.

1.2 Summary of Previous Studies

A number of assessments and investigations have been conducted at the Subject Property including the following:

- A Phase I Property Assessment (PA) and Phase II PA conducted by Soil and Materials Engineers (SME) in 2011 and 2012, respectively (SME 2011; 2012).
- Phase II PAs conducted by Tetra Tech in 2017 (Tetra Tech 2017; 2022a;b).
- Two investigations conducted by the Ohio Site Investigation Field Unit (SIFU) in 2017 (SIFU 2017a;b).
- A Phase I PA and two Supplemental Phase II PAs conducted by Tetra Tech in 2022 (Tetra Tech 2022a;b;and c).

Based on prior assessments of the Subject Property as described above, contamination has been identified above applicable Ohio EPA VAP Generic Direct Contact Soil Standards (GDCSS) for the commercial/industrial land use and/or construction/excavation worker exposure scenarios, as well as the Bureau of Underground Storage Tank Regulations (BUSTR) Soil Saturation Limits (SSL). Chemicals of concern (COC) consist of total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs), and metals. Additionally, concentrations of VOCs, semi volatile organic compounds (SVOCs), and metals (arsenic and lead) have been detected above Ohio EPA VAP Unrestricted Potable Use Standards (UPUS) in perched groundwater and VOCs have been detected above the U.S. Environmental Protection Agency's (U.S. EPA) Vapor Intrusion Screening Levels (VISL) for sub-slab soil gas commercial/industrial exposure pathway. A summary of past Subject Property assessment activities is presented below.

SME 2011 Phase I PA: In 2011, SME conducted an Ohio VAP Phase I PA for the Subject Property. The purpose of the PA was to satisfy all appropriate inquiry (AAI) requirements as well as to "determine whether there is reason to believe that any releases of hazardous substances or petroleum have or may have occurred on, underlying, or are emanating from the property including any release from management, handling, treatment, storage, or disposal activities from on- or off-property activities" through the definition of recognized environmental conditions (RECs) that can be grouped into identified areas (IAs) for subsequent investigation. An IA is an area on the property where a release of petroleum or hazardous substances has or may have occurred, as defined by Ohio VAP guidelines 3700-300-06.

SME initially identified 31 RECs that were grouped into 15 IAs (IA-1 through IA-15) where past releases and/or suspected releases may be associated with the Subject Property. The IAs identified at the Subject Property include the following:

- <u>IA-01: Site-Wide Soil and Areas Under Former Buildings</u>. Subject Property-wide concerns related to the prior use of the property for manufacturing. Potential releases associated with these operations were observed and noted.
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- <u>IA-02: Subject Property Groundwater</u>. Subject Property-wide groundwater was identified as an IA because of prior property use and potential releases to soil and groundwater.

- <u>IA-03: South Central Portion of Subject Property</u>. This area included the storage of lubricating oils in former underground storage tanks (USTs) 23, 24, and 25; a metallurgical laboratory; storage of cutting oils and other materials stored in former ASTs; metal plating operations; and filtration operations.

- <u>IA-04: Northwestern Portion of Subject Property</u>. This area included storage of gasoline, quench oil and Stoddard solvents in former USTs 21, 22, and 16b, respectively; storage of leaded gasoline (former UST 14) and Stoddard solvent in former USTs 15 and 16 in the former slug coating area, heat treating and plating area. Additionally, painting operations were in this area and concrete and brick fill were observed in the slug coating area.

- IA-05: Eastern Portion of Subject Property. Former USTs 7 and 8 were used for storing reclaimed cutting oil in the machining room within this area of the property. The former compressor room was also present in this area.

- IA-06: Southeastern Portion of Subject Property. Former USTs 12 (leaded gasoline) and 13 (benzene/oil), the former oil storage room, and the former extractor pit and associated chip conveyor were located in this portion of the property.

- IA-07: Former Transformer and Oil Tank located in Southwestern Portion of Subject Property: An area of polychlorinated biphenyls (PCB) contamination was reportedly excavated and cleaned up to less than 25 parts per million (ppm) in 2005.

- IA-08: Former Paint Room, Paint Storage, and Drum Storage in Southwestern Portion of Subject Property: Former use of paints and storage of waste/chemicals in drums.

- IA-09: Transformers Located in Former Courtyard in Northeast Portion of Subject Property: Historic record of three transformers in the former courtyard.

- IA-10: Historic Drum Storage Area in Northern Portion of Subject Property: This area used to store drums and then became the Research and Development Area.

- IA-11: Former Transformers Located North of the Former Slug Coating Building: Former transformers were in the northwest portion of the property.

- IA-12: Former Maintenance Shop and Drum Storage: This area was the former maintenance area in and the adjacent area used to store drums. Additionally, this was the location of a former pole-mounted transformer.

- IA-13: Former Pad-Mounted Transformer Z5: Possibility of releases from a pad-mounted transformer that was in the northwest portion of the main building.

- IA-14: Former Hydraulic Reservoir Tanks: Former tanks that contained hydraulic oil for machinery were in the west central portion of the property.

- IA-15: Former Industrial Machines and Possible Parts Washer: Two industrial machines, one of which may have been a parts washer, were located in the northwest portion of the former main building.

SME 2012 Phase II PA: SME drilled 25 direct-push soil borings (SB1 through SB25), and four hollow-stem auger borings (MW-1 through MW4) to evaluate soil conditions and assess potential releases associated with RECs identified in the SME 2011 Phase 1 PA. Groundwater monitoring wells were installed in soil borings MW1 through MW4 to evaluate current groundwater conditions. **Figure 2** shows the soil boring and monitoring well locations. SME collected soil samples from each of the soil borings for visual classification, field screening with a photoionization detector (PID), and chemical analyses. Groundwater samples were collected from monitoring wells MW1 through MW4 for chemical analyses.

Soil samples were screened for evidence of contamination and logged to describe lithology. Soil was observed to consist of fill of variable composition extending to depths ranging from 1 to 8 feet below ground surface (bgs); fill was underlain by lean clay extending to a depth of at least 50 feet bgs, the maximum depth explored. Layers of fine to coarse sand, 2 to 4 feet in thickness, were encountered at depths of 24 feet bgs and 42 feet bgs at MW1. Sandy lean clay with fractures and a higher occurrence of sand and silt seams were encountered around 25 feet to 30 feet bgs at MW3 and MW4. Fractures were also encountered in the clay at depths of 28 to 30 feet at MW2. Groundwater was reportedly not encountered during drilling. Some moist seams of silt or sand and gravel were encountered at depths ranging from 26 to 30 feet. Groundwater was present in all four wells within 24 hours of drilling at depths ranging from 13.75 feet bgs (MW4) to 40.28 feet bgs (MW1) suggesting that the fractures in the clay and the observed silt and sand and gravel seams could yield groundwater.

A total of 26 soil samples were collected and analyzed for VOCs, 19 for SVOCs, TPH gasoline range organics (GRO), TPH diesel range organics (DRO), TPH organic range organics (ORO), 12 for metals, and 2 for PCBs, and cyanide. Soil sample results showed various compounds detected at concentrations exceeding laboratory reporting limits (RLs) and/or method detection limits (MDL) in one or more soil samples collected at the Subject Property. A number of compounds were detected above VAP GDCSS including: benzo(a)pyrene (at MW2), trichloroethene (TCE) (at SB9), 1,2,4-trimethylbenzene (at SB12), and lead (at MW3). The concentrations of TPH GRO, DRO, or ORO (compounds with no VAP direct contact standards) exceeded the BUSTR applicable soil saturation limits (SSLs) at locations SB1, SB3, SBl0, SB12, and SB22. Several COC also exceeded the VAP Derived Leach-Based Soil Values.

Groundwater samples were collected from the installed monitoring wells MW1 to MW4. Metals including aluminum, arsenic, barium, chromium, iron, lead, magnesium, manganese, nickel, and zinc were detected at concentrations above laboratory RLs in the groundwater samples. No VOCs, SVOCs, PCBs or other target metals were detected at concentrations exceeding the laboratory RLs in the groundwater samples. Only arsenic and lead concentrations in groundwater collected at monitoring well MW3 exceeded the VAP UPUS.

Tetra Tech 2017 Phase II PA: Tetra Tech conducted a Phase II that included installation of ten soil borings (SB26 through SB35) and one monitoring well (MW5); soil and groundwater sampling; and surveying (see **Figures 2, 3** and **4**). Soil borings and soil sampling were completed using direct-push technology (DPT). Subsurface materials were continuously sampled to the completion depth at each drilling location. Soil borings SB26 to SB35 were advanced to 10 feet bgs, while the borehole associated with monitoring well MW5 was advanced to 41.5 feet bgs. Soil cores were collected in 4-foot sections and logged for lithological classification, field screening, and laboratory analysis. Field screening activities included screening with a calibrated PID, as well as visual and olfactory inspection.

Tetra Tech collected two soil samples from each boring location and submitted the samples to ALS Environmental (ALS) (Ohio VAP accredited) located in Cincinnati, Ohio, for analysis. The first sample from each boring was collected from surface soils (0-2 feet bgs) while the second sample was collected from subsurface soils (2-10 feet bgs). The subsurface sample interval was chosen based upon field observations (PID, visual, and/or olfactory). Samples submitted to ALS were analyzed for VOCs, SVOCs, Resource Conservation and Recovery Act (RCRA) metals, TPH GRO, TPH DRO, TPH ORO, cyanide, and/or PCBs. Soil sample analysis was dependent on the specific IA in which the samples were located.

Groundwater samples were collected from existing monitoring wells MW1 through MW4 for laboratory analysis of VOCs, SVOCs, RCRA metals (total and dissolved). Monitoring well MW5 was purged dry during low-flow sampling activities and did not recharge by the completion of the sampling event. As such, Tetra Tech was not able to collect groundwater samples from MW5 using low-flow sampling techniques but was able to collect a grab groundwater sample from MW5 using a bailer while conducting investigation-derived waste (IDW) removal activities on August 8, 2017. The grab groundwater sample was submitted to ALS for VOC analysis only.

Soil analytical results were evaluated relative to the Ohio VAP GDCSS for the commercial/industrial land use scenario as well as to the construction/excavation worker scenario. The point of compliance for the commercial/industrial scenario is 2 feet bgs and 10 feet bgs for the construction/excavation scenario. Soil results for TPHs (compounds with no VAP direct contact standards) were compared to the BUSTR SSLs in accordance with the Ohio EPA Technical Guidance Compendium (TGC) VA30008.14.001. Chromium results for the samples were un-speciated; for this reason, evaluations were conservatively compared to standards for hexavalent chromium.

Soil results indicated detections of VOCs, RCRA metals, TPH GRO, TPH DRO, TPH ORO, and PCB compounds in soils across the Subject Property. However, only one sample (the 0-2-foot bgs sample from SB28) contained concentrations exceeding applicable standards. Soil collected from boring location SB28 (0-2-foot bgs sample) contained TPH GRO at 1,100 milligrams per kilogram (mg/kg) and TPH ORO at 5,500 mg/kg, both exceeding their BUSTR SSLs of 1,000 mg/kg and 5,000 mg/kg, respectively for Type I soil.

Groundwater results indicated detections of SVOC and RCRA metal compounds in Subject Property groundwater. One monitoring well (MW1) contained an exceedance of UPUS. The SVOC compound - dibenzo(a,h)anthracene was detected at a concentration of 0.17 micrograms per liter (µg/L) which exceeded the UPUS of 0.092 µg/L. Unfiltered metal samples contained COCs exceeding VAP UPUS in wells MW3 and MW4, though the filtered sample results for those samples were less than laboratory RLs. Analytical results from the MW5 grab groundwater sample indicated no detections of VOCs greater than laboratory RLs.

Ohio EPA 2017 Investigations: Ohio EPA's SIFU conducted two investigations at the Subject Property in 2017 to evaluate the vapor intrusion pathway. SIFU conducted the first investigation in August 2017, which included the installation and sampling of four soil gas probes (SG-1 through SG-4) and nine vapor pins (VP-1 through VP-9). The vapor pins were installed below the residual building slab and the soil gas probes were completed at depths between 4 and 12 feet bgs. Samples were collected in 1-liter stainless steel canisters and submitted to ALS's VAP accredited laboratory in Cincinnati, Ohio for EPA Method TO-15 analysis. **Figure 5** shows the 2017 soil gas sample locations and VISL exceedances.

SIFU conducted a second investigation in September 2017, which included the installation and sampling of eight soil gas probes in five locations (SG-5 through SG-9). Probes were installed as either nested or single points and sampled for VOCs. Nested wells were installed at depths of 5 and 11 feet bgs at locations SG-5 through SG-7 and at a single depth of 7 feet bgs at locations SG-8 and SG-9. SIFU also installed and sampled a vapor pin below the building slab and collected an indoor air sample at the adjacent property to the west (1357 Baltimore Street). Additionally, subsurface soil samples were collected at two locations based on the prior sampling event results. The soil gas and indoor air samples were submitted to ALS for analysis using Method TO-15. The soil samples were analyzed by ALS for VOCs only.

The results of soil gas and indoor air results were evaluated using U.S. EPA's VISL calculator (U.S. EPA 2016) and in accordance with Ohio EPA's Indoor Air Commercial/Industrial Standards (Ohio EPA 2016). In accordance with VAP protocol, default criteria were used for a hazard index of 1, an excess cancer or non-cancer risk of 10^{-5}, a temperature of 25 degrees Celsius (°C), and a commercial/industrial exposure pathway. The table below summarizes the compounds that exceeded VISL risk criteria, the frequency they exceeded the VISL, the highest observed result, and the VISL used during the SIFU assessment.

Compound	Frequency of Detection	Highest Observed Concentration in ug/m^3	VISL Screening Level for Soil Gas
Trichloroethene	6 of 21	61,800	293
1,1-dichloroethane	2 of 21	4,350	2,560
1,1-dichloroethene	1 of 21	30,700	29,400
Trans-1,2 dichloroethene	2 of 21	18,900	5,840
Tetrachloroethane	5 of 21	2,650	242
Vinyl chloride	6 of 21	56,300	24.5

Notes:
VISL: Vapor intrusion screening level
ug/m^3: Micrograms per cubic meter of air

Tetra Tech 2022 Phase I PA: Tetra Tech conducted a Phase I PA to provide an update of the prior Phase I PA conducted by SME in 2011. The Phase I PA confirmed the 15 IAs identified in the prior Phase I PA. Additionally, Tetra Tech identified a new concern as a result of the site reconnaissance. Tetra Tech noted the presence of two on-property wells that had not been abandoned and were observed to be in poor condition, resulting in an additional IA (IA-16). These wells will have to be properly abandoned as part of remediation activities in the future.

Tetra Tech 2022 Supplemental Phase II PA: Tetra Tech completed Supplemental Phase II field activities from July 18 to July 21, 2022, to further evaluate soil, soil gas, and groundwater conditions in IAs where previous sampling had identified contamination exceeding either VAP GDCSS standards, VAP UPUS, or EPA VISL for sub slab soil gas for the commercial/industrial exposure pathway. Additionally, due to the possible presence of USTs that were either closed in place or removed, geophysical methods were employed to locate potential USTs and subsurface utilities or conveyances. Supplemental sampling activities were conducted in accordance with the Sampling and Analysis Plan (SAP) prepared for this sampling event (Tetra Tech 2022b).

Prior to conducting intrusive work, Tetra Tech utilized a geophysical subcontractor (Jones GPRR LLC) to evaluate the Subject Property for potential USTs and subsurface utilities and clear drilling locations. Two areas were identified with subsurface anomalies and potential USTs, one in IA-05 near soil boring SB45 and one in IA-12 near borings SB48, 49, and 51.

Tetra Tech conducted intrusive Supplemental Phase II activities, which included installing 21 soil borings (SB36 through SB57), collecting soil samples from each soil boring, converting three of the soil borings into temporary wells (TW36, TW50, and TW57, corresponding to SB36, SB50, and SB57), sampling groundwater from existing monitoring wells and newly installed temporary wells, and installing vapor pins and sampling soil gas at ten locations (VP10 through VP19).

Tetra Tech utilized EnviroCore of Plain City, Ohio to install soil borings and temporary wells. EnviroCore used a 54DT Geoprobe rig to sample subsurface soils at each of the 21 soil boring locations to an approximate 10-foot depth. Subsurface soils were continuously sampled using a Macropore sampler. Soil samples were retrieved in dedicated 4-foot acetate liners from the ground surface to the completion depth of each drilling location (approximately 10 feet bgs). Two samples were collected from each boring for targeted parameters based on results from prior sampling events – PCBs, polyaromatic hydrocarbons (PAHs), metals, and/or VOCs. All soil samples were submitted to the ALS VAP certified laboratory located in Cincinnati, Ohio for analysis.

Tetra Tech installed three temporary wells in soil borings SB36, SB50, and SB57, which were termed TW-36, TW-50, and TW-57, respectively. At the completion of soil sampling, 5-foot polyvinyl chloride (PVC) screens (1-inch inside diameter) and PVC riser were installed by EnviroCore at the base of the borings.

Newly installed temporary wells (TW-50 and TW-57) and existing monitoring wells (MW1, MW2, MW03, MW04 and MW05) were sampled by Tetra Tech about 24 hours after completion. Temporary well TW36 did not yield groundwater and thus was not sampled.

Tetra Tech directed EnviroCore to install vapor pins at nine locations (VP-10 to VP-19). The locations were chosen based on past soil gas investigation data collected by Ohio EPA in 2017 that exhibited elevated concentrations of VOCs. Soil gas was collected from each location in 6-liter batch-certified SUMMA cannisters and submitted to ALS air toxics laboratory located in Simi Valley, California, for analysis using EPA Method TO-15.

Consistent with prior results, there were exceedances of VOCs, TPH, and metals for either VAP GDCSS standards for commercial/industrial land use or construction/excavation activities and BUSTR SSLs. **Figures 2** through **5** show sample locations and exceedances of applicable standards.

Tetra Tech 2022 Second Supplemental Phase II PA: To prepare the Remedial Action Plan (RAP) for the Subject Property, Tetra Tech evaluated the results of prior sampling events and identified data gaps to be addressed, which included:

- The extent of soil contamination in areas of known VOC and TPH contamination, including primarily the south-central portion of the Subject Property.
- The extent of lead, TPH, and PAH contamination in the western portion of the Subject Property.
- The lack of data in the extreme western portion of the property outside of the fence but within the parcel boundary.
- The lack of data necessary to determine if soils contaminated with high concentrations of VOCs may exhibit a hazardous characteristic.

Tetra Tech conducted a Second Supplemental Phase II PA on November 10 and 11, 2022 that included the installation of 20 soil borings to a depth of 10 feet bgs using DPT (SB58 through SB77) and collecting soil samples from each soil boring for VOC and/or TPH analysis; additionally, Tetra Tech collected samples for PCB, and metals analysis near locations of prior exceedances. Samples were also collected for toxicity characteristic leaching procedure (TCLP) VOC analysis to determine whether soil if excavated would exhibit a hazardous characteristic based on leachate concentrations. Samples were submitted to ALS located in Cincinnati, Ohio for analysis. **Figures 2** and **3** show sample locations and exceedances of applicable standards. Results for PCBs and metals did not exceed GDCSS standards, which addressed data gaps relating to the extent of exceedances of those COCs.

In order to evaluate the nature and extent of VOC and TPH results in soil, results from all investigations were used to model the extent of contamination. Tetra Tech used ARCs GIS software to create modeled iso-concentration maps. The results of modeling are shown in **Figures 6 and 7** for VOCs and TPH, respectively. The results suggest there are two primary hotspots within the south-central portion of the Subject Property with lesser isolated hotspots in the north and southwestern portion of the property. Results of TCLP VOC analysis suggest that soil in the south-central portion of the property would likely exhibit a hazardous characteristic if excavated, suggesting that in-situ treatment should be considered as an alternative, either as a stand-alone remedy or to render the material non-hazardous prior to off-property disposal. The results also suggest that soil contamination may extend off the property to the south, within the adjacent railroad right of way (ROW). Additional delineation south of the ROW was recommended as part of the RAP.

1.3 Project Goals

The planned reuse for the Subject Property is light commercial/industrial. The following project goals for the Subject Property will incorporate applicable VAP regulatory standards in accordance with Ohio Administrative Code (OAC) 3745-300-11 along with development guidelines and best practices:

- Clean up impacted environmental media at the Subject Property to be protective of construction workers and future commercial/industrial end users.

1.4 Human Health and Ecological Risk Assessment

Possible human exposure via direct contact with soil, water and/or indoor air at the Subject Property could threaten human health. Exposure routes include dermal contact, inhalation, and ingestion. Potential future receptors include tenants, workers, and construction/utility workers. Tetra Tech's cleanup goals aim to reduce analyte concentrations that exceeded background concentrations. Risk-based screening values for these analytes will be used to gauge the effectiveness of remedial activities. Further institutional and/or engineering controls along with a Risk Mitigation Plan will be implemented, if necessary, to further eliminate routes of potential exposure to the COCs.

1.5 Cleanup Goals and Objectives

Remedial activities on the Subject Property will have end goal objectives of redevelopment to meet applicable commercial and industrial standards including VAP GDCSS for the commercial/industrial land use scenario and construction/excavation worker scenario, UPUS, and VISL. Based on the commercial/industrial scenario, it is expected that the primary potentially exposed populations will be adult commercial/industrial and construction workers. Meeting the cleanup objective will require elimination of these exposure pathways through implementation of VAP-approved remedial actions protective of human health and the environment. Property-specific criteria for cleanup goals will be presented in the RAP.

2.0 APPLICABLE CLEANUP REGULATIONS AND STANDARDS

Section 2.0 presents oversight and responsibilities for cleanup at the Subject Property, conveys cleanup standards, and summarizes applicable laws and regulations.

2.1 Responsibility for Cleanup Oversight

DCLRC and Ohio EPA will enter into an agreement for cleanup and redevelopment of the Subject Property. The VAP provides certain liability protections to DCLRC to encourage cleanup and redevelopment of blighted contaminated properties. The law establishes a process for eligible property owners to obtain immunities, conduct property assessments, and implement response actions as necessary to ensure eligibility of the property for reuse or redevelopment. Ohio EPA is the lead regulatory agency to oversee the VAP process and cleanup of the property. DCLRC has also engaged the services of a qualified environmental contractor (Tetra Tech) to develop and implement an appropriate remediation work plan. Tetra Tech employs a VAP Certified Professional, licensed Professional Geologists (PG), a licensed professional engineer (PE), a Certified Hazardous Materials Manager (CHMM), and qualified All-Appropriate Inquiry (AAI) Environmental Professionals.

2.2 Cleanup Standards

The commercial/industrial VAP cleanup standards for the COCs found in environmental media associated with the Subject Property will be outlined in the RAP.

2.3 Laws and Regulations Applicable to the Cleanup

The cleanup will comply with the Ohio EPA VAP and U.S. EPA Brownfields Program requirements (e.g., for information repository, public comment, ABCA, cleanup oversight, etc.). Cleanup activities at the Subject Property will generally follow the guidelines outlined in OAC 3745-300-11 and other applicable federal, state, and local laws, rules, and regulations.

3.0 IDENTIFICATION OF POTENTIAL CLEANUP ALTERNATIVES

Based on findings of the Phase II investigations at the Subject Property, four potential cleanup alternatives were evaluated for consideration including the following:

1. Hazardous and Non-Hazardous Soil Excavation and Disposal Off Property
2. In-situ Treatment of Hazardous Soil to Non-Hazardous Levels and Excavation of Non-Hazardous Soil for Disposal Off Property
3. In-Situ Treatment Using Thermal Desorption to Reduce Concentrations of VOCs to Below Hazardous Concentrations Followed by Removal and Disposal Off Property
4. No Cleanup

3.1 Alternative 1 – Hazardous and Non-Hazardous Soil Excavation and Disposal Off Property

This alternative would involve the removal of hazardous and non-hazardous soil exceeding potentially hazardous concentrations of VOCs will be excavated, remediated, and disposed of off-property as hazardous waste; soil exceeding TPH SSLs will be excavated and disposed of as non-hazardous waste. This will also require the removal of the former building slabs and associated foundations prior to removal of soil and backfilling excavations with either recycled on-property crushed concrete or import of virgin stone.

3.2 Alternative 2 – In-Situ Treatment of Hazardous Soil to Non-Hazardous Levels and Excavation of Non-Hazardous Soil for Disposal Off Property

Soil exceeding potentially hazardous concentrations of VOCs will be treated in-situ by mixing with persulfate or similar oxidizer and then removed from the property as non-hazardous waste along with soil exceeding TPH SSLs. As with Option 1, backfilling of the excavation would be conducted using recycled on-property concrete or import of virgin stone.

3.3 Alternative 3 – In-Situ Treatment Using Thermal Desorption to Reduce Concentrations of VOCs to Below Hazardous Concentrations Followed by Removal and Disposal Off Property

Soil will be treated in-situ using thermal desorption to reduce concentrations of VOCs to below hazardous concentrations, followed by removal and off-property disposal of treated soil as non-hazardous waste. As with the prior two options, the excavation would be backfilled.

The areas where treatment is considered necessary are identified on **Figure 8**. Soil that exceeds TPH SSLs, but is not considered potentially hazardous, is identified in **Figure 9**.

Pilot-scale treatment may be considered to evaluate the feasibility of the treatment options to address VOC contaminated soil that also contains elevated TPH. If pilot-scale treatment is implemented, it would be implemented in the south-central portion of the Subject Property.

3.4 Alternative 3 – No Cleanup

This alternative would involve no remedial activities at the Subject Property, leaving it in its current condition. No Action would entail no further response actions of any type, including administrative controls or monitoring. The No Action alternative is retained as a basis for comparison with other remedial alternatives.

3.5 Evaluation of Cleanup Alternatives

The cleanup alternatives were evaluated based on the following criteria: effectiveness, feasibility of implementation, remedial costs, and general reasonableness. Each alternative's sustainability was also assessed based on the EPA Office of Solid Waste and Emergency Response (OSWER) technology primer titled "Green Remediation: Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites" (EPA 2008) that consider the following:

- Energy requirements of the treatment system
- Air emissions
- Water requirements and impacts on water resources
- Land and ecosystem impacts
- Material consumption and waste generation
- Long-term stewardship actions

Based on these evaluation criteria, the recommended cleanup alternative for the Subject Property is Alternative 2: In-Situ Treatment of Hazardous Soil to Non-Hazardous Levels and Excavation of Non-Hazardous Soil for Disposal Off Property. This alternative would provide long-term effectiveness, is easily implemented, supports some sustainability factors, and would be less expensive than Alternatives 1 and 3.

3.5.1 Alternative 1 – Hazardous and Non-Hazardous Soil Excavation and Disposal Off Property

- *Effectiveness* – This alternative would require excavation of contaminated soil with COCs and ex situ treatment. Ex situ treatment alternatives include landfarming or enhanced bioremediation in biocells for organic compounds.

- *Implementation Feasibility* – This alternative would be moderately difficult to technically implement. Ex-situ treatment requires a large area for treatment and runoff control.

- *Remedial Costs* – This alternative would have moderately high capital and low operation and maintenance (O&M) costs. The all-in cost per ton (excavation, transportation, and disposal) would be $212 per ton for waste that is directly disposed and the cost per ton waste requiring treatment would $442 per ton. Additionally backfilling of the excavations either through import of soil or use of on-property recycled concrete is estimated at $25 per ton.

TPH contaminated soil that is non-hazardous is estimated at 2,900 tons. This soil would be excavated and transported to a non-hazardous landfill at an estimated cost of $50 per ton. Backfill would either be recycled on-property concrete or imported stone at an estimated cost of $25 per ton.

- *General Reasonableness* – This alternative would provide the quickest remedial action to be taken on the Subject Property, however, would require a high capital cost.
- *Sustainability:* This alternative would pose short term consequences affecting the sustainability factors. Heavy equipment mobilization, demobilization, and operations. However, long-term greenhouse gas generation would be minimal, and long-term electricity demand would be avoided. This alternative also increases the potential for stormwater runoff carrying COC impacted soil during ex situ treatment.

3.5.2 Alternative 2 – In-Situ Treatment of Hazardous Soil to Non-Hazardous Levels and Excavation of Non-Hazardous Soil for Disposal Off Property

- *Effectiveness* – This alternative This alternative would require in situ treatment on-property. In situ treatment would include injection of treatment compounds to enhance biodegradation and oxidize the organic compounds in soil to be categorized as non-hazardous.
- *Implementation Feasibility* – This alternative would be moderately difficult to technically implement. In situ treatment of unsaturated zone soils requires a large amount of injection points closely spaced together to achieve remediation goals. However, injection using a Geoprobe is a standard technology and resources would be readily available. Chemical enhancements to be used would require some lead time for procurement.
- *Remedial Costs* – This alternative would have moderately high capital and low O&M costs. The volumes of hazardous and non-hazardous waste would be the same as in Alternative 1; however, persulfate would be mixed in-situ with soil at a cost of about $94 per ton, excavated, transported and disposed at a non-hazardous landfill at a cost of $50 per ton. The excavations would be backfilled as in Alternative 1.
- *General Reasonableness* – This alternative ranks high for reasonableness. It would remove the impacted soil, eliminating the risk and threat to the environment and human health, allow for redevelopment of the property, at approximately half the cost of Alternative 1.
- *Sustainability:* This alternative would pose short term consequences affecting the sustainability factors. Heavy equipment mobilization, demobilization, and operations

during injection/mixing operations would generate greenhouse gases during initial installation of the substrate amendment. The amendment may have to be injected multiple times until the soil has been remediated. The system's electrical energy usage during pumping may indirectly lead to greenhouse gas generation if that power is generated from fossil fuels. Production of the amendment would contribute to energy use, as well as greenhouse gas production. However, long-term greenhouse gas generation would be minimal, and long-term electricity demand would be avoided.

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3.5.3 Alternative 3 – In-Situ Treatment Using Thermal Desorption to Reduce Concentrations of VOCs to Below Hazardous Concentrations Followed by Removal and Disposal Off Property

Effectiveness – This alternative could be highly effective in treating the COCs in the soil; however, this technology also requires that a significant number of vertical holes be placed throughout the target area to ensure complete heating. Incomplete heating, inflow of low temperature, and missed portions of the source zone can allow significant contaminant mass to remain in the soil.

- *Implementation Feasibility* – This alternative would be moderately difficult to technically implement. This technology involves the installation of an array of heating elements, the installation of vapor recovery wells, and the installation of condensate removal and vapor and condensate treatment using granular activated carbon (GAC). Liquids generated would be discharged after passing through the GAC filtration unit and solids would require off-property disposal or regeneration. If free product was generated, then that would be disposed of as well.

- *Remedial Costs* – Thermal remediation has high capital and moderate O&M costs. It requires off-property disposal, treatment studies, and can create additional waste types. This alternative was not retained for further consideration.

- *General Reasonableness* – This alternative could be highly effective in treating the COCs in soil. However, this technology requires a significant number of vertical holes be placed throughout the target area to ensure complete heating and the high cost of installation and energy usage make it cost prohibitive.
- *Sustainability:* This alternative would pose several significant consequences affecting the sustainability factors. Heavy equipment mobilization, demobilization, and operations during installation of heating elements. Thermal treatment is also the most energy intensive alternatives proposed that would contribute to greenhouse gas production during operation. However, long-term greenhouse gas generation would be minimal, and long-term electricity demand would be avoided following treatment.

3.5.4 Alternative 4 – No Action

- *Effectiveness* – Under this alternative no remediation would be carried out at the Subject Property. Under the current land-use scenario, COCs in soil would pose an unacceptable risk to receptor populations.
- *Implementation Feasibility* – No action would not require implementation of construction and operation of a remedial system. However, this alternative fails other crucial criteria and cannot be implemented.
- *Remedial Costs* – No costs are associated with this alternative.
- *General Reasonableness* – The no action alternative provides a reference to evaluate other alternatives.
- *Sustainability:* This alternative is highly sustainable since no action would occur. No energy or resources would be consumed, no greenhouse gases would be generated, and no waste would be generated.

3.6 Recommended Cleanup Alternative

Based on the comparative analysis, the recommended cleanup alternative for the Subject Property is Alternative 2, In-Situ Treatment of Hazardous Soil to Non-Hazardous Levels and Excavation of Non-Hazardous Soil for Disposal Off Property. This alternative would eliminate exposure pathways and threats to the environment and human health on the property, allowing for commercial/industrial redevelopment. This alternative is the most effective in the short term, it is easy to implement compared with the other alternatives, and it costs less than Alternatives 1 and 3.