ENGINEERING EVALUATION/COST ANALYSIS (EE/CA)

NON-TIME-CRITICAL REMOVAL ACTION

St. Joe Minerals Corp – Viburnum Site
Iron, Crawford, and Washington Counties, Missouri

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Prepared by:

The Doe Run Resources Corporation

Engineering Evaluation/Cost Analysis (EE/CA) Non-Time-Critical Removal Action

St. Joe Minerals Corp. - Viburnum Site, Missouri

1.0 EXECUTIVE SUMMARY

This Engineering Evaluation/Cost Analysis (EE/CA) has been prepared on behalf of The Doe Run Resources Corporation ("Doe Run") as part of a Non-Time-Critical Removal Action at the St. Joe Minerals Corp. – Viburnum Site (Viburnum Site). The Viburnum Site is defined in section 7(p) of the Administrative Order on Consent (AOC) for Time-Critical Removal Action as "any residence or child high-use area (1) within the City of Viburnum, adjacent to the City of Viburnum or within the cross-hatched area on the map attached as Appendix A to this Order; (2) adjacent to and within 200 feet of either edge of the haul roads from the City of Viburnum to the Viburnum No. 27, No. 29, and Casteel mines; (3) within 1,000 feet of the head frames of Viburnum No. 27, No. 29 and Casteel mines; and (4) within the area within 1,000 feet from the edge of all Doe Run and St. Joe Minerals-Viburnum mine waste disposal areas (e.g. tailings piles)."

Appendix A to the order was redrawn using modern GIS technology and is now represented in Figure 1. Figure 2 and Figure 3 show details of those areas of the Site that exist in Crawford and Washington counties.

An investigation on lead content in residential soils within the Site began in 2005. Yard screening results showing lead levels in some yards above 1,200 parts per million (ppm) lead prompted a Time-Critical Removal Action. As part of the Time-Critical Removal Action, soils with lead levels exceeding 1,200 parts per million (ppm) lead were removed from residential yards and child high use areas. In these same yards, any soils in excess of 400 ppm lead were also removed and replaced. The Non-Time-Critical Removal Action will address those remaining residential yards and child high use areas that have been identified as containing soil lead levels exceeding 400 ppm lead but were less than 1,200 ppm lead.

The Non-Time-Critical Removal Action, which will be subject to a separate AOC or similar document among Doe Run and USEPA, will follow completion of the Time-Critical Removal Action that has been performed at the Viburnum Site under the AOC USEPA Docket No. CERCLA-07-2007-0013, effective date May 2, 2007 (referred to herein as the AOC for Time-Critical Removal Action).

1.1 General EE/CA Process

The EE/CA is a mechanism for the development, screening and detailed evaluation of alternative removal actions, and recommendation of the alternative that best satisfies the evaluation criteria. The purpose of an EE/CA is to document development, screening and detailed evaluation of proven focused alternatives to facilitate selection of an environmentally-sound, cost-effective removal alternative which can be implemented to attain chemical-specific removal goals to ensure protection of human health. The tasks performed for this EE/CA are summarized as follows:

- Summarizing the identification of process options and removal technologies
- Summarizing the technology screening. The evaluated technologies in Section 4.0 are as follows:
    - No action
    - Institutional Controls
    - Public Health Actions
    - Containment
    - Soil removal
- Developing alternatives for removal based on the technology screening
    - Soil Removal was chosen and further evaluated
- Evaluating the removal action alternatives to develop the most cost effective solution that meets the RAOs.
    - Three disposal options for soil removal were evaluated. On-site repository at the Viburnum facility was chosen.

1.2 Report Organization

The EE/CA documents the development of Applicable or Relevant and Appropriate Requirements (ARARs) and removal action objectives, technology screening, alternative development, and the results of the screening and analysis process. The EE/CA report outline is provided below:

Section 1.0	Executive Summary
Section 2.0	Site Characterization
Section 3.0	Identification of Removal Action Objectives
Section 4.0	Removal Action Technology Screening and Alternative Development
Section 5.0	Removal Alternative Evaluation

Section 6.0 Recommended Removal Action Alternative

Section 7.0 References.

1.3 Definitions and Acronyms

The following Definitions and Acronyms appear in this report:

AOC – Administrative Order on Consent

ARAR – Applicable or Relevant and Appropriate Requirements

CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended.

Child high use area – A play and recreational area frequented by children and not part of a residential yard (*e.g.,* apartment or school playground, or daycare yard).

COC – Contaminants of Concern, in this evaluation, primarily lead

EBL child – a child under 72 months of age whose blood lead concentration is elevated, *i.e.,* greater than or equal to 10 µg/dL.

EE/CA – Engineering Evaluation and Cost Analysis – a document that evaluates alternative strategies to meet removal action objectives and identifies the one that satisfies the goal while being the most cost efficient.

IEUBK – Integrated Exposure Uptake Biokinetic model – model to determine allowable exposure levels to be protective of human health

MDNR – Missouri Department of Natural Resources

NCP – National Contingency Plan, 40 CFR 300.415(j), specifies that removal alternatives must be protective of human health and the environment and must meet the ARARs identified for the action.

NTCRA – Non Time Critical Removal Action – A Removal Action for soils that are below Time Critical levels of 1,200 ppm lead but still exceed EPA residential screening levels of 400 ppm lead.

PA/SI – Preliminary Assessment and Site Inspection – first step in characterizing the site

PRG – Preliminary Remediation Goal

RAO – Removal Action Objectives – the goal of the removal action, typically to protect human health.

SARA – Superfund Amendments and Reauthorization Act (1986).

TCRA – Time Critical Removal Action – A Removal Action for soils that are above 1,200 ppm lead.

USEPA – United States Environmental Protection Agency

VTHR – Viburnum Trend Haul Roads – an adjacent site also associated with potential lead contamination from mining-related activities.

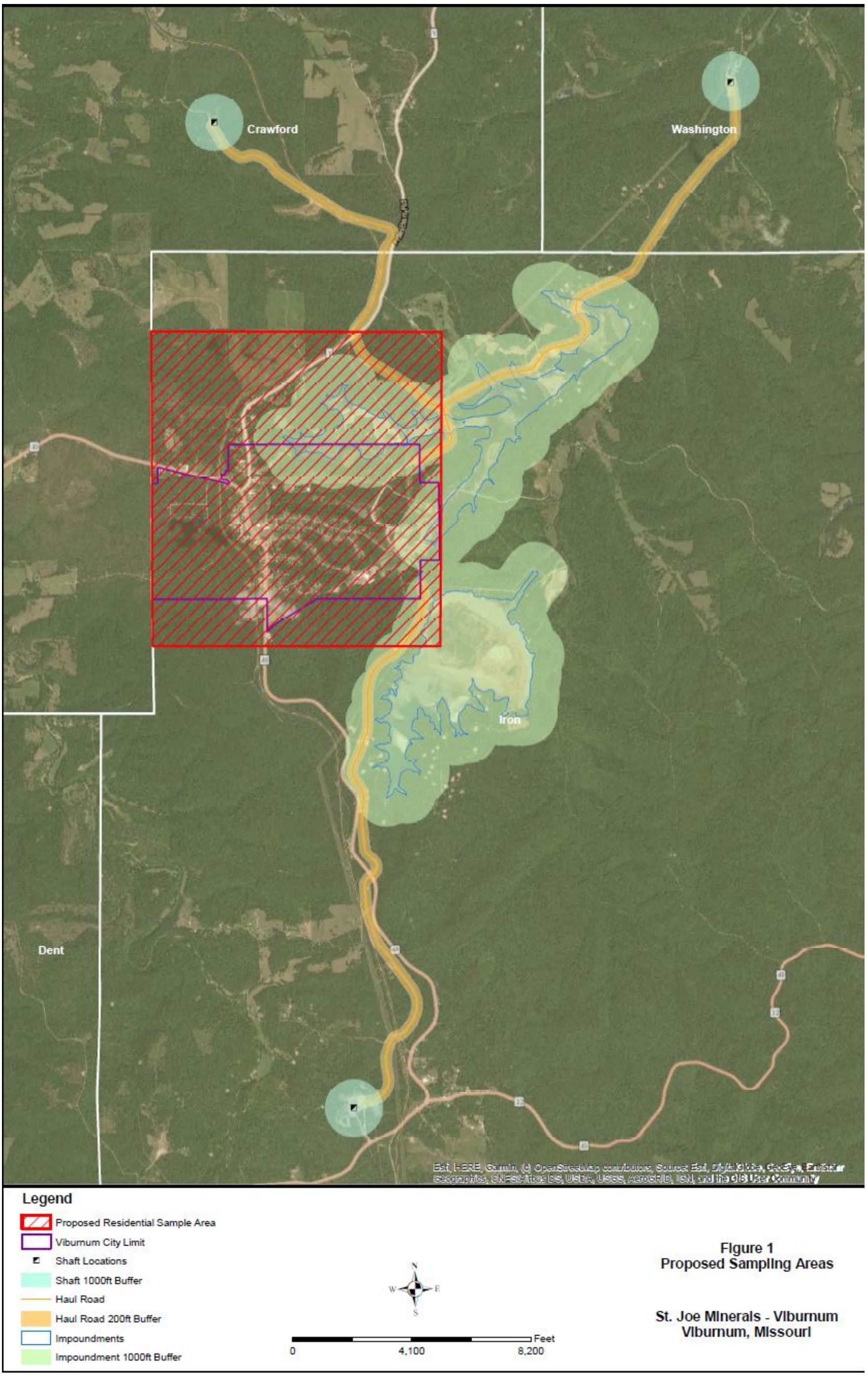

Figure 1: Site Location Map

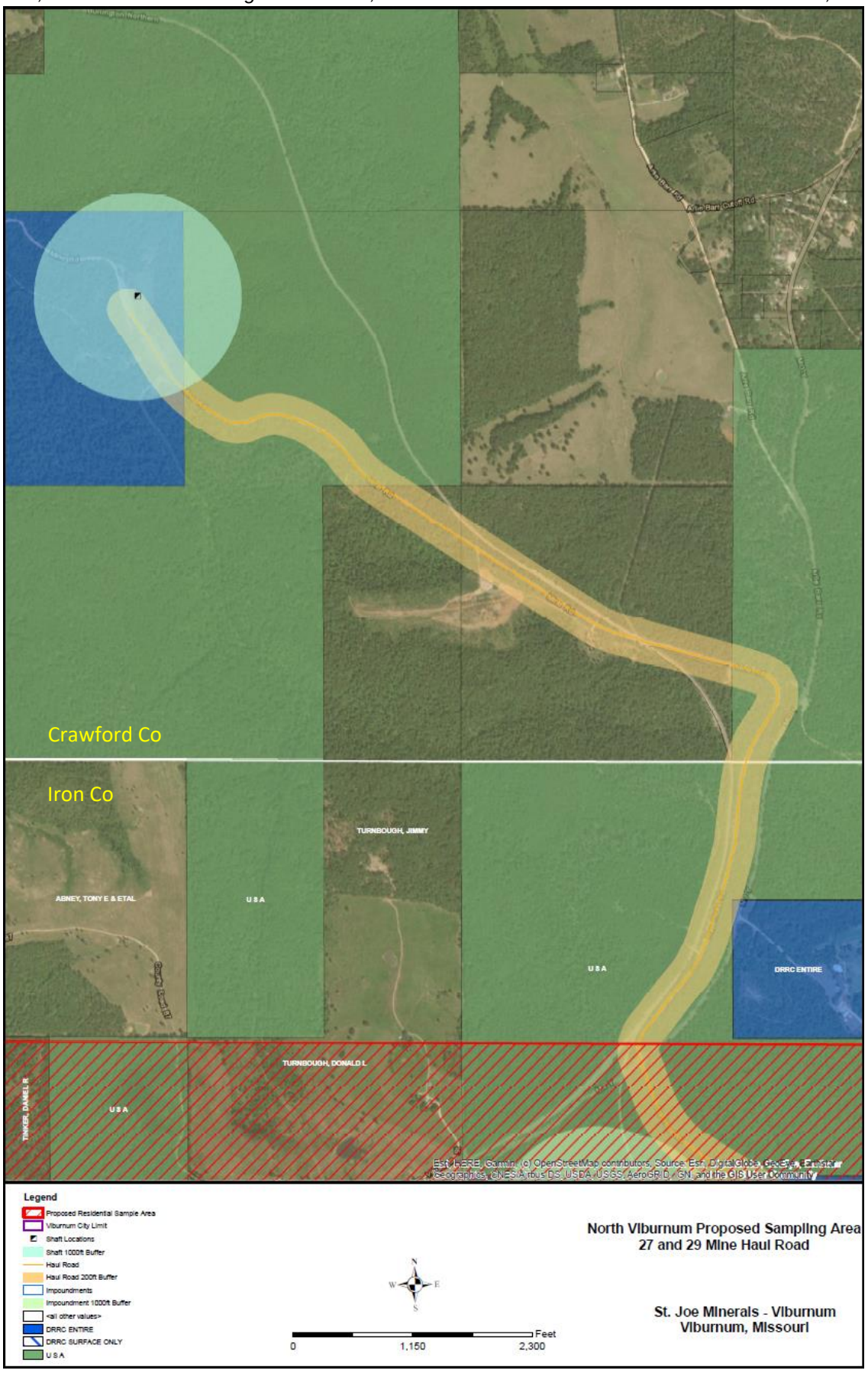

Figure 2: Crawford County Property Along Haul Road & Adjacent to No. 27 Mine

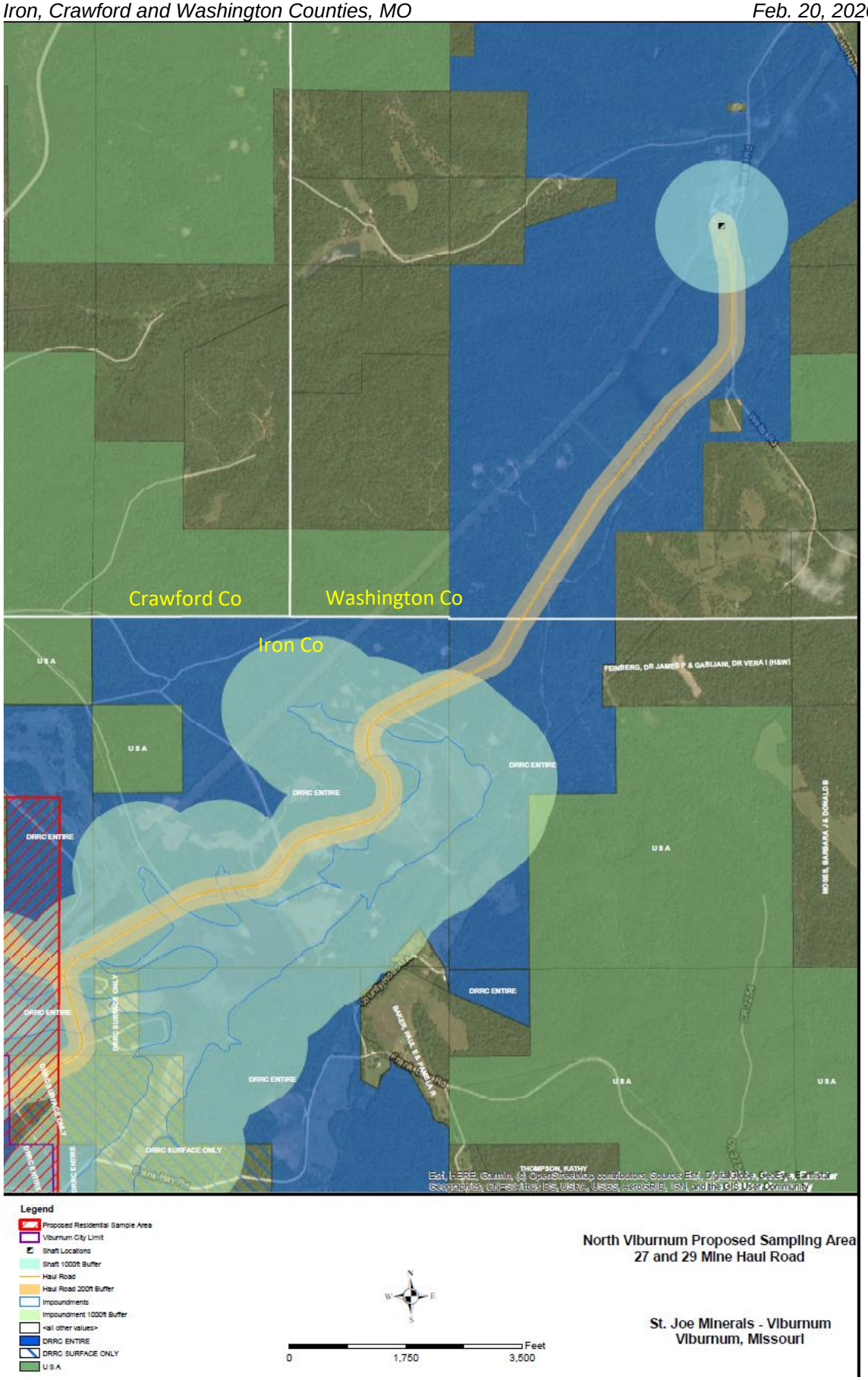

Figure 3: Washington County Property Along Haul Road & Adjacent to No. 29 Mine

2.0 SITE CHARACTERISTICS

2.1 Site Description and Physical Setting

The Viburnum Site is located in southeastern Missouri within Iron County and parts of Crawford and Washington Counties, approximately 90 miles southwest of St. Louis and consists of residential properties and child high use areas that are within or adjacent to the City of Viburnum in a polygon defined by the Iron-Crawford County boundary on the Western edge and has corners at approximate coordinates (37°44'00"N, 91°08'47"W), (37°43'58"N, 91°06'43"W), (37°42'11"N, 91°06'47"W), and (37°42'13"N, 91°08'49"W); adjacent to and within 200 feet of either edge of the haul roads from the Viburnum Mill to the Viburnum No. 27, No. 29, and Casteel mines; within 1,000 feet of the head frames of Viburnum No. 27, No. 29 and Casteel mines; and within the area within 1,000 feet from the edge of all Doe Run and St. Joe Minerals-Viburnum mine waste disposal areas (e.g. tailings piles). These are presented on Figure 1. Figure 2 shows a detail of the Crawford County portion of this site with property boundaries, and Figure 3 shows a detail of the Washington County portion of this site with property boundaries. Child high use areas are defined as play and recreational areas frequented by children and not part of a residential yard (*e.g.,* apartment or school playground, or daycare yard).

The topography is hilly with elevations ranging from about 700 to 1,000 feet above mean sea level (msl). The climate is continental with cold winters and hot summers. Annual precipitation is approximately 40 inches with a rainy season in fall and winter. Average annual snowfall is 13.7 inches. Prevailing winds are from the south and west-northwest (NewFields 2005). The population within the three counties is roughly 59,000 according to the 2017 Census projections. The City of Viburnum has a population of 668 (2017).

The Site is located in what is commonly known as the New Lead Belt or Viburnum Trend. The mining of lead ores began in the Viburnum Trend in 1960 around the town of Viburnum, Missouri, and continues production to this day. In the vicinity of the town of Viburnum, four mines historically operated: #27, #28, #29, and Casteel. From 1960-2000, a mill operated at the Mine 28 site on the outskirts of the town of Viburnum. Ore was trucked from the smaller mines to the mill to be processed via privately owned haul roads. Today Mines #27 and #28 are inactive, and the Mine #27 site has been cleared and reclaimed. Ore from the active #29 and Casteel mines is hauled on public roads to other mills owned by Doe Run for processing. Ore from the mines is crushed, milled, and beneficiated in order to form lead concentrate. The lead concentrate is shipped by truck—historically also by rail—to various smelters where it is further processed.

The presence of lead has been identified along haul routes and in the town of Viburnum through investigations conducted by USEPA, MDNR, and Doe Run during the Preliminary

Assessment and Site Inspection (PA/SI) ordered under AOC USEPA Docket No. CERCLA-07-2005-0339. Decades of mining, milling, and transporting of ores and concentrates are the suspected sources of the lead found at the site.

2.2 Exposure Pathways and Constituent of Concern

As discussed in the *Streamlined Risk Evaluation Report for the Viburnum Trend Haul Road Site* (NewFields 2008), lead in soil is considered to be the constituent of concern. This would also hold true for the Viburnum Site, as it is adjacent to the Viburnum Trend Haul Road (VTHR) Site and has a similar history. Local residents are assumed to be the primary population potentially exposed to lead in soil under the current and reasonably anticipated future land uses. Based on the site conceptual model, the only complete exposure pathways are incidental ingestion of lead in surficial soils and inhalation of lead in dust generated from surface soil. Therefore, the exposure pathways of concern for adult and child residents are incidental ingestion of soil and inhalation of dust in and about the home and yard.

2.3 Nature and Extent of Contamination and Scope of the Removal Action

The preliminary cleanup level for total lead in soils for the Non-Time-Critical Removal Action has been established at 400 ppm. This preliminary level is based on the residential preliminary remediation goal (PRG) accepted by the USEPA as being protective of sensitive residential receptors.

Based on yard sampling results from the Preliminary Assessment/Site Investigation (PA/SI) Report (Newfields 2006) and the Time-Critical Removal Action, one hundred nineteen (119) yards required remediation under the Time-Critical Removal Action. Of the Time-Critical yards, only one hundred ten (110) owners consented to remediation, and one (1) yard was capped by the homeowner and then retested below screening levels. Eight (8) property owners refused remediation. The remediation consisted of excavating 12 inches of soil; verifying lead levels in the bottom of the excavation (i.e. “subgrade”) were below EPA screening levels; if not, plastic construction barrier was placed and this was documented; then excavation was backfilled with USEPA-approved clean backfill of either soil or crushed stone, as appropriate to the material that had been excavated. The Removal Action was accomplished in 2007-2008, with two additional yards identified and remediated in 2018.

An additional sixty-eight (68) residential yards or child high use areas were identified during the PA/SI that exceed the threshold value for lead of 400 ppm in surface soil but were below Time-Critical levels of 1,200 ppm. These yards will be addressed as part of the Non-Time-Critical Removal Action. A list of the properties to be included in this action are in Table 1. Residences may be added as a result of additional sampling as a part of this Non-Time-Critical Removal Action.

3.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

This section of the EE/CA presents the Removal Action Objectives (RAOs) established to address lead in soil and identifies ARARs with which a selected removal action must comply.

3.1 Removal Action Objectives (RAO)

The overall cleanup goal for the Viburnum Site is to protect human health. As discussed previously, soil with lead concentrations above 400 ppm in residential yards or child high use areas will be addressed by the Non-Time-Critical Removal Action. Residents are assumed to be the primary population potentially exposed to soil under the current and reasonably anticipated future land uses. For the Viburnum Site, the specific RAO is to:

> Limit exposure to lead in soil such that no more than 5 percent of young children (72 months or younger) who live within the site are at risk for blood lead levels higher than 10 μg/dL from such exposure, based on the IEUBK model.

This objective is consistent with USEPA's guidance that USEPA should "…limit exposure to soil lead levels such that a typical child or group of similarly exposed children would have an estimated risk of no more than 5 percent of exceeding the 10 μg/dL blood lead level." Under this scenario, it is assumed that acceptable exposure point concentration (EPC) protective of this sensitive subpopulation could be reasonably assumed to be protective of other sensitive receptors.

USEPA's child lead uptake model ("IEUBK": Integrated Exposure Uptake Biokinetic model) considers many exposure, uptake, and biokinetic parameters in predicting the blood lead concentrations in young children exposed to lead from several sources and by several routes. The four primary components of the model include exposure, uptake, biokinetics, and variability. Complete exposure requires the contact and absorption of lead through exchange boundaries such as the gastrointestinal tract, lungs and skin. Uptake models the process by which lead that has entered a child's body is transferred to the blood. The biokinetic component describes the movement of absorbed lead throughout the body over time by physiologic or biochemical processes. Finally, variability addresses the different concentrations observed among exposed children. Using the default values for the model (*e.g.*, a bioavailability of 60 percent), an EPC of 400 ppm lead in soil is derived that is protective of a child receptor and meets the RAO established above.

3.2 Identification of ARARs

As part of the EE/CA and in accordance with the National Contingency Plan (NCP), 40 CFR 300.415(j), ARARs were evaluated to ensure that all requirements are met for the scope of work to be performed. As specified in the NCP, removal alternatives must satisfy two "threshold" criteria specified in order to be eligible for selection: 1) the remedy must be protective of human health and the environment; and 2) the remedy must meet (or provide the basis for waiving) the ARARs identified for the action.

Federal standards, requirements, criteria or limitations that are determined to be legal ARARs must be met by removal actions, as required by CERCLA (Section 121(d)(2)(A)). Also, State ARARs must be met if they are more stringent than Federal requirements. ARARs are designed to assure that potential removal actions at a site are protective of human health and the environment, cost-effective, and use permanent solutions, alternative treatment technologies or resource recovery technologies to the maximum extent practicable (USEPA 1988a). The Superfund Amendments and Reauthorization Act (SARA) requires that any hazardous substance or pollutant remaining on a site must meet the level or standard of control that is established by the ARARs for that site, unless the ARAR is waived.

Applicable requirements are defined by the NCP as those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, removal action, location, or other circumstances at a site (40 CFR 300.5).

Although a requirement may not be applicable as a matter of law, it may still be relevant and appropriate. A requirement is deemed relevant and appropriate if it regulates or addresses problems or situations sufficiently similar to those encountered such that it is well suited to that particular site. Determination of whether a requirement is relevant and appropriate is site-specific and determined by professional judgment based on the characteristics of the removal action, the hazardous substances present at the site, and the physical circumstances of the site and of the release. In some cases, only a portion of a requirement may be deemed relevant and appropriate (USEPA 1988b).

Compliance with all requirements found to be applicable or relevant and appropriate is required under SARA. A waiver from an ARAR may be obtained under certain circumstances (CERCLA Section 121(d)(4)). Other CERCLA statutory requirements, such as the requirement that remedies be protective of human health and the environment, cannot be waived. CERCLA Section 121(d)(2)(A) specifically limits the scope of State ARARs to standards, requirements, criteria, or limitations under environmental or facility siting laws that are promulgated and more stringent than Federal requirements.

ARARs are grouped into three categories:

- Chemical-Specific
- Location-Specific
- Action-Specific.

The NCP identifies a fourth category of information termed "to be considered" (TBC) when evaluating appropriate removal action goals or approaches. This fourth category generally includes Federal and State advisories, criteria or guidance that are not ARARs, and while not legally binding may be useful in developing CERCLA remedies (see 40 CFR 300.400(g)(3)).

The following sections provide a discussion of those requirements that have significant potential to be applicable or relevant and appropriate to removal actions at the Viburnum Site.

3.2.1 Potential Chemical-Specific ARARs

Chemical-specific requirements are based on health- or risk-based concentration limits or discharge limitations in environmental media (*i.e.*, water, soil, air) for specific hazardous chemicals. These requirements may be used to set cleanup levels for the chemicals of concern in the designated media or to set a safe level of releases where releases occur as part of the removal activity.

Sources for potential target cleanup levels include selected standards, criteria, and guidelines that are typically considered ARARs for removal actions conducted under CERCLA. Potential chemical-specific ARARs are presented in Table 2. No chemical-specific ARARs have been identified that directly relate to development of RAOs. However, they are pertinent to how the removal action may be implemented.

3.2.2 Potential Location-Specific ARARs

Location-specific ARARs are restrictions placed on the types of removal activities that may be implemented at particular site locations. The location of a site may be an important factor in determining the potential impact of removal actions on human health and the environment. These ARARs may restrict or preclude certain removal actions or they may apply only to certain portions of a site. The only potential location-specific State ARARs identified for the Viburnum Site were related to management of the waste materials. Potential Federal and State location-specific ARARs for the Viburnum Site are presented in Table 3.

3.2.3 Potential Action-Specific ARARs

Action-specific ARARs are usually technology or activity-based requirements or limitations on actions taken with respect to hazardous substances. These requirements are triggered by the removal activities selected to accomplish a remedy. Because there may be several alternative actions for any site, different requirements may be established. The action-specific requirements do not in themselves determine the removal alternative; rather, they indicate how a selected alternative should be implemented to achieve the requirement. Table 4 lists and describes potential Federal and State action-specific ARARs. The regulations on these tables represent potential action-specific ARARs for activities generally encountered in hazardous substance site remediation (*e.g.*, generation, transportation, storage, disposal, etc.). Regulations regarding worker health and safety such as Occupational Safety and Health Administration (OSHA) requirements are not included because they are not environmental requirements and are therefore not technically ARARs.

3.2.4 Other Guidance To Be Considered

For the Viburnum Site, guidance TBC that may be potentially applicable is related to location standards for hazardous waste facilities. As the Viburnum tailings facility that may be used to accept the excavated soils is a mine tailings pile and (most) mining wastes are explicitly excluded from RCRA regulations, these regulations are not enforceable but should be considered as part of the best management practices for the Viburnum Site.

4.0 REMOVAL ACTION TECHNOLOGY SCREENING AND ALTERNATIVE DEVELOPMENT

Consistent with USEPA's Guidance for conducting an EE/CA (USEPA 1993a), this section includes a summary of the identification and screening of removal technologies followed by the development of removal action alternatives to achieve the RAO developed in the previous section.

4.1 Technology Identification and Screening

Based on Viburnum Site conditions and the RAO, a range of General Response Actions (GRAs) were identified. GRAs are general categories of removal activities (*e.g.* no action, institutional controls, containment, etc.) that may be taken, either singly or in combination, to satisfy the requirements of the RAO.

Following this, removal action technologies and process options to be considered under each GRA were identified that would be applicable to the Viburnum Site. However, unlike a comprehensive Feasibility Study (FS), the purpose of an EE/CA is not to systematically evaluate every potential technology but to focus on proven technologies based on similar contamination scenarios at other sites. For the Non-Time-Critical Removal Action, these necessarily include the Time-Critical Removal Action at the Viburnum Site and Removal Action(s) at the VTHR Site. Additionally, similar sites such as the Jasper County Superfund Site in Joplin, Missouri and Vasquez Boulevard and I-70 Superfund Site in Denver, Colorado provide examples of potential available remedies for residential soil with elevated lead concentrations.

GRAs that are pertinent to the Non-Time-Critical Removal Action therefore include:

- No action
- Institutional Controls
- Public Health Actions
- Containment
- Soil removal.

Following the identification of the pertinent removal technologies and process options under each GRA, the technologies and process options were evaluated for effectiveness, implementability, and relative cost. The removal action technologies and process options that remained following the screening were carried forward for consideration in the development of removal action alternatives. The overall goal is to narrow the focus to a

subset of options consisting of only the most viable removal alternatives. Factors considered for each evaluation are as follows.

Effectiveness Evaluation. The primary measure of effectiveness used in this evaluation is the degree to which a process option would contribute to achievement of the RAO. Other effectiveness criteria include:

- The capacity to handle the estimated areas or volumes of soils to be cleaned up
- Potential impacts to human health and the environment during the construction and implementation phase
- The demonstrated reliability with respect to the Contaminants of Concern (COCs) and conditions at the site.

Process options may also be evaluated on the basis of effectiveness relative to other processes within the same technology type.

Implementability Evaluation. Technically inapplicable and infeasible removal technologies were eliminated from further consideration during the initial screening process described in the previous section. The technical and administrative feasibility of implementing a technology or process option is further considered during this final evaluation. Some of the administrative and technical aspects of a technology's implementability considered during this screening step include the following:

- Anticipated community acceptance (in particular compatibility with residential yard use)
- Availability of treatment, storage, and disposal services
- Availability of resources to implement the technology
- Availability of analytical services.

Cost Evaluation. The cost analysis is performed on the basis of information contained in USEPA guidance documents, experience in costing similar projects, independent estimates, and engineering judgment. Those process options providing similar effectiveness at significantly higher relative costs are eliminated from further consideration at this screening level. Relative cost evaluations between process options were only performed where they were necessary to facilitate the screening process. Detailed costs are provided for all retained options in Section 5.0.

The identified removal technologies and an evaluation are summarized on Table 5 and discussed in the following subsections.

4.1.1 No Action

No Action would entail performing no additional removal activities. The NCP requires that a No Action alternative be retained as a baseline against which other alternatives can be

compared in the detailed analysis, and therefore this alternative is retained without screening.

4.1.2 Institutional Controls

Institutional Controls are non-engineering mechanisms that provide the means by which Federal, State and local governments or private parties can prevent or limit access to or use of contaminated environmental media, the use of areas impacted by COCs, and/or to ensure the integrity and maintenance of engineered removal components. Institutional Controls may be applied on a stand-alone basis or implemented in conjunction with other response actions as part of an overall site remedy.

Types of land use controls are: (1) local land use regulations (such as subdivision ordinances or zoning regulations implemented by local governments for the purpose of protecting the health, safety and general welfare of the people by limiting access); (2) easements created by a grant from a property owner to another party prohibiting the property owner from conducting certain activities that may have the potential to cause a health threat; and (3) restrictive covenants, which are written restrictions or requirements placed on the title to real property that pass with the property and bind both current and future owners of the property to prohibit activities which may have the potential to cause a health threat.

Land use controls are typically used in situations where current use is something other than residential and RAOs are developed to protect workers or visitors. Controls that prevent future residential land use can, in these situations, achieve the requirements of risk-based RAOs. Because the Viburnum Site is already residential, in order to achieve the RAO, land use controls would need to restrict common activities that are associated with incidental exposure to soil and dust. It is likely that land use controls would neither be effective in protecting human health nor would they be accepted by the community. Land use controls would also not remove the COC from the environment, and potential for re-entrainment or transport to adjacent properties would exist. Therefore this technology alternative is eliminated from further consideration.

4.1.3 Public Health Actions

Public health actions could entail a program targeting specific subpopulations at risk and/or specific behavior that could potentially cause higher exposure. Actions may include education, biomonitoring and environmental sampling, public health referrals and engineering response to protect health.

Educational Materials

The deployment of educational materials was implemented during the investigation performed during the PA/SI and Time-Critical Removal Action as required under the AOC

and is currently in effect for the Viburnum Site. Additionally, educational materials have been used at other similar sites to assist in managing risks and to assist in preventing or minimizing exposures that are associated with specific subpopulations and activities, are very infrequent, or are suspected to be from multiple sources. Educational materials can be used to raise overall community awareness of the potential health risks, inform the community about behaviors and activities that result in exposure, inform the community on how to reduce or prevent exposures, and provide information about public health resources. However, this action is not protective of the environment or prevent the potential contamination of adjacent properties. Therefore this technology alternative is eliminated from further consideration.

Biomonitoring

Biomonitoring programs (such as blood lead testing) have been implemented successfully at other similar sites and would potentially be appropriate at the Viburnum Site for identifying higher than normal exposures that result from reasonable maximum exposure behavior and/or sources other than soil, as well as for evaluation of the effectiveness of other removal action engineering and response components.

However, under the Time-Critical Removal Action those portions of residential yards and child high use areas containing lead above 1,200 ppm were removed, as well as portions of the same property containing lead above 400 ppm. Under other alternatives considered, properties to be addressed as part of the Non-Time-Critical Removal Action will have the remaining surface soils above 400 ppm capped, stabilized or removed. Confirmation sampling will be conducted to ensure that post removal action objectives are met. Consequently, continued monitoring of sensitive receptors will not be necessary at properties where removal activities have occurred, as the EPC would be reduced below risk-based levels.

This method is reactive to exposure as opposed to preventive of potential exposure. It is also not protective of the environment nor does it address the potential of contamination of adjacent properties. As a result, this option of continued monitoring of sensitive receptors has not been retained as a remedial technology.

Environmental Sampling and Response

Environmental sampling and response activities could be implemented to address health risks identified by the biomonitoring program by accurately identifying sources of unacceptable exposure and addressing these sources.

As with biomonitoring, this method is reactive to exposure as opposed to preventive of potential exposure. It is also not protective of the environment nor does it address the potential of contamination of adjacent properties. Other alternatives considered examine removal or isolation of remaining lead in residential surface soils above 400 ppm, and confirmation sampling will be conducted to ensure that post removal action objectives are met. As

biomonitoring (above) has not been retained, there would be no basis for undertaking further environmental sampling. Consequently, environmental sampling (beyond confirmation sampling) has not been retained for the Non-Time-Critical Removal Action.

4.1.4 Containment

Containment actions entail isolating the COCs by physical means. Containment technologies include covering and surface control.

Covering

Containment of residential soils may be achieved by installation of engineered covers to prevent direct contact. There are a variety of available engineered cover designs, including simple soil, rock/gravel, geosynthetic, asphalt, concrete and multimedia (for example, soil-synthetic membrane, soil-synthetic membrane-clay caps, etc.). While this alternative does reduce risks to the environment and to adjacent properties, the impact to property owners may be unacceptable. The Viburnum Site is residential in nature, and the application of a cover would restrict normal activities and not be compatible with residential yard use. As a result, application of a cover is not retained as an option in the development of removal alternatives.

Surface Control

Surface controls may include soil grading, vegetation or tilling. Soil grading typically entails contouring the ground surface to potentially reduce exposure. Vegetation consists of seeding appropriate grass, legume or shrub species to provide a stand of vegetation that will reduce erosion and stabilize soils. Tilling includes mechanically turning over and mixing of the upper soil column such that contaminant levels at the surface are reduced. Grading would not be implementable in residential yards due to existing use requirements. Grading would also not address risks to the environment or transport of contamination to adjacent properties. Vegetation would not be effective as a stand-alone solution but could be used as a component of a tilling and restoration alternative.

Tilling includes mechanically turning over and mixing the upper soil column such that contaminant levels at the surface are reduced or in conjunction with other treatment technologies such as phosphate amendment. Tilling with revegetation may be a viable stand-alone alternative in cases where contaminant concentrations are close to cleanup goal levels and decrease with depth. It would not be effective as a stand-alone solution in situations where similar levels and/or relatively high levels of contamination exist throughout the tilling depth. Hand rototilling would be the most consistently practical option (larger mechanical tillers may be usable in large open areas with easy access, but this would not consistently be the case for the yards at the Viburnum Site where access is limited). Hand rototilling typically achieves about a 6-inch tilling depth. At the Viburnum Site the rocky soil and the established tree root structure would tend to effectively prohibit rototilling in most of the yards by either damaging the roots or equipment. Since tilling has

some problems associated with implementation at the Viburnum Site, it was not retained as an option in the development of removal alternatives.

4.1.5 Soil Removal

Conventional open cut excavation of shallow soils is typically conducted by means of earthmoving equipment, including excavators, wheel loaders, and scrapers. This technology was used during the Time-Critical Removal Action at the Viburnum Site and is therefore applicable to Viburnum Site conditions and retained for further evaluation.

Excavated soils may be disposed at an appropriate landfill or other facility. Disposal was used during the previous Time-Critical Removal Action and therefore is applicable to site conditions and is retained for further evaluation. Under the soil removal action the soils would be excavated and disposed of at the Viburnum Tailings Facility, a permitted Remedial Soil repository, near the City of Viburnum, Missouri or a suitable landfill. Soils that fall between 400 and 1,200 ppm total lead, which are expected to comprise the bulk of the soils from the future Non-Time-Critical Removal, are expected to be non-hazardous by RCRA toxicity characteristics based on the results obtained from the Time-Critical Removal Action and could be placed in a suitable Subtitle D landfill. Soils with lead concentrations greater than 1,200 ppm may be hazardous by RCRA toxicity characteristic and thus will need to be placed in a Subtitle C landfill if disposed of off-site. Doe Run has received a Remedial Action Plan (RAP) permit (USEPA ID# MOD 000-823-252) authorizing the treatment, storage and disposal of hazardous remediation waste (as defined under 40 CFR §260.10). This permit allows, among other things, the placement of up to 100,000 tons of remediation waste (including soils from both the City of Viburnum Time-Critical and No-Time-Critical Removal Actions and the VTHR Time-Critical and Non-Time-Critical Removal Actions) at the existing permitted Viburnum tailings facility. Sampling will be performed on the soils at the Viburnum tailings facility at a rate of one sample per excavated waste pile to determine if the soils are hazardous by characteristic. If the Toxicity Characteristic Leaching Procedure (TCLP) test results equal or exceed 5 mg/L, the soils will be amended with phosphate or a similar metal stabilizing reagent and retested prior to placement in the Viburnum tailings facility. Final placement following amendment will be contingent on meeting a treatment value of 10 times the Universal Treatment Standard for lead in non-wastewaters (7.5 mg/L) as determined by TCLP analysis.

All excavated areas of the yard will be replaced with clean fill (soil or crushed stone that has no levels of COC's that would pose a threat to human health). Once clean soil has been brought in to bring the excavated areas to approximate pre-excavation grade, filled areas will be seeded with lawn grass. Vegetation will be used to stabilize restored yard soils.

This technology would be effective at reducing exposure to humans and the environment from the COC. Once the affected soil is removed, there would be no risk to adjacent properties either. This technology is also implementable as it has historically been used for

remediating residential areas across the United States and specifically in Missouri, and the resources to accomplish the task (mobile equipment, haul trucks, soil testing equipment, analytical labs, etc.) are readily available. Therefore this option is retained.

4.2 Removal Alternative Development

Cleanup of residential yards with elevated lead levels has been performed at many Sites across the United States, including the New Lead Belt and Viburnum Trend Haul Road (VTHR) Site. Consistent with experience gained at those Sites, the following basic conceptual removal alternatives have been identified for the Site:

- **Alternative 1: No Action**

- **Alternative 2: Soil Removal**

  2.a Disposal at the Viburnum tailings facility

  2.b Disposal at the Viburnum tailings facility and Subtitle C (Hazardous Waste) Landfill

  2.c Disposal at Subtitle D (Solid Waste) and Subtitle C (Hazardous Waste) Landfills.

The conceptual alternatives are described in more detail in the following subsections. Supporting actions such as addressing potential tracking of impacted soils into home interiors and distributing health education materials will be considered for all action alternatives.

4.2.1 Alternative 1 – No Action

No Action would entail performing no additional removal activities. The NCP requires that a No Action alternative be retained as a baseline against which other alternatives can be compared in the EE/CA analysis.

4.2.2 Alternative 2 – Soil Removal

Under this Alternative 2, accessible surface soils in residential yards and child high use areas with lead concentrations greater than 400 ppm would be removed to a depth of 6 to 12 inches and confirmation sampling performed to document the lead concentrations at the base of the excavation. An area of a yard may be excavated to a depth of less than 12 inches provided confirmation sampling indicates that remaining soil lead concentrations do not exceed 400 ppm. Should lead concentrations after removing 12 inches of soil be greater than 1,200 ppm, excavation would continue in 6-inch lifts until the soil concentration falls below 1,200 ppm. As a result, in these areas, the excavations would be greater than 12 inches. Excavation typically stops at 24 inches and a

demarcation barrier is placed and documented. Based on results of the Time-Critical Removal Action and the recently completed VTHR Non-Time Critical Removal Action, these deeper excavations are expected to be rare. Conventional open cut excavation of shallow soils is typically conducted by means of earthmoving equipment, including excavators, wheel loaders, and scrapers. This technology was used during the Time-Critical Removal Action at the Viburnum Site and is therefore applicable to Viburnum Site conditions. Excavated areas would be backfilled with clean soil or other suitable material and the area restored for use.

Excavated soils that contain between 400 and 1,200 ppm total lead, which comprise the bulk of the soils from the Non-Time-Critical Removal, are expected to be non-hazardous by characteristic (TCLP test) based on the soil results obtained from the Time-Critical Removal Action. However, it is possible that some soils will be hazardous by characteristic. There are a number of laboratories within a few hours travel from the site that can perform these TCLP analyses.

There are certain basic options for disposal of excavated soil as described below.

Summary of Soil Disposal Options – Removal Alternative 2

Alternative	Soils Non-Hazardous By Characteristic	Soils Hazardous by Characteristic
2.a	Viburnum tailings facility	Viburnum tailings facility (after Stabilization Chemical Amendment)
2.b	Viburnum tailings facility	Subtitle C Landfill
2.c	Subtitle D Landfill	Subtitle C Landfill

Doe Run has received a RAP permit (USEPA ID# MOD 000-823-252) authorizing the treatment, storage, and disposal of hazardous remediation waste (as defined under 40 CFR §260.10) at its existing Viburnum tailings facility. This permit allows the placement of up to 100,000 tons of remediation waste (including soils and other materials from both the City of Viburnum and VTHR Time-Critical and Non-Time-Critical Removal Actions). Remedial Soils are stockpiled in a staging area upon entering the facility and characterized by stockpile. Soils passing TCLP (containing less than 5 mg/L leachable lead) are placed in the repository. If the TCLP results of a stockpile equal or exceed 5 mg/L lead, the soils could be amended with phosphate or another suitable metal-stabilizing agent until the TCLP result is reduced to meet acceptable standards and then placed in the Viburnum tailings facility. Final placement following amendment will be contingent on meeting a treatment value of 10 times the Universal Treatment Standard for lead in non-wastewaters (7.5 mg/L) as determined by TCLP analysis. The TCLP samples are usually submitted to analytical labs with a standard turnaround time of 10 days, but samples can be accelerated to 2-3 days if needed.

Excavated soils could also be disposed at a Subtitle D landfill (non-hazardous by characteristic) or at a Subtitle C landfill (hazardous by characteristic).

5.0 REMOVAL ALTERNATIVE EVALUATION

This section provides a detailed analysis of the removal alternatives developed in Section 4. The alternatives are evaluated to ensure that the selected removal alternative will be protective of human health; comply with or include a waiver of ARARs; be cost-effective; utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and address the statutory preference for treatment as a principal element.

5.1 Evaluation Criteria

The evaluation of the overall protection of human health and the environment is based on a composite of factors assessed under the evaluation criteria. The criteria specifically considered are: short-term effectiveness, long-term effectiveness and permanence, implementability, cost, and compliance with ARARs.

5.1.1 Effectiveness

Short-Term Effectiveness

This evaluation criterion addresses the effects of the removal alternative during the construction and implementation phase until the removal objectives are met. Alternatives are evaluated with respect to their potential effects on human health and the environment during implementation of the removal action. As specified in the CERCLA guidance, the short-term impacts of each removal alternative are assessed considering the following factors:

- Short-term risks that might be posed to the community during implementation of removal action
- Potential impacts on workers during removal action and the effectiveness and reliability of protective measures
- Potential environmental impacts of the removal action and the effectiveness and reliability of mitigative measures during implementation
- The time until protection is achieved.

Long-Term Effectiveness/Permanence

Evaluation of long-term effectiveness and permanence considers the risks remaining after the response objectives have been met. Factors considered, as appropriate, include the following.

- Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the removal activities.

- Adequacy and reliability of controls. This factor assesses the adequacy and suitability of controls, if any, that are used to manage untreated wastes that remain at the site. The long-term reliability of management controls for providing continued protection are also assessed, including the potential need to replace technical components of the alternative, and the potential exposure pathway and the risks, should the removal action need replacement.

5.1.2 Implementability

This criterion addresses the technical and administrative feasibility of implementing each removal alternative and the availability of various services and materials required during its implementation. As specified in the CERCLA guidance, the evaluation of implementability includes three categories of analysis: technical feasibility, administrative feasibility, and availability of services and materials. The services and materials needed to execute the retained options are all readily available.

5.1.3 Cost

For each alternative, a -30 to +50 percent cost estimate is developed in accordance with procedures in the *Remedial Action Costing Procedures Manual (USEPA 2000)*. Cost estimates for each alternative are based on conceptual engineering and design and are expressed in terms of 2010 dollars. The cost estimate for a removal alternative consists of four principal elements.

- **Removal action cost** – Removal action cost consists of direct (construction), indirect (non-construction and overhead) costs, and costs associated with the implementation of health educational materials. Direct costs include the cost for equipment, labor, and materials incurred to develop, construct, and implement a removal action. Indirect costs are expenditures for engineering, financial, and other services that are not actually a part of construction but are required to implement a removal alternative. These items are included in the detailed cost analysis.

- **Operation and maintenance cost** – Operation and maintenance (O&M) cost refers to post-removal action cost items necessary to ensure the continued effectiveness of a removal action. For the alternatives under consideration in this

EE/CA, there are no O&M activities other than periodic review. Long-term actions, such as implementation of distribution of health education materials, are considered to be a component of the removal action.

- **Present worth analysis** – This analysis is used to evaluate the removal action and O&M costs of a removal alternative based on its present worth. A present worth analysis compares expenditures for various alternatives where those expenditures occur over different time periods. By discounting all costs to a common base year, the costs for different removal action alternatives can be compared based on a single cost figure for each alternative. The total present worth for a single alternative is equal to the full amount of all costs incurred through the end of the first year of operation (capital cost), plus the series of expenditures in following years reduced by the appropriate future value/present worth discount factor. This analysis allows the comparison of removal alternatives on the basis of a single cost representing an amount that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the removal action over its planned life. A discount rate of 7 percent is assumed for base calculations (USEPA 1993b). The discount rate represents the anticipated difference between the rate of inflation and investment return.

5.2 Individual Removal Alternative Evaluation

5.2.1 Alternative 1 – No Action

The No Action alternative provides a baseline for the evaluation of other alternatives in accordance with the NCP. No additional protective measures would be taken for the no-action option. As noted previously, soils have already been removed from 110 residential properties at the site.

The No Action alternative does not meet the requirements of the RAO and does not provide protection of human health or the environment for the remaining non-time-critical properties.

5.2.2 Alternative 2 – Soil Removal

This alternative considers the removal of Viburnum Site surface soils in yards with total lead concentrations greater than 400 ppm. Accessible soils would be removed to a typical depth of 6-12 inches and confirmation sampling performed to document that remaining soil concentrations are below 1,200 ppm. Areas that have subgrade soil concentrations greater than 1,200 ppm would be removed until subgrade soils contain total lead concentrations less than 1,200 ppm per the procedures required under the Time-Critical Removal Action.

Effectiveness

Alternative 2 would meet the requirements of the RAO by removal of all soil with lead concentrations above 400 ppm within the upper foot of soil and backfilling with clean material. This would prevent direct contact with soils with lead concentrations above 400 ppm. The alternative would provide a high level of protection of human health and the environment, although there would be increased short-term risks associated with transportation of excavated soil from and clean backfill to the site.

ARARs relating to the generation of fugitive dust and lead concentrations in ambient air would be applicable to actions performed to implement Alternative 2. Although the potential exists for dust generation during soil excavation, transport and backfilling activities, engineering controls, such as tarping loads or water application, and would be readily implementable and effective to achieving compliance with the applicable regulations. ARARs relating to the characterization, transport and disposal of solid wastes would be applicable and would be met by standard construction and transportation practices. Alternative 2 would therefore meet the requirements of all ARARs.

Short Term

The short-term risk to the community and workers during implementation of this alternative would be low.

Risks would be posed to members of the community due to the operation of heavy equipment in the residential areas and by truck traffic associated with transportation of excavated soil off site and import of clean backfill. As a screening level estimate, a total of approximately 1836 dump truck trips would be needed to transport the excavated soil to the Viburnum tailings facility and to transport the clean backfill soil to the site (about 11,000 cubic yards of excavated soil and an equal amount of backfill transported in 12 cubic yard capacity trucks). The injury and fatality rates for accidents involving large trucks in 2007 (FMCSA 2008) were 33.4 per 100 million vehicle miles driven and 2.02 per 100 million vehicle miles driven, respectively. Assuming a maximum transport distance of 2 miles to the Viburnum tailings facility and 20 miles to the backfill source, application of the 2007 statistics estimates that there would be a 1.3 percent probability that one of the trucks would be involved in an accident that injures someone and a 0.08 percent chance of a fatality.

Long Term

This alternative would provide a high degree of long-term effectiveness and protection, because accessible soils with lead concentrations above 400 ppm within the upper foot of soil would be removed from the site and replaced with clean backfill.

Implementability

Alternative 2 would be implementable with standard equipment and services, and trained personnel would be readily available for this type of work. The construction technologies required to implement this alternative are commonly used and widely accepted. Adequate disposal facilities are available in the area, as are suitable sources of clean backfill. Analytical labs for testing removed soils are also readily available. Removal is a reliable technology, and no future removal actions would be required because soils of concern would be removed from the Viburnum Site.

Cost

The present net worth cost for Alternative 2 using the Viburnum tailings facility disposal option (2a) is approximately $1.4 million. Detailed information on the unit rates, quantities and assumptions used in the development of the costs are presented in Table 6. A cost comparison of the Alternative using the other combinations of disposal options is presented below.

Summary Cost by Soil Disposal Options – Removal Alternative 2

Alternative	Soils Non-Hazardous By Characteristic	Soils Hazardous by Characteristic	Total Cost	Net Present Worth (assumes capital costs are distributed equally over two years)
2.a	Viburnum tailings facility	Viburnum tailings facility (with Metal Stabilization Amendment)	$1,437,261	$1,405,929
2.b	Viburnum tailings facility	Subtitle C Landfill	$1,567,960	$1,533,778
2.c	Subtitle D Landfill	Subtitle C Landfill	$3,072,350	$3,005,373

After initial seeding and watering, all lawn care will be the responsibility of the property owner. Therefore, no periodic or ongoing costs are associated with this Alternative.

5.3 Comparative Analysis of Alternatives

This section contains a comparative analysis of the alternatives. However, the No Action Alternative is not protective of human health and is not evaluated. Therefore, Alternative 2 is the recommended alternative.

6.0 RECOMMENDED ALTERNATIVE

Based on the above comparison, it is recommended that Alternative 2 be selected. Alternative 2 contains the following elements:

- Residential yard and child high use area soils with lead greater than 400 ppm will be excavated to a depth of 6-12 inches or until the subgrade soil lead concentrations are less than 1,200 ppm and replaced with clean materials. Excavated soils will be disposed of at the Viburnum tailings facility or appropriate Subtitle C and/or D landfill.

- Consistent with the Time-Critical Removal activities, health educational materials will be provided.

7.0 REFERENCES

FMSCA, 2008. *2007 Large Truck Crash Overview*, prepared by Analysis Division, Federal Motor Carrier Safety Administration, U.S. Department of Transportation, December. http://www.fmcsa.dot.gov/facts-research/research-technology/report/2007LargeTruckCrashOverview.pdf.

NewFields, 2007. *Work Plan for Time-Critical Removal Action, St. Joe Minerals Corp – Viburnum Site.* July.

NewFields, 2008. *Streamline Risk Evaluation Report. Viburnum Trend Haul Roads Site.* August.

NewFields, 2010. *Engineering Evaluation/Cost Analysis Work Plan. Non-Time-Critical Removal Action. Viburnum Trend Haul Roads Site.* March.

NewFields, 2018. *Removal Action Report: Time-Critical Removal Action, St. Joe Minerals Corp – Viburnum Site*. December.

Tetra Tech EM Inc. (TTEMI), 2005. *Removal Site Evaluation Report, Viburnum Trend Lead Site – Viburnum Missouri*. Prepared for USEPA Region 7, START 2 Contract No. 68-S7-01-41, Task Order No. 0188, July 27.

United States Environmental Protection Agency (USEPA), 1988a. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA Interim Final.* EPA/540/G-89/004, OSWER Directive 9355.3-01. October.

USEPA, 1988b. *CERCLA Compliance with Other Laws Manual Draft Guidance*. August.

USEPA, 1993a. *Guidance on Conducting Non-Time Critical Removal Actions under CERCLA.* EPA/540/R-93/057. OSWER 9360.0.32. August.

USEPA, 1993b. *Memorandum: Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis.* OSWER Directive No. 9355.3-20. June.

USEPA, 2000. *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study.* OSWER 9355.0-75. EPA/540/R-00/002. July.

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Appendix A

Basis of Cost Estimates

Appendix A
Basis of Cost Estimates

Detailed cost estimates for the action alternative are provided in Table 5. Alternative 1 (No Action) is the baseline for the cost estimates for the other alternatives and is assumed to have no associated cost. These detailed estimates present the quantities made in establishing the scope of work (areas, volumes, etc.) and the calculations from which the estimated costs were derived. The unit costs shown for each work item reflect an assessment of the labor, materials and equipment required for each identified item and include allowances for appurtenant and incidental work as well as contractor overhead and profit. Unit cost rates and assumptions are discussed below. These costs have been developed such that the accuracy of the estimates is anticipated to fall within the acceptable range for typical feasibility study/EECA evaluations of +50% to -30%, in accordance with USEPA guidance ("A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" OSWER 9355.0-75).

Direct Capital Costs

The basis and assumption for direct costs for each major task as it relates to the alternatives evaluated under the Non-Time-Critical Removal Action are broken down in the following sections.

General

Number of residences included in Non-Time-Critical Removal Action was set at 68 based on information provided by NewFields. NewFields compiled this information during the Preliminary Assessment/Site Investigation (PA/SI) phase in 2005-2006.For estimating purposes the residences on the included list were used. The estimated areas used for each excavation feature were developed based on professional judgement and representative estimates made from GIS software of a typical Viburnum yard.

Soil Removal and Placement

For the purposes of costing, all removals were conservatively estimated to be one foot deep, which is the basis for the Non-Time-Critical Removal Action. Based on information obtained from the Viburnum Trend Haul Road (VTHR) Non-Time-Critical Removal Action, most contamination was found to drop below 400 ppm within six inches with only a few areas requiring excavation greater than 12" depth. Consequently, the use of one foot is conservative and likely biased high.

Unit costs are based on per volume estimates provided by Entact in their 2018 bid for work on the VTHR Non-Time-Critical Removal Action, a similar project.

Soil Hauling and Disposal

As part of the RAP, the Doe Run Viburnum tailings facility has been approved to accept 100,000 tons of soil generated as part of the Non-Time-Critical Removal Action. This is sufficient to accommodate the expected soils generated as part of the removal action. Soils less than 1,200 ppm lead are anticipated to be non-hazardous by characteristic and meet the requirements for direct placement (Toxicity Characteristic Leaching Procedure [TCLP] test less than 5 mg/L). Each stockpile of excavated waste will be sampled and tested for TCLP lead prior to final disposal. For the cost estimate it is assumed that one test will be performed per 400 tons excavated material. Analytical cost per sample for the TCLP lead is based on recent invoices from labs doing business with Doe Run and the assumption that several samples can be shipped and analyzed at the same time.

For the VTHR Time Critical Removal Action, a similar project, LFI reports that only 2.5 to 5% of the Time-Critical yard soils were found to be hazardous. As the Non-Time-Critical Removal Action soils are not expected to be greater than 1,200 ppm lead, the assumption that 2.5% of the total excavated waste will be considered hazardous by characteristic and would require special disposal (either a metal stabilizing amendment prior to placement in the Viburnum tailings facility as required under the RAP or disposal at a Subtitle C landfill) is considered over-conservative. A single phosphate treatment was estimated assuming the same ratio as required in the 2006 version of the RAP permit of 2% by weight (8 tons per 400 ton stockpile). Labor for the mixing and placement of soils on the pile were not included as these were assumed to be performed by Doe Run personnel as part of mine O&M activities.

The distances provided to the nearest Subtitle D landfill (Crawford County, MO) and Subtitle C landfill (Peoria, IL) that could accept the soils were approximately 70 miles and 290 miles, respectively. The average distance to the on-site Repository was given as approximately 2 miles by Doe Run which was used as the basis for the estimate. For the purposes of this estimate, the unit rate for hauling the excavated soils provided by Entact in 2018 for the VTHR Non-Time-Critical Removal Action, a similar project, was used. Likewise, for the borrow soils, it was estimated that these would be available locally (within 20 miles of the Viburnum Site) and the unit rate provided by Entact in 2018 for the VTHR Non-Time-Critical Removal Action was used.

Education Materials

For the Known Yards, educational materials have already been distributed and no direct additional cost was assumed for the purposes of this evaluation.

Indirect Capital Costs

Indirect capital costs were developed based on the USEPA Guidance (USEPA, 2000) and professional judgment. For these, recommended factors were applied to the direct capital costs as provided on Table 5.

Additionally, as the costs have been developed based (primarily) on the Time-Critical Removal Action, and a related Non-Time Critical Removal Action, the low end of the recommended contingency for the bidding of ten percent was selected. Therefore, the overall scope and bid contingency was established at 31 percent for the Non-Time-Critical Removal Action.

Ongoing Removal Action Annual Cost Estimates

There are no ongoing costs associated with any of the alternatives – all activities are considered to be part of remedial action.

Periodic Costs

There are no periodic costs associated with any of the alternatives – all activities are considered to be part of remedial action. As specified in USEPA guidance (USEPA, 1988), a 30-year period has been used for costing purposes. All periodic costs for this facility are managed under the RAP permit.

Operation and Maintenance Costs

There are no Operation and Maintenance costs associated with any of the alternatives – all activities are considered to be part of remedial action.

Present Worth Calculations

Present worth analyses were performed on estimated costs associated with each remedial alternative to provide a common basis for comparison. Present worth analysis calculates a current value, or worth, of all costs incurred in the present or at some future date at an assumed constant rate of return, or discount rate. The present worth calculated represents an amount, which if invested in 2018 at a certain rate of return would yield the

appropriate dollar amount to meet the required expenditures over the construction and 30-year remedial action periods. The exact duration of initial implementation and corresponding capital costs will be dependent on the results of the remedial design phase. At that time the most appropriate implementation scenario can be developed. However, the assumed durations are reasonable and allow for an objective, relative comparison of the alternatives. Capital costs have been spread over two years, assuming two-thirds of the work could be completed in the first year, with the remainder being completed in the second year. Present worth calculations are presented in Table A-1 for Alternative 2.

Because total remedial action costs could be especially sensitive to the prevailing rate of return used in the present worth analyses, rates of return of 3%, 7%, and 10% were used to prepare present worth estimates for each alternative. The capital costs spread out over the anticipated implementation period of two years were also discounted to constant 2018 dollars using rates of return of 3%, 7%, and 10%. As recommended in the USEPA Guidance (USEPA 2000), only the present worth calculated at an assumed 7% rate of return has been presented in the text and used in the comparison of costs. The present worth analyses performed in this report are considered before-tax analyses and do not consider future escalation of costs.

Cited References

Tetra Tech EM Inc. (TTEMI), 2005. *Removal Site Evaluation Report, Viburnum Trend Lead Site – Viburnum Missouri*. Prepared for USEPA Region 7, START 2 Contract No. 68-S7-01-41, Task Order No. 0188, July 27, 2005.

United States Environmental Protection Agency (USEPA), 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA Interim Final.* EPA/540/G-89/004, OSWER Directive 9355.3-01. October 1998.

USEPA, 2000. *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study.* OSWER 9355.0-75. EPA/540/R-00/002. July 2000.

USEPA, 2003. *Superfund Lead-Contaminated Residential Sites Handbook. Prepared by the Environmental Protection Agency Lead Sites Workgroup (LSW)*, OSWER 9285.7-50, August 2003.

Entact, 2018. Proposal for the Viburnum Trend Lead Haul Roads (VTHR) Project. June 18, 2018.

TABLE A-1

PRESENT WORTH ANALYSIS VIBURNUM
NON-TIME-CRITICAL REMOVAL ALTERNATIVE
2 - REMOVAL AND DISPOSAL

Option 2a - Onsite Disposal				Rate of Return = 3%		Rate of Return = 7%		Rate of Return = 10%	
Year	Capital Costs	Ongoing Costs	Total Annual Expenditure	Discount Factor	Present Worth	Discount Factor	Present Worth	Discount Factor	Present Worth
0	$ 958,174	$ -	$ 958,174	1.0000	$ 958,174	1.0000	$ 958,174	1.0000	$ 958,174
1	$ 479,087	$ -	$ 479,087	0.9709	$ 465,146	0.9346	$ 447,755	0.9091	$ 435,538
2		$ -	$ -	0.9426	$ -	0.8734	$ -	0.8264	$ -
3		$ -	$ -	0.9151	$ -	0.8163	$ -	0.7513	$ -
4		$ -	$ -	0.8885	$ -	0.7629	$ -	0.6830	$ -
5		$ -	$ -	0.8626	$ -	0.7130	$ -	0.6209	$ -
6		$ -	$ -	0.8375	$ -	0.6663	$ -	0.5645	$ -
7		$ -	$ -	0.8131	$ -	0.6227	$ -	0.5132	$ -
8		$ -	$ -	0.7894	$ -	0.5820	$ -	0.4665	$ -
9		$ -	$ -	0.7664	$ -	0.5439	$ -	0.4241	$ -
10		$ -	$ -	0.7441	$ -	0.5083	$ -	0.3855	$ -
11		$ -	$ -	0.7224	$ -	0.4751	$ -	0.3505	$ -
12		$ -	$ -	0.7014	$ -	0.4440	$ -	0.3186	$ -
13		$ -	$ -	0.6810	$ -	0.4150	$ -	0.2897	$ -
14		$ -	$ -	0.6611	$ -	0.3878	$ -	0.2633	$ -
15		$ -	$ -	0.6419	$ -	0.3624	$ -	0.2394	$ -
16		$ -	$ -	0.6232	$ -	0.3387	$ -	0.2176	$ -
17		$ -	$ -	0.6050	$ -	0.3166	$ -	0.1978	$ -
18		$ -	$ -	0.5874	$ -	0.2959	$ -	0.1799	$ -
19		$ -	$ -	0.5703	$ -	0.2765	$ -	0.1635	$ -
20		$ -	$ -	0.5537	$ -	0.2584	$ -	0.1486	$ -
21		$ -	$ -	0.5375	$ -	0.2415	$ -	0.1351	$ -
22		$ -	$ -	0.5219	$ -	0.2257	$ -	0.1228	$ -
23		$ -	$ -	0.5067	$ -	0.2109	$ -	0.1117	$ -
24		$ -	$ -	0.4919	$ -	0.1971	$ -	0.1015	$ -
25		$ -	$ -	0.4776	$ -	0.1842	$ -	0.0923	$ -
26		$ -	$ -	0.4637	$ -	0.1722	$ -	0.0839	$ -
27		$ -	$ -	0.4502	$ -	0.1609	$ -	0.0763	$ -
28		$ -	$ -	0.4371	$ -	0.1504	$ -	0.0693	$ -
29		$ -	$ -	0.4243	$ -	0.1406	$ -	0.0630	$ -
30		$ -	$ -	0.4120	$ -	0.1314	$ -	0.0573	$ -
TOTAL PRESENT WORTH				NPV at 3%	$ 1,423,320	NPV at 7%	$ 1,405,929	NPV at 10%	$ 1,393,712

Option 2b - Onsite Non-Haz with offsite Haz Disposal				Rate of Return = 3%		Rate of Return = 7%		Rate of Return = 10%	
Year	Capital Costs	Ongoing Costs	Total Annual Expenditure	Discount Factor	Present Worth	Discount Factor	Present Worth	Discount Factor	Present Worth
0	$ 1,045,306	$ -	$ 1,045,306	1.0000	$ 1,045,306	1.0000	$ 1,045,306	1.0000	$ 1,045,306
1	$ 522,653.17	$ -	$ 522,653	0.9709	$ 507,444	0.9346	$ 488,472	0.9091	$ 475,144
2		$ -	$ -	0.9426	$ -	0.8734	$ -	0.8264	$ -
3		$ -	$ -	0.9151	$ -	0.8163	$ -	0.7513	$ -
4		$ -	$ -	0.8885	$ -	0.7629	$ -	0.6830	$ -
5		$ -	$ -	0.8626	$ -	0.7130	$ -	0.6209	$ -
6		$ -	$ -	0.8375	$ -	0.6663	$ -	0.5645	$ -
7		$ -	$ -	0.8131	$ -	0.6227	$ -	0.5132	$ -
8		$ -	$ -	0.7894	$ -	0.5820	$ -	0.4665	$ -
9		$ -	$ -	0.7664	$ -	0.5439	$ -	0.4241	$ -
10		$ -	$ -	0.7441	$ -	0.5083	$ -	0.3855	$ -
11		$ -	$ -	0.7224	$ -	0.4751	$ -	0.3505	$ -
12		$ -	$ -	0.7014	$ -	0.4440	$ -	0.3186	$ -
13		$ -	$ -	0.6810	$ -	0.4150	$ -	0.2897	$ -
14		$ -	$ -	0.6611	$ -	0.3878	$ -	0.2633	$ -
15		$ -	$ -	0.6419	$ -	0.3624	$ -	0.2394	$ -
16		$ -	$ -	0.6232	$ -	0.3387	$ -	0.2176	$ -
17		$ -	$ -	0.6050	$ -	0.3166	$ -	0.1978	$ -
18		$ -	$ -	0.5874	$ -	0.2959	$ -	0.1799	$ -
19		$ -	$ -	0.5703	$ -	0.2765	$ -	0.1635	$ -
20		$ -	$ -	0.5537	$ -	0.2584	$ -	0.1486	$ -
21		$ -	$ -	0.5375	$ -	0.2415	$ -	0.1351	$ -
22		$ -	$ -	0.5219	$ -	0.2257	$ -	0.1228	$ -
23		$ -	$ -	0.5067	$ -	0.2109	$ -	0.1117	$ -
24		$ -	$ -	0.4919	$ -	0.1971	$ -	0.1015	$ -
25		$ -	$ -	0.4776	$ -	0.1842	$ -	0.0923	$ -
26		$ -	$ -	0.4637	$ -	0.1722	$ -	0.0839	$ -
27		$ -	$ -	0.4502	$ -	0.1609	$ -	0.0763	$ -
28		$ -	$ -	0.4371	$ -	0.1504	$ -	0.0693	$ -
29		$ -	$ -	0.4243	$ -	0.1406	$ -	0.0630	$ -
30		$ -	$ -	0.4120	$ -	0.1314	$ -	0.0573	$ -
TOTAL PRESENT WORTH				NPV at 3%	$ 1,552,750	NPV at 7%	$ 1,533,778	NPV at 10%	$ 1,520,450

TABLE A-1

PRESENT WORTH ANALYSIS VIBURNUM
NON-TIME-CRITICAL REMOVAL ALTERNATIVE
2 - REMOVAL AND DISPOSAL

Option 2c - Offsite Non-Haz and Haz Disposal				Rate of Return = 3%		Rate of Return = 7%		Rate of Return = 10%	
Year	Capital Costs	Ongoing Costs	Total Annual Expenditure	Discount Factor	Present Worth	Discount Factor	Present Worth	Discount Factor	Present Worth
0	$ 2,048,233	$ -	$ 2,048,233	1.0000	$ 2,048,233	1.0000	$ 2,048,233	1.0000	$ 2,048,233
1	$ 1,024,117	$ -	$ 1,024,117	0.9709	$ 994,315	0.9346	$ 957,139	0.9091	$ 931,024
2		$ -	$ -	0.9426	$ -	0.8734	$ -	0.8264	$ -
3		$ -	$ -	0.9151	$ -	0.8163	$ -	0.7513	$ -
4		$ -	$ -	0.8885	$ -	0.7629	$ -	0.6830	$ -
5		$ -	$ -	0.8626	$ -	0.7130	$ -	0.6209	$ -
6		$ -	$ -	0.8375	$ -	0.6663	$ -	0.5645	$ -
7		$ -	$ -	0.8131	$ -	0.6227	$ -	0.5132	$ -
8		$ -	$ -	0.7894	$ -	0.5820	$ -	0.4665	$ -
9		$ -	$ -	0.7664	$ -	0.5439	$ -	0.4241	$ -
10		$ -	$ -	0.7441	$ -	0.5083	$ -	0.3855	$ -
11		$ -	$ -	0.7224	$ -	0.4751	$ -	0.3505	$ -
12		$ -	$ -	0.7014	$ -	0.4440	$ -	0.3186	$ -
13		$ -	$ -	0.6810	$ -	0.4150	$ -	0.2897	$ -
14		$ -	$ -	0.6611	$ -	0.3878	$ -	0.2633	$ -
15		$ -	$ -	0.6419	$ -	0.3624	$ -	0.2394	$ -
16		$ -	$ -	0.6232	$ -	0.3387	$ -	0.2176	$ -
17		$ -	$ -	0.6050	$ -	0.3166	$ -	0.1978	$ -
18		$ -	$ -	0.5874	$ -	0.2959	$ -	0.1799	$ -
19		$ -	$ -	0.5703	$ -	0.2765	$ -	0.1635	$ -
20		$ -	$ -	0.5537	$ -	0.2584	$ -	0.1486	$ -
21		$ -	$ -	0.5375	$ -	0.2415	$ -	0.1351	$ -
22		$ -	$ -	0.5219	$ -	0.2257	$ -	0.1228	$ -
23		$ -	$ -	0.5067	$ -	0.2109	$ -	0.1117	$ -
24		$ -	$ -	0.4919	$ -	0.1971	$ -	0.1015	$ -
25		$ -	$ -	0.4776	$ -	0.1842	$ -	0.0923	$ -
26		$ -	$ -	0.4637	$ -	0.1722	$ -	0.0839	$ -
27		$ -	$ -	0.4502	$ -	0.1609	$ -	0.0763	$ -
28		$ -	$ -	0.4371	$ -	0.1504	$ -	0.0693	$ -
29		$ -	$ -	0.4243	$ -	0.1406	$ -	0.0630	$ -
30		$ -	$ -	0.4120	$ -	0.1314	$ -	0.0573	$ -
TOTAL PRESENT WORTH				NPV at 3%	$ 3,042,548	NPV at 7%	$ 3,005,373	NPV at 10%	$ 2,979,258

Tables

Table 1 - NTCRA Properties

Yard ID	Street Address (or rural road description)	Area of Yard Qualifying for NTCRA
VS06030	9 Maple St	FR
VS06069	54 Spruce St	FL BL BR DZ
VS06146	22 Hickory St	FR DZ
VS06198	35 Spruce St	FL
VS06008	9 Crescent St	BR DZ
VS06009	14 Crescent St	FR
VS06013	14 Conway St	FL DZ
VS06014	15 Conway St	FL FR BR DZ
VS06024	1 Live Oak Ct	FL BR DZ
VS06025	2 Live Oak Ct	FR DZ
VS06026	3 Live Oak Ct	FR DZ
VS06027	4 Live Oak Ct	FL BL
VS06028	3 Maple St	FR
VS06029	8 Maple St	FL DZ
VS06034	24 Maple St	FR DZ
VS06035	27 Maple St	BL DW DZ
VS06041	25 Redbud Dr	DW DZ
VS06045	25 St Joseph St	BL DZ
VS06050	37 St Joseph St	FR DZ
VS06057	25 Spruce St	DW
VS06059	31 Spruce St	FL BL
VS06072	58 Spruce St	FR DZ
VS06089	3 Wayfarer Ln	FL DZ
VS06098	14 Briarcrest Dr	FR DZ
VS06099	21 Briarcrest Dr	DW DZ
VS06101	26 Crescent St	SS DZ
VS06114	16 Spruce St	FR DZ
VS06126	46 Walnut St	FL
VS06131	11 Briarcrest Dr	DW
VS06137	20 Crescent St	FR BL BR DZ
VS06142	5 Hickory St	DW
VS06145	20 Hickory St	FR DZ
VS06154	23 Maple St	FR DZ
VS06164	32 St Joseph St	FR DZ
VS06165	35 St Joseph St	FL FR
VS06167	40 St Joseph St	FL DZ
VS06171	7 Spruce St	BL DZ
VS06174	38 Spruce St	FL DZ
VS06180	35 Walnut St	FL FR BR DZ
VS06182	39 Walnut St	BL BR
VS06183	40 Walnut St	SS SS2
VS06184	41 Walnut St	BL BR

VS06191	59 Walnut St	DW DZ
VS06195	4 Meadow Crest Dr	BL DW
VS06196	19 St Joseph St	FR BR DZ
VS06197	11 Conway St	FR DZ
VS06202	28 Hickory St	FL DZ
VS06214	Hwy 49 HC 82 Box 490; Next to Quad Co. Plumbing	FL
VS06220	Hwy 49 Iron Co Rte 2, second house on right	DW
VS06221	Hwy 49 40 Iron Co Rte 2	DW
VS06224	Hwy Y HC 86 BOX 6537	DW
VS06226	Hwy Y	FR DW DW2 DZ
VS06228	Hwy Y	FR DW DZ
VS06229	Hwy Y Box 286	FL
VS06230	Hwy Y across from Zepher gas station	FL FR DZ
VS06231	Hwy Y HC 86 Box 6532	FR DW
VS06236	Hwy Y	BL DZ
VS06241	Hwy Y Residence next to Stonecrest Health Care	DW
VS06242	Hwy Y BOX 6567	DW DZ
VS06246	Iron Co Rte 88 First house on right	DW
VS06247	#3 Iron Co Rte 89	FR DZ
VS06248	Iron Co Rte 89 Hwy Y First house on left	FR
VS06249	Iron Co Rte 89 Hwy Y Second house on left	DW2
VS06251	3 W St Joseph St Vib Apt Off B 1	FR BR DZ
VS06252	3 W St Joseph St Vib Apt Bldg 2	FL DZ
VS06256	3 W St Joseph St Vib Apt Bldg 6	FR DZ
VS06292	Hwy 49 HC 86 BOX 6510	FR DZ
VS06293	Iron Co Rte 88 Second house on right	DW
STJTC33	#33 St. Joe Trailer Court	DW
STJTC35	#35 St. Joe Trailer Court	DW

TABLE 2

SUMMARY OF POTENTIAL CHEMICAL-SPECIFIC ARARs
Viburnum Site – Non-Time-Critical

Standard, Requirement or Criteria	Applicable	Relevant and Appropriate	Citation	Description	Comment
FEDERAL					
Hazardous Waste Criteria	Potentially	--	40 CFR 264	Establishes criteria for use in determining hazardous wastes and disposal requirements. Excavated soil would be classified as D008 hazardous waste if the lead concentration from the TCLP test was greater than 5.0 mg/L.	Would be applicable if hazardous wastes are generated and disposed of off-site at a RCRA Facility. Based on data from the Time-Critical Removal, soils containing less than 1,200 ppm lead were all non-hazardous by TCLP. However, soils with total lead greater than 1,200 ppm did exhibit TCLP values greater than 5.0 mg/L. This would be relevant to the residences that have areas greater than 1,200 ppm that are being addressed under the Non-Time-Critical Removal action. These regulations are potentially applicable if future sampling indicates that excavated soil is hazardous.
National Ambient Air Quality Standards	No	Yes	40 CFR Part 50	Establishes ambient air quality standards for certain "criteria pollutants" to protect public health and welfare. Standard is: 1.5 microgram lead per cubic meter ($\mu g/m^3$) maximum – arithmetic mean averaged over a calendar quarter.	National ambient air quality standards (NAAQS) are implemented through the New Source Review Program and State Implementation Plans (SIPs). The Federal New Source Review Program addresses only major sources. Emissions associated with the removal action would be limited to fugitive dust emissions associated with earth moving activities during construction. These activities will not constitute a major source. Therefore, attainment and maintenance of NAAQS pursuant to the New Source Review Program are not applicable. However, the standards relating to lead are relevant and appropriate.

TABLE 2

SUMMARY OF POTENTIAL CHEMICAL-SPECIFIC ARARs
Viburnum Site – Non-Time-Critical

Standard, Requirement or Criteria	Applicable	Relevant and Appropriate	Citation	Description	Comment
STATE					
Missouri Ambient Air Standards	Yes	--	Missouri Code of State Regulations (CSR) 10 CSR 010-06.010	Missouri uses the National Ambient Air Quality Standards (NAAQS) as the state standards for airborne emissions. The NAAQS air quality standards for particulates, as PM_{10}, are 50 $\mu g/m^3$ (annual geometric mean) and 150 $\mu g/m^3$ (24 hour), as $PM_{2.5}$ they are 15 $\mu g/m^3$ (annual geometric mean) and 65 $\mu g/m^3$ (24 hour). The NAAQS emission limit for lead is 1.5 $\mu g/m^3$ averaged over a three-month period.	Relevant and appropriate to actions that generate fugitive dust at individual properties and the staging area.

TABLE 3

SUMMARY OF POTENTIAL LOCATION-SPECIFIC ARARs
Viburnum Site – Non-Time-Critical

Standard, Requirement or Criteria	Applicable	Relevant and Appropriate	Citation	Description	Comment
FEDERAL					
Archaeological and Historic Preservation Act	No	No	16 USC Sec. 469	Establishes procedures to provide for preservation of historical and archaeological data that might be destroyed through alteration of terrain as a result of a Federally licensed activity or program.	Area to be part of soil cleanup activities is not believed to contain any historical or archaeological resources due to residential nature of Site and shallow depth (<1 ft) of excavation activities to be performed (if necessary).
Archaeological Resources Protection Act	No	No	16 USC Secs. 470 aa - mm	Requires permits for any excavation or removal of archaeological resources from public or Indian lands. Provides guidance for federal land managers to protect such resources.	Activities will not take place on public land or Indian land.
National Historic Preservation Act	No	No	16 USC Sec. 470 36 CFR Part 800 Executive Order 11593, May 3, 1971	Requires Federal agencies to take into account the effect of any Federally assisted undertaking or licensing on any district, site, building, structure, or object that is included in or eligible for Register of Historic Places.	Area to be part of soil cleanup activities is not believed to contain any feature that would be eligible for registration as a historic place due to residential nature and location of Site.
Historic Sites, Buildings, and Antiquities Act	No	No	16 USC Secs. 461 - 467, 470h-2(f)	Requires Federal agencies to consider the existence and location of landmarks on the National Registry of Natural Landmarks to avoid undesirable impacts on such landmarks.	Area to be part of soil cleanup activities is not believed to contain any National Natural Landmarks due to residential nature and location of Site.

TABLE 3

SUMMARY OF POTENTIAL LOCATION-SPECIFIC ARARs
Viburnum Site – Non-Time-Critical

Standard, Requirement or Criteria	Applicable	Relevant and Appropriate	Citation	Description	Comment
Fish and Wildlife Coordination Act	No	No	16 USC Secs. 661 - 666	Requires any Federal agency or permitted entity to consult with the U.S. Fish and Wildlife Service and appropriate state agency prior to modification of any stream or other water body. The intent of this requirement is to conserve, improve, or prevent loss of wildlife habitat and resources.	Area to be part of soil cleanup activities is not believed to directly impact any stream or water feature. However, streams adjacent to properties could be potentially affected by runoff from cleanup activities.
Fish and Wildlife Conservation Act	No	No	16 USC Secs. 2901 - 2912	Requires Federal agencies to utilize their statutory and administrative authority to conserve and promote conservation of non-game fish and wildlife species.	Area to be part of soil cleanup activities is not believed to directly impact any stream or water feature. However, streams adjacent to properties could be potentially affected by runoff from cleanup activities.
Endangered Species Act	No	No	16 USC Secs. 1531-1544 50 CFR Parts 17, 402	Requires that Federal agencies ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify critical habitat.	Area to be part of soil cleanup activities is not believed to directly impact any critical habitat. Cleanup activities will be restricted to residential properties and are not expected to adversely impact listed species.
Federal Migratory Bird Treaty Act	No	No	16 USC Secs. 703 - 712	Prohibits taking of any migratory bird.	Area to be part of soil cleanup activities is not believed to directly impact any critical habitat. Cleanup activities will be restricted to residential properties and not expected to adversely impact migratory birds.

TABLE 3

SUMMARY OF POTENTIAL LOCATION-SPECIFIC ARARs
Viburnum Site – Non-Time-Critical

Standard, Requirement or Criteria	Applicable	Relevant and Appropriate	Citation	Description	Comment
Executive Order on Floodplain Management	No	No	Executive Order No. 11988	Requires Federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid, to the maximum extent possible, the adverse impacts associated with direct and indirect development of a floodplain.	Cleanup activities to be performed are comprised of restoration of residential properties. As such, no additional development within the floodplain is anticipated beyond that previously performed during the original development of the property.
Executive Order on Protection of Wetlands	No	No	Executive Order No. 11990	Requires Federal agencies to avoid, to the maximum extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid new construction in wetlands, if a practicable alternative exists.	Cleanup activities to be performed are comprised of restoration of residential properties. As such, no adverse impacts on wetlands are anticipated.
Farmland Protection Policy Act	No	No	7 USC Sec. 4201 *et. seq.*	Protects significant or important agricultural lands from irreversible conversion to uses that result in its loss as an environmental or essential food production resource.	Cleanup activities to be performed are comprised of restoration of residential properties and are not expected to impact agricultural lands. As such, no loss of environmental or essential food production resources is anticipated.
RCRA – Location Standards for Hazardous Waste Facilities	Potentially	--	42 USC Sec. 6901 40 CFR 264.18	Requires that any hazardous waste facility located within the 100-year floodplain be designed, constructed, operated, and maintained to avoid washout. Also, contains requirements for locating facilities away from seismically active zones. Because most mining and mill wastes are explicitly excluded from RCRA regulations, these requirements are only TBCs for the Site.	Materials from removal action may be placed on Doe Run Viburnum tailings facility consistent with VTHR Time-Critical Removal. This unit is to be managed according to the USEPA RAP permit (USEPA ID# MOD 000-823-252) for Management of Hazardous Remediation Waste.

TABLE 3

SUMMARY OF POTENTIAL LOCATION-SPECIFIC ARARs
Viburnum Site – Non-Time-Critical

Standard, Requirement or Criteria	Applicable	Relevant and Appropriate	Citation	Description	Comment
Rivers and Harbors Act	No	No	33 CFR Secs. 320 - 330	Requires preapproval of the US Army Corps of Engineers prior to placement of any structures in waterways and restricts the placement of structures in waterways.	Area to be part of soil cleanup activities is not believed to directly impact any navigable stream or water feature or necessitate placement of any structures within these features.
STATE					
Missouri Hazardous Waste Regulations	--	Potentially	10 CSR 25-7.264 - 270	Hazardous waste disposal areas shall not be placed within a 100-year floodplain or wetland. Provisions related to placement and management of hazardous waste units.	Relevant and appropriate to actions that generate hazardous waste. Soils with lead greater than 1,200 ppm likely to be hazardous by characteristic. Materials from removal action may be placed on Doe Run Viburnum tailings facility consistent with Time-Critical Removal.
Missouri Metallic Minerals Waste Management Act	--	Yes	10 CSR 45	Actions involving placement of metallic mineral waste shall be performed according to permit.	Materials from removal action are expected to be placed on Doe Run Viburnum tailings facility consistent with Time-Critical Removal. This unit is to be managed according to the USEPA RAP permit (USEPA ID# MOD 000-823-252) for Management of Hazardous Remediation Waste and Permit.
Missouri Solid Waste Regulations	Potentially	--	11 CSR 80-11.010	Actions involving solid waste disposal areas shall not cause degradation to wetlands or jeopardize existence of endangered or threatened species protected under the Endangered Species Act of 1973 or violate any requirement under the Marine Protection, Research, and Sanctuaries Act of 1972.	Relevant and appropriate to actions that generate solid waste. Materials from removal action are to be placed on Doe Run Viburnum tailings facility consistent with Time-Critical Removal.

TABLE 4

SUMMARY OF POTENTIAL ACTION-SPECIFIC ARARS
Viburnum Site – Non-Time-Critical

Action	Applicable	Relevant and Appropriate	Citation	Description	Comment
FEDERAL					
Hazardous and Solid Waste: 1. Criteria for Classification of Solid Waste and Disposal Facilities and Practices	Yes	--	40 CFR Part 257	Establishes criteria for use in determining solid wastes and disposal requirements.	Excavated soil is a solid waste.
2. Criteria for Classification of Hazardous Waste and Disposal Facilities and Practices	Potentially	--	40 CFR 264	Establishes criteria for use in determining hazardous wastes and disposal requirements. Excavated soil would be classified as D008 hazardous waste if the lead concentration from the TCLP test was greater than 5.0 mg/L.	Would be applicable if hazardous wastes are generated. Based on data from the Time-Critical Removal, soils containing less than 1,200 ppm lead were all non-hazardous by TCLP. However, some soils with total lead greater than 1,200 ppm did exhibit TCLP values greater than 5.0 mg/L. This would be relevant to the residences that have areas greater than 1,200 ppm that are being addressed under the Non-Time-Critical Removal action. These regulations are potentially applicable if future sampling indicates that excavated soil is hazardous.
3. Hazardous Materials Transportation Regulations	Potentially	--	49 CFR Parts 107, 171-177	Regulates transportation of hazardous materials.	Applicable only if the Cleanup action involves off-site transportation of hazardous materials. The regulations affecting packaging, labeling, marking, placarding, using proper containers, and reporting discharges of hazardous materials would be potential ARARs.

TABLE 4

SUMMARY OF POTENTIAL ACTION-SPECIFIC ARARS
Viburnum Site – Non-Time-Critical

Action	Applicable	Relevant and Appropriate	Citation	Description	Comment
Air Emission Control:					
1. National Ambient Air Quality Standards	No	Yes	40 CFR Part 50	Establishes ambient air quality standards for certain "criteria pollutants" to protect public health and welfare. Standards are: 150 µg/m^3 for particulate matter for a 24 hour period; 50 µg/m^3 for particulate matter – annual arithmetic mean; 1.5 µg/m^3 maximum – arithmetic mean averaged over a calendar quarter.	NAAQS are implemented through the New Source Review Program and State Implementation Plans (SIPs). The federal New Source Review Program addresses only major sources. Emissions associated with the Cleanup would be limited to fugitive dust emissions associated with earth moving activities during construction. These activities will not constitute a major source. Therefore, attainment and maintenance of NAAQS pursuant to the New Source Review Program are not applicable. However, the standards relating to particulate matter and to lead are relevant and appropriate.
STATE					
Hazardous and Solid Waste:					
1. Solid waste determination	Yes	--	Missouri Solid Waste Regulations 11 CSR 80-11	A solid waste is any discarded material that is not excluded by Regulation.	Applicable to soil excavated from residential yards.
2. Determination of hazardous waste.	Yes	--	Missouri Hazardous Waste Regulations 10 CSR 25-7.264 - 270	If an extract from a solid waste, tested using the Toxicity Characteristic Leaching Procedure (test Method 1311 in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", EPA publication SW 846), contains concentrations of any of the materials above the listed level (5 mg/L for lead), the waste is considered hazardous.	Applicable to soil excavated from residential yards.

TABLE 4

SUMMARY OF POTENTIAL ACTION-SPECIFIC ARARS
Viburnum Site – Non-Time-Critical

Action	Applicable	Relevant and Appropriate	Citation	Description	Comment
3. Transportation of Hazardous Waste	Potentially	--	Missouri Solid Waste Regulations 11 CSR 80-11	Rules regarding Transportation of Hazardous Substances.	Applicable only if the Cleanup action involves off-site transportation of hazardous materials. The regulations affecting packaging, labeling, marking, placarding, using proper containers, and reporting discharges of hazardous materials would be potential ARARs.
Air Emission Control:					
1. Particulate emissions during excavation and backfill.	Yes	--	Missouri Code of State Regulations 10 CSR 010-06	Missouri air pollution regulations require persons that emit fugitive particulates to minimize emissions through use of all reasonable precautions. In addition, no visible fugitive dust transport is allowed beyond the lot line of the property where the emissions originate.	Applicable to actions that entail excavation, moving, storing, transportation of redistribution of soil.
2. Ambient Air Standard for Total Suspended Particulate Matter	No	Yes	Missouri Code of State Regulations 10 CSR 010-06	Missouri uses the NAAQS as the state standards for airborne emissions. The NAAQS air quality standards for particulates, as PM_{10}, are 50 $\mu g/m^3$ (annual geometric mean) and 150 $\mu g/m^3$ (24 hour), as $PM_{2.5}$ they are 15 $\mu g/m^3$ (annual geometric mean) and 65 $\mu g/m^3$ (24 hour).	Cleanup activities will not constitute a major source and therefore regulations are not applicable. Relevant and appropriate to actions that generate fugitive dust at individual properties and the staging area.
3. Ambient Air Standards	No	Yes	Missouri Code of State Regulations 10 CSR 010-06	Missouri uses the NAAQS as the state standards for airborne emissions. Excavation and backfill of soils could potentially cause emission of hazardous air pollutants. The NAAQS emission limit for lead is 1.5 $\mu g/m^3$ averaged over a three-month period.	Relevant and appropriate to actions that generate fugitive dust at individual properties and the staging area.

TABLE 4

SUMMARY OF POTENTIAL ACTION-SPECIFIC ARARS
Viburnum Site – Non-Time-Critical

Action	Applicable	Relevant and Appropriate	Citation	Description	Comment
Storm water Controls:					
1. Storm water NPDES Permit	No	Yes	Missouri Clean Water Commission 10 CSR 020-06	Missouri has established General NPDES Storm Water Permit for a land disturbance site such as would be encountered during the soil removal action at the Site. The permit requires the establishment of best management practices (BMP) to control runoff.	This project is being performed under CERCLA as an Emergency Removal Action and therefore does not require a permit. However, the substantive requirements of the Missouri General Permit will be implemented at the site including CBMP, routine inspections and record keeping.

TABLE 5

SUMMARY[1] OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS
Viburnum Site – Non-Time-Critical Removal

General Removal Action (GRA)	Remedial Technology	Process Options	Effectiveness	Implementability	Screening Results/Comments
No action	No action	- [2]	-	-	Retained as required by NCP.
Institutional Controls	Land Use Controls	Local Land Use Regulations Easements Restrictive Covenants	Would not be protective of human health or the environment because land use is already residential and would require restrictions on common activities. Does not prevent future transport of contaminant.	Would likely not be accepted by community since common activities would be restricted.	Eliminated from further consideration.
Public Health Actions	Education	Educational Materials	Effective in modifying behavior patterns that contribute to possible exposure, but not protective of the environment or surrounding properties.	Readily implementable.	Already performed during the Preliminary Assessment/Site Investigation (PA/SI) and Time-Critical Removal Action. But not protective of adjacent properties, so this alternative has been eliminated from further consideration.
	Monitoring	Biomonitoring for lead (elevated blood lead testing)	Could be used to direct environmental sampling activities.	Readily implementable. Facilities available to analyze blood lead levels.	Biomonitoring has not been actively performed as part of the PA/SI or Time- Critical Removal; however, child elevated blood lead has been documented for certain residences in the past. Soils above health risk based standards are being removed; therefore the applicability of biomonitoring as it relates to soil is removed and not considered further.
	Sampling and Response	Environmental Sampling and Response Program	Effective in addressing residual risks by identifying sources of and preventing unacceptable exposures. Does not address environmental risks.	Readily implementable. Technology and facilities readily available to analyze soil.	Assuming that soils above health risk based standards are removed the need for biomonitoring would not be necessary. Without active biomonitoring, additional environmental sampling is unnecessary and has been removed from further consideration.

TABLE 5

SUMMARY[(1)] OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS
Viburnum Site – Non-Time-Critical Removal

General Removal Action (GRA)	Remedial Technology	Process Options	Effectiveness	Implementability	Screening Results/Comments
Containment	Covering	Rock Geosynthetic Asphalt Concrete Multimedia/Soil	Barriers would generally be effective in preventing direct contact with contaminated soil. Effectiveness would be increased if used in conjunction with other options.	Surface cover would not be compatible with residential yard use.	Installation of a cover is not retained at this time.
	Surface Control	Soil Grading	Not effective.	-	Vegetation is retained for further consideration in conjunction with other remedial options. Tilling and grading are not retained at this time.
		Vegetation	Not effective as a stand-alone option, but could be part of a comprehensive alternative.	Could be implemented in a residential yard setting.	
		Tilling	Not effective as a stand-alone option, but could be effective in conjunction with treatment option.	Could be implemented in a residential yard setting. However, equipment access, existing tree roots and tilling depth would limit yards that could benefit from this technique.	
Removal/Disposal	Removal	Excavation	Effective in removing contaminated soil.	Implementable in a residential yard setting.	Retained.

TABLE 5

SUMMARY[1] OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS
Viburnum Site – Non-Time-Critical Removal

General Removal Action (GRA)	Remedial Technology	Process Options	Effectiveness	Implementability	Screening Results/Comments
Removal/Disposal (cont.)	Disposal	On-site	Effective in preventing contact with excavated contaminated soil.	Implementable – Viburnum tailings facility used in the Time-Critical Removal is available for Non-Time-Critical Removal.	Retained for further consideration.
		Off-site	Effective in preventing contact with excavated contaminated soil.	Implementable-suitable off-site disposal facilities are currently used to accept waste from mining operations in the area. However, distance to nearest landfill used for disposal is 100 miles from Site.	Retained for further consideration.

NOTES:
(1) Per CERCLA guidance relative cost evaluation is only performed to evaluate process options providing similar effectiveness. This was performed following detailed evaluation.
(2) Evaluation not performed if not required for screening purposes.

TABLE 6

DETAILED COST ESTIMATE
VIBURNUM SITE - NON-TIME-CRITICAL REMOVAL ALTERNATIVE
2 - REMOVAL AND DISPOSAL

Item/Description	Quantity	Est. Area per each	Extension	Unit	Unit Cost	Total Cost
DIRECT CAPITAL COSTS						
Excavation & Placement		Cubic Feet				
Yard Quadrants/Areas	69	4000	10,222	CY	$ 58.93	$ 602,396
Driveway	20	1000	741	CY	$ 62.93	$ 46,615
Swing Set, Play Areas	3	500	56	CY	$ 58.93	$ 3,274
Hauling						
Excavated Soils - assumes staging area at the Old Viburnum tailings facility						
Old Viburnum tailings facility (Doe Run Viburnum Lead Tailings Pile)	11019	CY	459	Hours haul	$ 97.79	$ 44,896
Clean Backfill	11019	CY	1377	Hours haul	$ 97.79	$ 134,688
HazWaste Testing (TCLP) - one per 400 tons	45	Samples	45	Samples	$ 55.00	$ 2,475
Disposal Options						
a Old Viburnum tailings facility Only						
Non-Hazardous (no additional cost)						
Hazardous - Phosphate Treatment (Soils > 5 mg/L TCLP) at Old Viburnum tailings facility	275	CY	441	Ton		
TSP (2017 rate per ton delivered)	2	% by Wt	8.8	Ton	$ 360.00	$ 3,173
b Old Viburnum tailings facility/Subtitle C Landfill						
Non-Hazardous (no additional cost)						
Hazardous - Offsite Disposal	275	CY	441	Ton		
Subtitle C Landfill (Peoria IL) - Live Load actual from 2012			441	Ton	$ 180.00	$ 79,333
c Subtitle D/Subtitle C Landfill						
Non-Hazardous - Offsite Disposal	10743	CY	17189	Ton		
Subtitle D Landfill (Crawford County, MO) - Based on as-delivered quotes from 2014-2015			17189	Ton	$ 51.00	$ 876,633
Hazardous - Offsite Disposal	275	CY	441	Ton		
Subtitle C Landfill (Peoria IL) - Live Load actual from 2012			441	Ton	$ 180.00	$ 79,333
SUBTOTAL DIRECT CAPITAL COSTS - Disposal Option 2a						$ 837,516
SUBTOTAL DIRECT CAPITAL COSTS - Disposal Option 2b						$ 913,676
SUBTOTAL DIRECT CAPITAL COSTS - Disposal Option 2c						$ 1,790,309
INDIRECT CAPITAL COSTS						
2a Old Viburnum tailings facility Only						
Mob/Demob					10%	$ 83,752
Engineering/Administration Costs					10%	$ 83,752
Construction Management Costs					8%	$ 67,001
Health & Safety					3%	$ 25,125
2b Old Viburnum tailings facility/Subtitle C Landfill						
Mob/Demob					10%	$ 91,368
Engineering/Administration Costs					10%	$ 91,368
Construction Management Costs					8%	$ 73,094
Health & Safety					3%	$ 27,410
2c Subtitle D/Subtitle C Landfill						
Mob/Demob					10%	$ 179,031
Engineering/Administration Costs					10%	$ 179,031
Construction Management Costs					8%	$ 143,225
Health & Safety					3%	$ 53,709
SUBTOTAL INDIRECT CAPITAL COSTS - Disposal Option 2a						$ 259,630
SUBTOTAL INDIRECT CAPITAL COSTS - Disposal Option 2b						$ 283,240
SUBTOTAL INDIRECT CAPITAL COSTS - Disposal Option 2c						$ 554,996
Scope and Bid Contingencies						
2a Old Viburnum tailings facility Only					31%	$ 340,115
2b Old Viburnum tailings facility/Subtitle C Landfill					31%	$ 371,044
2c Subtitle D/Subtitle C Landfill					31%	$ 727,045
TOTAL ESTIMATED CAPITAL COST - Disposal Option 2a						$ 1,437,261
TOTAL ESTIMATED CAPITAL COST - Disposal Option 2b						$ 1,567,960
TOTAL ESTIMATED CAPITAL COST - Disposal Option 2c						$ 3,072,350
PERIODIC COSTS - FIVE YEAR REVIEWS						
None - No Hazardous Materials remain in residential yards						
SUBTOTAL FIVE YEAR REVIEW COSTS						$ -
Five Year Review Contingency					10%	
TOTAL FIVE YEAR REVIEW COSTS						$ -
TOTAL PRESENT WORTH					**2a**	$ 1,405,929
(7% rate of return, 1 year period)					**2b**	$ 1,533,778
					2c	$ 3,005,373

NOTES:
Details of cost assumptions are provided in Appendix A. Total Present Worth calculation presented in Table A-1