

4.6 Baseline Risk Assessment for Operable Unit 1

4.6.1 Human-Health Risk Assessment for Operable Unit 1

The MDHSS performed a Human-Health Risk Assessment for OU1 at the Riverfront Site in Summer 2002. A complete assessment of human-health risks associated with OU1 can be found in Baseline Risk Assessment for Operable Unit 1 (OU1)–Front Street, The Riverfront Site, New Haven, Franklin County, Missouri, (Missouri Department of Health and Senior Services, 2003).

The Baseline Risk Assessment evaluated the risks to human health in various hypothetical exposures to contaminated media. MDHSS used soil and ground-water sample results from the investigations discussed in this RI to generate the contaminant levels for the exposure scenarios. All exposure scenarios assumed that no remedial actions or contaminant attenuation would occur at OU1. The Baseline Risk Assessment also identified contaminants and exposure pathways that should be addressed by any future remedial actions. Based on the results of this Baseline Risk Assessment, OU1 poses risks from both the surface soil and ground-water pathways.

The following sections discuss the risks from the contaminated soils at OU1 and from the contaminated ground water at OU1. Tables 4-7 and 4-8 summarize the potentially affected populations, the applicable exposure pathways, and the degree of risk to each population.

Table 4-7. Summary of carcinogenic human-health risks at operable unit OU1.

| Population scenario | Exposure pathway | Type of exposure (RI sample results evaluated) | Pathway carcinogenic risk | Total risk for scenario |
|---|------------------|---|---------------------------|-------------------------|
| Future Resident | Ground Water | Drinking Water Ingestion (well water sampling) | 1.7×10^{-3} | 1.7×10^{-3} |
| | | Dermal Contact (well water sampling) | 5.7×10^{-5} | |
| | | Inhalation (well water sampling) | 7.1×10^{-6} | |
| Future Resident | Ground Water | Drinking Water Ingestion (borehole sampling) | 1.0×10^{-2} | 1.1×10^{-2} |
| | | Dermal Contact (borehole sampling) | 6.2×10^{-4} | |
| | | Inhalation (borehole sampling) | 7.2×10^{-5} | |
| Future Resident | Surface Soil | Incidental Ingestion | 7.1×10^{-5} | 1.2×10^{-4} |
| | | Dermal Contact | 2.1×10^{-5} | |
| | | Inhalation | 2.9×10^{-5} | |
| Future Occupational Worker | Ground Water | Drinking Water Ingestion (well water sampling) | 3.1×10^{-4} | 3.1×10^{-4} |
| Future Occupational Worker | Ground Water | Drinking Water Ingestion (borehole sampling) | 2.3×10^{-3} | 2.3×10^{-3} |
| Current or Future Occupational Worker | Surface Soil | Incidental Ingestion | 7.8×10^{-6} | 2.9×10^{-5} |
| | | Dermal Contact | 9.8×10^{-6} | |
| | | Inhalation | 1.1×10^{-5} | |
| Future Recreational | Surface Soil | Incidental Ingestion | 1.2×10^{-5} | 2.1×10^{-5} |
| | | Dermal Contact | 3.6×10^{-6} | |
| | | Inhalation | 5.0×10^{-6} | |
| Current Trespasser | Surface Soil | Incidental Ingestion | 3.0×10^{-6} | 5.3×10^{-6} |
| | | Dermal Contact | 5.4×10^{-7} | |
| | | Inhalation | 1.8×10^{-6} | |
| Current or Future Construction/Utility Worker | Subsurface Soil | Incidental Ingestion | 2.9×10^{-7} | 1.1×10^{-6} |
| | | Dermal Contact | 1.3×10^{-8} | |
| | | Inhalation | 8.4×10^{-7} | |
| <p>Note 1: USEPA considers a total lifetime cancer risk for a reasonable maximum exposure that exceeds 10^{-4} to be unacceptable. Total excess lifetime cancer risks below 10^{-6} are considered acceptable.</p> <p>Table adapted from the Missouri Department of Health and Senior Services (2003a).</p> | | | | |

Table 4-8. Summary of non-carcinogenic human-health risks at operable unit OU1.

| Non-Carcinogenic Risks | | | | |
|---|------------------|---|-------------------------------|-------------------------|
| Population scenario | Exposure pathway | Type of exposure (RI sample results evaluated) | Pathway non-carcinogenic risk | Total risk for scenario |
| Future Resident | Groundwater | Drinking Water Ingestion (well water sampling) | 11 | 12 |
| | | Dermal Contact (well water sampling) | 0.5 | |
| | | Inhalation (well water sampling) | 0.04 | |
| Future Resident | Groundwater | Drinking Water Ingestion (borehole sampling) | 181 | 192 |
| | | Dermal Contact (borehole sampling) | 11 | |
| | | Inhalation (borehole sampling) | 0.8 | |
| Future Occupational Worker | Groundwater | Drinking Water Ingestion (well water sampling) | 3 | 3 |
| Future Occupational Worker | Groundwater | Drinking Water Ingestion (borehole sampling) | 51 | 51 |
| Note: Human health risks may exist when the Total Hazard Index for Non-carcinogenic effects exceeds a value of 1.0. | | | | |
| Table adapted from MDHSS, 2003a. | | | | |

4.6.1.1 Risks from Surface Soils at OU1

There is the potential for substantial carcinogenic risks for current or future occupational workers, future residents, current trespassers, and future recreational visitors from contact with soils at OU1. There is a potential for incidental ingestion of soils, dermal contact with soils, and inhalation of particulate matter or volatiles from soils, which combine to create an unacceptable risk for the future resident scenario. These pathways present carcinogenic risks that are greater than 1×10^{-6} (1 in 1 million). PCE drives the risk for the inhalation pathway, and arsenic and benzo(a)pyrene drive the soil ingestion and dermal contact pathways.

4.6.1.2 Risks from Ground Water Underlying OU1

There is the potential for unacceptable excess carcinogenic risks and adverse non-carcinogenic health effects for future residents and occupational workers who ingest ground water from the contaminated aquifers that underlie OU1. In addition, there is the potential for unacceptable excess carcinogenic risks for future residents from the inhalation of, ingestion of, and dermal

contact with ground-water contaminants while showering. PCE, TCE, VC, and the other breakdown products of these chlorinated solvents are largely responsible for these health risks.

4.6.1.3 Other Pathways at OU1

The sediment and surface water pathways at OU1 were not evaluated as a part of the Baseline Risk Assessment because these pathways did not contain sufficient detections of site-related contaminants. The Baseline Risk Assessment also did not include a qualitative analysis of human exposure to PCE and other volatile organic compounds from vapor seepage into home and building foundations. This exposure pathway could potentially be a completed pathway. However, the basement, building interior, and ambient air sampling results were not available at the time of the publication of the Risk Assessment. Quantitative assessment and risk calculations based on these air sampling results will be conducted by the Missouri Department of Health and Senior Services, when the data become available.

4.6.2 Ecological Risk Assessment for Operable Unit 1

An Ecological Risk Assessment (ERA) was conducted during this RI to evaluate the ecological risks at the Riverfront Site. A complete assessment of the ecological risks for the Riverfront Site can be found in *Ecological Risk Assessment Riverfront Superfund Site, City of New Haven, Franklin County, Missouri*, (Black & Veatch Special Projects Corp., 2002). The methodology used in the ERA was based on, and complied with, the latest guidance described in the *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (USEPA, 1997).

Based on site conditions and the physical properties of the contaminants at OU1, the ERA considered the direct exposure risks associated with stream sediment and surface water in the Missouri River. In addition, the ERA also evaluated a food chain ingestion model for herbivores. Ecological screening values (ESVs) are contaminant-specific, media-specific concentrations that are used to determine the risk that any particular contaminant might pose to ecological receptors. Concentrations of the chlorinated ethenes PCE, TCE, cis-DCE, trans-DCE, VC, and the volatile hydrocarbons benzene and toluene were compared to ESVs to determine the risk that contaminants in each media might pose to ecological receptors. Benzene and toluene were

included in the ecological assessment because small concentrations of these compounds had been detected in ground-water samples from OU1

Analytical results from Missouri River sediment samples collected near OU1 were compared to the selected ESVs for stream sediment. Toluene was detected in two of the stream sediment samples, but the detected concentrations were well below the ESVs for sediment (table 4-9). Based on this comparison, there are no significant ecological risks presented by sediment sampled in the Missouri River near OU1. It is important to note that the reporting limit for VC was higher than the ESV, so there could be concentrations of this compound between the reporting limit and the ESV.

Analytical results for Missouri River surface water associated with OU1 were compared to the selected ESVs for surface water. Toluene was detected in several of the surface-water samples, but the concentrations were well below the ESVs for surface water (table 4-9). No significant ecological risks are presented by surface water contamination at OU1.

Estimated concentrations of compounds detected by the portable GC in tree-core and fruit samples from OU1 were converted to exposure doses. All seven target compounds were detected in the tree tissue samples at OU1. The estimated average daily doses for the representative mammal and bird species were compared to the wildlife ESVs. Based on these comparisons, none of the target compounds were present at levels that indicate a significant risk to herbivores. The overall conclusion of the ERA was that ecological risks are minimal at OU1 of the Riverfront Site (BVSPC, 2002).

Table 4-9. Summary of laboratory results for the Ecological Risk Assessment at Operable Unit OU1.

[ug/kg, micrograms per kilogram; ug/L, micrograms per liter; PCE, tetrachloroethene; TCE, trichloroethene; cis-DCE, cis-1,2-dichloroethene; trans-DCE, trans-1,2-dichloroethene; VC, vinyl chloride; nd, not detected

| Target Compound | Number of samples | Number of detections | Minimum detected | Maximum detected | Ecological Screening Value (ESV) ¹ |
|---|-------------------|----------------------|------------------|------------------|---|
| Stream-bed Sediment (Missouri River) | | | | | |
| PCE | 8 | 0 | nd | nd | 195.83 ug/kg |
| TCE | 8 | 0 | nd | nd | 179.56 ug/kg |
| cis-DCE | 8 | 0 | nd | nd | 208.94 ug/kg |
| trans-DCE | 8 | 0 | nd | nd | 208.94 ug/kg |
| VC | 8 | 0 | nd | nd | 2 ug/kg |
| Benzene | 8 | 0 | nd | nd | 57 ug/kg |
| Toluene | 8 | 2 | 19 ug/kg | 270 ug/kg | 670 ug/kg |
| Surface Water (Missouri River) | | | | | |
| PCE | 10 | 0 | nd | nd | 8.9 ug/L |
| TCE | 10 | 0 | nd | nd | 75 ug/L |
| cis-DCE | 10 | 0 | nd | nd | 310 ug/L |
| trans-DCE | 10 | 0 | nd | nd | 310 ug/L |
| VC | 10 | 0 | nd | nd | 9.2 ug/L |
| Benzene | 10 | 0 | nd | nd | 46 ug/L |
| Toluene | 10 | 10 | 0.48 ug/L | 0.98 ug/L | 130 ug/L |

¹ All results listed above are from *Ecological Risk Assessment Riverfront Superfund Site, City of New Haven, Franklin County, Missouri*, (BVSPC, 2002).

4.7 Summary and Conclusions for Operable Unit 1

Results of the investigations at OU1 indicate the presence of substantial PCE contamination in soils at the site and in ground water in the alluvial aquifer beneath and downgradient (northeast) of the site. Concentrations of PCE were detected in 128 of 144 soil sample locations at the site. The largest PCE concentrations (as large as 6,200,000 µg/kg) were detected in soils beneath the southeast part of the Front Street building and beneath Front Street immediately south of the building. PCE waste was washed out loading doors on the south side of the building. PCE concentrations at most soil sampling locations beneath the building and south of the building exceeded the USEPA residential use PRG of 5,700 µg/kg. PCE concentrations at about one-half the soil sampling locations beneath the building and at many locations south of the building also exceeded the industrial use PRG of 19,000 µg/kg. Concentrations of PCE generally increased with increasing depth; peak concentrations were at depths below 6 ft. The maximum lateral extent of soil contamination at the site occurred between 14 and 16 ft deep. More than 5,000 yd³ of PCE-contaminated soil, containing an estimated PCE mass of 1,938 kg or about 309 gallons, are present in soil at OU1. No PCE contamination above the residential use PRG was detected in soils north of the building, east of the loading dock on the east side of the building, or on a vacant lot west of the building. Substantial degradation of PCE is not occurring in soils at the site, and the PCE in the soils will continue to be a source of contamination to ground water for decades.

A selected number of soil samples from the site also were analyzed for metals, pesticides, PCBs, and SVOCs. Concentrations of Pb exceeded the residential use PRG of 400 mg/kg in eight shallow (less than 2 ft deep) soil samples collected from three locations (one beneath the building, one north of the building, and one on the vacant lot west of the building). Concentrations of one or more SVOCs (all PAHs) exceeded the residential use PRGs at seven locations with the largest concentrations detected in a sample from the vacant lot west of the building. No pesticides or PCBs were detected above the residential use PRGs in any soil samples from the site.

Large concentrations of PCE and its microbial degradation products TCE, cis-DCE, and VC were detected in ground-water samples from the alluvial aquifer at OU1 and downgradient (northeast) of the site near the Missouri River. PCE was detected in 22 of the 28 ground-water sampling locations in the alluvial aquifer, and concentrations exceeded the MCL of 5 µg/L at 13 locations. The largest PCE concentrations (as large as 11,000 µg/L) were detected in ground-water samples collected beneath the northeast corner of the Front Street building (location G67). Samples from this location also contained large concentrations of TCE (5,500 µg/L) and cis-DCE (3,000 µg/L).

Based on results of ground-water sampling and PCE concentrations detected in tree-core samples (which are thought to mimic the ground-water concentrations), a plume of PCE-contaminated ground water extends from near the south side of the Front Street building toward the northeast beneath several residences to the Missouri River about 600 ft away. Because of the small hydraulic gradient in the alluvial aquifer, the rate of PCE migration through the alluvial aquifer to the Missouri River is small, and travel times are on the order of 9 to 19 years.

Conditions within the alluvial aquifer generally are conducive to the biodegradation of PCE to TCE, cis-DCE, and VC. Substantial microbial degradation of PCE is occurring as the PCE migrates from source areas along the south side of the Front Street building to the Missouri River. Near the source areas, PCE composes more than 75 percent of the total chlorinated ethenes, whereas downgradient near the Missouri River, PCE composes less than 10 percent of the chlorinated ethenes with cis-DCE and VC being the predominant compounds detected. Estimates of the half-life of PCE in the alluvial aquifer range from 0.8 to 4.1 years. Although substantial microbial degradation of PCE is occurring in the alluvial aquifer, the degradation appears to generally stall at the production of cis-DCE (estimated half-life of 12 years). Because of the relatively slow rate of advection through the alluvial aquifer and generally slow degradation rate, concentrations of PCE and its microbial degradation products in the alluvial aquifer likely will remain above USEPA MCLs for decades.

Baseline Risk Assessment scenarios for OU1 found that there are human-health risks associated with the contamination at OU1. The potential for future exposure to ground water and surface soil contamination at OU1 was found to pose significant health risks. Ground water underlying OU1 poses unacceptable excess carcinogenic and non-carcinogenic health risks for future residents who might inhale, ingest, or have dermal contact with contaminated ground water. In addition, future occupational workers are also susceptible to unacceptable excess carcinogenic and non-carcinogenic health risks from ingestion of the contaminated ground water. Contact with soils at OU1 poses unacceptable excess carcinogenic health risks to future residents, current and future occupational workers, current trespassers, and future recreational visitors.

The Ecological Risk Assessment indicated that contamination at OU1 is of minimal risk to environmental receptors. Toluene was detected in the surface water and stream sediment in the Missouri River near OU1; but the concentrations of the contaminants were not large enough to present a significant risk to ecological receptors. VOCs were found to be present in vegetation at OU1, but the concentrations were not high enough to pose an unacceptable risk to herbivores.