# Appendix A

**Revised Development of Risk-Based Concentrations for Arsenic in Soil Memorandum**
**CRA, Revision 3, November 13, 2014**

CONESTOGA-ROVERS & ASSOCIATES

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# MEMORANDUM

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| TO: | Greg Carli/Jeni Quigley | REF. NO.: | 056394 |
| FROM: | April Gowing/Vincent Nero/ds/16 JQ for | DATE: | June 26, 2013 |
| | | REVISION 1 | December 20, 2013 |
| | | REVISION 2 | August 7, 2014 |
| | | REVISION 3 | November 13, 2014 |

**RE: Revised Development of Risk-Based Concentrations for Arsenic and PCBs in Soil**
**Former Plainwell, Inc. Mill Property**
**Plainwell, Michigan**

## 1.0 Introduction

Conestoga-Rovers & Associates (CRA) has prepared this memorandum to document the development of risk-based concentrations (RBCs) that are protective of human health direct contact exposure to arsenic and polychlorinated biphenyls (PCBs) in soil located at the former Plainwell, Inc. Mill Property in Plainwell, Michigan (Site). The development of the RBCs generally followed the approved Human Health Risk Assessment (HHRA) portion of the Remedial Investigation Report (Revision 2) (RI Report), which indicated that direct contact exposure to arsenic and PCBs in soil were the major contributors to unacceptable risks/hazards. Therefore, any actions that are required to mitigate potential exposure to the arsenic and PCB impacts would need to address the unacceptable risks/hazards associated with direct contact exposure with soil. The RI Report (Revision 2) was submitted to United States Environmental Protection Agency (U.S. EPA) on February 4, 2013 and was approved by U.S. EPA on February 26, 2013.

The development of the RBCs for arsenic is presented in Section 2.0 and the development of the RBCs for PCBs is presented in Section 3.0

## 2.0 Development of Risk-Based Concentrations for Arsenic in Soil

RBCs were developed for arsenic in soil that are protective of trespassers, recreational users, residents, commercial workers, utility workers, and construction workers. These same receptors were evaluated in the RI Report. Two RBCs were initially developed: one protective of carcinogenic health impacts and a second protective of non-carcinogenic health impacts. The RBC for each receptor was determined to be the lower value between carcinogenic and non-carcinogenic health impacts.

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The equations used to develop the RBCs are presented in Section 2.1. Section 2.2 presents the receptor-specific exposure assumptions applied in the development of the RBCs. Section 2.3 presents the human health toxicity values applied for arsenic. The equations, exposure assumptions, and toxicity values utilized in the derivation of the RBCs are the same as those used in the forward risk and hazard calculations, as summarized in the RI Report, unless otherwise noted below. Section 2.4 presents the calculated RBCs for each receptor.

## 2.1 RBC Equations

RBCs have been developed for a trespasser, recreational user, resident, commercial worker, utility worker, and construction worker exposure to arsenic in soil. The soil RBCs were developed for incidental ingestion, dermal contact, and inhalation routes of exposure using the following equations:

***<u>Recreational User/Resident</u>***

Carcinogenic Endpoint:

Carcinogenic RBCs were developed to be protective of the child and adult recreational user/resident exposure. Therefore, exposure for each life stage was combined in the following equation:

$$RBC_{soil} = \frac{TR \times AT_c}{(((CSF \times IR_c \times ABS_o \times CF \times EFa \times ED_c)/BW_c)) + ((CSF \times SA_c \times AF_c \times ABS_d \times CF \times EFb \times ED_c)/BW_c)) + ((URF \times FT \times EFa \times ED_c \times (1/PEF))) + ((CSF \times IR_a \times ABS_o \times CF \times EFa \times ED_a)/BW_a)) + ((CSF \times SA_a \times AF_a \times ABS_d \times CF \times EFb \times ED_a)/BW_a)) + ((URF \times FT \times EFa \times ED_a \times (1/PEF)))}$$

Non-Carcinogenic Endpoint:

For the determination of the non-carcinogenic RBCs, the exposure for the child recreational user/resident, the most sensitive life stage, was applied as a conservative method using the following equation:

$$RBC_{soil} = \frac{THQ \times ATnc}{ED_c \times [((1/RfD) \times IR_c \times ABS_o \times CF \times EFa)/BW_c) + ((1/RfD) \times SA_c \times AF_c \times ABS_d \times CF \times EFb)/BW_c) + ((1/RfC) \times EFa \times FT \times (1/(PEF))]}$$

Where:

| | | |
|---|---|---|
| ***$RBC_{soil}$*** | = | Risk-based concentration in soil based on ingestion, dermal contact, and inhalation exposure (mg/kg) |
| ***TR*** | = | Target Cancer Risk |
| ***THQ*** | = | Target Hazard Quotient |
| ***$BW_c$*** | = | Body Weight - child (kg) |
| ***$BW_a$*** | = | Body Weight - adult (kg) |
| ***ATc*** | = | Averaging Time - carcinogen |
| ***ATnc*** | = | Averaging Time - non-carcinogen - child (days) |
| ***CSF*** | = | Cancer Slope Factor – oral/dermal - chemical-specific $(mg/kg/day)^{-1}$ |
| ***URF*** | = | Unit Risk Factor - inhalation - chemical-specific $(mg/m^3)^{-1}$ |
| ***RfD*** | = | Reference Dose – oral/dermal - chemical-specific (mg/kg/day) |

| | | |
|---|---|---|
| ***RfC*** | = | Reference Concentration - inhalation - chemical-specific ($mg/m^3$) |
| ***$ABS_o$*** | = | Absorption Factor - oral - chemical-specific (%/100) |
| ***$ABS_d$*** | = | Absorption Factor - dermal - chemical-specific (%/100) |
| ***$IR_c$*** | = | Ingestion Rate - child (mg/day) |
| ***$IR_a$*** | = | Ingestion Rate - adult (mg/day) |
| ***CF*** | = | Conversion Factor ($1.0 \times 10^{-6}$ kg/mg) |
| ***$SA_c$*** | = | Surface Area Exposed - child ($cm^2$/day) |
| ***$SA_a$*** | = | Surface Area Exposed - adult ($cm^2$/day) |
| ***$AF_c$*** | = | Adherence Factor - child ($mg/cm^2$) |
| ***$AF_a$*** | = | Adherence Factor - adult ($mg/cm^2$) |
| ***FT*** | = | Fraction Time Exposed (hours/24 hours) |
| ***EFa*** | = | Exposure Frequency (days/year) – ingestion/inhalation |
| ***EFb*** | = | Exposure Frequency (days/year) – dermal |
| ***$ED_c$*** | = | Exposure Duration - child (years) |
| ***$ED_a$*** | = | Exposure Duration - adult (years) |
| ***PEF*** | = | Particulate Emission Factor - inhalation ($m^3$/kg) |

***<u>Trespasser/Commercial Worker/ Utility Worker/Construction Worker</u>***

Carcinogenic Endpoint:

$$RBC_{soil} = \frac{TR \times AT_c}{ED \times [((CSF \times IR \times CF \times ABS_o \times EFa)/BW) + ((CSF \times SA \times AF \times CF \times ABS_d \times EFb)/BW) + ((URF \times FT \times EFa \times (1/PEF))]}$$

Non-Carcinogenic Endpoint:

$$RBC_{soil} = \frac{THQ \times ATnc}{ED \times [((1/RfD) \times IR \times CF \times ABS_o \times EFa)/BW) + ((1/RfD) \times SA \times AF \times CF \times ABS_d \times EFb)/BW) + ((1/RfC) \times FT \times EFa \times (1/PEF))]}$$

Where:

| | | |
|---|---|---|
| ***$RBC_{soil}$*** | = | Risk-based concentration in soil based on ingestion, dermal contact, and inhalation exposure (µg/g) |
| ***TR*** | = | Target Cancer Risk |
| ***THQ*** | = | Target Hazard Quotient |
| ***BW*** | = | Body Weight (kg) |
| ***ATc*** | = | Averaging Time - carcinogen |
| ***ATnc*** | = | Averaging Time - non-carcinogen |
| ***CSF*** | = | Cancer Slope Factor – oral/dermal - chemical-specific $(mg/kg/day)^{-1}$ |
| ***URF*** | = | Unit Risk Factor – inhalation - chemical-specific $(mg/m^3)^{-1}$ |
| ***RfD*** | = | Reference Dose – oral/dermal - chemical-specific (mg/kg/day) |
| ***RfC*** | = | Reference Concentration – inhalation – chemical-specific ($mg/m^3$) |
| ***$ABS_o$*** | = | Absorption Factor - oral - chemical-specific (%/100) |

| | | |
|---|---|---|
| ***$ABS_d$*** | = | Absorption Factor - dermal - chemical-specific (%/100) |
| ***IR*** | = | Ingestion Rate (mg/day) |
| ***CF*** | = | Conversion Factor ($1.0 \times 10^{-6}$kg/mg) |
| ***SA*** | = | Surface Area Exposed ($cm^2$/day) |
| ***AF*** | = | Adherence Factor (mg/$cm^2$) |
| ***FT*** | = | Fraction Time Exposed (hours/24 hours) |
| ***EFa*** | = | Exposure Frequency (days/year) – ingestion/inhalation |
| ***EFb*** | = | Exposure Frequency (days/year) – dermal |
| ***ED*** | = | Exposure Duration (years) |
| ***PEF*** | = | Particulate Emission Factor - inhalation ($m^3$/kg) |

For utility and construction workers, the potential inhalation exposure to arsenic in soil particulates migrating to ambient air as part of fugitive dust emissions was determined through the calculation of a particulate emission factor (PEF), which was used to estimate ambient air concentrations based on soil concentrations. The PEF is Site-specific and was calculated using the approach presented in U.S. EPA (2002)[1]. The equations and inputs for the calculated PEF values for soil are presented in Tables 1 and 2 for the utility worker and construction worker, respectively.

## 2.2 Receptor-Specific Exposure Assumptions

With the exception of the oral absorption factor and exposure frequency, all other exposure assumptions that were applied in the equations presented above for the derivation of the RBCs were obtained from the RI Report for each of the receptors indicated above and thus are not reproduced here. These exposure assumptions are primarily U.S. EPA default exposure assumptions. A detailed discussion of receptor-specific exposure assumptions applied is presented in the RI Report. The assumptions applied for the oral absorption factor and exposure frequency in the derivation of the RBCs is presented below.

***<u>Oral Absorption Factor</u>***

Absorption factors are applied in the development of the RBCs as a measure of the bioavailable fraction that enters the human body as a result of oral, dermal, and inhalation exposure. An oral absorption factor of 100 percent, or 1 was applied in the RI Report. More recent information has been published that indicates that this absorption factor is highly conservative and significantly overestimated risks/hazards. The current default oral absorption factor is based on the assumption that the bioavailability of arsenic in soil is the same as the bioavailability in the exposure medium used to derive the toxicity value (water in the case of arsenic), and; therefore, relative bioavailability of arsenic is assumed to be 100 percent (i.e., oral absorption factor of 1). However, studies have shown that the bioavailability of arsenic in soil is less than that of arsenic in water. U.S. EPA have conducted a review of these studies, and based on the results have recommended a relative bioavailability factor of 60 percent or 0.6 for arsenic in soil (U.S. EPA, 2012)[2]. Therefore, an oral absorption factor of 0.6 was applied in the development of the RBCs for arsenic in soil.

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[1] U.S. EPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.
[2] U.S. EPA, 2012. Recommendations for Default Value for Relative Bioavailability of Arsenic in Soil, OSWER 9200.1-113, December 2012.

***Exposure Frequency***

Generic screening criteria are developed in a conservative manner, based on an assumed exposure frequency of 7 days per week for 50 weeks per year, or 350 days per year (2 weeks for vacation is assumed) for residential land use and an assumed exposure frequency of 5 days per week for 50 weeks per year, or 250 days per year (2 weeks for vacation is assumed) for commercial land use (U.S. EPA, 2004)[3]. In reality, the exposure frequency to soils in residential and/or commercial settings is influenced by weather conditions.

Direct contact exposure to soil can be affected by weather conditions. For instance, it is expected that soils during the winter months are snow-covered and; therefore, unavailable for dermal contact. Based on this information, soil exposure frequency was based on consideration of local climate conditions, specifically, the number of days where the soil is not snow-covered (and the ground is not frozen), similar to the approach applied by the Michigan Department of Environment Quality (MDEQ) in the development of the Michigan Act 451, Part 201 (Part 201) Generic Cleanup Criteria (GCC)(MDEQ, 2013)[4]. This approach assumes that ingestion and inhalation exposure pathways would occur for a period of 350 days per year for a resident and 245 days per year (50 weeks per year x 5 days per week – 5 days per year for vacation/sick leave) for a commercial worker. For dermal exposure to soil, the MDEQ approach assumes that soils are snow-covered for a period of 4 months of the year (120 days per year) and during this period there is no dermal contact with soils. Therefore, dermal exposure pathways are assessed based on exposure frequencies of 245 days per year for a resident (365 days per year – 120 days per year snow cover) and 160 days per year for a commercial worker (365 days per year -120 days per year snow cover – 21 days per year vacation/sick leave x 5/7 days per week). The table below presents the exposure frequencies applied for the trespasser and recreational user using the same approach applied by the MDEQ for the resident and commercial worker.

| ***Exposure Assumption*** | ***Trespasser*** [(1)] | ***Recreational User*** [(2)] |
|---|---|---|
| Exposure Frequency – Ingestion/Inhalation | 50 | 70 |
| Exposure Frequency - Dermal | 34 | 48 |

Notes:

(1) The basis for the Exposure Frequency is the 50th percentile from Table 16-1, Recommended Values for Activity Factors – Time Outdoors (total) from U.S. EPA (2008)[5]. ***Ingestion/Inhalation***: the time spent outdoors for 11 to 16 year olds of 100 minutes/day out of a possible 365 days equates to 25 days (100 minutes/day x 365 days x 1 hour/60 minutes x 1 day/24 hours). The final exposure frequency is double the 50th percentile value, or 50 days. ***Dermal***: the time spent outdoors for 11 to 16 year olds of 100 minutes/day out of a possible 245 days (365 days per year – 120 days snow cover) equates to 17 days (100 minutes/day x 245 days x 1 hour/60 minutes x 1 day/24 hours). The final exposure frequency is double the 50th percentile value, or 34 days.

[3] U.S. EPA, 2004. U.S. EPA Risk Assessment Guidance for Superfund (RAGS): Volume 1 Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), EPA/540/R/99/005, July 2004.

[4] MDEQ, 2013. Operational Memoranda for the Remediation and Redevelopment Division: Part 201 Cleanup Criteria and Part 213 Risk Based Screening Levels. December 30, 2013.

[5] U.S. EPA, 2008. Child-Specific Exposure Factors Handbook, September 2008.

(2) The basis for the exposure frequency is the 50th percentile from Table 16-1, Recommended Values for Activity Factors – Time Outdoors (total) from U.S. EPA (2008). ***Ingestion/Inhalation***: the time spent outdoors for 6 to 12 month olds of 139 minutes/day out of a possible 365 days equates to 35 days (139 minutes/day x 365 days x 1 hour/60 minutes x 1 day/24 hours). The final exposure frequency is double the 50th percentile value, or 70 days. ***Dermal***: the time spent outdoors for 6 to 12 month olds of 139 minutes/day out of a possible 245 days (365 days per year – 120 days snow cover) equates to 24 days (139 minutes/day x 245 days x 1 hour/60 minutes x 1 day/24 hours). The final exposure frequency is double the 50th percentile value, or 48 days. It is assumed that the adult will spend the same amount of time outdoors with their child.

The exposure frequencies for the utility worker and construction worker were unchanged from those applied in the RI Report, given the fact that utility worker and construction worker activities could occur any time during the year regardless of the weather.

### 2.3 Toxicity Values

The toxicity values that were applied in the equations presented above for the derivation of the RBCs are the same as those applied in the RI Report.

### 2.4 Summary of Risk-Based Concentrations for Arsenic

The anticipated future use scenarios based on the current redevelopment plan for the Site consists of the following 11 Redevelopment Areas:

- Residential Area 1
- Residential Area 2
- Residential Area 3
- Residential Area 4
- Waterfront Plaza
- Mixed Residential/Commercial Area 1
- Mixed Residential/Commercial Area 2
- Commercial Area 1
- Commercial Area 2
- Commercial Area 3
- Commercial Area 4

A RBC was selected for each area representing the minimum calculated RBC for all receptors (for the most sensitive receptor) that could potentially be present within that area. All potential receptors could be present at Residential Areas 1 through 4 and Mixed Residential/Commercial Areas 1 and 2. All potential receptors, except residents and recreational users could be present at Commercial Areas 1 through 4. All potential receptors, except residents, could be present at Waterfront Plaza.

The calculated RBCs for arsenic in soil are presented in the following tables:

| ***Receptor*** | ***Table Reference*** |
|---|---|
| Trespasser | Table 3 |
| Recreational User | Table 4 |
| Resident | Table 5 |
| Commercial Worker | Table 6 |
| Utility Worker | Table 7 |
| Construction Worker | Table 8 |

Table 9 presents a summary of the calculated RBCs for each receptor at target cancer risk levels of $10^{-4}$, $10^{-5}$, and $10^{-6}$, respectively, and a target hazard quotient of 1.0.

The proposed RBCs for each area of redevelopment are presented in the table below. These RBCs are based on the most sensitive receptor that is present within these areas, and target cancer risk range of $10^{-6}$ to $10^{-4}$ and target hazard quotient of 1.0. It should be noted that the calculated arsenic RBCs based on a cancer risk of $10^{-5}$ and $10^{-6}$ are below the Part 201 GCC for arsenic based on direct contact (7.6 µg/g for residential land use and 37 µg/g for non-residential land use) and the calculated arsenic RBCs based on a cancer risk of $10^{-6}$ are below the Part 201 Statewide Default Background Level (SDBL) (5.8 µg/g).

| ***Redevelopment Area*** | ***Arsenic RBC (µg/g)*** | | |
|---|---|---|---|
| | ***Cancer Risk = $10^{-4}$ Hazard Quotient = 1*** | ***Cancer Risk = $10^{-5}$ Hazard Quotient = 1*** | ***Cancer Risk = $10^{-6}$ Hazard Quotient = 1*** |
| Residential Area 1 | 36 | 6.4 | 0.64 |
| Residential Area 2 | 36 | 6.4 | 0.64 |
| Residential Area 3 | 36 | 6.4 | 0.64 |
| Residential Area 4 | 36 | 6.4 | 0.64 |
| Waterfront Plaza | 178 | 27 | 2.7 |
| Mixed Residential/Commercial Area 1 | 36 | 6.4 | 0.64 |
| Mixed Residential/Commercial Area 2 | 36 | 6.4 | 0.64 |
| Commercial Area 1 | 267 | 27 | 2.7 |
| Commercial Area 2 | 267 | 27 | 2.7 |
| Commercial Area 3 | 267 | 27 | 2.7 |
| Commercial Area 4 | 267 | 27 | 2.7 |

The sections below compare the surface soil and soil (surface and subsurface) exposure point concentrations (EPCs) to the RBCs calculated for arsenic at each cancer risk level. Those areas with EPCs greater than the RBCs will require further action (management or remediation) to ensure protection of human receptors from direct contact exposure to soil. Those areas with EPCs less than the RBCs will require no further action with respect to direct contact with soil. The EPC for each area is based on the 95 percent upper confidence limit (UCL) of the mean, which is calculated using U.S. EPA's ProUCL 5.0 statistical software. It should be noted that the EPCs calculated in the RI Report were based on a previous

version of ProUCL (Version 4.1) that was current at that time; however, subsequently U.S. EPA have published an updated version of ProUCL (as of September 2013), which was applied within this document. Given the low sample numbers available for Waterfront Plaza, soil samples collected adjacent to Waterfront Plaza and within Residential Areas 3 and 4 were combined to form the Waterfront Plaza soil dataset to permit evaluation of soil exposure within this Redevelopment Area.

### 2.1.1 Arsenic RBC (Cancer Risk = $10^{-4}$; Hazard Quotient = 1)

The table below presents a comparison of the arsenic EPC to the calculated arsenic RBC for each redevelopment area. The calculated RBC is based on a cancer risk of 1 x $10^{-4}$ and hazard quotient of 1.

| ***Redevelopment Area*** | ***EPC (µg/g)*** | | ***Arsenic RBC (Cancer Risk = $10^{-4}$ and Hazard Quotient = 1) (µg/g)*** |
|---|---|---|---|
| | ***Surface Soil*** | ***Soil (Surface and Subsurface)*** | |
| Residential Area 1 | 7.382 | 10.21 | 36 |
| Residential Area 2 | 8.751 | 8.7 | 36 |
| Residential Area 3 | 11.16 | 13.05 | 36 |
| Residential Area 4 | 9.391 | 12.3 | 36 |
| Waterfront Plaza | 69.28 | 18.13 | 178 |
| Mixed Residential/Commercial Area 1 | 8.111 | 11.02 | 36 |
| Mixed Residential/Commercial Area 2 | 19.31 | **47.39** | 36 |
| Commercial Area 1 | 7.361 | 7.234 | 267 |
| Commercial Area 2 | 9.947 | 13.33 | 267 |
| Commercial Area 3 | 12.24 | 9.59 | 267 |
| Commercial Area 4 | 19.38 | 16.68 | 267 |

Notes:
Bold and Shading: EPC exceeds the arsenic RBC

Based on the information presented in the above table, only one Redevelopment Area (Mixed Residential/Commercial Area 2) requires further action to mitigate potential exposure to arsenic through direct contact with soil. Using an iterative approach, specific soil sampling locations containing the highest concentrations of arsenic from this Redevelopment Area were removed from the soil dataset used to calculate the EPC until the EPC met the RBC. The results of this analysis are presented in the table below for Mixed Residential/Commercial Area 2.

| *Mixed Residential/Commercial Area 2* | | | | |
|---|---|---|---|---|
| *Original EPC (µg/g)* | *Soil Locations Removed* | | *Revised EPC (µg/g)* | *Arsenic RBC (Cancer Risk = $10^{-4}$ and Hazard Quotient = 1) (µg/g)* |
| | *Location* | *Arsenic Concentration (µg/g)* | | |
| **Soil (Surface and Subsurface)** | | | | |
| 47.39 | SB-232 (6-8 ft BGS) | 804 | 18.44 | 36 |

Notes:
ft BGS: feet below ground surface

As indicated in the above table, removal of one soil location reduced the arsenic surface and subsurface soil EPC from 47.39 to 18.44 µg/g, which is below the arsenic RBC based on a cancer risk of $10^{-4}$.

### 2.1.2 Arsenic RBC (Cancer Risk = 10-5; Hazard Quotient = 1)

The table below presents a comparison of the arsenic EPC to the calculated arsenic RBC for each redevelopment area. The calculated RBC is based on a cancer risk of 1 x 10-5 and hazard quotient of 1.

| *Redevelopment Area* | *EPC (µg/g)* | | *Arsenic RBC (Cancer Risk = $10^{-5}$ and Hazard Quotient = 1) (µg/g)* |
|---|---|---|---|
| | *Surface Soil* | *Soil (Surface and Subsurface)* | |
| Residential Area 1 | **7.382** | **10.21** | 6.4 |
| Residential Area 2 | **8.751** | **8.7** | 6.4 |
| Residential Area 3 | **11.16** | **13.05** | 6.4 |
| Residential Area 4 | **9.391** | **12.3** | 6.4 |
| Waterfront Plaza | **69.28** | 18.13 | 27 |
| Mixed Residential/Commercial Area 1 | **8.111** | **11.02** | 6.4 |
| Mixed Residential/Commercial Area 2 | **19.31** | **47.39** | 6.4 |
| Commercial Area 1 | 7.361 | 7.234 | 27 |
| Commercial Area 2 | 9.947 | 13.33 | 27 |
| Commercial Area 3 | 12.24 | 9.59 | 27 |
| Commercial Area 4 | 19.38 | 16.68 | 27 |

Notes:
Bold and Shading: EPC exceeds the arsenic RBC

Based on the information presented in the above table, all Redevelopment Areas, with the exception of Commercial Areas 1 through 4 require further action to mitigate potential exposure to arsenic through direct contact with soil. Using an iterative approach, specific soil sampling locations containing the highest concentrations of arsenic from these Redevelopment Areas were removed from the soil datasets used to calculate the EPCs until the EPCs met the RBC. The results of this analysis are presented in Table 10 for each Redevelopment Area.

The Part 201 GCC for arsenic based on direct contact are 7.6 µg/g for residential land use and 37 µg/g for non-residential land use, which are higher in comparison to the arsenic RBCs calculated in this memorandum (residential = 6.4 µg/g; commercial = 27 µg/g) using the same target cancer risk ($10^{-5}$) and hazard quotient (1). Therefore, the iterative approach was also conducted using the Part 201 GCC.

The table below presents a comparison of the arsenic EPC to the Part 201 GCC for each redevelopment area. The MDEQ GCC is based on a cancer risk of 1 x $10^{-5}$ and hazard quotient of 1.

| ***Redevelopment Area*** | ***EPC (µg/g)*** | | ***Part 201 GCC (µg/g)*** |
|---|---|---|---|
| | ***Surface Soil*** | ***Soil (Surface and Subsurface)*** | |
| Residential Area 1 | 7.382 | **10.71** | 7.6 |
| Residential Area 2 | **8.751** | **8.7** | 7.6 |
| Residential Area 3 | **11.16** | **13.05** | 7.6 |
| Residential Area 4 | **9.391** | **12.3** | 7.6 |
| Waterfront Plaza | 69.28 (34.7) [(1)] | 18.13 | 37 |
| Mixed Residential/Commercial Area 1 | **8.111** | **11.02** | 7.6 |
| Mixed Residential/Commercial Area 2 | **19.31** | **47.39** | 7.6 |
| Commercial Area 1 | 7.361 | 7.234 | 37 |
| Commercial Area 2 | 9.947 | 13.33 | 37 |
| Commercial Area 3 | 12.24 | 9.59 | 37 |
| Commercial Area 4 | 19.38 | 16.68 | 37 |

Notes:
Bold and Shading: EPC exceeds the Part 201 GCC
(1) The calculated EPC is greater than the maximum detected concentration of 34.7 µg/g for surface and subsurface soil due to the low sample numbers. Given that the Part 201 GCC is greater than the maximum detected concentration, no locations need to be removed.

Based on the information presented in the above table, all Redevelopment Areas, with the exception of Waterfront Plaza and Commercial Areas 1 through 4 require further action to mitigate potential exposure to arsenic through direct contact with soil. Using an iterative approach, specific soil sampling locations containing the highest concentrations of arsenic from these Redevelopment Areas were removed from the soil datasets used to calculate the EPCs until the EPCs met the MDEQ GCC. The results of this analysis are presented in Table 11 for each Redevelopment Area.

### 2.1.3 Arsenic RBC (Cancer Risk = 10-6; Hazard Quotient = 1)

The table below presents a comparison of the arsenic EPC to the calculated arsenic RBC for each development area. The calculated RBC is based on a cancer risk of 1 x $10^{-6}$ and hazard quotient of 1.

| *Development Area* | *EPC (µg/g)* | | *Arsenic RBC (Cancer Risk = $10^{-6}$ and Hazard Quotient = 1) (µg/g)* |
|---|---|---|---|
| | *Surface Soil* | *Soil (Surface and Subsurface)* | |
| Residential Area 1 | **7.382** | **10.21** | 0.64 |
| Residential Area 2 | **8.751** | **8.7** | 0.64 |
| Residential Area 3 | **11.16** | **13.05** | 0.64 |
| Residential Area 4 | **9.391** | **12.3** | 0.64 |
| Waterfront Plaza | **69.28** | **18.13** | 2.7 |
| Mixed Residential/Commercial Area 1 | **8.111** | **11.02** | 0.64 |
| Mixed Residential/Commercial Area 2 | **19.31** | **47.39** | 0.64 |
| Commercial Area 1 | **7.361** | **7.234** | 2.7 |
| Commercial Area 2 | **9.947** | **13.33** | 2.7 |
| Commercial Area 3 | **12.24** | **9.59** | 2.7 |
| Commercial Area 4 | **19.38** | **16.68** | 2.7 |

Notes:
Bold and Shading: EPC exceeds the arsenic RBC

Based on the information presented in the above table, all Redevelopment Areas require further action to mitigate potential exposure to arsenic through direct contact with soil. The calculated arsenic RBCs for both residential and non-residential land use based on a cancer risk of 1 x $10^{-6}$ are extremely low, and below the Part 201 SDBL of 5.8 µg/g. Virtually all soil sampling locations within each Redevelopment Area would need to be removed to meet the arsenic RBCs based on a cancer risk of 1 x $10^{-6}$, and; therefore, the iterative approach was not conducted for this scenario. However, given that the calculated RBCs based on a cancer risk of 1 x $10^{-6}$ are below the Part 201 SDBL, the iterative approach was conducted using the Part 201 SDBL. The results of this analysis are presented in Table 12 for each Redevelopment Area.

## 3.0 Development of Risk-Based Concentrations for PCBs in Soil

The RBCs for PCBs were developed using the same methodology used in the development of the RBCs for arsenic (see Section 2.0), with the exception of the changes discussed in Section 3.1. A summary of the RBCs developed for PCBs in soil is presented in Section 3.2

### 3.1 Summary of Changes in the RBC Development

The following changes to the RBC development methodology presented for arsenic (Section 2.0) were applied in the development of the PCBs for soil.

- ***Development of Recreational User and Resident RBCs for PCBs***

The recreational user and resident RBCs were calculated using age-adjusted ingestion and dermal factors, consistent with the approach applied by MDEQ in the development of the Part 201 GCC (MDEQ, 2013) for residential land use. These age-adjusted ingestion and dermal factors were applied in the following RBC equations:

Carcinogenic Endpoint:

$$RBC_{soil} = \frac{TR \times AT_c}{((CSF \times IF \times ABS_o \times CF \times EFa) + (CSF \times DF \times ABS_d \times CF \times EFb) + (URF \times FT \times EFa \times ED \times (1/PEF))}$$

Non-Carcinogenic Endpoint:

$$RBC_{soil} = \frac{THQ \times ATnc}{((1/RfD) \times IF \times ABS_o \times CF \times EFa) + ((1/RfD) \times DF \times ABS_d \times CF \times EFb) + ((1/RfC) \times EFa \times ED \times FT \times (1/(PEF))}$$

Where:

| | | |
|---|---|---|
| ***$RBC_{soil}$*** | = | Risk-based concentration in soil based on ingestion, dermal contact, and inhalation exposure (mg/kg) |
| ***TR*** | = | Target Cancer Risk |
| ***THQ*** | = | Target Hazard Quotient |
| ***ATc*** | = | Averaging Time - carcinogen |
| ***ATnc*** | = | Averaging Time - non-carcinogen – child and adult (days) |
| ***CSF*** | = | Cancer Slope Factor – oral/dermal - chemical-specific $(mg/kg/day)^{-1}$ |
| ***URF*** | = | Unit Risk Factor - inhalation - chemical-specific $(mg/m^3)^{-1}$ |
| ***RfD*** | = | Reference Dose – oral/dermal - chemical-specific (mg/kg/day) |
| ***RfC*** | = | Reference Concentration - inhalation - chemical-specific $(mg/m^3)$ |
| ***$ABS_o$*** | = | Absorption Factor - oral - chemical-specific (%/100) |
| ***$ABS_d$*** | = | Absorption Factor - dermal - chemical-specific (%/100) |
| ***IF*** | = | Age-adjusted Ingestion Factor (mg-year/kg-day) |
| ***DF*** | = | Age-adjusted Dermal Factor (mg-year/kg-day) |
| ***CF*** | = | Conversion Factor ($1.0 \times 10^{-6}$ kg/mg) |
| ***FT*** | = | Fraction Time Exposed (hours/24 hours) |
| ***EFa*** | = | Exposure Frequency (days/year) – ingestion/inhalation |
| ***EFb*** | = | Exposure Frequency (days/year) – dermal |
| ***ED*** | = | Exposure Duration – child and adult (years) |
| ***PEF*** | = | Particulate Emission Factor - inhalation $(m^3/kg)$ |

With the exception of the age-adjusted ingestion factor, age-adjusted dermal factor, exposure duration, and oral absorption factor, all other exposure assumptions were identical to those applied in the equations for the derivation of the recreational user and resident RBCs for arsenic indicated above (Section 2.0) and thus are not reproduced here.

The age-adjusted ingestion factor of 114 mg-year/kg-day was obtained from MDEQ (2013), and calculated using the child and adult ingestion rates, exposure durations, and body weights. The age-adjusted dermal factor of 353 mg-year/kg-day was also obtained from MDEQ (2013), and calculated using the child and adult skin surface areas available for contact, soil to skin adherence factors, exposure durations, and body weights. The exposure duration is 30 years, and accounts for the exposure durations of the child (6 years) and adult (24 years), consistent with the approach applied by MDEQ (2013). It is common to see federal and state agencies apply age-adjusted ingestion and dermal factors in the development of criteria using a risk-based approach. U.S. EPA applies age-adjusted ingestion and dermal factors in the development of

their Regional Screening Levels (RSLs)[6], and U.S. EPA also recommends using age-adjusted ingestion and dermal factors in the development of risk-based Preliminary Remediation Goals (PRGs)[7].

- ***Oral Absorption Factors***

An oral absorption factor of 1 was applied for PCBs, consistent with the oral absorption factor applied in the RI Report. Oral absorption factors are chemical-specific; however, it is conservatively assumed that 100 percent of PCBs is absorbed into the body through oral exposure. Unlike arsenic, oral absorption factors specific to PCBs are not available, and; therefore, assuming a factor of 1 is considered to be appropriate.

### 3.2 Summary of Risk-Based Concentrations for PCBs

The calculated RBCs for PCBs in soil are presented in the following tables:

| ***Receptor*** | ***Table Reference*** |
|---|---|
| Trespasser | Table 13 |
| Recreational User | Table 14 |
| Resident | Table 15 |
| Commercial Worker | Table 16 |
| Utility Worker | Table 17 |
| Construction Worker | Table 18 |

Table 19 presents a summary of the calculated RBCs for each receptor at target cancer risk levels of $10^{-4}$, $10^{-5}$, and $10^{-6}$, respectively, and a target hazard quotient of 1.0. The proposed RBCs for PCBs for each area of redevelopment were selected similar to the approach presented above for arsenic, and are summarized in the table below.

[6] U.S. EPA, 2014. Regional Screening Levels for Chemical Contaminants at Superfund Sites, User's Guide, May 2014.
[7] U.S. EPA, 1991. Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals, EPA/540/R-92/003, December 1991.

| ***Redevelopment Area*** | ***PCBs RBC (µg/g)*** | | |
|---|---|---|---|
| | ***Cancer Risk = $10^{-4}$ Hazard Quotient = 1*** | ***Cancer Risk = $10^{-5}$ Hazard Quotient = 1*** | ***Cancer Risk = $10^{-6}$ Hazard Quotient = 1*** |
| Residential Area 1 | 4.2 | 2.5 | 0.25 |
| Residential Area 2 | 4.2 | 2.5 | 0.25 |
| Residential Area 3 | 4.2 | 2.5 | 0.25 |
| Residential Area 4 | 4.2 | 2.5 | 0.25 |
| Waterfront Plaza | 9.1 | 9.1 | 0.91 |
| Mixed Residential/Commercial Area 1 | 4.2 | 2.5 | 0.25 |
| Mixed Residential/Commercial Area 2 | 4.2 | 2.5 | 0.25 |
| Commercial Area 1 | 9.1 | 9.1 | 0.91 |
| Commercial Area 2 | 9.1 | 9.1 | 0.91 |
| Commercial Area 3 | 9.1 | 9.1 | 0.91 |
| Commercial Area 4 | 9.1 | 9.1 | 0.91 |

These RBCs are based on the most sensitive receptor that is present within these areas, and target cancer risk range of $10^{-6}$ to $10^{-4}$ and target hazard quotient of 1.0.

**TABLE 1**

**DERIVATION OF PARTICULATE EMISSION FACTOR (PEF) FOR SOIL**
**CURRENT/ FUTURE UTILITY WORKER INHALATION EXPOSURE**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

$$PEF_{SC} = Q/C_{sr} \times 1/F_D \times [ (T \times A_R) / (556 \times ((W/3)^{0.4} \times ((365\ d/y - p) / 365\ d/y) \times VKT)]$$

$$Q/C_{sr} = A \times EXP [ (\ln A_s - B)^2 / C]$$

| *INPUT PARAMETERS* | | *REFERENCE* |
|---|---|---|
| **$PEF_{sc}$/ subchronic road particulate emission factor ($m^3$/kg) =** | **2.39E+09** | Equation 5-5, U.S. EPA, 2002 |
| $Q/C_{sr}$/ inverse of ratio of the 1-h geometric mean air concentration = | 23.02 | Equation 5-6, U.S. EPA, 2002 |
| A/ constant (unitless) = | 12.9351 | U.S. EPA, 2002 |
| B/ constant (unitless) = | 5.7383 | U.S. EPA, 2002 |
| C/ constant (unitless) = | 71.7711 | U.S. EPA, 2002 |
| $A_s$/ areal extent of site surface soil contamination (acres) = | 0.5 | U.S. EPA, 2002 |
| $F_D$/ dispersion correction factor (unitless) = | 0.185 | U.S. EPA, 2002 |
| T/ exposure interval (s) = | 7.88E+08 | U.S. EPA, 2002 (site-specific, within 25 year duration) |
| $A_R$/ surface area of contaminated road segment ($m^2$) = | 274 | U.S. EPA, 2002 (AR = LR*WR*0.092903 m2/ft2) |
| LR - length of road segment (ft) = | 148 | U.S. EPA, 2002 |
| WR - width of road segment (ft) = | 20 | U.S. EPA, 2002 |
| W/ mean vehicle weight (tons) = | 8 | U.S. EPA, 2002, Assumes 20 two-ton cars and 10 twenty-ton trucks (W = (20*2+10*20)/30) |
| p/ number of days with at least 0.01 inches of precipitation (days/yr) = | 180 | U.S. EPA, 2002 |
| VKT/ sum of fleet vehicle kilometres travelled during the exposure duration (km) = | 27.0 | Assuming that the area is configured as a square with the unpaved construction access road segment dividing the square evenly, the road length would be equal to the square root of 2023.5 $m^2$, also equal to 45 m or 0.045 km. Assuming that each vehicle travels the length of the road for a total of 20 days, (30*0.045*20). |

Reference:

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.

**TABLE 2**

**DERIVATION OF PARTICULATE EMISSION FACTOR (PEF) FOR SOIL**
**FUTURE CONSTRUCTION WORKER INHALATION EXPOSURE**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

$$PEF_{SC} = Q/C_{sr} \times 1/F_D \times [ (T \times A_R) / (556 \times ((W/3)^{0.4} \times ((365\ d/y - p) / 365\ d/y) \times VKT)]$$

$$Q/C_{sr} = A \times EXP [ (\ln A_s - B)^2 / C]$$

| *INPUT PARAMETERS* | | *REFERENCE* |
|---|---|---|
| **$PEF_{sc}$/ subchronic road particulate emission factor ($m^3$/kg) =** | **1.59E+07** | Equation 5-5, U.S. EPA, 2002 |
| $Q/C_{sr}$/ inverse of ratio of the 1-h geometric mean air concentration = | 23.02 | Equation 5-6, U.S. EPA, 2002 |
| A/ constant (unitless) = | 12.9351 | U.S. EPA, 2002 |
| B/ constant (unitless) = | 5.7383 | U.S. EPA, 2002 |
| C/ constant (unitless) = | 71.7711 | U.S. EPA, 2002 |
| $A_s$/ areal extent of site surface soil contamination (acres) = | 0.5 | U.S. EPA, 2002 |
| $F_D$/ dispersion correction factor (unitless) = | 0.185 | U.S. EPA, 2002 |
| T/ total time over which construction occurs (s) = | 3.15E+07 | U.S. EPA, 2002 (site-specific, within a 1 year construction campaign) |
| $A_R$/ surface area of contaminated road segment ($m^2$) = | 274 | U.S. EPA, 2002 (AR = LR*WR*0.092903 m2/ft2) |
| LR - length of road segment (ft) = | 148 | U.S. EPA, 2002 |
| WR - width of road segment (ft) = | 20 | U.S. EPA, 2002 |
| W/ mean vehicle weight (tons) = | 8 | U.S. EPA, 2002, Assumes 20 two-ton cars and 10 twenty-ton trucks (W = (20*2+10*20)/30) |
| p/ number of days with at least 0.01 inches of precipitation (days/yr) = | 180 | U.S. EPA, 2002 |
| VKT/ sum of fleet vehicle kilometres travelled during the exposure duration (km) = | 162 | Assuming that the area is configured as a square with the unpaved construction access road segment dividing the square evenly, the road length would be equal to the square root of 2023.5 $m^2$, also equal to 45 m or 0.045 km. Assuming that each vehicle travels the length of the road once per day, 5 days per week for a total of 120 days, (30*0.045*120). |

Reference:

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.

**TABLE 3**

**DERIVATION OF RISK-BASED CONCENTRATIONS (RBCs) FOR ARSENIC IN SOIL**
**TRESPASSER ORAL, DERMAL, AND INHALATION EXPOSURE**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Chemical of Potential Concern* | *CSF oral 1/(mg/kg-d)* | *CSF dermal 1/(mg/kg-d)* | *URF inhalation 1/(mg/m³)* | *RfD oral (mg/kg-d)* | *RfD dermal (mg/kg-d)* | *RfC inhalation (mg/m³)* | *Oral Absorption Factor, $ABS_o$ (%/100)* | *Dermal Absorption Factor, $ABS_d$ (%/100)* | *Trespasser Carcinogen TR Adolescent (µg/g)* | *Trespasser Non-Carcinogen THQ Adolescent (µg/g)* | *Soil Risk-Based Concentration $RBC_{soil}$ (1) (µg/g)* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Metals*** | | | | | | | | | | | |
| Arsenic ($10^{-4}$ cancer risk) | 1.50E+00 | 1.50E+00 | 4.30E+00 | 3.00E-04 | 3.00E-04 | 1.50E-05 | 6.0E-01 | 3.0E-02 | 1.96E+03 | 1.26E+03 | 1,258 |
| Arsenic ($10^{-5}$ cancer risk) | 1.50E+00 | 1.50E+00 | 4.30E+00 | 3.00E-04 | 3.00E-04 | 1.50E-05 | 6.0E-01 | 3.0E-02 | 1.96E+02 | 1.26E+03 | 196 |
| Arsenic ($10^{-6}$ cancer risk) | 1.50E+00 | 1.50E+00 | 4.30E+00 | 3.00E-04 | 3.00E-04 | 1.50E-05 | 6.0E-01 | 3.0E-02 | 1.96E+01 | 1.26E+03 | 20 |

Notes:

-- = Not Available

NV = No Value

(1) The selected RBC is the lower of the carcinogenic-based concentration and the non-carcinogenic-based concentration.

(2) The basis for SA is assuming that potential exposed skin (U.S. EPA Exhibit C-1) consists of the face (425 $cm^2$), hands (700 $cm^2$), forearms (787 $cm^2$), lower legs (1610 $cm^2$) and feet (949 $cm^2$).

(3) The basis for the FT is the 50th percentile from Table 16-1, Recommended Values for Activity Factors - Time Outdoors (total).
The time spent outdoors for 11-16 years old of 100 min/day equates to 1.7 hours (100 min/60 min). The final FT is double the 50th percentile value or 3.4 hours.

(4) The basis for the EF is the 50th percentile from Table 16-1, Recommended Values for Activity Factors - Time Outdoors (total).
Ingestion/Inhalation: The time spent outdoors for 11-16 years old of 100 min/day out of a possible 365 days equates to 25 days (CT) (100 min/day x 365 days x 1 hour/60 min x 1 day/24 hours).
The final EF is double the 50th percentile value or 50 days.
Dermal: the time spent outdoors for 11-16 years old of 100 min/day out of a possible 245 days equates to 17 days (CT) (100 min/day x 365 days x 1 hour/60 min x 1 day/24 hours).
The final EF is double the 50th percentile value or 34 days.

(5) Trespasser is a 7 through 16 year old therefore the exposure duration is 10 years, based on U.S. EPA Region 4 (2000).

Trespasser Assumptions

| | | | |
|---|---|---|---|
| Risk-Based Concentration in Soil (µg/g) | $RBC_{soil}$ | calculated | |
| Target Cancer Risk (unitless) | TR | 1.0E-04 | |
| Target Cancer Risk (unitless) | TR | 1.0E-05 | |
| Target Cancer Risk (unitless) | TR | 1.0E-06 | |
| Target Hazard Quotient (unitless) | THQ | 1.0 | |
| Cancer Slope Factor (per mg/kg-day) | CSF | chemical-specific | IRIS |
| Reference Dose (mg/kg-day) | RfD | chemical-specific | IRIS |
| Unit Risk Factor (per $mg/m^3$) | URF | chemical-specific | IRIS |
| Reference Concentration ($mg/m^3$) | RfC | chemical-specific | U.S. EPA RSL Table |
| Ingestion Rate (mg/day) - adult | IR | 100 | U.S. EPA, 2002 |
| Surface Area Exposed ($cm^2$/day) | SA | 4,471 | U.S. EPA, 2004 (2) |
| Adherence Factor ($mg/cm^2$) | AF | 0.2 | U.S. EPA, 2004 |
| Absorption Factor - Oral (%/100) | $ABS_o$ | chemical-specific | see Section 2.2 of the Memorandum |
| Absorption Factor - Dermal (%/100) | $ABS_d$ | chemical-specific | U.S. EPA, 2004 |
| Fraction Time Exposed (hours/24 hours) | FT | 3.4/24 | U.S. EPA, 2008 (3) |
| Exposure Frequency (days/year) - ingestion/inhalation | EFa | 50 | see Section 2.2 of the Memorandum (4) |
| Exposure Frequency (days/year) - dermal | EFb | 34 | see Section 2.2 of the Memorandum (4) |
| Exposure Duration (years) | ED | 10 | U.S. EPA, 2000 (5) |
| Body Weight (kg) | BW | 45 | U.S. EPA, 2000 |
| Conversion Factor (kg/mg) | CF | 1.0E-06 | |
| Averaging Time - carcinogenic (days) | ATc | 25,550 | U.S. EPA, 1989 |
| Averaging Time - non-carcinogenic (days) | ATnc | 3,650 | U.S. EPA, 1989 |
| Particulate Emission Factor ($m^3$/kg) | PEF | 1.36E+09 | U.S. EPA, 2002 |

Exposure Equations

Carcinogenic Endpoints:

$$RBC_{soil} = \frac{TR \times ATc}{ED \times [(CSF \times IR \times EFa \times CF \times ABS_o)/BW + (CSF \times SA \times AF \times EFb \times CF \times ABS_d)/BW + (URF \times EFa \times FT \times (1/PEF))]}$$

Non-Carcinogenic Endpoints:

$$RBC_{soil} = \frac{THQ \times ATnc}{ED \times [((1/RfD) \times IR \times EFa \times CF \times ABS_o)/BW + ((1/RfD) \times SA \times AF \times EFb \times CF \times ABS_d)/BW + ((1/RfC) \times EFa \times FT \times (1/PEF))]}$$

References:


IRIS, Integrated Risk Information System (IRIS) Database, (http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList).

U.S. EPA RSL Table, U.S. EPA Regional Screening Levels Summary Table, November 2013.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund (RAGS): Volume 1 – Human Health Evaluation Manual (Part A), Interim Final, EPA/540/1-89/002, December 1989.

U.S. EPA, 2000: Region 4 Human Health Risk Assessment Bulletins – Supplement to RAGS, Section 4: Exposure Assessment, May.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.

U.S. EPA, 2004: Risk Assessment Guidance for Superfund (RAGS):Volume 1 - Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), EPA/540/R/99/005, July 2004.

U.S. EPA, 2008: Child Specific Exposure Factors Handbook, September 2008.

**TABLE 4**

**DERIVATION OF RISK-BASED CONCENTRATIONS (RBCs) FOR ARSENIC IN SOIL**
**RECREATIONAL USER ORAL, DERMAL, AND INHALATION EXPOSURE**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Chemical of Potential Concern (COPC)* | *CSF* | | *URF* | *RfD* | | *RfC* | *Oral Absorption Factor, $ABS_o$ (%/100)* | *Dermal Absorption Factor, $ABS_d$ (%/100)* | *Recreational User* | | *Soil Risk-Based Concentration $RBC_{soil}$ (1) (µg/g)* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *oral 1/(mg/kg-d)* | *dermal 1/(mg/kg-d)* | *inhalation 1/(mg/m³)* | *oral (mg/kg-d)* | *dermal (mg/kg-d)* | *inhalation (mg/m³)* | | | *TR Child & Adult (µg/g)* | *THQ Child (µg/g)* | |
| ***Metals*** | | | | | | | | | | | |
| Arsenic ($10^{-4}$ cancer risk) | 1.50E+00 | 1.50E+00 | 4.30E+00 | 3.00E-04 | 3.00E-04 | 1.50E-05 | 6.0E-01 | 3.0E-02 | 3.20E+02 | 1.78E+02 | 178 |
| Arsenic ($10^{-5}$ cancer risk) | 1.50E+00 | 1.50E+00 | 4.30E+00 | 3.00E-04 | 3.00E-04 | 1.50E-05 | 6.0E-01 | 3.0E-02 | 3.20E+01 | 1.78E+02 | 32 |
| Arsenic ($10^{-6}$ cancer risk) | 1.50E+00 | 1.50E+00 | 4.30E+00 | 3.00E-04 | 3.00E-04 | 1.50E-05 | 6.0E-01 | 3.0E-02 | 3.20E+00 | 1.78E+02 | 3.2 |

Notes:

(1) The selected RBC is the lower of the carcinogenic-based concentration and the non-carcinogenic-based concentration.

(2) The basis for the EF is the 50th percentile from Table 16-1, Recommended Values for Activity Factors - Time Outdoors (total).

Ingestion/Inhalation: The time spent outdoors for 6-12 month olds of 139 min/day out of a possible 365 days equates to 35 days (CT) (139 min/day x 365 days x 1 hour/60 min x 1 day/24 hours).

The final EF is double the 50th percentile value or 70 days.

Dermal: the time spent outdoors for 6-12 month olds of 139 min/day out of a possible 245 days equates to 24 days (CT) (139 min/day x 365 days x 1 hour/60 min x 1 day/24 hours).

The final EF is double the 50th percentile value or 48 days.

(3) The basis for the FT is based on ages 3-5 yrs from Table 16-1, Recommended Values for Activity Factors - Time Outdoors Playing on Dirt.

It is assumed that the adult will spend the same amount of time outdoors with their child.

Recreational User Exposure Assumptions

| | | | |
|---|---|---|---|
| Risk-Based Concentration in Soil (µg/g) | $RBC_{soil}$ | calculated | |
| Target Cancer Risk (unitless) | TR | 1.0E-04 | |
| Target Cancer Risk (unitless) | TR | 1.0E-05 | |
| Target Cancer Risk (unitless) | TR | 1.0E-06 | |
| Target Hazard Quotient (unitless) | THQ | 1.0 | |
| Cancer Slope Factor (per mg/kg-day) | CSF | chemical-specific | IRIS |
| Reference Dose (mg/kg-day) | RfD | chemical-specific | IRIS |
| Unit Risk Factor (per mg/m³) | URF | chemical-specific | IRIS |
| Reference Concentration (mg/m³) | RfC | chemical-specific | U.S. EPA RSL Table |
| Ingestion Rate (mg/day) - child | $IR_c$ | 200 | U.S. EPA, 2002 |
| Ingestion Rate (mg/day) - adult | $IR_a$ | 100 | U.S. EPA, 2002 |
| Surface Area Exposed (cm²/day) - child | $SA_c$ | 2,800 | U.S. EPA, 2004 |
| Surface Area Exposed (cm²/day) - adult | $SA_a$ | 5,700 | U.S. EPA, 2004 |
| Adherence Factor (mg/cm²) - child | $AF_c$ | 0.2 | U.S. EPA, 2004 |
| Adherence Factor (mg/cm²) - adult | $AF_a$ | 0.07 | U.S. EPA, 2004 |
| Absorption Factor - Oral (%/100) | $ABS_o$ | chemical-specific | see Section 2.2 of the Memorandum |
| Absorption Factor - Dermal (%/100) | $ABS_d$ | chemical-specific | U.S. EPA, 2004 |
| Exposure Frequency (days/year) - ingestion/inhalation | EFa | 70 | see Section 2.2 of the Memorandum (2) |
| Exposure Frequency (days/year) - dermal | EFb | 48 | see Section 2.2 of the Memorandum (2) |
| Exposure Duration (years) - child | $ED_c$ | 6 | U.S. EPA, 2004 |
| Exposure Duration (years) - adult | $ED_a$ | 24 | U.S. EPA, 2004 |
| Fraction Time Exposed (hours/24 hours) | FT | 2/24 | U.S. EPA, 2008 (3) |
| Body Weight (kg) - child | $BW_c$ | 15 | U.S. EPA, 2008 |
| Body Weight (kg) - adult | $BW_a$ | 70 | U.S. EPA, 2002 |
| Conversion Factor (kg/mg) | CF | 1.0E-06 | |
| Averaging Time - carc. (days) | ATc | 25,550 | U.S. EPA, 1989 |
| Averaging Time - noncarc. (days) - child | ATnc | 2,190 | U.S. EPA, 1989 |
| Averaging Time - noncarc. (days) - adult | ATnc - a | 8,760 | U.S. EPA, 1989 |
| Particulate Emission Factor (m³/kg) | PEF | 1.36E+09 | U.S. EPA, 2002 |

Exposure Equations

Carcinogenic Endpoints:

$$RBC_{soil} = \frac{TR \times ATc}{\begin{array}{c}[(((CSF \times IR_c \times EFa \times ED_c \times CF \times ABS_o)/BW_c + (CSF \times SA_c \times AF_c \times EFb \times ED_c \times CF \times ABS_d)/BW_c + (URF \times FT \times EFa \times ED_c \times (1/PEF))) + \\ (((CSF \times IR_a \times EFa \times ED_a \times CF \times ABS_o)/BWa + (CSF \times SA_a \times AF_a \times EFb \times ED_a \times CF \times ABS_d)/BW_a) + (URF \times FT \times EFa \times ED_a \times (1/PEF))]\end{array}}$$

Non-Carcinogenic Endpoints:

$$RBC_{soil} = \frac{THQ \times ATnc}{ED_c \times [(((1/RfD) \times IR_c \times EFa \times CF \times ABS_o)/BW_c + ((1/RfD) \times SA_c \times AF_c \times EFb \times CF \times ABS_d)/BW_c + ((1/RfC) \times FT \times EFa \times (1/PEF))]}$$

References:


IRIS, Integrated Risk Information System (IRIS) Database, (http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList).

U.S. EPA RSL Table, U.S. EPA Regional Screening Levels Summary Table, November 2013.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund (RAGS): Volume 1 – Human Health Evaluation Manual (Part A), Interim Final, EPA/540/1-89/002, December 1989.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.

U.S. EPA, 2004: Risk Assessment Guidance for Superfund (RAGS):Volume 1 - Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), EPA/540/R/99/005, July 2004.

U.S. EPA, 2008: Child Specific Exposure Factors Handbook, September 2008.

**TABLE 5**

**DERIVATION OF RISK-BASED CONCENTRATIONS (RBCs) FOR ARSENIC IN SOIL**
**RESIDENTIAL ORAL, DERMAL, AND INHALATION EXPOSURE**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Chemical of Potential Concern (COPC)* | *CSF oral 1/(mg/kg-d)* | *CSF dermal 1/(mg/kg-d)* | *URF inhalation 1/(mg/m³)* | *RfD oral (mg/kg-d)* | *RfD dermal (mg/kg-d)* | *RfC inhalation (mg/m³)* | *Oral Absorption Factor, $ABS_o$ (%/100)* | *Dermal Absorption Factor, $ABS_d$ (%/100)* | *Resident TR Child & Adult (µg/g)* | *Resident THQ Child (µg/g)* | *Soil Risk-Based Concentration $RBC_{soil}$ (1) (µg/g)* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Metals*** | | | | | | | | | | | |
| Arsenic ($10^{-4}$ cancer risk) | 1.50E+00 | 1.50E+00 | 4.30E+00 | 3.00E-04 | 3.00E-04 | 1.50E-05 | 6.0E-01 | 3.0E-02 | 6.39E+01 | 3.56E+01 | 36 |
| Arsenic ($10^{-5}$ cancer risk) | 1.50E+00 | 1.50E+00 | 4.30E+00 | 3.00E-04 | 3.00E-04 | 1.50E-05 | 6.0E-01 | 3.0E-02 | 6.39E+00 | 3.56E+01 | 6.4 |
| Arsenic ($10^{-6}$ cancer risk) | 1.50E+00 | 1.50E+00 | 4.30E+00 | 3.00E-04 | 3.00E-04 | 1.50E-05 | 6.0E-01 | 3.0E-02 | 6.39E-01 | 3.56E+01 | 0.64 |

Notes:

(1) The selected RBC is the lower of the carcinogenic-based concentration and the non-carcinogenic-based concentration.

(2) The basis for the FT is based on ages 3-5 yrs from Table 16-1, Recommended Values for Activity Factors - Time Outdoors Playing on Dirt.

Resident Exposure Assumptions

| | | | |
|---|---|---|---|
| Risk-Based Concentration in Soil (µg/g) | $RBC_{soil}$ | calculated | |
| Target Cancer Risk (unitless) | TR | 1.0E-04 | |
| Target Cancer Risk (unitless) | TR | 1.0E-05 | |
| Target Cancer Risk (unitless) | TR | 1.0E-06 | |
| Target Hazard Quotient (unitless) | THQ | 1.0 | |
| Cancer Slope Factor (per mg/kg-day) | CSF | chemical-specific | IRIS |
| Reference Dose (mg/kg-day) | RfD | chemical-specific | IRIS |
| Unit Risk Factor (per mg/m³) | URF | chemical-specific | IRIS |
| Reference Concentration (mg/m³) | RfC | chemical-specific | U.S. EPA RSL Table |
| Ingestion Rate (mg/day) - child | $IR_c$ | 200 | U.S. EPA, 2002 |
| Ingestion Rate (mg/day) - adult | $IR_a$ | 100 | U.S. EPA, 2002 |
| Surface Area Exposed (cm²/day) - child | $SA_c$ | 2,800 | U.S. EPA, 2004 |
| Surface Area Exposed (cm²/day) - adult | $SA_a$ | 5,700 | U.S. EPA, 2004 |
| Adherence Factor (mg/cm²) - child | $AF_c$ | 0.2 | U.S. EPA, 2004 |
| Adherence Factor (mg/cm²) - adult | $AF_a$ | 0.07 | U.S. EPA, 2004 |
| Absorption Factor - Oral (%/100) | $ABS_o$ | chemical-specific | see Section 2.2 of the Memorandum |
| Absorption Factor - Dermal (%/100) | $ABS_d$ | chemical-specific | U.S. EPA, 2004 |
| Exposure Frequency (days/year) - ingestion/inhalation | EFa | 350 | see Section 2.2 of the Memorandum |
| Exposure Frequency (days/year) - dermal | EFb | 245 | see Section 2.2 of the Memorandum |
| Exposure Duration (years) - child | $ED_c$ | 6 | U.S. EPA, 2004 |
| Exposure Duration (years) - adult | $ED_a$ | 24 | U.S. EPA, 2004 |
| Fraction Time Exposed (hours/24 hours) | FT | 2/24 | U.S. EPA, 2008 (2) |
| Body Weight (kg) - child | $BW_c$ | 15 | U.S. EPA, 2008 |
| Body Weight (kg) - adult | $BW_a$ | 70 | U.S. EPA, 2002 |
| Conversion Factor (kg/mg) | CF | 1.0E-06 | |
| Averaging Time - carc. (days) | ATc | 25,550 | U.S. EPA, 1989 |
| Averaging Time - noncarc. (days) - child | ATnc | 2,190 | U.S. EPA, 1989 |
| Averaging Time - noncarc. (days) - adult | ATnc - a | 8,760 | U.S. EPA, 1989 |
| Particulate Emission Factor (m³/kg) | PEF | 1.36E+09 | U.S. EPA, 2002 |

Exposure Equations

Carcinogenic Endpoints:

$$RBC_{soil} = \frac{TR \times ATc}{[(((CSF \times IR_c \times EFa \times ED_c \times CF \times ABS_o)/BW_c + (CSF \times SA_c \times AF_c \times EFb \times ED_c \times CF \times ABS_d)/BW_c + (URF \times FT \times EFa \times ED_c \times (1/PEF))) + (((CSF \times IR_a \times EFa \times ED_a \times CF \times ABS_o)/BW_a + (CSF \times SA_a \times AF_a \times EFb \times ED_a \times CF \times ABS_d)/BW_a) + (URF \times FT \times EFa \times ED_a \times (1/PEF))]}$$

Non-Carcinogenic Endpoints:

$$RBC_{soil} = \frac{THQ \times ATnc}{ED_c \times [(((1/RfD) \times IR_c \times EFa \times ABS_o)/BW_c + ((1/RfD) \times SA_c \times AF_c \times EFb \times CF \times ABS_d)/BW_c + ((1/RfC) \times EFa \times FT \times (1/PEF))]}$$

References:


IRIS, Integrated Risk Information System (IRIS) Database, (http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList).

U.S. EPA RSL Table, U.S. EPA Regional Screening Levels Summary Table, November 2013.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund (RAGS): Volume 1 – Human Health Evaluation Manual (Part A), Interim Final, EPA/540/1-89/002, December 1989.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.

U.S. EPA, 2004: Risk Assessment Guidance for Superfund (RAGS):Volume 1 - Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), EPA/540/R/99/005, July 2004.

U.S. EPA, 2008: Child Specific Exposure Factors Handbook, September 2008.

**TABLE 6**

**DERIVATION OF RISK-BASED CONCENTRATIONS (RBCs) FOR ARSENIC IN SOIL**
**COMMERCIAL WORKER ORAL, DERMAL, AND INHALATION EXPOSURE**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Chemical of Potential Concern* | *CSF oral 1/(mg/kg-d)* | *CSF dermal 1/(mg/kg-d)* | *URF inhalation 1/(mg/m³)* | *RfD oral (mg/kg-d)* | *RfD dermal (mg/kg-d)* | *RfC inhalation (mg/m³)* | *Oral Absorption Factor, $ABS_o$ (%/100)* | *Dermal Absorption Factor, $ABS_d$ (%/100)* | *Commercial Worker Carcinogen TR Adult (µg/g)* | *Commercial Worker Non-Carcinogen THQ Adult (µg/g)* | *Soil Risk-Based Concentration $RBC_{soil}$ (1) (µg/g)* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Metals*** | | | | | | | | | | | |
| Arsenic ($10^{-4}$ cancer risk) | 1.50E+00 | 1.50E+00 | 4.30E+00 | 3.00E-04 | 3.00E-04 | 1.50E-05 | 6.00E-01 | 3.0E-02 | 2.67E+02 | 4.27E+02 | 267 |
| Arsenic ($10^{-5}$ cancer risk) | 1.50E+00 | 1.50E+00 | 4.30E+00 | 3.00E-04 | 3.00E-04 | 1.50E-05 | 6.00E-01 | 3.0E-02 | 2.67E+01 | 4.27E+02 | 27 |
| Arsenic ($10^{-6}$ cancer risk) | 1.50E+00 | 1.50E+00 | 4.30E+00 | 3.00E-04 | 3.00E-04 | 1.50E-05 | 6.00E-01 | 3.0E-02 | 2.67E+00 | 4.27E+02 | 2.7 |

Notes:

(1) The selected RBC is the lower of the carcinogenic-based concentration and the non-carcinogenic-based concentration.

(2) Professional Judgment; assumed 8 hour work day.

Commercial Worker Assumptions

| | | | |
|---|---|---|---|
| Risk-Based Concentration in Soil (µg/g) | $RBC_{soil}$ | calculated | |
| Target Cancer Risk (unitless) | TR | 1.0E-04 | |
| Target Cancer Risk (unitless) | TR | 1.0E-05 | |
| Target Cancer Risk (unitless) | TR | 1.0E-06 | |
| Target Hazard Quotient (unitless) | THQ | 1.0 | |
| Cancer Slope Factor (per mg/kg-day) | CSF | chemical-specific | IRIS |
| Reference Dose (mg/kg-day) | RfD | chemical-specific | IRIS |
| Unit Risk Factor (per $mg/m^3$) | URF | chemical-specific | IRIS |
| Reference Concentration ($mg/m^3$) | RfC | chemical-specific | U.S. EPA RSL Table |
| Ingestion Rate (mg/day) - adult | IR | 100 | U.S. EPA, 2002 |
| Surface Area Exposed ($cm^2$/day) | SA | 3,300 | U.S. EPA, 2004 |
| Adherence Factor ($mg/cm^2$) | AF | 0.2 | U.S. EPA, 2004 |
| Absorption Factor - Oral (%/100) | $ABS_o$ | chemical-specific | see Section 2.2 of the Memorandum |
| Absorption Factor - Dermal (%/100) | $ABS_d$ | chemical-specific | U.S. EPA, 2004 |
| Fraction Time Exposed (hours/24 hours) | FT | 8/24 | Professional Judgement (2) |
| Exposure Frequency (days/year) - ingestion/inhalation | EFa | 245 | see Section 2.2 of the Memorandum |
| Exposure Frequency (days/year) - dermal | EFb | 160 | see Section 2.2 of the Memorandum |
| Exposure Duration (years) | ED | 25 | U.S. EPA, 2004 |
| Body Weight (kg) | BW | 70 | U.S. EPA, 2002 |
| Conversion Factor (kg/mg) | CF | 1.0E-06 | |
| Averaging Time - carcinogenic (days) | ATc | 25,550 | U.S. EPA, 1989 |
| Averaging Time - non-carcinogenic (days) | ATnc | 9,125 | U.S. EPA, 1989 |
| Particulate Emission Factor ($m^3$/kg) | PEF | 1.36E+09 | U.S. EPA, 2002 |

Exposure Equations

Carcinogenic Endpoints:

$$RBC_{soil} = \frac{TR \times ATc}{ED \times [(CSF \times IR \times EFa \times CF \times ABS_o)/BW + (CSF \times SA \times AF \times EFb \times CF \times ABS_d)/BW + (URF \times EFa \times FT \times (1/PEF))]}$$

Non-Carcinogenic Endpoints:

$$RBC_{soil} = \frac{THQ \times ATnc}{ED \times [((1/RfD) \times IR \times EFa \times CF \times ABS_o)/BW + ((1/RfD) \times SA \times AF \times EFb \times CF \times ABS_d)/BW + ((1/RfC) \times EFa \times FT \times (1/PEF))]}$$

References:

IRIS, Integrated Risk Information System (IRIS) Database, (http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList).

U.S. EPA RSL Table, U.S. EPA Regional Screening Levels Summary Table, November 2013.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund (RAGS): Volume 1 – Human Health Evaluation Manual (Part A), Interim Final, EPA/540/1-89/002, December 1989.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.

U.S. EPA, 2004: Risk Assessment Guidance for Superfund (RAGS):Volume 1 - Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), EPA/540/R/99/005, July 2004.

**TABLE 7**

**DERIVATION OF RISK-BASED CONCENTRATIONS (RBCs) FOR ARSENIC IN SOIL**
**UTILITY WORKER ORAL, DERMAL, AND INHALATION EXPOSURE**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| Chemical of Potential Concern | CSF oral 1/(mg/kg-d) | CSF dermal 1/(mg/kg-d) | URF inhalation 1/(mg/m$^3$) | RfD oral (mg/kg-d) | RfD dermal (mg/kg-d) | RfC inhalation (mg/m$^3$) | Oral Absorption Factor, $ABS_o$ (%/100) | Dermal Absorption Factor, $ABS_d$ (%/100) | Utility Worker Carcinogen TR Adult (µg/g) | Utility Worker Non-Carcinogen THQ Adult (µg/g) | Soil Risk-Based Concentration $RBC_{soil}$ (1) (µg/g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Metals*** | | | | | | | | | | | |
| Arsenic ($10^{-4}$ cancer risk) | 1.50E+00 | 1.50E+00 | 4.30E+00 | 3.00E-04 | 3.00E-04 | 1.50E-05 | 6.0E-01 | 3.0E-02 | 4.36E+03 | 2.80E+02 | 280 |
| Arsenic ($10^{-5}$ cancer risk) | 1.50E+00 | 1.50E+00 | 4.30E+00 | 3.00E-04 | 3.00E-04 | 1.50E-05 | 6.0E-01 | 3.0E-02 | 4.36E+02 | 2.80E+02 | 280 |
| Arsenic ($10^{-6}$ cancer risk) | 1.50E+00 | 1.50E+00 | 4.30E+00 | 3.00E-04 | 3.00E-04 | 1.50E-05 | 6.0E-01 | 3.0E-02 | 4.36E+01 | 2.80E+02 | 44 |

Notes:

-- = Not Available

NV = No Value

(1) The selected RBC is the lower of the carcinogenic-based concentration and the non-carcinogenic-based concentration.

(2) Professional Judgement; assumed 8 hour work day.

(3) Professional Judgement; assumes 5 days/week for 6 months or 120 days/year.

(4) Professional Judgement; assumes utility maintenance activities occurs within a one year time period.

Utility Worker Assumptions

| | | | |
|---|---|---|---|
| Risk-Based Concentration in Soil (µg/g) | $RBC_{soil}$ | calculated | |
| Target Cancer Risk (unitless) | TR | 1.0E-04 | |
| Target Cancer Risk (unitless) | TR | 1.0E-05 | |
| Target Cancer Risk (unitless) | TR | 1.0E-06 | |
| Target Hazard Quotient (unitless) | THQ | 1.0 | |
| Cancer Slope Factor (per mg/kg-day) | CSF | chemical-specific | IRIS |
| Reference Dose (mg/kg-day) | RfD | chemical-specific | IRIS |
| Unit Risk Factor (per mg/m$^3$) | URF | chemical-specific | IRIS |
| Reference Concentration (mg/m$^3$) | RfC | chemical-specific | U.S. EPA RSL Table |
| Ingestion Rate (mg/day) - adult | IR | 330 | U.S. EPA, 2002 |
| Surface Area Exposed (cm$^2$/day) | SA | 3,300 | U.S. EPA, 2004 |
| Adherence Factor (mg/cm$^2$) | AF | 0.3 | U.S. EPA, 2004 |
| Absorption Factor - Oral (%/100) | $ABS_o$ | chemical-specific | see Section 2.2 of the Memorandum |
| Absorption Factor - Dermal (%/100) | $ABS_d$ | chemical-specific | U.S. EPA, 2004 |
| Fraction Time Exposed (hours/24 hours) | FT | 8/24 | Professional Judgement (2) |
| Exposure Frequency (days/year) | EF | 120 | Professional Judgement (3) |
| Exposure Duration (years) | ED | 1 | Professional Judgement (4) |
| Body Weight (kg) | BW | 70 | U.S. EPA, 2002 |
| Conversion Factor (kg/mg) | CF | 1.0E-06 | |
| Averaging Time - carcinogenic (days) | ATc | 25,550 | U.S. EPA, 1989 |
| Averaging Time - non-carcinogenic (days) | ATnc | 365 | U.S. EPA, 1989 |
| Particulate Emission Factor (m$^3$/kg) | PEF | 2.39E+09 | U.S. EPA, 2002; See Table 1 |

Exposure Equations

Carcinogenic Endpoints:

$$RBC_{soil} = \frac{TR \times ATc}{EF \times ED \times [(CSF \times IR \times CF \times ABS_o)/BW + (CSF \times SA \times AF \times CF \times ABS_d)/BW + (URF \times FT \times (1/PEF))]}$$

Non-Carcinogenic Endpoints:

$$RBC_{soil} = \frac{THQ \times ATnc}{EF \times ED \times [((1/RfD) \times IR \times CF \times ABS_o)/BW + ((1/RfD) \times SA \times AF \times CF \times ABS_d)/BW + ((1/RfC) \times FT \times (1/PEF))]}$$

References:

IRIS, Integrated Risk Information System (IRIS) Database, (http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList).

U.S. EPA RSL Table, U.S. EPA Regional Screening Levels Summary Table, November 2013.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund (RAGS): Volume 1 – Human Health Evaluation Manual (Part A), Interim Final, EPA/540/1-89/002, December 1989.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.

U.S. EPA, 2004: Risk Assessment Guidance for Superfund (RAGS):Volume 1 - Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), EPA/540/R/99/005, July 200

**TABLE 8**

**DERIVATION OF RISK-BASED CONCENTRATIONS (RBCs) FOR ARSENIC IN SOIL**
**CONSTRUCTION WORKER ORAL, DERMAL, AND INHALATION EXPOSURE**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| Chemical of Potential Concern | CSF oral 1/(mg/kg-d) | CSF dermal 1/(mg/kg-d) | URF inhalation 1/(mg/m$^3$) | RfD oral (mg/kg-d) | RfD dermal (mg/kg-d) | RfC inhalation (mg/m$^3$) | Oral Absorption Factor, $ABS_o$ (%/100) | Dermal Absorption Factor, $ABS_d$ (%/100) | Construction Worker Carcinogen TR Adult (µg/g) | Construction Worker Non-Carcinogen THQ Adult (µg/g) | Soil Risk-Based Concentration $RBC_{soil}$ (1) (µg/g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Metals*** | | | | | | | | | | | |
| Arsenic ($10^{-4}$ cancer risk) | 1.50E+00 | 1.50E+00 | 4.30E+00 | 3.00E-04 | 3.00E-04 | 1.50E-05 | 6.0E-01 | 3.0E-02 | 1.03E+03 | 1.49E+03 | 1,028 |
| Arsenic ($10^{-5}$ cancer risk) | 1.50E+00 | 1.50E+00 | 4.30E+00 | 3.00E-04 | 3.00E-04 | 1.50E-05 | 6.0E-01 | 3.0E-02 | 1.03E+02 | 1.49E+03 | 103 |
| Arsenic ($10^{-6}$ cancer risk) | 1.50E+00 | 1.50E+00 | 4.30E+00 | 3.00E-04 | 3.00E-04 | 1.50E-05 | 6.0E-01 | 3.0E-02 | 1.03E+01 | 1.49E+03 | 10.3 |

Notes:

-- = Not Available

NV = No Value

(1) The selected RBC is the lower of the carcinogenic-based concentration and the non-carcinogenic-based concentration.

(2) Professional Judgement; assumed 8 hour work day.

(3) Professional Judgement; assumes 5 days/week for 1 month or 20 days/year.

Construction Worker Assumptions

| | | | |
|---|---|---|---|
| Risk-Based Concentration in Soil (µg/g) | $RBC_{soil}$ | calculated | |
| Target Cancer Risk (unitless) | TR | 1.0E-04 | |
| Target Cancer Risk (unitless) | TR | 1.0E-05 | |
| Target Cancer Risk (unitless) | TR | 1.0E-06 | |
| Target Hazard Quotient (unitless) | THQ | 1.0 | |
| Cancer Slope Factor (per mg/kg-day) | CSF | chemical-specific | IRIS |
| Reference Dose (mg/kg-day) | RfD | chemical-specific | IRIS |
| Unit Risk Factor (per mg/m$^3$) | URF | chemical-specific | IRIS |
| Reference Concentration (mg/m$^3$) | RfC | chemical-specific | U.S. EPA RSL Table |
| Ingestion Rate (mg/day) - adult | IR | 330 | U.S. EPA, 2002 |
| Surface Area Exposed (cm$^2$/day) | SA | 3,300 | U.S. EPA, 2004 |
| Adherence Factor (mg/cm$^2$) | AF | 0.3 | U.S. EPA, 2004 |
| Absorption Factor - Oral (%/100) | $ABS_o$ | chemical-specific | see Section 2.2 of the Memorandum |
| Absorption Factor - Dermal (%/100) | $ABS_d$ | chemical-specific | U.S. EPA, 2004 |
| Fraction Time Exposed (hours/24 hours) | FT | 8/24 | Professional Judgement (2) |
| Exposure Frequency (days/year) | EF | 20 | Professional Judgement (3) |
| Exposure Duration (years) | ED | 25 | U.S. EPA, 2004 |
| Body Weight (kg) | BW | 70 | U.S. EPA, 2002 |
| Conversion Factor (kg/mg) | CF | 1.0E-06 | |
| Averaging Time - carcinogenic (days) | ATc | 25,550 | U.S. EPA, 1989 |
| Averaging Time - non-carcinogenic (days) | ATnc | 9,125 | U.S. EPA, 1989 |
| Particulate Emission Factor (m$^3$/kg) | PEF | 1.59E+07 | U.S. EPA, 2002; see Table 2 |

Exposure Equations

Carcinogenic Endpoints:

$$RBC_{soil} = \frac{TR \times ATc}{EF \times ED \times [(CSF \times IR \times CF \times ABS_o)/BW + (CSF \times SA \times AF \times CF \times ABS_d)/BW + (URF \times FT \times (1/PEF))]}$$

Non-Carcinogenic Endpoints:

$$RBC_{soil} = \frac{THQ \times ATnc}{EF \times ED \times [((1/RfD) \times IR \times CF \times ABS_o)/BW + ((1/RfD) \times SA \times AF \times CF \times ABS_d)/BW + ((1/RfC) \times FT \times (1/PEF))]}$$

References:

IRIS, Integrated Risk Information System (IRIS) Database, (http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList).

U.S. EPA RSL Table, U.S. EPA Regional Screening Levels Summary Table, November 2013.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund (RAGS): Volume 1 – Human Health Evaluation Manual (Part A), Interim Final, EPA/540/1-89/002, December 1989.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.

U.S. EPA, 2004: Risk Assessment Guidance for Superfund (RAGS):Volume 1 - Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), EPA/540/R/99/005, July 2004.

**TABLE 9**

**SUMMARY OF RISK-BASED CONCENTRATIONS (RBCs) FOR ARSENIC IN SOIL**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Chemical of Potential Concern (COPC)* | *Units* | *Risk-Based Concentration for Soil, $RBC_{soil}$* | | | | | | *Minimum $RBC_{soil}$* | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Trespasser* | *Recreational User* | *Resident* | *Commercial Worker* | *Utility Worker* | *Construction Worker* | *Residential (1)* | *Commercial (2)* | *Commercial+Recreational (3)* |
| **TARGET CANCER RISK = 1.0 x $10^{-4}$; TARGET HAZARD QUOTIENT = 1.0** | | | | | | | | | | |
| Arsenic | µg/g | 1,258 | 178 | 36 | 267 | 280 | 1,028 | 36 | 267 | 178 |
| **TARGET CANCER RISK = 1.0 x $10^{-5}$; TARGET HAZARD QUOTIENT = 1.0** | | | | | | | | | | |
| Arsenic | µg/g | 196 | 32 | 6.4 | 27 | 280 | 103 | 6.4 | 27 | 27 |
| **TARGET CANCER RISK = 1.0 x $10^{-6}$; TARGET HAZARD QUOTIENT = 1.0** | | | | | | | | | | |
| Arsenic | µg/g | 20 | 3.2 | 0.64 | 2.7 | 44 | 10.3 | 0.64 | 2.7 | 2.7 |

Notes:
(1) $RBC_{soil}$ for the residential areas include all receptors.
(2) $RBC_{soil}$ for the commercial areas include all receptors, except residents and recreational users.
(3) $RBC_{soil}$ for the commercial+recreational areas include all receptors, except residents.

**TABLE 10**

**LOCATIONS REQUIRING REMOVAL TO MEET THE ARSENIC RBC BASED ON A CANCER RISK = $10^{-5}$ AND HAZARD QUOTIENT = 1**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Redevelopment Area* | *Depth* | *Original EPC µg/g* | *Soil Locations Removed* | | *Revised Arsenic EPC µg/g* | *Arsenic RBC µg/g* |
|---|---|---|---|---|---|---|
| | | | *Location* | *Arsenic Concentration µg/g* | | |
| Residential Area 1 | Surface Soil | 7.382 | SB-102 (0-1 ft bgs) | 16.2 | 6.318 | 6.4 |
| | | | SB-132 (0-1 ft bgs) | 13.4 | | |
| | Surface and Subsurface Soil | 10.71 | SB-102 (0-1 ft bgs) | 16.2 | 6.384 | 6.4 |
| | | | SB-104 (3-5) ft bgs | 25.3 J | | |
| | | | SB-104 (5-7) ft bgs | 92 J | | |
| | | | SB-104 (8-10) ft bgs | 29 J | | |
| | | | SB-118 (7.5-9.5) ft bgs | 21 J | | |
| | | | SB-132 (0-1) ft bgs | 13.4 | | |
| | | | SB-132 (8-10) ft bgs | 16.7 | | |
| Residential Area 2 | Surface Soil | 8.751 | SB-105 (0-1) ft bgs | 9.6 | 5.805 | 6.4 |
| | | | SB-124 (0-1) ft bgs | 8.4 J | | |
| | | | SB-125 (0-1) ft bgs | 13.5 | | |
| | Surface and Subsurface Soil | 8.7 | SB-105 (0-1) ft bgs | 9.6 | 6.439 | 6.4 |
| | | | SB-105 (1-3) ft bgs | 17.5 | | |
| | | | SB-124 (0-1) ft bgs | 8.4 J | | |
| | | | SB-124 (7-9) ft bgs | 8.9 J | | |
| | | | SB-125 (0-1) ft bgs | 13.5 | | |
| | | | SB-126 (7.5-9.5) ft bgs | 9.4 | | |
| Residential Area 3 | Surface Soil | 11.16 | MW-15 (0-2) ft bgs | 19.9 | 6.262 | 6.4 |
| | | | SB-137 (0-1) ft bgs | 8.7 | | |
| | | | SB-139 (0-1) ft bgs | 12.5 | | |
| | | | SB-140 (0-1) ft bgs | 12.1 | | |
| | | | SB-141 (0-1) ft bgs | 8.5 | | |
| | Surface and Subsurface Soil | 13.05 | MW-15 (0-2) ft bgs | 19.9 | 5.682 | 6.4 |
| | | | MW-15 (4-6) ft bgs | 11.9 | | |
| | | | SB-134 (1.5-3.5) ft bgs | 20.3 | | |
| | | | SB-136 (8-10) ft bgs | 21.1 | | |
| | | | SB-137 (0-1) ft bgs | 8.7 | | |
| | | | SB-137 (8-10) ft bgs | 26.4 | | |
| | | | SB-139 (0-1) ft bgs | 12.5 | | |
| | | | SB-140 (0-1) ft bgs | 12.1 | | |
| | | | SB-140 (8-10) ft bgs | 19/15 | | |
| | | | SB-141 (0-1) ft bgs | 8.5 | | |
| Residential Area 4 | Surface | 9.391 | DG4 (0-1.5) ft bgs | 16 | 6.133 | 6.4 |
| | | | SB-301 (0-1) ft bgs | 21.6 | | |
| | | | TP-311 (0-1) ft bgs | 13.9 | | |
| | | | TP-314 (0-1) ft bgs | 12.1 | | |
| | Surface and Subsurface Soil | 12.3 | DG4 (0-1.5) ft bgs | 16 | 6.233 | 6.4 |
| | | | SB-301 (0-1) ft bgs | 21.6 | | |
| | | | SB-301 (5.5-7.5) ft bgs | 55.8 J/14.2 J | | |
| | | | TP-310 (8-10) ft bgs | 16.4 | | |
| | | | TP-311 (0-1) ft bgs | 13.9 | | |
| | | | TP-314 (0-1) ft bgs | 12.1 | | |
| | | | TP-314 (6-8) ft bgs | 25 | | |

**TABLE 10**

**LOCATIONS REQUIRING REMOVAL TO MEET THE ARSENIC RBC BASED ON A CANCER RISK = $10^{-5}$ AND HAZARD QUOTIENT = 1**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Redevelopment Area* | *Depth* | *Original EPC µg/g* | *Soil Locations Removed* | | *Revised Arsenic EPC µg/g* | *Arsenic RBC µg/g* |
|---|---|---|---|---|---|---|
| | | | *Location* | *Arsenic Concentration µg/g* | | |
| Waterfront Plaza | Surface Soil | 69.28 | TP-321 (0-1) ft bgs | 34.7 | NC | 27 |
| Mixed Residential/Commercial Area 1 | Surface Soil | 8.111 | TP-306 (0.5-1.5) ft bgs | 20 | 5.189 | 6.4 |
| | Surface and Subsurface Soil | 11.02 | TP-303 (6-8) ft bgs | 15 | 6.469 | 6.4 |
| | | | TP-306 (0.5-1.5) ft bgs | 20 | | |
| | | | TP-306 (6-7) ft bgs | --/20 | | |
| Mixed Residential/Commercial Area 2 | Surface Soil | 19.31 | MW-19 (0-2) ft bgs | 18 | 6.424 | 6.4 |
| | | | SB-208 (0-1) ft bgs | 30.8 | | |
| | | | SB-209 (0-1) ft bgs | 21.9 | | |
| | | | SB-220 (0-1) ft bgs | 12.3 J | | |
| | | | SB-230 (0-1) ft bgs | 24.3 J | | |
| | | | SB-231 (0-1) ft bgs | 17.6 | | |
| | | | SB-232 (0-1) ft bgs | 49.6 J | | |
| | | | SB-234 (0-1) ft bgs | 15.9 | | |
| | | | SB-235 (0.5-1.5) ft bgs | 12.1 | | |
| | | | SB-236 (0-1) ft bgs | 13.2 | | |
| | | | SB-237 (0-1) ft bgs | 39.6 | | |
| | | | SB-238 (0-1) ft bgs | 39.3 | | |
| | | | SB-240 (0-1) ft bgs | 12.6 J | | |
| | | | SB-241 (0-1) ft bgs | 13.6 J | | |
| | | | SB-243 (0-1) ft bgs | 9.9 J | | |
| | | | SB-244 (0-1) ft bgs | 13.6 J | | |
| | | | SB-303 (0-2) ft bgs | 12.8 | | |
| | | | SB-304 (0-2) ft bgs | 12.1 | | |
| | | | SB-306 (0-1) ft bgs | 11.4 | | |
| | | | SB-310 (0-1) ft bgs | 10.3 | | |
| | | | SB-312 (0-1) ft bgs | 95.4 | | |
| | | | SB-2010 (0-1) ft bgs | 12.5 | | |
| | | | SB-2013 (0-1) ft bgs | 31.4 | | |
| | | | TP-340 (0-1) ft bgs | 18.7 | | |
| | | | TP-342 (0-1) ft bgs | 102 | | |
| | | | TP-343 (0-1) ft bgs | 25.3 | | |
| | Surface and Subsurface Soil | 47.39 | CTP-4 (4-) ft bgs | 14.8 | 6.366 | 6.4 |
| | | | MW-19 (0-2) ft bgs | 18 | | |
| | | | SB-208 (0-1) ft bgs | 30.8 | | |
| | | | SB-209 (0-1) ft bgs | 21.9 | | |
| | | | SB-216 (0-4) ft bgs | 19 | | |
| | | | SB-218 (2.5-4.5) ft bgs | 15.1 J | | |
| | | | SB-220 (0-1) ft bgs | 12.3 J | | |
| | | | SB-222 (1.5-3.5) ft bgs | 15.7 | | |
| | | | SB-223 (1-4) ft bgs | 15.7 | | |
| | | | SB-230 (0-1) ft bgs | 24.3 J | | |
| | | | SB-231 (0-1) ft bgs | 17.6 | | |
| | | | SB-232 (0-1) ft bgs | 49.6 J | | |
| | | | SB-232 (6-8) ft bgs | 804 J | | |
| | | | SB-234 (0-1) ft bgs | 15.9 | | |
| | | | SB-235 (0.5-1.5) ft bgs | 12.1 | | |
| | | | SB-235 (3-5) ft bgs | 28.8 | | |

**TABLE 10**

**LOCATIONS REQUIRING REMOVAL TO MEET THE ARSENIC RBC BASED ON A CANCER RISK = $10^{-5}$ AND HAZARD QUOTIENT = 1**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Redevelopment Area* | *Depth* | *Original EPC µg/g* | *Soil Locations Removed* | | *Revised Arsenic EPC µg/g* | *Arsenic RBC µg/g* |
|---|---|---|---|---|---|---|
| | | | *Location* | *Arsenic Concentration µg/g* | | |
| | Surface and Subsurface Soil | (continued) | SB-236 (0-1) ft bgs | 13.2 | | |
| | | | SB-237 (0-1) ft bgs | 39.6 | | |
| | | | SB-237 (2-4) ft bgs | 57.9 | | |
| | | | SB-238 (0-1) ft bgs | 39.3 | | |
| | | | SB-238 (2-4) ft bgs | 49.7/46.7 | | |
| | | | SB-240 (0-1) ft bgs | 12.6 J | | |
| | | | SB-241 (0-1) ft bgs | 13.6 J | | |
| | | | SB-243 (0-1) ft bgs | 9.9 J | | |
| | | | SB-244 (0-1) ft bgs | 13.6 J | | |
| | | | SB-244 (4-6) ft bgs | 18.4 J | | |
| | | | SB-246 (3-4) ft bgs | 21.8 | | |
| | | | SB-303 (0-2) ft bgs | 12.8 | | |
| | | | SB-304 (0-2) ft bgs | 12.1 | | |
| | | | SB-306 (0-1) ft bgs | 11.4 | | |
| | | | SB-308 (3-5) ft bgs | 16.3 | | |
| | | | SB-310 (0-1) ft bgs | 10.3 | | |
| | | | SB-312 (0-1) ft bgs | 95.4 | | |
| | | | SB-2010 (0-1) ft bgs | 12.5 | | |
| | | | SB-2010 (7-9) ft bgs | 17.5 | | |
| | | | SB-2011 (3.4-4.75) ft bgs | 15.7 | | |
| | | | SB-2013 (0-1) ft bgs | 31.4 | | |
| | | | TP-340 (0-1) ft bgs | 18.7 | | |
| | | | TP-340 (3-4) ft bgs | 18.1 | | |
| | | | TP-342 (0-1) ft bgs | 102 | | |
| | | | TP-342 (3.5-4) ft bgs | 17.7 | | |
| | | | TP-343 (0-1) ft bgs | 25.3 | | |
| | | | TP-343 (3-4) ft bgs | 19.6 | | |
| | | | TP-344 (1-3) ft bgs | 16.6 | | |
| | | | TP-344 (4-6) ft bgs | 28.3 | | |

Notes:
EPC - Exposure point concentration
J Estimated
ft bgs - Feet below ground surface
RBC - Risk-based concentration

**TABLE 11**

**LOCATIONS REQUIRING REMOVAL TO MEET THE PART 201 GENERIC CLEANUP CRITERIA (DIRECT CONTACT) FOR ARSENIC**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Redevelopment Area* | *Depth* | *Original EPC µg/g* | *Soil Locations Removed* | | *Revised Arsenic EPC µg/g* | *Arsenic RBC µg/g* |
|---|---|---|---|---|---|---|
| | | | *Location* | *Arsenic Concentration µg/g* | | |
| Residential Area 1 | Surface and Subsurface Soil | 10.71 | SB-104 (5-7) ft bgs | 92 J | 7.61 | 7.6 |
| | | | SB-104 (8-10) ft bgs | 29 J | | |
| Residential Area 2 | Surface Soil | 8.751 | SB-125 (0-1) ft bgs | 13.5 | 7.348 | 7.6 |
| | Surface and Subsurface Soil | 8.7 | SB-105 (1-3) ft bgs | 17.5 | 7.279 | 7.6 |
| | | | SB-125 (0-1) ft bgs | 13.5 | | |
| Residential Area 3 | Surface Soil | 11.16 | MW-15 (0-2) ft bgs | 19.9 | 7.373 | 7.6 |
| | | | SB-139 (0-1) ft bgs | 12.5 | | |
| | | | SB-140 (0-1) ft bgs | 12.1 | | |
| | Surface and Subsurface Soil | 13.05 | MW-15 (0-2) ft bgs | 19.9 | 7.012 | 7.6 |
| | | | SB-134 (1.5-3.5) ft bgs | 20.3 | | |
| | | | SB-136 (8-10) ft bgs | 21.1 | | |
| | | | SB-137 (8-10) ft bgs | 26.4 | | |
| | | | SB-139 (0-1) ft bgs | 12.5 | | |
| | | | SB-140 (0-1) ft bgs | 12.1 | | |
| | | | SB-140 (8-10) ft bgs | 19/15 | | |
| Residential Area 4 | Surface | 9.391 | DG4 (0-1.5) ft bgs | 16 | 7.245 | 7.6 |
| | | | SB-301 (0-1) ft bgs | 21.6 | | |
| | Surface and Subsurface Soil | 12.3 | DG4 (0-1.5) ft bgs | 16 | 7.217 | 7.6 |
| | | | SB-301 (0-1) ft bgs | 21.6 | | |
| | | | SB-301 (5.5-7.5) ft bgs | 55.8 J/14.2 J | | |
| | | | TP-314 (6-8) ft bgs | 25 | | |
| Mixed Residential/Commercial Area 1 | Surface Soil | 8.111 | TP-306 (0.5-1.5) ft bgs | 20 | 5.189 | 7.6 |
| | Surface and Subsurface Soil | 11.02 | TP-306 (0.5-1.5) ft bgs | 20 | 7.198 | 7.6 |
| | | | TP-306 (6-7) ft bgs | --/20 | | |
| Mixed Residential/Commercial Area 2 | Surface Soil | 19.31 | MW-19 (0-2) ft bgs | 18 | 7.428 | 7.6 |
| | | | SB-208 (0-1) ft bgs | 30.8 | | |
| | | | SB-209 (0-1) ft bgs | 21.9 | | |
| | | | SB-230 (0-1) ft bgs | 24.3 J | | |
| | | | SB-231 (0-1) ft bgs | 17.6 | | |
| | | | SB-232 (0-1) ft bgs | 49.6 J | | |
| | | | SB-234 (0-1) ft bgs | 15.9 | | |
| | | | SB-236 (0-1) ft bgs | 13.2 | | |
| | | | SB-237 (0-1) ft bgs | 39.6 | | |
| | | | SB-238 (0-1) ft bgs | 39.3 | | |
| | | | SB-240 (0-1) ft bgs | 12.6 J | | |
| | | | SB-241 (0-1) ft bgs | 13.6 J | | |
| | | | SB-244 (0-1) ft bgs | 13.6 J | | |

**TABLE 11**

**LOCATIONS REQUIRING REMOVAL TO MEET THE PART 201 GENERIC CLEANUP CRITERIA (DIRECT CONTACT) FOR ARSENIC**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Redevelopment Area* | *Depth* | *Original EPC µg/g* | *Soil Locations Removed* | | *Revised Arsenic EPC µg/g* | *Arsenic RBC µg/g* |
|---|---|---|---|---|---|---|
| | | | *Location* | *Arsenic Concentration µg/g* | | |
| Mixed Residential/Commercial Area 2 | Surface Soil | (Continued) | SB-303 (0-2) ft bgs | 12.8 | | |
| | | | SB-312 (0-1) ft bgs | 95.4 | | |
| | | | SB-2010 (0-1) ft bgs | 12.5 | | |
| | | | SB-2013 (0-1) ft bgs | 31.4 | | |
| | | | TP-340 (0-1) ft bgs | 18.7 | | |
| | | | TP-342 (0-1) ft bgs | 102 | | |
| | | | TP-343 (0-1) ft bgs | 25.3 | | |
| Mixed Residential/Commercial Area 2 | Surface and Subsurface Soil | 47.39 | MW-19 (0-2) ft bgs | 18 | 7.519 | 7.6 |
| | | | SB-208 (0-1) ft bgs | 30.8 | | |
| | | | SB-209 (0-1) ft bgs | 21.9 | | |
| | | | SB-216 (0-4) ft bgs | 19 | | |
| | | | SB-230 (0-1) ft bgs | 24.3 J | | |
| | | | SB-231 (0-1) ft bgs | 17.6 | | |
| | | | SB-232 (0-1) ft bgs | 49.6 J | | |
| | | | SB-232 (6-8) ft bgs | 804 J | | |
| | | | SB-234 (0-1) ft bgs | 15.9 | | |
| | | | SB-235 (3-5) ft bgs | 28.8 | | |
| | | | SB-236 (0-1) ft bgs | 13.2 | | |
| | | | SB-237 (0-1) ft bgs | 39.6 | | |
| | | | SB-237 (2-4) ft bgs | 57.9 | | |
| | | | SB-238 (0-1) ft bgs | 39.3 | | |
| | | | SB-238 (2-4) ft bgs | 49.7/46.7 | | |
| | | | SB-240 (0-1) ft bgs | 12.6 J | | |
| | | | SB-241 (0-1) ft bgs | 13.6 J | | |
| | | | SB-244 (0-1) ft bgs | 13.6 J | | |
| | | | SB-244 (4-6) ft bgs | 18.4 J | | |
| | | | SB-246 (3-4) ft bgs | 21.8 | | |
| | | | SB-303 (0-2) ft bgs | 12.8 | | |
| | | | SB-312 (0-1) ft bgs | 95.4 | | |
| | | | SB-2010 (0-1) ft bgs | 12.5 | | |
| | | | SB-2010 (7-9) ft bgs | 17.5 | | |
| | | | SB-2013 (0-1) ft bgs | 31.4 | | |
| | | | TP-340 (0-1) ft bgs | 18.7 | | |
| | | | TP-340 (3-4) ft bgs | 18.1 | | |
| | | | TP-342 (0-1) ft bgs | 102 | | |
| | | | TP-342 (3.5-4) ft bgs | 17.7 | | |
| | | | TP-343 (0-1) ft bgs | 25.3 | | |
| | | | TP-343 (3-4) ft bgs | 19.6 | | |
| | | | TP-344 (1-3) ft bgs | 16.6 | | |
| | | | TP-344 (4-6) ft bgs | 28.3 | | |

Notes:
EPC - Exposure point concentration
J - Estimated
ft bgs - Feet below ground surface
RBC - Risk-based concentration

**TABLE 12**

**LOCATIONS REQUIRING REMOVAL TO MEET PART 201 STATEWIDE DEFAULT BACKGROUND LEVEL FOR ARSENIC**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Redevelopment Area* | *Depth* | *Original EPC µg/g* | *Soil Locations Removed* | | *Revised Arsenic EPC µg/g* | *Arsenic RBC µg/g* |
|---|---|---|---|---|---|---|
| | | | *Location* | *Arsenic Concentration µg/g* | | |
| Residential Area 1 | Surface Soil | 7.382 | SB-102 (0-1) ft bgs | 16.2 | 5.56 | 5.8 |
| | | | SB-103 (0-1) ft bgs | 10.6 J | | |
| | | | SB-120 (0-1) ft bgs | 14 J/11 J | | |
| | | | SB-132 (0-1) ft bgs | 13.4 | | |
| | Surface and Subsurface Soil | 10.71 | SB-101 (6.8-8.8) ft bgs | 15 | 5.778 | 5.8 |
| | | | SB-102 (0-1) ft bgs | 16.2 | | |
| | | | SB-103 (0-1) ft bgs | 10.6 J | | |
| | | | SB-104 (3-5) ft bgs | 25.3 J | | |
| | | | SB-104 (5-7) ft bgs | 92 J | | |
| | | | SB-104 (8-10) ft bgs | 29 J | | |
| | | | SB-109 (8-10) ft bgs | 14 | | |
| | | | SB-118 (7.5-9.5) ft bgs | 21 J | | |
| | | | SB-120 (0-1) ft bgs | 14 J/11 J | | |
| | | | SB-132 (0-1) ft bgs | 13.4 | | |
| | | | SB-132 (8-10) ft bgs | 16.7 | | |
| Residential Area 2 | Surface Soil | 8.751 | SB-105 (0-1) ft bgs | 9.6 | 5.805 | 5.8 |
| | | | SB-124 (0-1) ft bgs | 8.4 J | | |
| | | | SB-125 (0-1) ft bgs | 13.5 | | |
| | Surface and Subsurface Soil | 8.7 | SB-105 (0-1) ft bgs | 9.6 | 5.638 | 5.8 |
| | | | SB-105 (1-3) ft bgs | 17.5 | | |
| | | | SB-105 (3-5) ft bgs | 7.3/7.9 | | |
| | | | SB-105 (8-10) ft bgs | 7.8 | | |
| | | | SB-124 (0-1) ft bgs | 8.4 J | | |
| | | | SB-124 (7-9) ft bgs | 8.9 J | | |
| | | | SB-125 (0-1) ft bgs | 13.5 | | |
| | | | SB-126 (7.5-9.5) ft bgs | 9.4 | | |
| | | | SB-129 (6-8) ft bgs | 7.5 | | |
| | | | SB-129 (8-10) ft bgs | 7.2 | | |
| Residential Area 3 | Surface Soil | 11.16 | MW-15 (0-2) ft bgs | 19.9 | 5.853 | 5.8 |
| | | | SB-134 (0-1) ft bgs | 5.9 | | |
| | | | SB-135 (0-1) ft bgs | 6.6 | | |
| | | | SB-137 (0-1) ft bgs | 8.7 | | |
| | | | SB-138 (0-1) ft bgs | 6.2 | | |
| | | | SB-139 (0-1) ft bgs | 12.5 | | |
| | | | SB-140 (0-1) ft bgs | 12.1 | | |
| | | | SB-141 (0-1) ft bgs | 8.5 | | |
| | Surface and Subsurface Soil | 13.05 | MW-15 (0-2) ft bgs | 19.9 | 5.374 | 5.8 |
| | | | MW-15 (4-6) ft bgs | 11.9 | | |
| | | | SB-134 (0-1) ft bgs | 5.9 | | |
| | | | SB-134 (1.5-3.5) ft bgs | 20.3 | | |
| | | | SB-135 (0-1) ft bgs | 6.6 | | |
| | | | SB-136 (8-10) ft bgs | 21.1 | | |
| | | | SB-137 (0-1) ft bgs | 8.7 | | |
| | | | SB-137 (8-10) ft bgs | 26.4 | | |
| | | | SB-138 (0-1) ft bgs | 6.2 | | |
| | | | SB-139 (0-1) ft bgs | 12.5 | | |
| | | | SB-140 (0-1) ft bgs | 12.1 | | |
| | | | SB-140 (8-10) ft bgs | 19/15 | | |
| | | | SB-141 (0-1) ft bgs | 8.5 | | |

**TABLE 12**

**LOCATIONS REQUIRING REMOVAL TO MEET PART 201 STATEWIDE DEFAULT BACKGROUND LEVEL FOR ARSENIC**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Redevelopment Area* | *Depth* | *Original EPC µg/g* | *Soil Locations Removed* | | *Revised Arsenic EPC µg/g* | *Arsenic RBC µg/g* |
|---|---|---|---|---|---|---|
| | | | *Location* | *Arsenic Concentration µg/g* | | |
| Residential Area 4 | Surface | 9.391 | DG4 (0-1.5) ft bgs | 16 | 5.798 | 5.8 |
| | | | SB-301 (0-1) ft bgs | 21.6 | | |
| | | | TP-311 (0-1) ft bgs | 13.9 | | |
| | | | TP-312 (0-1) ft bgs | 9.7 | | |
| | | | TP-314 (0-1) ft bgs | 12.1 | | |
| | Surface and Subsurface Soil | 12.3 | DG4 (0-1.5) ft bgs | 16 | 5.611 | 5.8 |
| | | | SB-5 (2.5-3.5) ft bgs | 12 | | |
| | | | SB-301 (0-1) ft bgs | 21.6 | | |
| | | | SB-301 (5.5-7.5) ft bgs | 55.8 J/14.2 J | | |
| | | | SB-302 (6.8-8.8) ft bgs | 12.1 | | |
| | | | TP-310 (8-10) ft bgs | 16.4 | | |
| | | | TP-311 (0-1) ft bgs | 13.9 | | |
| | | | TP-312 (0-1) ft bgs | 9.7 | | |
| | | | TP-314 (0-1) ft bgs | 12.1 | | |
| | | | TP-314 (6-8) ft bgs | 25 | | |
| Waterfront Plaza | Surface Soil | 69.28 | TP-321 (0-1) ft bgs | 34.7 | NC | 5.8 |
| | | | SB-321 (0-1) ft bgs | 7.2/8.1 | | |
| | | | TP-309 (0-1) ft bgs | 6.4 | | |
| | Surface and Subsurface Soil | 18.13 | TP-321 (0-1) ft bgs | 34.7 | 4.632 | 5.8 |
| | | | SB-321 (0-1) ft bgs | 7.2/8.1 | | |
| | | | TP-309 (0-1) ft bgs | 6.4 | | |
| Mixed Residential/Commercial Area 1 | Surface Soil | 8.111 | TP-306 (0.5-1.5) ft bgs | 20 | 5.189 | 5.8 |
| | Surface and Subsurface Soil | 11.02 | SB-334 (8-10) ft bgs | 10.7 J | 5.47 | 5.8 |
| | | | SB-336 (8-10) ft bgs | 10.3 J | | |
| | | | SB-339 (8-10) ft bgs | 11.2 J | | |
| | | | TP-303 (6-8) ft bgs | 15 | | |
| | | | TP-306 (0.5-1.5) ft bgs | 20 | | |
| | | | TP-306 (6-7) ft bgs | --/20 | | |
| Mixed Residential/Commercial Area 2 | Surface Soil | 19.31 | MW-19 (0-2) ft bgs | 18 | 5.76 | 5.8 |
| | | | SB-208 (0-1) ft bgs | 30.8 | | |
| | | | SB-209 (0-1) ft bgs | 21.9 | | |
| | | | SB-219 (0-1) ft bgs | 9.8 | | |
| | | | SB-220 (0-1) ft bgs | 12.3 J | | |
| | | | SB-230 (0-1) ft bgs | 24.3 J | | |
| | | | SB-231 (0-1) ft bgs | 17.6 | | |
| | | | SB-232 (0-1) ft bgs | 49.6 J | | |
| | | | SB-233 (0-1) ft bgs | 8.5 J | | |
| | | | SB-234 (0-1) ft bgs | 15.9 | | |
| | | | SB-235 (0.5-1.5) ft bgs | 12.1 | | |
| | | | SB-236 (0-1) ft bgs | 13.2 | | |
| | | | SB-237 (0-1) ft bgs | 39.6 | | |
| | | | SB-238 (0-1) ft bgs | 39.3 | | |
| | | | SB-240 (0-1) ft bgs | 12.6 J | | |
| | | | SB-241 (0-1) ft bgs | 13.6 J | | |
| | | | SB-243 (0-1) ft bgs | 9.9 J | | |
| | | | SB-244 (0-1) ft bgs | 13.6 J | | |
| | | | SB-303 (0-2) ft bgs | 12.8 | | |

**TABLE 12**

**LOCATIONS REQUIRING REMOVAL TO MEET PART 201 STATEWIDE DEFAULT BACKGROUND LEVEL FOR ARSENIC**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Redevelopment Area* | *Depth* | *Original EPC µg/g* | *Soil Locations Removed* | | *Revised Arsenic EPC µg/g* | *Arsenic RBC µg/g* |
|---|---|---|---|---|---|---|
| | | | *Location* | *Arsenic Concentration µg/g* | | |
| Mixed Residential/Commercial Area 2 | Surface Soil | (Continued) | SB-304 (0-2) ft bgs | 12.1 | | |
| | | | SB-306 (0-1) ft bgs | 11.4 | | |
| | | | SB-310 (0-1) ft bgs | 10.3 | | |
| | | | SB-311 (0-1) ft bgs | 8.6 | | |
| | | | SB-312 (0-1) ft bgs | 95.4 | | |
| | | | SB-2010 (0-1) ft bgs | 12.5 | | |
| | | | SB-2013 (0-1) ft bgs | 31.4 | | |
| | | | TP-339 (0-1) ft bgs | 9 | | |
| | | | TP-340 (0-1) ft bgs | 18.7 | | |
| | | | TP-342 (0-1) ft bgs | 102 | | |
| | | | TP-343 (0-1) ft bgs | 25.3 | | |
| Mixed Residential/Commercial Area 2 | Surface and Subsurface Soil | 47.39 | CTP-4 (4-) ft bgs | 14.8 | 5.796 | 5.8 |
| | | | MW-19 (0-2) ft bgs | 18 | | |
| | | | SB-208 (0-1) ft bgs | 30.8 | | |
| | | | SB-208 (4-6) ft bgs | 9.5 | | |
| | | | SB-209 (0-1) ft bgs | 21.9 | | |
| | | | SB-210 (3-5) ft bgs | 9.8 | | |
| | | | SB-214 (3.5-5.5) ft bgs | 12.0 J | | |
| | | | SB-216 (0-4) ft bgs | 19 | | |
| | | | SB-218 (2.5-4.5) ft bgs | 15.1 J | | |
| | | | SB-219 (0-1) ft bgs | 9.8 | | |
| | | | SB-220 (0-1) ft bgs | 12.3 J | | |
| | | | SB-222 (1.5-3.5) ft bgs | 15.7 | | |
| | | | SB-223 (1-4) ft bgs | 15.7 | | |
| | | | SB-230 (0-1) ft bgs | 24.3 J | | |
| | | | SB-231 (0-1) ft bgs | 17.6 | | |
| | | | SB-232 (0-1) ft bgs | 49.6 J | | |
| | | | SB-232 (6-8) ft bgs | 804 J | | |
| | | | SB-233 (0-1) ft bgs | 8.5 J | | |
| | | | SB-234 (0-1) ft bgs | 15.9 | | |
| | | | SB-235 (0.5-1.5) ft bgs | 12.1 | | |
| | | | SB-235 (3-5) ft bgs | 28.8 | | |
| | | | SB-236 (0-1) ft bgs | 13.2 | | |
| | | | SB-237 (0-1) ft bgs | 39.6 | | |
| | | | SB-237 (2-4) ft bgs | 57.9 | | |
| | | | SB-238 (0-1) ft bgs | 39.3 | | |
| | | | SB-238 (2-4) ft bgs | 49.7/46.7 | | |
| | | | SB-240 (0-1) ft bgs | 12.6 J | | |
| | | | SB-241 (0-1) ft bgs | 13.6 J | | |
| | | | SB-243 (0-1) ft bgs | 9.9 J | | |
| | | | SB-244 (0-1) ft bgs | 13.6 J | | |
| | | | SB-244 (4-6) ft bgs | 18.4 J | | |
| | | | SB-246 (3-4) ft bgs | 21.8 | | |
| | | | SB-254 (0-4) ft bgs | 12.1 | | |
| | | | SB-303 (0-2) ft bgs | 12.8 | | |
| | | | SB-304 (0-2) ft bgs | 12.1 | | |
| | | | SB-306 (0-1) ft bgs | 11.4 | | |
| | | | SB-308 (3-5) ft bgs | 16.3 | | |
| | | | SB-308 (7.5-9.5) ft bgs | 10.1 | | |
| | | | SB-310 (0-1) ft bgs | 10.3 | | |
| | | | SB-311 (0-1) ft bgs | 8.6 | | |

**TABLE 12**

**LOCATIONS REQUIRING REMOVAL TO MEET PART 201 STATEWIDE DEFAULT BACKGROUND LEVEL FOR ARSENIC**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Redevelopment Area* | *Depth* | *Original EPC µg/g* | *Soil Locations Removed* | | *Revised Arsenic EPC µg/g* | *Arsenic RBC µg/g* |
|---|---|---|---|---|---|---|
| | | | *Location* | *Arsenic Concentration µg/g* | | |
| Mixed Residential/Commercial Area 2 | Surface and Subsurface Soil | (Continued) | SB-312 (0-1) ft bgs | 95.4 | | |
| | | | SB-2010 (0-1) ft bgs | 12.5 | | |
| | | | SB-2010 (7-9) ft bgs | 17.5 | | |
| | | | SB-2011 (3.4-4.75) ft bgs | 15.7 | | |
| | | | SB-2013 (0-1) ft bgs | 31.4 | | |
| | | | TP-339 (0-1) ft bgs | 9 | | |
| | | | TP-340 (0-1) ft bgs | 18.7 | | |
| | | | TP-340 (3-4) ft bgs | 18.1 | | |
| | | | TP-342 (0-1) ft bgs | 102 | | |
| | | | TP-342 (3.5-4) ft bgs | 17.7 | | |
| | | | TP-343 (0-1) ft bgs | 25.3 | | |
| | | | TP-343 (3-4) ft bgs | 19.6 | | |
| | | | TP-344 (1-3) ft bgs | 16.6 | | |
| | | | TP-344 (4-6) ft bgs | 28.3 | | |
| Commercial Area 1 | Surface Soil | 7.361 | SB-133 (0-1) ft bgs | 10.0 | 4.628 | 5.8 |
| | | | SS-103 (0-2) ft bgs | 8.6 | | |
| | | | SS-105 (0-2) ft bgs | 8.7 | | |
| | | | SS-106 (0-2) ft bgs | 8.8 /8.9 | | |
| | Surface and Subsurface Soil | 7.234 | SB-133 (0-1) ft bgs | 10.0 | 5.81 | 5.8 |
| | | | SB-144 (7-9) ft bgs | 10.6/5.0 | | |
| | | | SS-103 (0-2) ft bgs | 8.6 | | |
| | | | SS-105 (0-2) ft bgs | 8.7 | | |
| | | | SS-106 (0-2) ft bgs | 8.8 /8.9 | | |
| Commercial Area 2 | Surface Soil | 9.947 | TP-316 (0-1) ft bgs | 16.4 J | 5.742 | 5.8 |
| | | | TP-325 (0-1) ft bgs | 13.9 J | | |
| | | | TP-321 (0-1) ft bgs | 34.7 | | |
| | Surface and Subsurface Soil | 13.33 | SB-331 (8-10) ft bgs | 46.9 J | 5.757 | 5.8 |
| | | | TP-316 (0-1) ft bgs | 16.4 J | | |
| | | | TP-324 (9-10) ft bgs | 12.8 J/16.5 J | | |
| | | | TP-325 (0-1) ft bgs | 13.9 J | | |
| | | | TP-325 (8-10) ft bgs | 21.4 J | | |
| | | | TP-321 (0-1) ft bgs | 34.7 | | |
| Commercial Area 3 | Surface Soil | 12.24 | SB-248 (0-1) ft bgs | 8.5 J | NC | 5.8 |
| | | | SB-248 (0.5-1.5) ft bgs | 9.4 | | |
| | | | TP-307 (0.5-1.5) ft bgs | 16 /18 | | |
| | | | TP-305 (0.5-1.5) ft bgs | 16 | | |
| | Surface and Subsurface Soil | 9.59 | SB-248 (0-1) ft bgs | 8.5 J | 5.575 | 5.8 |
| | | | SB-248 (0.5-1.5) ft bgs | 9.4 | | |
| | | | TP-307 (0.5-1.5) ft bgs | 16 /18 | | |
| | | | TP-307 (2-3) ft bgs | 13.0 | | |
| | | | TP-337 (2-4) ft bgs | 13.3 | | |
| | | | TP-338 (8-10) ft bgs | 15.6 | | |
| | | | TP-304 (5-7) ft bgs | 11.1 | | |
| | | | TP-305 (0.5-1.5) ft bgs | 16 | | |

**TABLE 12**

**LOCATIONS REQUIRING REMOVAL TO MEET PART 201 STATEWIDE DEFAULT BACKGROUND LEVEL FOR ARSENIC**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Redevelopment Area* | *Depth* | *Original EPC µg/g* | *Soil Locations Removed* | | *Revised Arsenic EPC µg/g* | *Arsenic RBC µg/g* |
|---|---|---|---|---|---|---|
| | | | *Location* | *Arsenic Concentration µg/g* | | |
| Commercial Area 4 | Surface Soil | 19.38 | MW-16 (0-2) ft bgs | 8.9 | 5.723 | 5.8 |
| | | | MW-17 (0-2) ft bgs | 7.8/8.6 | | |
| | | | SB-201 (0-1) ft bgs | 9.1 J | | |
| | | | SB-202 (0-1) ft bgs | 9.8 J | | |
| | | | SB-203 (0-1) ft bgs | 9.8 J | | |
| | | | SB-204 (0-1) ft bgs | 8.9 J | | |
| | | | SB-245 (0-1) ft bgs | 16.4 J | | |
| | | | SB-249 (0-1) ft bgs | 9.9 J | | |
| | | | SB-263 (0-1) ft bgs | 8.6 | | |
| | | | SB-264 (0-1) ft bgs | 12.8 | | |
| | | | SB-265 (0-1) ft bgs | 31.6 | | |
| | | | SB-267 (0-1) ft bgs | 7.3 | | |
| | | | SB-268 (0-1) ft bgs | 7 | | |
| | | | SB-270B (0-1) ft bgs | 6.8 J | | |
| | | | SB-274 (0-1) ft bgs | 42.3 | | |
| | | | SB-275 (0-1) ft bgs | 14.6 | | |
| | | | SB-276 (0-1) ft bgs | 9.1 | | |
| | | | SB-277 (0-1) ft bgs | 7.2 | | |
| | | | SB-278 (0-1) ft bgs | 14.2 | | |
| | | | SB-279 (0-1) ft bgs | 16.8 | | |
| | | | SB-280 (0-1) ft bgs | 75.4 | | |
| | | | SB-281 (0-1) ft bgs | 17.2 | | |
| | | | SB-282 (0-1) ft bgs | 21.1 | | |
| | | | SB-283 (0-1) ft bgs | 16.4 | | |
| | | | SB-284 (0-1) ft bgs | 13.4 | | |
| | | | SB-285 (0-1) ft bgs | 14.2 | | |
| | | | SB-287 (0-1) ft bgs | 7.8 | | |
| | | | SB-289 (0-1) ft bgs | 21.6 J | | |
| | | | SB-290 (0-1) ft bgs | 36.0 J | | |
| | | | SB-293 (0-1) ft bgs | 8.3 J | | |
| | | | SB-294 (0-1) ft bgs | 20.5 | | |
| | | | SB-295 (0-1) ft bgs | 7.7 | | |
| | | | SB-298 (0-1) ft bgs | 8.4 J | | |
| | | | SB-299 (0-1) ft bgs | 9.0 J | | |
| | | | SB-2001 (0-1) ft bgs | 7.3 | | |
| | | | SB-2002 (0-1) ft bgs | 12.2 J | | |
| | | | SB-2004 (0-1) ft bgs | 8.6 | | |
| | | | SB-2005 (0-1) ft bgs | 9 | | |
| | | | SB-2008 (0-1) ft bgs | 10.4 | | |
| | | | SB-2012 (0-1) ft bgs | 8.5 | | |
| | | | TP-202 (0.5-1.5) ft bgs | 16.2/11.2 | | |
| | | | TP-341 (0.5-1.5) ft bgs | 20.1 | | |
| Commercial Area 4 | Surface and Subsurface Soil | 16.68 | BK5 (2.5-3) ft bgs | 11 | 5.758 | 5.8 |
| | | | NW Sidewall (1.5) ft bgs | 60.8 | | |
| | | | NE Sidewall (2) ft bgs | 65.6/49.4 | | |
| | | | SE Sidewall (1.5) ft bgs | 50.7 | | |
| | | | SW Sidewall (2) ft bgs | 31.5 | | |
| | | | MW-16 (0-2) ft bgs | 8.9 | | |
| | | | MW-16 (8-10) ft bgs | 11.6 | | |
| | | | MW-17 (8-10) ft bgs | 29.6 | | |
| | | | MW-17 (0-2) ft bgs | 7.8/8.6 | | |

**TABLE 12**

**LOCATIONS REQUIRING REMOVAL TO MEET PART 201 STATEWIDE DEFAULT BACKGROUND LEVEL FOR ARSENIC**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Redevelopment Area* | *Depth* | *Original EPC µg/g* | *Soil Locations Removed* | | *Revised Arsenic EPC µg/g* | *Arsenic RBC µg/g* |
|---|---|---|---|---|---|---|
| | | | *Location* | *Arsenic Concentration µg/g* | | |
| Commercial Area 4 | Surface and Subsurface Soil | (Continued) | SB-201 (0-1) ft bgs | 9.1 J | | |
| | | | SB-201 (2-4) ft bgs | 13.3 J | | |
| | | | SB-202 (0-1) ft bgs | 9.8 J | | |
| | | | SB-202 (2-4) ft bgs | 20.0 J | | |
| | | | SB-203 (0-1) ft bgs | 9.8 J | | |
| | | | SB-203 (2-4) ft bgs | 17.6 J/13 J | | |
| | | | SB-204 (0-1) ft bgs | 8.9 J | | |
| | | | SB-204 (2-4) ft bgs | 10.5 J | | |
| | | | SB-245 (0-1) ft bgs | 16.4 J | | |
| | | | SB-249 (0-1) ft bgs | 9.9 J | | |
| | | | SB-263 (0-1) ft bgs | 8.6 | | |
| | | | SB-263 (3-5) ft bgs | 10.4 | | |
| | | | SB-264 (0-1) ft bgs | 12.8 | | |
| | | | SB-265 (0-1) ft bgs | 31.6 | | |
| | | | SB-265 (2-4) ft bgs | 15.4 | | |
| | | | SB-266 (1.4-2.4) ft bgs | 7.5 | | |
| | | | SB-267 (0-1) ft bgs | 7.3 | | |
| | | | SB-268 (0-1) ft bgs | 7 | | |
| | | | SB-270B (0-1) ft bgs | 6.8 J | | |
| | | | SB-272 (1-3) ft bgs | 10.1 | | |
| | | | SB-274 (0-1) ft bgs | 42.3 | | |
| | | | SB-274 (2.5-4.5) ft bgs | 9.5 | | |
| | | | SB-275 (0-1) ft bgs | 14.6 | | |
| | | | SB-276 (0-1) ft bgs | 9.1 | | |
| | | | SB-277 (0-1) ft bgs | 7.2 | | |
| | | | SB-277 (3-5) ft bgs | 8.8 | | |
| | | | SB-278 (0-1) ft bgs | 14.2 | | |
| | | | SB-278 (3-5) ft bgs | 7.6 | | |
| | | | SB-279 (0-1) ft bgs | 16.8 | | |
| | | | SB-279 (3-5) ft bgs | 4.9 J/21.8 J | | |
| | | | SB-280 (0-1) ft bgs | 75.4 | | |
| | | | SB-280 (3-5) ft bgs | 12.5 | | |
| | | | SB-281 (0-1) ft bgs | 17.2 | | |
| | | | SB-282 (0-1) ft bgs | 21.1 | | |
| | | | SB-283 (0-1) ft bgs | 16.4 | | |
| | | | SB-284 (0-1) ft bgs | 13.4 | | |
| | | | SB-284 (2.5-4.5) ft bgs | 10.6 | | |
| | | | SB-285 (0-1) ft bgs | 14.2 | | |
| | | | SB-287 (0-1) ft bgs | 7.8 | | |
| | | | SB-289 (0-1) ft bgs | 21.6 J | | |
| | | | SB-290 (0-1) ft bgs | 36.0 J | | |
| | | | SB-292 (3-5) ft bgs | 11.4/7.7 | | |
| | | | SB-293 (0-1) ft bgs | 8.3 J | | |
| | | | SB-294 (0-1) ft bgs | 20.5 | | |
| | | | SB-294 (3-5) ft bgs | 7.7 | | |
| | | | SB-295 (0-1) ft bgs | 7.7 | | |
| | | | SB-297 (1-2) ft bgs | 10.7 | | |
| | | | SB-298 (0-1) ft bgs | 8.4 J | | |
| | | | SB-299 (0-1) ft bgs | 9.0 J | | |
| | | | SB-299 (4-5) ft bgs | 15.8 J | | |
| | | | SB-2001 (0-1) ft bgs | 7.3 | | |

**TABLE 12**

**LOCATIONS REQUIRING REMOVAL TO MEET PART 201 STATEWIDE DEFAULT BACKGROUND LEVEL FOR ARSENIC**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Redevelopment Area* | *Depth* | *Original EPC µg/g* | *Soil Locations Removed* | | *Revised Arsenic EPC µg/g* | *Arsenic RBC µg/g* |
|---|---|---|---|---|---|---|
| | | | *Location* | *Arsenic Concentration µg/g* | | |
| Commercial Area 4 | Surface and Subsurface Soil | (Continued) | SB-2002 (0-1) ft bgs | 12.2 J | | |
| | | | SB-2004 (0-1) ft bgs | 8.6 | | |
| | | | SB-2005 (0-1) ft bgs | 9 | | |
| | | | SB-2005 (2.5-4.5) ft bgs | 9 | | |
| | | | SB-2008 (0-1) ft bgs | 10.4 | | |
| | | | SB-2009 (1-2) ft bgs | 17.4 J | | |
| | | | SB-2009 (5-7) ft bgs | 7.6 J | | |
| | | | SB-2012 (0-1) ft bgs | 8.5 | | |
| | | | SB-2040 (1.5-2.5) ft bgs | 52.8 | | |
| | | | SB-2041 (1-2) ft bgs | 69.4 | | |
| | | | SB-2042 (2-5) ft bgs | 8.42 | | |
| | | | SB-2043 (2.5-2.7) ft bgs | 13.3 | | |
| | | | TP-17 (7-) ft bgs | 10.1 | | |
| | | | TP-18 (8-) ft bgs | 9.7 | | |
| | | | TP-19 (8-) ft bgs | 8 | | |
| | | | TP-20 (8.5-) ft bgs | 11.7 | | |
| | | | TP-201 (1-2) ft bgs | 11.7 | | |
| | | | TP-202 (0.5-1.5) ft bgs | 16.2/11.2 | | |
| | | | TP-202 (8-10) ft bgs | 11.7 | | |
| | | | TP-341 (0.5-1.5) ft bgs | 20.1 | | |

Notes:
EPC - Exposure point concentration
J - Estimated
ft bgs - Feet below ground surface
RBC - Risk-based concentration

**TABLE 13**

**DERIVATION OF RISK-BASED CONCENTRATIONS (RBCs) FOR POLYCHLORINATED BIPHENYLS IN SOIL**
**TRESPASSER ORAL, DERMAL, AND INHALATION EXPOSURE**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Chemical of Potential Concern* | *CSF oral 1/(mg/kg-d)* | *CSF dermal 1/(mg/kg-d)* | *URF inhalation 1/(mg/m³)* | *RfD oral (mg/kg-d)* | *RfD dermal (mg/kg-d)* | *RfC inhalation (mg/m³)* | *Oral Absorption Factor, $ABS_o$ (%/100)* | *Dermal Absorption Factor, $ABS_d$ (%/100)* | *Trespasser Carcinogen TR Adolescent (µg/g)* | *Trespasser Non-Carcinogen THQ Adolescent (µg/g)* | *Soil Risk-Based Concentration $RBC_{soil}$ (1) (µg/g)* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***PCBs*** | | | | | | | | | | | |
| Total PCBs ($10^{-4}$ cancer risk) | 2.00E+00 | 2.00E+00 | 5.70E-01 | 2.00E-05 | 2.00E-05 | -- | 1.0E+00 | 1.4E-01 | 6.21E+02 | 3.55E+01 | 35 |
| Total PCBs ($10^{-5}$ cancer risk) | 2.00E+00 | 2.00E+00 | 5.70E-01 | 2.00E-05 | 2.00E-05 | -- | 1.0E+00 | 1.4E-01 | 6.21E+01 | 3.55E+01 | 35 |
| Total PCBs ($10^{-6}$ cancer risk) | 2.00E+00 | 2.00E+00 | 5.70E-01 | 2.00E-05 | 2.00E-05 | -- | 1.0E+00 | 1.4E-01 | 6.21E+00 | 3.55E+01 | 6.2 |

Notes:

-- = Not Available

NV = No Value

(1) The selected RBC is the lower of the carcinogenic-based concentration and the non-carcinogenic-based concentration.

(2) The basis for SA is assuming that potential exposed skin (U.S. EPA Exhibit C-1) consists of the face (425 $cm^2$), hands (700 $cm^2$), forearms (787 $cm^2$), lower legs (1610 $cm^2$) and feet (949 $cm^2$).

(3) The basis for the FT is the 50th percentile from Table 16-1, Recommended Values for Activity Factors - Time Outdoors (total).
The time spent outdoors for 11-16 years old of 100 min/day equates to 1.7 hours (100 min/60 min). The final FT is double the 50th percentile value or 3.4 hours.

(4) The basis for the EF is the 50th percentile from Table 16-1, Recommended Values for Activity Factors - Time Outdoors (total).
Ingestion/Inhalation: The time spent outdoors for 11-16 years old of 100 min/day out of a possible 365 days equates to 25 days (CT) (100 min/day x 365 days x 1 hour/60 min x 1 day/24 hours).
The final EF is double the 50th percentile value or 50 days.
Dermal: the time spent outdoors for 11-16 years old of 100 min/day out of a possible 245 days equates to 17 days (CT) (100 min/day x 365 days x 1 hour/60 min x 1 day/24 hours).
The final EF is double the 50th percentile value or 34 days.

(5) Trespasser is a 7 through 16 year old therefore the exposure duration is 10 years, based on U.S. EPA Region 4 (2000).

Trespasser Assumptions

| | | | |
|---|---|---|---|
| Risk-Based Concentration in Soil (µg/g) | $RBC_{soil}$ | calculated | |
| Target Cancer Risk (unitless) | TR | 1.0E-04 | |
| Target Cancer Risk (unitless) | TR | 1.0E-05 | |
| Target Cancer Risk (unitless) | TR | 1.0E-06 | |
| Target Hazard Quotient (unitless) | THQ | 1.0 | |
| Cancer Slope Factor (per mg/kg-day) | CSF | chemical-specific | IRIS |
| Reference Dose (mg/kg-day) | RfD | chemical-specific | IRIS (Aroclor-1254) |
| Unit Risk Factor (per $mg/m^3$) | URF | chemical-specific | IRIS |
| Reference Concentration ($mg/m^3$) | RfC | chemical-specific | |
| Ingestion Rate (mg/day) - adult | IR | 100 | U.S. EPA, 2002 |
| Surface Area Exposed ($cm^2$/day) | SA | 4,471 | U.S. EPA, 2004 (2) |
| Adherence Factor ($mg/cm^2$) | AF | 0.2 | U.S. EPA, 2004 |
| Absorption Factor - Oral (%/100) | $ABS_o$ | Assumed | |
| Absorption Factor - Dermal (%/100) | $ABS_d$ | chemical-specific | U.S. EPA, 2004 |
| Fraction Time Exposed (hours/24 hours) | FT | 3.4/24 | U.S. EPA, 2008 (3) |
| Exposure Frequency (days/year) - ingestion/inhalation | EFa | 50 | see Section 2.2 of the Memorandum (4) |
| Exposure Frequency (days/year) - dermal | EFb | 34 | see Section 2.2 of the Memorandum (4) |
| Exposure Duration (years) | ED | 10 | U.S. EPA, 2000 (5) |
| Body Weight (kg) | BW | 45 | U.S. EPA, 2000 |
| Conversion Factor (kg/mg) | CF | 1.0E-06 | |
| Averaging Time - carcinogenic (days) | ATc | 25,550 | U.S. EPA, 1989 |
| Averaging Time - non-carcinogenic (days) | ATnc | 3,650 | U.S. EPA, 1989 |
| Particulate Emission Factor ($m^3$/kg) | PEF | 1.36E+09 | U.S. EPA, 2002 |

Exposure Equations

Carcinogenic Endpoints:

$$RBC_{soil} = \frac{TR \times ATc}{ED \times [(CSF \times IR \times EFa \times CF \times ABS_o)/BW + (CSF \times SA \times AF \times EFb \times CF \times ABS_d)/BW + (URF \times EFa \times FT \times (1/PEF))]}$$

Non-Carcinogenic Endpoints:

$$RBC_{soil} = \frac{THQ \times ATnc}{ED \times [((1/RfD) \times IR \times EFa \times CF \times ABS_o)/BW + ((1/RfD) \times SA \times AF \times EFb \times CF \times ABS_d)/BW + ((1/RfC) \times EFa \times FT \times (1/PEF))]}$$

References:


IRIS, Integrated Risk Information System (IRIS) Database, (http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList).

U.S. EPA, 1989: Risk Assessment Guidance for Superfund (RAGS): Volume 1 – Human Health Evaluation Manual (Part A), Interim Final, EPA/540/1-89/002, December 1989.

U.S. EPA, 2000: Region 4 Human Health Risk Assessment Bulletins – Supplement to RAGS, Section 4: Exposure Assessment, May.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.

U.S. EPA, 2004: Risk Assessment Guidance for Superfund (RAGS):Volume 1 - Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), EPA/540/R/99/005, July 2004.

U.S. EPA, 2008: Child Specific Exposure Factors Handbook, September 2008.

**TABLE 14**

**DERIVATION OF RISK-BASED CONCENTRATIONS (RBCs) FOR POLYCHLORINATED BIPHENYLS IN SOIL**
**RECREATIONAL USER ORAL, DERMAL, AND INHALATION EXPOSURE**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Chemical of Potential Concern (COPC)* | *CSF oral 1/(mg/kg-d)* | *CSF dermal 1/(mg/kg-d)* | *URF inhalation 1/(mg/m³)* | *RfD oral (mg/kg-d)* | *RfD dermal (mg/kg-d)* | *RfC inhalation (mg/m³)* | *Oral Absorption Factor, $ABS_o$ (%/100)* | *Dermal Absorption Factor, $ABS_d$ (%/100)* | *Recreational User TR Child & Adult (µg/g)* | *Recreational User THQ Child & Adult (µg/g)* | *Soil Risk-Based Concentration $RBC_{soil}$ (1) (µg/g)* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***PCBs*** | | | | | | | | | | | |
| Total PCBs ($10^{-4}$ cancer risk) | 2.00E+00 | 2.00E+00 | 5.70E-01 | 2.00E-05 | 2.00E-05 | -- | 1.0E+00 | 1.4E-01 | 1.23E+02 | 2.12E+01 | 21 |
| Total PCBs ($10^{-5}$ cancer risk) | 2.00E+00 | 2.00E+00 | 5.70E-01 | 2.00E-05 | 2.00E-05 | -- | 1.0E+00 | 1.4E-01 | 1.23E+01 | 2.12E+01 | 12 |
| Total PCBs ($10^{-6}$ cancer risk) | 2.00E+00 | 2.00E+00 | 5.70E-01 | 2.00E-05 | 2.00E-05 | -- | 1.0E+00 | 1.4E-01 | 1.23E+00 | 2.12E+01 | 1.2 |

Notes:

(1) The selected RBC is the lower of the carcinogenic-based concentration and the non-carcinogenic-based concentration.

(2) The basis for the FT is based on ages 3-5 yrs from Table 16-1, Recommended Values for Activity Factors - Time Outdoors Playing on Dirt.

Recreational User Exposure Assumptions

| | | | |
|---|---|---|---|
| Risk-Based Concentration in Soil (µg/g) | $RBC_{soil}$ | calculated | |
| Target Cancer Risk (unitless) | TR | 1.0E-04 | |
| Target Cancer Risk (unitless) | TR | 1.0E-05 | |
| Target Cancer Risk (unitless) | TR | 1.0E-06 | |
| Target Hazard Quotient (unitless) | THQ | 1.0 | |
| Cancer Slope Factor (per mg/kg-day) | CSF | chemical-specific | IRIS |
| Reference Dose (mg/kg-day) | RfD | chemical-specific | IRIS (Aroclor-1254) |
| Unit Risk Factor (per $mg/m^3$) | URF | chemical-specific | IRIS |
| Reference Concentration ($mg/m^3$) | RfC | chemical-specific | |
| Age-Adjusted Ingestion Factor | IF | 114 | MDEQ, 2013 |
| Age-Adjusted Dermal Factor | DF | 353 | MDEQ, 2013 |
| Absorption Factor - Oral (%/100) | $ABS_o$ | Assumed | |
| Absorption Factor - Dermal (%/100) | $ABS_d$ | chemical-specific | U.S. EPA, 2004 |
| Exposure Frequency (days/year) - ingestion/inhalation | EFa | 70 | see Section 2.2 of the Memorandum |
| Exposure Frequency (days/year) - dermal | EFb | 48 | see Section 2.2 of the Memorandum |
| Exposure Duration (years) - child & adult | ED | 30 | MDEQ, 2013 |
| Fraction Time Exposed (hours/24 hours) | FT | 2/24 | U.S. EPA, 2008 (2) |
| Conversion Factor (kg/mg) | CF | 1.0E-06 | |
| Averaging Time - carc. (days) | ATc | 25,550 | U.S. EPA, 1989 |
| Averaging Time - noncarc. (days) - child & adult | ATnc | 10,950 | U.S. EPA, 1989 |
| Particulate Emission Factor ($m^3/kg$) | PEF | 1.36E+09 | U.S. EPA, 2002 |

Exposure Equations

Carcinogenic Endpoints:

$$RBC_{soil} = \frac{TR \times ATc}{[(CSF \times IF \times EFa \times CF \times ABS_o) + (CSF \times DF \times EFb \times CF \times ABS_d) + (URF \times FT \times EFa \times ED \times (1/PEF))]}$$

Non-Carcinogenic Endpoints:

$$RBC_{soil} = \frac{THQ \times ATnc}{[(((1/RfD) \times IF \times EFa \times CF \times ABS_o) + ((1/RfD) \times DF \times EFb \times CF \times ABS_d) + ((1/RfC) \times EFa \times ED \times FT \times (1/PEF))]}$$

References:

IRIS, Integrated Risk Information System (IRIS) Database, (http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList).

MDEQ, 2013. Operational Memoranda for the Remediation and Redevelopment Division: Part 201 Cleanup Criteria and Part 213 Risk Based Screening Levels. December 2013.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund (RAGS): Volume 1 – Human Health Evaluation Manual (Part A), Interim Final, EPA/540/1-89/002, December 1989.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.

U.S. EPA, 2004: Risk Assessment Guidance for Superfund (RAGS):Volume 1 - Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), EPA/540/R/99/005, July 2004.

U.S. EPA, 2008: Child Specific Exposure Factors Handbook, September 2008.

**TABLE 15**

**DERIVATION OF RISK-BASED CONCENTRATIONS (RBCs) FOR POLYCHLORINATED BIPHENYLS IN SOIL**
**RESIDENTIAL ORAL, DERMAL, AND INHALATION EXPOSURE**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Chemical of Potential Concern (COPC)* | *CSF oral 1/(mg/kg-d)* | *CSF dermal 1/(mg/kg-d)* | *URF inhalation 1/(mg/m³)* | *RfD oral (mg/kg-d)* | *RfD dermal (mg/kg-d)* | *RfC inhalation (mg/m³)* | *Oral Absorption Factor, $ABS_o$ (%/100)* | *Dermal Absorption Factor, $ABS_d$ (%/100)* | *Resident TR Child & Adult (µg/g)* | *Resident THQ Child & Adult (µg/g)* | *Soil Risk-Based Concentration $RBC_{soil}$ (1) (µg/g)* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***PCBs*** | | | | | | | | | | | |
| Total PCBs ($10^{-4}$ cancer risk) | 2.00E+00 | 2.00E+00 | 5.70E-01 | 2.00E-05 | 2.00E-05 | -- | 1.0E+00 | 1.4E-01 | 2.46E+01 | 4.21E+00 | 4.2 |
| Total PCBs ($10^{-5}$ cancer risk) | 2.00E+00 | 2.00E+00 | 5.70E-01 | 2.00E-05 | 2.00E-05 | -- | 1.0E+00 | 1.4E-01 | 2.46E+00 | 4.21E+00 | 2.5 |
| Total PCBs ($10^{-6}$ cancer risk) | 2.00E+00 | 2.00E+00 | 5.70E-01 | 2.00E-05 | 2.00E-05 | -- | 1.0E+00 | 1.4E-01 | 2.46E-01 | 4.21E+00 | 0.25 |

Notes:

(1) The selected RBC is the lower of the carcinogenic-based concentration and the non-carcinogenic-based concentration.

(2) The basis for the FT is based on ages 3-5 yrs from Table 16-1, Recommended Values for Activity Factors - Time Outdoors Playing on Dirt.

Resident Exposure Assumptions

| | | | |
|---|---|---|---|
| Risk-Based Concentration in Soil (µg/g) | $RBC_{soil}$ | calculated | |
| Target Cancer Risk (unitless) | TR | 1.0E-04 | |
| Target Cancer Risk (unitless) | TR | 1.0E-05 | |
| Target Cancer Risk (unitless) | TR | 1.0E-06 | |
| Target Hazard Quotient (unitless) | THQ | 1.0 | |
| Cancer Slope Factor (per mg/kg-day) | CSF | chemical-specific | IRIS |
| Reference Dose (mg/kg-day) | RfD | chemical-specific | IRIS (Aroclor-1254) |
| Unit Risk Factor (per $mg/m^3$) | URF | chemical-specific | IRIS |
| Reference Concentration ($mg/m^3$) | RfC | chemical-specific | |
| Age-Adjusted Ingestion Factor | IF | 114 | MDEQ, 2013 |
| Age-Adjusted Dermal Factor | DF | 353 | MDEQ, 2013 |
| Absorption Factor - Oral (%/100) | $ABS_o$ | Assumed | |
| Absorption Factor - Dermal (%/100) | $ABS_d$ | chemical-specific | U.S. EPA, 2004 |
| Exposure Frequency (days/year) - ingestion/inhalation | EFa | 350 | see Section 2.2 of the Memorandum |
| Exposure Frequency (days/year) - dermal | EFb | 245 | see Section 2.2 of the Memorandum |
| Exposure Duration (years) - child & adult | ED | 30 | MDEQ, 2013 |
| Fraction Time Exposed (hours/24 hours) | FT | 2/24 | U.S. EPA, 2008 (2) |
| Conversion Factor (kg/mg) | CF | 1.0E-06 | |
| Averaging Time - carc. (days) | ATc | 25,550 | U.S. EPA, 1989 |
| Averaging Time - noncarc. (days) - child & adult | ATnc | 10,950 | U.S. EPA, 1989 |
| Particulate Emission Factor ($m^3/kg$) | PEF | 1.36E+09 | U.S. EPA, 2002 |

Exposure Equations

Carcinogenic Endpoints:

$$RBC_{soil} = \frac{TR \times ATc}{[(CSF \times IF \times EFa \times CF \times ABS_o) + (CSF \times DF \times EFb \times CF \times ABS_d) + (URF \times FT \times EFa \times ED \times (1/PEF))]}$$

Non-Carcinogenic Endpoints:

$$RBC_{soil} = \frac{THQ \times ATnc}{[(((1/RfD) \times IF \times EFa \times CF \times ABS_o) + ((1/RfD) \times DF \times EFb \times CF \times ABS_d) + ((1/RfC) \times EFa \times ED \times FT \times (1/PEF))]}$$

References:

IRIS, Integrated Risk Information System (IRIS) Database, (http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList).

MDEQ, 2013. Operational Memoranda for the Remediation and Redevelopment Division: Part 201 Cleanup Criteria and Part 213 Risk Based Screening Levels. December 2013.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund (RAGS): Volume 1 – Human Health Evaluation Manual (Part A), Interim Final, EPA/540/1-89/002, December 1989.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.

U.S. EPA, 2004: Risk Assessment Guidance for Superfund (RAGS):Volume 1 - Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), EPA/540/R/99/005, July 2004.

U.S. EPA, 2008: Child Specific Exposure Factors Handbook, September 2008.

**TABLE 16**

**DERIVATION OF RISK-BASED CONCENTRATIONS (RBCs) FOR POLYCHLORINATED BIPHENYLS IN SOIL**
**COMMERCIAL WORKER ORAL, DERMAL, AND INHALATION EXPOSURE**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Chemical of Potential Concern* | *CSF oral 1/(mg/kg-d)* | *CSF dermal 1/(mg/kg-d)* | *URF inhalation 1/(mg/m³)* | *RfD oral (mg/kg-d)* | *RfD dermal (mg/kg-d)* | *RfC inhalation (mg/m³)* | *Oral Absorption Factor, $ABS_o$ (%/100)* | *Dermal Absorption Factor, $ABS_d$ (%/100)* | *Commercial Worker Carcinogen TR Adult (µg/g)* | *Commercial Worker Non-Carcinogen THQ Adult (µg/g)* | *Soil Risk-Based Concentration $RBC_{soil}$ (1) (µg/g)* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***PCBs*** | | | | | | | | | | | |
| Total PCBs ($10^{-4}$ cancer risk) | 2.00E+00 | 2.00E+00 | 5.70E-01 | 2.00E-05 | 2.00E-05 | -- | 1.00E+00 | 1.4E-01 | 9.11E+01 | 1.30E+01 | 13 |
| Total PCBs ($10^{-5}$ cancer risk) | 2.00E+00 | 2.00E+00 | 5.70E-01 | 2.00E-05 | 2.00E-05 | -- | 1.00E+00 | 1.4E-01 | 9.11E+00 | 1.30E+01 | 9.1 |
| Total PCBs ($10^{-6}$ cancer risk) | 2.00E+00 | 2.00E+00 | 5.70E-01 | 2.00E-05 | 2.00E-05 | -- | 1.00E+00 | 1.4E-01 | 9.11E-01 | 1.30E+01 | 0.91 |

Notes:

(1) The selected RBC is the lower of the carcinogenic-based concentration and the non-carcinogenic-based concentration.

(2) Professional Judgment; assumed 8 hour work day.

Commercial Worker Assumptions

| | | | |
|---|---|---|---|
| Risk-Based Concentration in Soil (µg/g) | $RBC_{soil}$ | calculated | |
| Target Cancer Risk (unitless) | TR | 1.0E-04 | |
| Target Cancer Risk (unitless) | TR | 1.0E-05 | |
| Target Cancer Risk (unitless) | TR | 1.0E-06 | |
| Target Hazard Quotient (unitless) | THQ | 1.0 | |
| Cancer Slope Factor (per mg/kg-day) | CSF | chemical-specific | IRIS |
| Reference Dose (mg/kg-day) | RfD | chemical-specific | IRIS (Aroclor-1254) |
| Unit Risk Factor (per mg/m³) | URF | chemical-specific | IRIS |
| Reference Concentration (mg/m³) | RfC | chemical-specific | |
| Ingestion Rate (mg/day) - adult | IR | 100 | U.S. EPA, 2002 |
| Surface Area Exposed (cm²/day) | SA | 3,300 | U.S. EPA, 2004 |
| Adherence Factor (mg/cm²) | AF | 0.2 | U.S. EPA, 2004 |
| Absorption Factor - Oral (%/100) | $ABS_o$ | Assumed | |
| Absorption Factor - Dermal (%/100) | $ABS_d$ | chemical-specific | U.S. EPA, 2004 |
| Fraction Time Exposed (hours/24 hours) | FT | 8/24 | Professional Judgement (2) |
| Exposure Frequency (days/year) - ingestion/inhalation | EFa | 245 | see Section 2.2 of the Memorandum |
| Exposure Frequency (days/year) - dermal | EFb | 160 | see Section 2.2 of the Memorandum |
| Exposure Duration (years) | ED | 25 | U.S. EPA, 2004 |
| Body Weight (kg) | BW | 70 | U.S. EPA, 2002 |
| Conversion Factor (kg/mg) | CF | 1.0E-06 | |
| Averaging Time - carcinogenic (days) | ATc | 25,550 | U.S. EPA, 1989 |
| Averaging Time - non-carcinogenic (days) | ATnc | 9,125 | U.S. EPA, 1989 |
| Particulate Emission Factor (m³/kg) | PEF | 1.36E+09 | U.S. EPA, 2002 |

Exposure Equations

Carcinogenic Endpoints:

$$RBC_{soil} = \frac{TR \times ATc}{ED \times [(CSF \times IR \times EFa \times CF \times ABS_o)/BW + (CSF \times SA \times AF \times EFb \times CF \times ABS_d)/BW + (URF \times EFa \times FT \times (1/PEF))]}$$

Non-Carcinogenic Endpoints:

$$RBC_{soil} = \frac{THQ \times ATnc}{ED \times [((1/RfD) \times IR \times EFa \times CF \times ABS_o)/BW + ((1/RfD) \times SA \times AF \times EFb \times CF \times ABS_d)/BW + ((1/RfC) \times EFa \times FT \times (1/PEF))]}$$

References:

IRIS, Integrated Risk Information System (IRIS) Database, (http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList).

U.S. EPA, 1989: Risk Assessment Guidance for Superfund (RAGS): Volume 1 – Human Health Evaluation Manual (Part A), Interim Final, EPA/540/1-89/002, December 1989.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.

U.S. EPA, 2004: Risk Assessment Guidance for Superfund (RAGS):Volume 1 - Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), EPA/540/R/99/005, July 2004.

**TABLE 17**

**DERIVATION OF RISK-BASED CONCENTRATIONS (RBCs) FOR POLYCHLORINATED BIPHENYLS IN SOIL**
**UTILITY WORKER ORAL, DERMAL, AND INHALATION EXPOSURE**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Chemical of Potential Concern* | *CSF oral 1/(mg/kg-d)* | *CSF dermal 1/(mg/kg-d)* | *URF inhalation 1/(mg/m$^3$)* | *RfD oral (mg/kg-d)* | *RfD dermal (mg/kg-d)* | *RfC inhalation (mg/m$^3$)* | *Oral Absorption Factor, ABS$_o$ (%/100)* | *Dermal Absorption Factor, ABS$_d$ (%/100)* | *Utility Worker Carcinogen TR Adult (µg/g)* | *Utility Worker Non-Carcinogen THQ Adult (µg/g)* | *Soil Risk-Based Concentration RBC$_{soil}$ (1) (µg/g)* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***PCBs*** | | | | | | | | | | | |
| Total PCBs ($10^{-4}$ cancer risk) | 2.00E+00 | 2.00E+00 | 5.70E-01 | 2.00E-05 | 2.00E-05 | -- | 1.0E+00 | 1.4E-01 | 1.59E+03 | 9.09E+00 | 9.1 |
| Total PCBs ($10^{-5}$ cancer risk) | 2.00E+00 | 2.00E+00 | 5.70E-01 | 2.00E-05 | 2.00E-05 | -- | 1.0E+00 | 1.4E-01 | 1.59E+02 | 9.09E+00 | 9.1 |
| Total PCBs ($10^{-6}$ cancer risk) | 2.00E+00 | 2.00E+00 | 5.70E-01 | 2.00E-05 | 2.00E-05 | -- | 1.0E+00 | 1.4E-01 | 1.59E+01 | 9.09E+00 | 9.1 |

Notes:

-- = Not Available

NV = No Value

(1) The selected RBC is the lower of the carcinogenic-based concentration and the non-carcinogenic-based concentration.

(2) Professional Judgement; assumed 8 hour work day.

(3) Professional Judgement; assumes 5 days/week for 6 months or 120 days/year.

(4) Professional Judgement; assumes utility maintenance activities occurs within a one year time period.

Utility Worker Assumptions

| | | | |
|---|---|---|---|
| Risk-Based Concentration in Soil (µg/g) | $RBC_{soil}$ | calculated | |
| Target Cancer Risk (unitless) | TR | 1.0E-04 | |
| Target Cancer Risk (unitless) | TR | 1.0E-05 | |
| Target Cancer Risk (unitless) | TR | 1.0E-06 | |
| Target Hazard Quotient (unitless) | THQ | 1.0 | |
| Cancer Slope Factor (per mg/kg-day) | CSF | chemical-specific | IRIS |
| Reference Dose (mg/kg-day) | RfD | chemical-specific | IRIS (Aroclor-1254) |
| Unit Risk Factor (per mg/m$^3$) | URF | chemical-specific | IRIS |
| Reference Concentration (mg/m$^3$) | RfC | chemical-specific | |
| Ingestion Rate (mg/day) - adult | IR | 330 | U.S. EPA, 2002 |
| Surface Area Exposed (cm$^2$/day) | SA | 3,300 | U.S. EPA, 2004 |
| Adherence Factor (mg/cm$^2$) | AF | 0.3 | U.S. EPA, 2004 |
| Absorption Factor - Oral (%/100) | $ABS_o$ | Assumed | |
| Absorption Factor - Dermal (%/100) | $ABS_d$ | chemical-specific | U.S. EPA, 2004 |
| Fraction Time Exposed (hours/24 hours) | FT | 8/24 | Professional Judgement (2) |
| Exposure Frequency (days/year) | EF | 120 | Professional Judgement (3) |
| Exposure Duration (years) | ED | 1 | Professional Judgement (4) |
| Body Weight (kg) | BW | 70 | U.S. EPA, 2002 |
| Conversion Factor (kg/mg) | CF | 1.0E-06 | |
| Averaging Time - carcinogenic (days) | ATc | 25,550 | U.S. EPA, 1989 |
| Averaging Time - non-carcinogenic (days) | ATnc | 365 | U.S. EPA, 1989 |
| Particulate Emission Factor (m$^3$/kg) | PEF | 2.39E+09 | U.S. EPA, 2002; See Table 1 |

Exposure Equations

Carcinogenic Endpoints:

$$RBC_{soil} = \frac{TR \times ATc}{EF \times ED \times [(CSF \times IR \times CF \times ABS_o)/BW + (CSF \times SA \times AF \times CF \times ABS_d)/BW + (URF \times FT \times (1/PEF))]}$$

Non-Carcinogenic Endpoints:

$$RBC_{soil} = \frac{THQ \times ATnc}{EF \times ED \times [((1/RfD) \times IR \times CF \times ABS_o)/BW + ((1/RfD) \times SA \times AF \times CF \times ABS_d)/BW + ((1/RfC) \times FT \times (1/PEF))]}$$

References:

IRIS, Integrated Risk Information System (IRIS) Database, (http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList).

U.S. EPA, 1989: Risk Assessment Guidance for Superfund (RAGS): Volume 1 – Human Health Evaluation Manual (Part A), Interim Final, EPA/540/1-89/002, December 1989.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.

U.S. EPA, 2004: Risk Assessment Guidance for Superfund (RAGS):Volume 1 - Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), EPA/540/R/99/005, July 2004.

**TABLE 18**

**DERIVATION OF RISK-BASED CONCENTRATIONS (RBCs) FOR POLYCHLORINATED BIPHENYLS IN SOIL**
**CONSTRUCTION WORKER ORAL, DERMAL, AND INHALATION EXPOSURE**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| Chemical of Potential Concern | CSF oral 1/(mg/kg-d) | CSF dermal 1/(mg/kg-d) | URF inhalation 1/(mg/m$^3$) | RfD oral (mg/kg-d) | RfD dermal (mg/kg-d) | RfC inhalation (mg/m$^3$) | Oral Absorption Factor, $ABS_o$ (%/100) | Dermal Absorption Factor, $ABS_d$ (%/100) | Construction Worker Carcinogen TR Adult (µg/g) | Construction Worker Non-Carcinogen THQ Adult (µg/g) | Soil Risk-Based Concentration $RBC_{soil}$ (1) (µg/g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***PCBs*** | | | | | | | | | | | |
| Total PCBs ($10^{-4}$ cancer risk) | 2.00E+00 | 2.00E+00 | 5.70E-01 | 2.00E-05 | 2.00E-05 | -- | 1.0E+00 | 1.4E-01 | 3.81E+02 | 5.45E+01 | 55 |
| Total PCBs ($10^{-5}$ cancer risk) | 2.00E+00 | 2.00E+00 | 5.70E-01 | 2.00E-05 | 2.00E-05 | -- | 1.0E+00 | 1.4E-01 | 3.81E+01 | 5.45E+01 | 38 |
| Total PCBs ($10^{-6}$ cancer risk) | 2.00E+00 | 2.00E+00 | 5.70E-01 | 2.00E-05 | 2.00E-05 | -- | 1.0E+00 | 1.4E-01 | 3.81E+00 | 5.45E+01 | 3.8 |

Notes:

-- = Not Available

NV = No Value

(1) The selected RBC is the lower of the carcinogenic-based concentration and the non-carcinogenic-based concentration.

(2) Professional Judgement; assumed 8 hour work day.

(3) Professional Judgement; assumes 5 days/week for 1 month or 20 days/year.

Construction Worker Assumptions

| | | | |
|---|---|---|---|
| Risk-Based Concentration in Soil (µg/g) | $RBC_{soil}$ | calculated | |
| Target Cancer Risk (unitless) | TR | 1.0E-04 | |
| Target Cancer Risk (unitless) | TR | 1.0E-05 | |
| Target Cancer Risk (unitless) | TR | 1.0E-06 | |
| Target Hazard Quotient (unitless) | THQ | 1.0 | |
| Cancer Slope Factor (per mg/kg-day) | CSF | chemical-specific | IRIS |
| Reference Dose (mg/kg-day) | RfD | chemical-specific | IRIS (Aroclor-1254) |
| Unit Risk Factor (per mg/m$^3$) | URF | chemical-specific | IRIS |
| Reference Concentration (mg/m$^3$) | RfC | chemical-specific | |
| Ingestion Rate (mg/day) - adult | IR | 330 | U.S. EPA, 2002 |
| Surface Area Exposed (cm$^2$/day) | SA | 3,300 | U.S. EPA, 2004 |
| Adherence Factor (mg/cm$^2$) | AF | 0.3 | U.S. EPA, 2004 |
| Absorption Factor - Oral (%/100) | $ABS_o$ | Assumed | |
| Absorption Factor - Dermal (%/100) | $ABS_d$ | chemical-specific | U.S. EPA, 2004 |
| Fraction Time Exposed (hours/24 hours) | FT | 8/24 | Professional Judgement (2) |
| Exposure Frequency (days/year) | EF | 20 | Professional Judgement (3) |
| Exposure Duration (years) | ED | 25 | U.S. EPA, 2004 |
| Body Weight (kg) | BW | 70 | U.S. EPA, 2002 |
| Conversion Factor (kg/mg) | CF | 1.0E-06 | |
| Averaging Time - carcinogenic (days) | ATc | 25,550 | U.S. EPA, 1989 |
| Averaging Time - non-carcinogenic (days) | ATnc | 9,125 | U.S. EPA, 1989 |
| Particulate Emission Factor (m$^3$/kg) | PEF | 1.59E+07 | U.S. EPA, 2002; see Table 2 |

Exposure Equations

Carcinogenic Endpoints:

$$RBC_{soil} = \frac{TR \times ATc}{EF \times ED \times [(CSF \times IR \times CF \times ABS_o)/BW + (CSF \times SA \times AF \times CF \times ABS_d)/BW + (URF \times FT \times (1/PEF))]}$$

Non-Carcinogenic Endpoints:

$$RBC_{soil} = \frac{THQ \times ATnc}{EF \times ED \times [((1/RfD) \times IR \times CF \times ABS_o)/BW + ((1/RfD) \times SA \times AF \times CF \times ABS_d)/BW + ((1/RfC) \times FT \times (1/PEF))]}$$

References:

IRIS, Integrated Risk Information System (IRIS) Database, (http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList).

U.S. EPA, 1989: Risk Assessment Guidance for Superfund (RAGS): Volume 1 – Human Health Evaluation Manual (Part A), Interim Final, EPA/540/1-89/002, December 1989.

U.S. EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.

U.S. EPA, 2004: Risk Assessment Guidance for Superfund (RAGS):Volume 1 - Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), EPA/540/R/99/005, July 2004.

**TABLE 19**

**SUMMARY OF RISK-BASED CONCENTRATIONS (RBCs) FOR POLYCHLORINATED BIPHENYLS IN SOIL**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Chemical of Potential Concern (COPC)* | *Units* | *Risk-Based Concentration for Soil, $RBC_{soil}$* | | | | | | *Minimum $RBC_{soil}$* | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Trespasser* | *Recreational User* | *Resident* | *Commercial Worker* | *Utility Worker* | *Construction Worker* | *Residential (1)* | *Commercial (2)* | *Commercial+Recreational (3)* |
| **TARGET CANCER RISK = 1.0 x $10^{-4}$; TARGET HAZARD QUOTIENT = 1.0** | | | | | | | | | | |
| Total PCBs | µg/g | 35 | 21 | 4.2 | 13 | 9.1 | 55 | 4.2 | 9.1 | 9.1 |
| **TARGET CANCER RISK = 1.0 x $10^{-5}$; TARGET HAZARD QUOTIENT = 1.0** | | | | | | | | | | |
| Total PCBs | µg/g | 35 | 12 | 2.5 | 9.1 | 9.1 | 38 | 2.5 | 9.1 | 9.1 |
| **TARGET CANCER RISK = 1.0 x $10^{-6}$; TARGET HAZARD QUOTIENT = 1.0** | | | | | | | | | | |
| Total PCBs | µg/g | 6.2 | 1.2 | 0.25 | 0.91 | 9.1 | 3.8 | 0.25 | 0.91 | 0.91 |

Notes:
(1) $RBC_{soil}$ for the residential areas include all receptors.
(2) $RBC_{soil}$ for the commercial areas include all receptors, except residents and recreational users.
(3) $RBC_{soil}$ for the commercial+recreational areas include all receptors, except residents.

# Appendix B

**Revised Ecological Risk Assessment – Step 3 – Refinement of Constituents of Potential Ecological Concern and Development of Ecological Remedial Action Objectives**
**CRA, Revision 3, November 2014**

CONESTOGA-ROVERS & ASSOCIATES

www.CRAworld.com

# Ecological Risk Assessment

Step 3 Refinement of Constituents of Potential Ecological Concern and Development of Ecological Remedial Action Objectives

Prepared for: Weyerhaeuser NR Company


**Conestoga-Rovers & Associates**

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November 13, 2014 • 056394 • Report No. 10_Rev. 3


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## Executive Summary

Conestoga-Rovers & Associates (CRA), on behalf of Weyerhaeuser NR Company (Weyerhaeuser), conducted a refinement of chemical constituents identified in the screening-level ecological risk assessment (SLERA) portion of the Remedial Investigation Report (RI Report) as constituents of potential ecological concern (COPECs) for the former Plainwell Inc., Mill Property in Plainwell, Michigan (Site). The RI Report was approved on February 26, 2013. The refinement process is Step 3 of the 8-step process for conducting ecological risk assessment under guidance developed by the United States Environmental Protection Agency (U.S. EPA).

The majority of the Site evaluated in the SLERA is anticipated to be redeveloped for residential and/or commercial use. As complete exposure pathways will be eliminated in those areas that will be developed, the dataset for the refinement process consisted of samples from those areas that will not be disturbed by development activities. The revised assessment area is within the riparian corridor of the Kalamazoo River. The data for the revised assessment were re-screened using the same methodology and ecological screening values (ESVs) that were used in the SLERA. The re-screening retained two volatile organic compounds (VOCs) (i.e., acetone and isopropylbenzene), three benzene, toluene, ethylbenzene, and xylenes (BTEX) constituents (i.e., benzene, toluene, and m&p-xylenes), one semi-volatile organic compound (SVOC) (i.e., carbazole), high molecular weight (HMW) polycyclic aromatic hydrocarbons (PAHs), total polychlorinated biphenyls (PCBs), and 14 inorganic constituents [i.e., antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, selenium, vanadium, zinc, and cyanide (total)] as COPECs.

The refinement process focused on avian and mammalian wildlife. Refinement consisted of a two-phase process. In the first phase, 95 percent upper confidence limit (UCL) concentrations of the COPECs were compared to ecological benchmarks (i.e., soil concentrations) specific to avian and/or mammalian wildlife. A constituent was carried forward to the second phase if the 95 percent UCL concentration was greater than the ecological benchmark or if an ecological benchmark was not available. This phase eliminated total PCBs, antimony, arsenic, barium, chromium, manganese, and vanadium as COPECs.

The second phase of the refinement process involved use of food chain models to assess the potential for risk to avian and mammalian wildlife. The food chain models identified a potential for risk to avian insectivores exposed to lead at both a no observed adverse effect level (NOAEL) and lowest observed adverse effect level (LOAEL), and mammalian wildlife exposed to lead at the LOAEL. The food chain models also identified a potential for risk to avian and/or

mammalian wildlife exposed to carbazole, HMW PAHs, cadmium, copper, mercury, selenium, and zinc at the NOAEL, but not the LOAEL.

Ecological preliminary remediation goals (PRGs) were developed for carbazole, HMW PAHs, cadmium, copper, lead, mercury, selenium, and zinc. The ecological PRGs were the lowest of the PRGs for avian and mammalian wildlife. The ecological PRGs were compared to the 95 percent UCL concentrations of the COPECs. The 95 percent UCL concentrations for carbazole, HMW PAHs, cadmium, copper, lead, mercury, selenium, and zinc were below their ecological PRGs. The 95 percent UCL concentrations for these seven COEPCS were also less than 50 percent of the PRGs for all COPECs. Due to the uncertainty associated with the LOAEL for avian wildlife, lower and upper PRGs were developed for lead. The 95 percent UCL concentration for lead was above the lower end PRG and below the upper end PRG. Removal of the maximum concentration of lead from the dataset produces a 95 percent UCL below the lower end PRG.

The ecological PRGs are 0.672 milligrams per kilogram (mg/kg) for carbazole, 59.6 mg/kg for HMW PAHs, 2.01 mg/kg for cadmium, 634 mg/kg for copper, 140 mg/kg (lower end) and 812 mg/kg (upper end) for lead, 3.19 mg/kg for mercury, 9.09 mg/kg for selenium, and 1,705 mg/kg for zinc. The data and analyses presented in this document are sufficient for decisions to be made regarding the protection of ecological receptors within the corridor of the Kalamazoo River. Consequently, the ecological risk assessment process is not advancing to the next steps of the BERA.

## Table of Contents

Page

**Section 1.0 Introduction ..... 1**

**Section 2.0 Summary of the Screening-Level Ecological Risk Assessment ..... 2**

2.1 Constituents of Potential Ecological Concern ..... 2

2.2 Assessment Endpoints ..... 3

2.3 Measurement Endpoints ..... 3

**Section 3.0 Refinement Methodology ..... 4**

3.1 Dataset ..... 4

3.2 Re-Screening for Constituents of Potential Ecological Concern ..... 4

3.3 Avian and Mammalian Wildlife ..... 4

**Section 4.0 Re-Screening of the Dataset for the Refinement Process ..... 5**

**Section 5.0 Refinement of Constituents of Potential Ecological Concern ..... 7**

5.1 Comparison to Wildlife Benchmarks ..... 7

5.1.1 Avian Wildlife ..... 7

5.1.2 Mammalian Wildlife ..... 8

5.2 Food Chain Models ..... 8

5.2.1 Overview ..... 8

5.2.2 Avian Wildlife ..... 10

5.2.3 Mammalian Wildlife ..... 12

5.3 Summary of Food Chain Models ..... 13

**Section 6.0 Analysis of Uncertainties ..... 14**

**Section 7.0 Ecological Preliminary Remediation Goals ..... 16**

7.1 Overview ..... 16

7.2 Methodology ..... 16

7.3 Comparison of Ecological Preliminary Remediation Goals to Exposure Concentrations ..... 18

7.4 Risk Management Considerations ..... 18

**Section 8.0 Complete Exposure Pathways and Ecosystems at Risk ..... 19**

8.1 Complete Exposure Pathways ..... 19

8.2 Ecosystems at Risk ..... 19

## Table of Contents

**Page**

**Section 9.0 Selection of Assessment Endpoints ..... 19**

**Section 10.0 Conceptual Site Model and Risk Questions ..... 20**

10.1 Conceptual Site Model ..... 20

10.2 Risk Questions ..... 20

**Section 11.0 Summary and Conclusions ..... 20**

**Section 12.0 References ..... 22**

## List of Figures
## (Following Text)

Figure 1.1 Locations of Surface Soil Samples

## List of Tables
## (Following Text)

Table 2.1 Constituents of Potential Ecological Concern Identified in the Screening-Level Ecological Risk Assessment
Table 4.1 Re-Screening Summary for Refinement Dataset
Table 5.1 Refinement Benchmarks for Avian Wildlife
Table 5.2 Refinement of Constituents of Potential Ecological Concern – Avian Wildlife
Table 5.3 Refinement Benchmarks for Mammalian Wildlife
Table 5.4 Refinement of Constituents of Potential Ecological Concern – Mammalian Wildlife
Table 5.5 Exposure Parameters for Avian Indicator Species
Table 5.6 Exposure Parameters for Mammalian Indicator Species
Table 5.7 Equations for Calculating Exposure Concentrations in Dietary Items
Table 5.8 Exposure Concentrations for Food Chain Models
Table 5.9 Toxicity Reference Values for Avian and Mammalian Wildlife
Table 5.10 Summary of Food Chain Model for American Woodcock
Table 5.11 Summary of Food Chain Model for Mourning Dove
Table 5.12 Summary of Food Chain Model for Red-Tailed Hawk
Table 5.13 Summary of Food Chain Model for Short-Tailed Shrew
Table 5.14 Summary of Food Chain Model for Meadow Vole
Table 5.15 Summary of Food Chain Model for Long-Tailed Weasel
Table 7.1 Exposure Parameters for American Woodcock and Short-Tailed Shrew for Development of Preliminary Remediation Goals
Table 7.2 Ecological Preliminary Remediation Goals
Table 7.3 Comparison of Ecological Preliminary Remediation Goals to Exposure Concentrations

## List of Appendices

Appendix A Dataset for the Refinement Process
Appendix B Food Chain Calculations for Refinement Process
Appendix C Food Chain Calculations for Ecological Preliminary Remediation Goals

## List of Acronyms and Abbreviations

| | |
|---|---|
| BCOC | Bioaccumulative Chemical of Concern |
| BERA | Baseline Ecological Risk Assessment |
| bgs | Below Ground Surface |
| BW | Body Weight |
| BTEX | Benzene, Toluene, Ethylbenzene, and Xylenes |
| CCME | Canadian Council of Ministers of the Environment |
| $Conc_{food}$ | Concentration of a Chemical Constituent in Food |
| $Conc_{soil}$ | Concentration of a Chemical Constituent in Soil |
| $Conc_{water}$ | Concentration of a Chemical Constituent in Water |
| COPEC | Constituent of Potential Ecological Concern |
| CRA | Conestoga-Rovers & Associates |
| CSM | Conceptual Site Model |
| DW | Dry Weight |
| ECO-SSL | Ecological Soil Screening Level |
| ESL | Ecological Screening Level |
| ESV | Ecological Screening Value |
| FOD | Frequency of Detection |
| g | gram |
| HMW | High Molecular Weight |
| HQ | Hazard Quotient |
| $HQ_{LOAEL}$ | Hazard Quotient Based on the Lowest Observed Adverse Effect Level |
| $HQ_{NOAEL}$ | Hazard Quotient Based on the No Observed Adverse Effect Level |
| $IR_{food}$ | Ingestion Rate of Food |
| $IR_{total}$ | Total Ingestion Rate of a Chemical Constituent |
| $IR_{water}$ | Ingestion Rate of Water |
| IRIS | Integrated Risk Information System |
| kcal | kilocalories |
| kg | kilogram |
| $K_{OW}$ | Octanol-Water Partition Coefficient |
| L | Liter |
| LMW | Low Molecular Weight |
| LOAEL | Lowest Observed Adverse Effect Level |
| LOD | Limit of Detection |
| MDEQ | Michigan Department of Environmental Quality |
| mg | milligram |
| NOAEL | No Observed Adverse Effect Level |
| OSWER | Office of Solid Waste and Emergency Response |
| $P_S$ | Proportion of Soil Ingested |
| PCB | Polychlorinated Biphenyl |

## List of Acronyms and Abbreviations (continued)

| | |
|---|---|
| PAH | Polycyclic Aromatic Hydrocarbon |
| PRG | Preliminary Remediation Goal |
| RAO | Remedial Action Objective |
| RB | Refinement Benchmark |
| RCRA | Resource Conservation and Recovery Act |
| RI | Remedial Investigation |
| RME | Reasonable Maximum Exposure |
| RQ | Refinement Quotient |
| $RQ_{UCL}$ | Refinement Quotient Based on the 95% Upper Confidence Limit |
| SLERA | Screening-Level Ecological Risk Assessment |
| SQ | Screening Quotient |
| $SQG_E$ | Soil Quality Guideline-Environment |
| SVOC | Semi-Volatile Organic Compound |
| TRV | Toxicity Reference Value |
| UCL | Upper Confidence Limit |
| µg | microgram |
| U.S. EPA | United States Environmental Protection Agency |
| VOC | Volatile Organic Compound |
| WSB | Wildlife Scenario Builder |

# Section 1.0 Introduction

Conestoga-Rovers & Associates (CRA), on behalf of Weyerhaeuser NR Company (Weyerhaeuser), conducted a Remedial Investigation (RI) at the former Plainwell Inc., Mill property in Plainwell, Michigan (Site). The RI Report was submitted to the United States Environmental Protection Agency (U.S. EPA) on June 20, 2011, with revisions submitted on April 20, 2012 (Revision 1), July 10, 2012 (Revision 1), October 19, 2012 (Revision 2), and February 4, 2013 (Revision 2), respectively, based on comments received from and discussions with representatives of the U.S. EPA and the Michigan Department of Environmental Quality (MDEQ). The RI Report was approved by the U.S. EPA on February 26, 2013.

A screening-level ecological risk assessment (SLERA) was included as a component of the RI. The SLERA consisted of Steps 1 and 2 of the 8-step process for conducting ecological risk assessment in accordance with guidance published by the United States Environmental Protection Agency (U.S. EPA, 1997). The SLERA identified 42 individual chemical constituents or constituent groups as constituents of potential ecological concern (COPECs). The methods and assumptions used in the SLERA were intentionally conservative in order to minimize the probability of incorrectly eliminating constituents that may actually pose risk to ecological receptors. Consequently, not all of the individual constituents or constituent groups are expected to pose an unacceptable potential for risk.

This document represents the next step in the 8-step process. In this step, which is Step 3, or the problem formulation for the baseline ecological risk assessment (BERA), the constituents identified in the SLERA as COPECs are refined by evaluating the assumptions for exposure and toxicological responses of ecological receptors to the COPECs. The primary objective of the refinement process is to eliminate from further consideration those constituents that have a limited potential for risk so the BERA can focus on those constituents and pathways that have the greatest potential to pose risk.

The majority of the Site evaluated for the SLERA will ultimately be redeveloped for residential, commercial, and mixed residential and commercial land use. Consequently, ecological receptors will not be exposed to those areas that will be developed. The dataset for the refinement process has been modified to include only samples from those areas that are unlikely to be disturbed by development activities. These samples are located within the riparian corridor of the Kalamazoo River, as shown on Figure 1.1.

The remainder of this report is organized as follows:

- Section 2.0 – summarizes the results of the SLERA
- Section 3.0 – provides a general description of the methodology for the refinement process
- Section 4.0 – presents the results of re-screening of the revised dataset
- Section 5.0 – provides additional details and results of the refinement process
- Section 6.0 - discusses uncertainties associated with the refinement process
- Section 7.0 – describes the methodology and presents results for development of ecological preliminary remediation goals (PRGs)
- Section 8.0 – identifies complete exposure pathways and ecosystems at risk
- Section 9.0 – identifies assessment endpoints for the BERA
- Section 10.0 – presents the conceptual site model and risk questions for the BERA
- Section 11.0 – presents summary and conclusions of the refinement process
- Section 12.0 – provides citations for references

# Section 2.0 Summary of the Screening-Level Ecological Risk Assessment

## 2.1 Constituents of Potential Ecological Concern

The SLERA, which was submitted as part of the RI report, identified a total of 42 individual or groups of chemical constituents as COPECs. A constituent was identified as a COPEC if:

- The maximum concentration exceeded an ecological screening value (ESV)
- The constituent was detected and an ESV was not identified
- The constituent was not detected and the limit of detection (LOD) in greater than 20 percent of the samples exceeded an ESV
- The constituent was detected and was identified as a bioaccumulative chemical of concern (BCOC)

Table 2.1 summarizes the constituents and groups of constituents identified in the SLERA as COPECs and the basis upon which each was identified as a COPEC.

In order to minimize the potential for incorrectly eliminating a constituent as a COPEC, the SLERA employed a number of conservation assumptions. In Step 3 of the process, those assumptions are evaluated and, as appropriate, replaced with more ecological realistic assumptions with the overall objective of refining the list of COPECs identified in Table 2.1 to those with the greatest potential for posing risk to ecological receptors.

## 2.2 Assessment Endpoints

Assessment endpoints are explicit expressions of environmental values or characteristics to be protected at a site, and reflect societal and ecological values (Suter, 1993). Societal values address the need to protect species that are endangered, threatened, or of special interest, important as game or commercial species, or that are recognized as having aesthetic value. The assessment endpoints for the SLERA were species richness and productivity of terrestrial plant and soil invertebrate communities, and the relative and absolute densities of avian and mammalian insectivores, herbivores, omnivores, and carnivores.

The refinement process presented in this document focuses on the assessment endpoints associated with avian and mammalian wildlife. The rationale for this focus is that the methods and exposure factors for evaluating potential for wildlife are better developed and have a stronger technical basis than those available for terrestrial plants and soil invertebrates. As an example, the vast majority of studies used to evaluate risk to terrestrial plants have been conducted using common agricultural crops. These "species" are typically annuals that have been artificially selected for yield over many generations and, as a result, lack the genetic diversity characteristic of naturally occurring species. Furthermore, observations of the assessment area during numerous sampling events and other field activities have not identified significant areas of stressed vegetation.

## 2.3 Measurement Endpoints

Data necessary to directly evaluate the assessment endpoints are difficult to generate and rarely available. Therefore, measurement endpoints are used to bridge this gap. Measurement endpoints are quantifiable responses to stressors related to assessment endpoints, and are intended to provide a basis for assessing risk potential for the assessment endpoint. They may be defined in terms of an unacceptable level of impact to ecological receptors, such as a certain relative percent decrease in survival, growth or reproduction of ecological populations (Suter, 1993).

For the refinement process, two types of measurement endpoints are considered. One type consists of ecological benchmarks, or concentrations, that have been developed specifically to assess the potential for risk to avian and/or mammalian wildlife. The second type of measurement endpoints are toxicity reference values (TRVs), which are expressed as milligrams of a chemical ingested per body weight of a receptor per day (mg/kg/day). A no observed adverse effect level (NOAEL) is a TRV below which adverse effects on growth, reproduction, and/or survival are not expected to be expressed. A lowest observed adverse effect level (LOAEL) is the lowest TRV at which adverse effects have been documented to occur.

# Section 3.0 Refinement Methodology

## 3.1 Dataset

The dataset evaluated in the SLERA consisted of all samples of surface soil collected within the assessment area. Surface soil is considered to be that collected from the depth interval of 0 to 2 feet below ground surface (bgs). The Site was partitioned into 11 redevelopment areas, with each area evaluated as a separate sub-area. For the refinement process, those areas that will ultimately be developed for residential, commercial, and mixed land use have been removed from the dataset. Development of these areas will result in an incomplete exposure pathway. Samples from those locations that are not likely to be disturbed by redevelopment activities and that provide habitat for ecological receptors have been retained. These samples are located along the riparian corridor of the Kalamazoo River. The riparian corridor of the Kalamazoo River was evaluated as a single assessment area.

Figure 1.1 identifies the locations of the samples retained for the refinement process. Appendix A presents the analytical data associated with those sample locations used for the refinement process.

## 3.2 Re-Screening for Constituents of Potential Ecological Concern

The dataset for the SLERA had a total of 250 samples. The dataset for the refinement process consists of 30 samples. As many of the constituents identified in the SLERA as COPECs were detected in only one or a few samples, the first step in the refinement process was to re-screen those constituents identified in the SLERA as COPECs and were detected in one or more samples in the revised dataset. The ESVs used in the SLERA were also used for the re-screening. The maximum concentration of a COPEC was divided by its ESV to produce a screening quotient (SQ). A constituent was retained as a COPEC if the maximum concentration exceeded its ESV (SQ > 1.0), or the constituent was detected and an ESV was not identified.

The refinement process did not consider those constituents that were not detected as they are not expected to be the primary drivers of risk to ecological receptors.

## 3.3 Avian and Mammalian Wildlife

Assessment of risk to avian and mammalian wildlife in the refinement process was conducted using a two-phase approach. In the first phase, the 95 percent upper confidence limit (UCL) concentrations for the COPECs were compared to ecological benchmarks specific to avian and/or mammalian wildlife, if available. The 95 percent UCL were selected as the exposure concentrations as they represent reasonable maximum exposure (RME) to receptors that

forage at numerous locations within the assessment area. The 95 percent UCLs were calculated using ProUCL, Version 5.0 (U.S. EPA, 2013a).

Sources of benchmarks for avian and mammalian wildlife were the source documents for the ecological soil screening levels (ECO-SSLs), Efroymson et al. (1997a), and fact sheets prepared by the Canadian Council of Ministers of the Environment (CCME). For mammalian wildlife, ecological screening levels (ESLs) identified by U.S. EPA, Region 5 (2003) were used if an ESL was based on masked shrew or meadow vole. Benchmarks for the refinement process were selected using the following hierarchy:

- ECO-SSLs were the first tier of the hierarchy for both avian and mammalian wildlife
- n wildlife and third tier benchmarks for mammalian wildlife
- For mammalian wildlife, ESLs based on the masked shrew or meadow vole, were the second tier of the hierarchy if an ECO-SSL was not available
- PRGs identified by Efroymson et al. (1997a) were the second tier benchmarks for avia
- Soil quality guidelines ($SQG_E$) for agricultural land use developed by CCME were the third tier benchmarks for avian wildlife and fourth tier benchmarks for mammalian wildlife

If the 95 percent UCL concentration of a constituent was greater than benchmarks specific to avian and/or mammalian wildlife, the constituent was carried forward to the second phase of the assessment. This second phase consisted of the use of food chain models to further evaluate the potential for risk. Section 5.2.1 provides details for the use of food chain models.

## Section 4.0 Re-Screening of the Dataset for the Refinement Process

Table 4.1 summarizes the results of the re-screening of the data for the refinement process. Information presented in Table 4.1 includes the ESV and source of the ESV, or lack thereof, for each constituent detected; the number of samples, number of samples with detected concentrations, and frequency of detection (FOD); maximum concentration and area and sample with the maximum concentration; SQ; identification of bioaccumulative chemicals of concern (BCOCs); retention of a constituent as a COPEC; and rationale for retaining or eliminating a constituent as a COPEC.

Two volatile organic compounds (VOCs), acetone and isopropylbenzene, were detected. The SQ for acetone (2.2) is greater than 1.0. An ESV was not identified for isopropylbenzene. Accordingly, both acetone and isopropylbenzene are retained as COPECs.

Four BTEX (benzene, toluene, ethylbenzene, and xylenes) constituents were detected. The SQs for benzene (5.1), toluene (4.0), and m&p-xylene (1.1) are greater than 1.0. These three constituents are retained as COPECs. The SQ for o-xylene (0.74) is less than 1.0. Consequently, o-xylene is eliminated as a COPEC.

Two semi-volatile organic compounds (SVOCs), bis(2-ethylhexyl)phthalate and carbazole, were detected. The SQ for bis(2-ethylhexyl)phthalate (0.38) is less than 1.0. An ESV was not identified for carbazole. Accordingly, bis(2-ethylhexyl)phthalate is eliminated as a COPEC and carbazole is retained.

The SLERA identified high molecular weight (HMW) polycyclic aromatic hydrocarbons (PAHs) as a COPEC. For the revised dataset, the SQ (24) for HMW PAHs [benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, and pyrene] is greater than 1.0. Based on this SQ, all HMW PAHs are retained as COPECs.

Three Aroclors of polychlorinated biphenyls (PCBs) were detected. The three Aroclors are Aroclor-1248, Aroclor-1254, and Aroclor-1260. Similar to PAHs, PCBs are evaluated as a group. For the revised dataset, the SQ for total PCBs (1,205) is greater than 1.0. Consequently, total PCBs, which are BCOCs, are retained as a COPEC.

Sixteen inorganic constituents identified as COPECs in the SLERA were detected. The SQs for cobalt (0.59) and nickel (0.77) are less than 1.0. Nickel is a BCOC. Although the ESV for nickel (38 mg/kg) is based on plants, it is lower than the ECO-SSLs for avian (210 mg/kg) and mammalian (130 mg/kg) wildlife (U.S. EPA, 2007d). Cobalt and nickel are eliminated as COPECs.

The SQs for antimony (11), arsenic (1.2), barium (1.5), cadmium (11), chromium (1.5), copper (11), iron (111), lead (90), manganese (3.2), mercury (56), selenium (3.5), vanadium (3.6), zinc (17), and cyanide (total) (1.3) are greater than 1.0. Iron is a naturally occurring metal with limited toxicity to ecological receptors (U.S. EPA, 2003a), and is eliminated as a COPEC. Antimony, arsenic, barium, cadmium, chromium, copper, lead, manganese, mercury, selenium, vanadium, zinc, and cyanide (total) are retained as COPECs. Cadmium, chromium, copper, lead, mercury, selenium, and zinc are BCOCs.

# Section 5.0 Refinement of Constituents of Potential Ecological Concern

## 5.1 Comparison to Wildlife Benchmarks

### 5.1.1 Avian Wildlife

Table 5.1 identifies the available benchmarks for avian wildlife. Information presented in Table 5.1 includes benchmark concentrations identified in ECO-SSL source documents (U.S. EPA 2005a-d,f, 2007b,f-g, 2008), Efroymson et al. (1997a), and CCME (1999a-f, 2001, 2009, 2010) as well as background concentrations specific to the Michigan Glacial Lobe identified by the MDEQ (MDEQ, 2005) and specific to Michigan identified by U.S. EPA (2007a). Table 5.1 also identifies the value selected as the refinement benchmark (RB).

Background concentrations were considered in the selection of RBs. Priority in the selection of RBs was given to the ECO-SSLs developed by U.S. EPA. If an ECO-SSL was not available, RBs were selected using the hierarchy discussed in Section 3.3, with the following exceptions. The ECO-SSL for cadmium is 0.77 mg/kg, which is below the background concentration of 0.90 mg/kg identified by U.S. EPA (2007a). Similarly, the ECO-SSL for vanadium of 7.8 mg/kg is below the background concentration of 44 mg/kg. An ecological benchmark specific to avian wildlife is not available for antimony. For these three metals, background concentrations were selected as the RBs.

Table 5.2 summarizes the first phase of refinement for avian wildlife. Information presented in Table 5.2 includes the RB, number of samples, number of samples with detected concentrations, the minimum and maximum detected concentrations, 95 percent UCLs, the refinement quotients ($RQ_{UCL}$ = 95 percent UCL concentration divided by the RB), and rationale for retaining or eliminating a constituent as a COPEC.

Refinement benchmarks are not available for acetone, isopropylbenzene, benzene, toluene, xylenes (total), and carbazole. These six organic compounds are retained as COPECs.

The $RQ_{UCL}$s for HMW PAHs (23), cadmium (1.1), copper (5.1), lead (16), mercury (2,990), and zinc (7.2) are greater than 1.0. These six constituents are retained as COPECs and carried forward for further evaluation using food chain models.

The $RQ_{UCL}$s for total PCBs (0.29), antimony (0.73), arsenic (0.25), barium (0.60), chromium (0.64), manganese (0.11), selenium (0.62), vanadium (0.41), and cyanide (total)(0.13) are less than 1.0. These nine constituents are eliminated as COPECs for avian wildlife.

### 5.1.2 Mammalian Wildlife

Table 5.3 identifies the available benchmarks for mammalian wildlife. Information presented in Table 5.3 is similar to that presented in Table 5.1 for avian wildlife. The sources of ecological benchmarks for mammalian wildlife are the same as those for avian wildlife, with the addition of the U.S. EPA, Region 5 ESLs that are based on masked shrew or meadow vole (U.S. EPA, 2003).

As was done for avian wildlife, background concentrations were considered in the selection of RBs for mammalian wildlife. Priority in the selection of RBs was given to the ECO-SSLs developed by U.S. EPA. If an ECO-SSL was not available, RBs were selected using the hierarchy discussed in Section 3.3, with the following exceptions. The ECO-SSL of 0.27 mg/kg and ESL of 0.142 mg/kg for antimony are below the mean background concentration of 1.3 mg/kg identified by U.S. EPA (2007a). The ECO-SSL of 0.36 mg/kg and ESL of 0.0022 mg/kg for cadmium are also below the mean background concentration of 0.90 mg/kg. The mean background concentrations were selected as the RBs for antimony and cadmium.

Table 5.4 summarizes the first phase of refinement for mammalian wildlife. Information presented in Table 5.4 is similar to that presented in Table 5.2 for avian wildlife.

Refinement benchmarks are not available for isopropylbenzene, xylenes (total), and carbazole. These three organic compounds are retained as COPECs.

The $RQ_{UCL}$s for acetone (2.2), HMW PAHs (13), cadmium (1.1), copper (2.9), lead (3.2), mercury (10), selenium (1.2), zinc (4.2), and cyanide (total) (1.1) are greater than 1.0. These nine constituents are retained as COPECs and carried forward for further evaluation using food chain models.

The $RQ_{UCL}$s for benzene (0.65), toluene (0.49), total PCBs (0.14), antimony (0.73), arsenic (0.24), barium (0.085), chromium (0.49), manganese (0.12), and vanadium (0.065) are less than 1.0. These nine constituents are eliminated as COPECs for mammalian wildlife.

## 5.2 Food Chain Models

### 5.2.1 Overview

Six species were selected as indicator species for avian and mammalian insectivores, herbivores, and carnivores. American woodcock and short-tailed shrew were selected as the indicator species for avian and mammalian insectivores, respectively. Mourning dove and meadow vole were selected as the indicator species for avian and mammalian herbivores,

respectively. Red-tailed hawk and long-tailed weasel were selected as the indicator species for avian and mammalian carnivores, respectively. The six indicator species were selected based on their use by U.S. EPA to develop the ECO-SSLs for avian and mammalian wildlife (U.S. EPA, 2007a).

For each indicator species, total ingestion of a COPEC was calculated using the general equation:

$$IR_{total} = (IR_{food} * Conc_{food}) + (IR_{water} * Conc_{water}) + (P_S * IR_{food} * Conc_{soil}) \quad \text{Equation 1}$$

Where:

**$IR_{total}$** = Total ingestion rate of a COPEC (mg of COPEC per kg body weight per day)
**$IR_{food}$** = Ingestion rate of food (kg of food [dry weight] per kg body weight per day)
**$IR_{water}$** = Ingestion rate of drinking water (liter per kg body weight per day)
**$P_S$** = Proportion of $IR_{food}$ that is soil (incidental soil ingestion)
**$Conc_{food}$** = Concentration of a COPEC in food (mg of COPEC per kg [dry weight] of food)
**$Conc_{water}$** = Concentration of a COPEC in drinking water (mg of COPEC per liter)
**$Conc_{soil}$** = Concentration of a COPEC in soil (mg of COPEC per kg [dry weight] of soil)

The calculated $IR_{total}$ for each COPEC was divided by a TRV (NOAEL and/or LOAEL) specific to the COPEC to produce a hazard quotient (HQ). A HQ greater than 1.0 identifies a potential for risk.

Table 5.5 and Table 5.6 identify $IR_{food}$, $IR_{water}$, and $P_S$ for the avian and mammalian indicator species, respectively. The values for $IR_{food}$ and $P_S$ are from U.S. EPA (2007a). The values for $IR_{water}$ are from U.S. EPA (1999a). Tables 5.5 and 5.6 also identify the diets of the indicator species. The food chain models assumed that all food consumed by all indicator species is obtained from the assessment area. Bioavailability of all COPECs evaluated was conservatively assumed to be 100 percent.

Concentrations of the COPECs in soil invertebrates, terrestrial plants, and small mammals consumed by the indicator species were calculated using general equations available in the risk assessment literature. Sources of the equations were U.S. EPA (1999b, 2007a) and Sample et al. (1998). Table 5.7 identifies the equations for each dietary item and COPEC, as well as the source. If available, equations used to develop the ECO-SSLs (U.S. EPA, 2007a) were used.

For organic compounds with a log water-octanol partitioning coefficient (log $K_{ow}$) less than 3.5 [acetone and xylenes (total)], soil-to-invertebrate and soil-to-plant bioaccumulation was assumed to be negligible (U.S. EPA, 2000). For organic compounds with a log $K_{ow}$ greater than 3.5 (isopropylbenzene and carbazole), equations identified in U.S. EPA (1999b) were used to

calculate concentrations in soil invertebrates and terrestrial plants. Equations for soil-to-small mammals are not available for several COPECs. For these COPECs, concentrations in small mammals were assumed to be the higher of the concentrations in soil invertebrates and plants. Concentrations in all dietary items were calculated on a dry weight (DW) basis.

Table 5.8 identifies the exposure concentrations for soil invertebrates, terrestrial plants, and small mammals as calculated using the equations identified in Table 5.7. The 95 percent UCL concentrations in soil, calculated using ProUCL, Version 5.0 (U.S. EPA, 2013a), were used to calculate exposure concentrations in dietary items. As there are no open water bodies within the assessment area (the Kalamazoo River is outside the assessment area), concentrations of COPECs in drinking water were assumed to be negligible.

Table 5.9 identifies the TRVs (NOAELs and LOAELs) for avian and mammalian wildlife. The values for acetone, HMW PAHs, cadmium, copper, lead, mercury, selenium, and zinc were submitted to U.S. EPA Region 5, and subsequently approved, in a Technical Memorandum dated October 19, 2012 (CRA, 2012). The NOAELs and/or LOAELs for benzene, toluene, xylenes (total), and cyanide (total) are from Sample et al. (1996). The TRVs for isopropylbenzene were developed based on studies identified in the U.S. EPA's Integrated Risk Information System (IRIS) database. The TRVs for carbazole were developed based on studies identified in the National Library of Medicine's TOXNET database. Table 5.9 also identifies the source of each TRV.

TRVs for avian receptors were not identified for isopropylbenzene, benzene, toluene, xylenes (total), and carbazole. As TRVs for these constituents are available for mammalian wildlife, evaluation of risk to wildlife will be based on the food chain models for mammalian wildlife.

### 5.2.2 Avian Wildlife

***American Woodcock***

Table 5.10 summarizes the results of the food chain model for American woodcock, the indicator species for avian insectivores. Information presented in Table 5.10 includes ingestion of a COPEC via food and soil, total ingestion, the NOAEL and HQ based on the NOAEL ($HQ_{NOAEL}$), LOAEL and HQ based on the LOAEL ($HQ_{LOAEL}$), and if the constituent is carried forward for development of a Site-specific ecological PRG. A constituent was carried forward for development of a PRG if the $HQ_{NOAEL}$ was greater than 1.0.

The $HQ_{NOAEL}$ for acetone (0.037) is below 1.0. Based on this result, it can be concluded that acetone does not pose a potential for risk to avian insectivores above the threshold for concern and; therefore, calculation of a Site-specific PRG is not required.

For HMW PAHs, cadmium, copper, mercury, and zinc, the $HQ_{NOAEL}$s are greater than 1.0, whereas the $HQ_{LOAEL}$s are less than 1.0. The $HQ_{NOAEL}$s are 5.9 for HMW PAHs, 2.5 for cadmium, 9.0 for copper, 3.4 for mercury, and 7.8 for zinc, respectively. The $HQ_{LOAEL}$s are 0.59 for HMW PAHs, 0.17 for cadmium, 0.40 for copper, 0.73 for mercury, and 0.78 for zinc, respectively. For lead, both the $HQ_{NOAEL}$ (1,269) and $HQ_{LOAEL}$ (2.0) are greater than 1.0. HMW PAHs, cadmium, copper, lead, mercury, and zinc are carried forward for development of Site-specific PRGs for avian wildlife.

***Mourning Dove***

Table 5.11 summarizes the results of the food chain model for mourning dove, the indicator species for avian herbivores. Information presented in Table 5.11 is similar to that presented in Table 5.10 for American woodcock.

The $HQ_{NOAEL}$s for acetone (0.028), HMW PAHs (0.56), and cadmium (0.20) are below 1.0. Based on these results, it can be concluded that acetone, HMW PAHs, and cadmium do not pose a potential for risk to avian herbivores above the threshold for concern and; therefore, calculation of Site-specific PRGs is not required.

For copper, lead, mercury, and zinc, the $HQ_{NOAEL}$ is greater than 1.0, whereas the $HQ_{LOAEL}$ is less than 1.0. The $HQ_{NOAEL}$s are 2.8 for copper, 408 for lead, 1.3 for mercury, and 1.8 for zinc, respectively. The $HQ_{LOAEL}$s are 0.12 for copper, 0.65 for lead, 0.29 for mercury, and 0.18 for zinc, respectively. Copper, lead, mercury, and zinc are carried forward for development of Site-specific PRGs for avian wildlife.

***Red-Tailed Hawk***

Table 5.12 summarizes the results of the food chain model for red-tailed hawk, the indicator species for avian carnivores. Information presented in Table 5.12 is similar to that presented in Table 5.10 for American woodcock and Table 5.11 for mourning dove.

The $HQ_{NOAEL}$s for acetone (0.002), HMW PAHs (0.020), cadmium (0.017), copper (0.37), mercury (0.15), and zinc (0.28) are below 1.0. Based on these results, it can be concluded that acetone, HMW PAHs, cadmium, copper, mercury, and zinc do not pose a potential for risk to avian carnivores above the threshold for concern and; therefore, calculation of Site-specific PRGs is not required.

For lead, the $HQ_{NOAEL}$ (53) is greater than 1.0, whereas the $HQ_{LOAEL}$ (0.085) is less than 1.0. Lead is carried forward for development of a Site-specific PRG for avian wildlife.

### 5.2.3 Mammalian Wildlife

***Short-Tailed Shrew***

Table 5.13 summarizes the results of the food chain model for short-tailed shrew, the indicator species for mammalian insectivores. Information presented in Table 5.13 includes ingestion of a COPEC via food and soil, total ingestion, the NOAEL and $HQ_{NOAEL}$, LOAEL and $HQ_{LOAEL}$, and if the constituent is carried forward for development of a Site-specific ecological PRG. A constituent was carried forward for development of a PRG if the $HQ_{NOAEL}$ was greater than 1.0.

The $HQ_{NOAEL}$s for acetone (0.003), isopropylbenzene (0.086), xylenes (total) (0.007), and cyanide (total) (0.030) are below 1.0. Based on these results, it can be concluded that acetone, isopropylbenzene, xylenes (total), and cyanide (total) do not pose a potential for risk to mammalian insectivores above the threshold for concern and; therefore, calculation of Site-specific PRGs.

For carbazole, HMW PAHs, cadmium, copper, lead, mercury, selenium, and zinc, the $HQ_{NOAEL}$s are greater than 1.0, whereas the $HQ_{LOAEL}$s are less than 1.0. The $HQ_{NOAEL}$s are 1.6 for carbazole, 18 for HMW PAHs, 28 for cadmium, 6.1 for copper, 12 for lead, 3.2 for mercury, 3.2 for selenium, and 13 for zinc, respectively. The $HQ_{LOAEL}$s are 0.14 for carbazole, 0.38 for HMW PAHs, 0.026 for cadmium, 0.026 for copper, 0.051 for lead, 0.022 for mercury, 0.13 for selenium, and 0.30 for zinc, respectively. Carbazole, HMW PAHs, cadmium, copper, lead, mercury, selenium, and zinc are carried forward for development of Site-specific PRGs for avian wildlife.

***Meadow Vole***

Table 5.14 summarizes the results of the food chain model for meadow vole, the indicator species for mammalian herbivores. Information presented in Table 5.14 is similar to that presented in Table 5.13 for short-tailed shrew.

The $HQ_{NOAEL}$s for acetone (0.002), isopropylbenzene (0.00003), xylenes (total) (0.003), carbazole (0.0004), HMW PAHs (0.53), cadmium (0.93), copper (0.60), lead (0.94), mercury (0.34), selenium (0.68), and cyanide (total) (0.002) are below 1.0. Based on these results, it can be concluded that acetone, isopropylbenzene, xylenes (total), carbazole, HMW PAHs, cadmium, copper, lead, mercury, selenium, and cyanide (total) do not pose a potential for risk to mammalian herbivores above the threshold for concern and; therefore, calculation of Site-specific PRGs is not required.

For zinc, the $HQ_{NOAEL}$ (1.2) is greater than 1.0, whereas the $HQ_{LOAEL}$ (0.028) is less than 1.0. Zinc is carried forward for development of a Site-specific PRG for mammalian wildlife.

***Long-Tailed Weasel***

Table 5.15 summarizes the results of the food chain model for long-tailed weasel, the indicator species for mammalian carnivores. Information presented in Table 5.15 is similar to that presented in Table 5.13 for short-tailed shrew and Table 5.14 for meadow vole.

The $HQ_{NOAEL}$s for acetone (0.003), isopropylbenzene (0.054), xylenes (total) (0.006), carbazole (0.99), HMW PAHs (0.18), cadmium (0.69), mercury (0.72), and cyanide (total) (0.019) are below 1.0. Based on these results, it can be concluded that acetone, isopropylbenzene, xylenes (total), carbazole, HMW PAHs, cadmium, mercury, and cyanide (total) do not pose a potential for risk to mammalian carnivores above the threshold for concern and; therefore, calculation of Site-specific PRGs is not required.

For copper, lead, selenium, and zinc, the $HQ_{NOAEL}$s are greater than 1.0, whereas the $HQ_{LOAEL}$s are less than 1.0. The $HQ_{NOAEL}$s are 1.1 for copper, 2.4 for lead, 1.6 for mercury, and 1.8 for zinc, respectively. The $HQ_{LOAEL}$s are 0.005 for copper, 0.010 for lead, 0.067 for mercury, and 0.042 for zinc, respectively. Copper, lead, selenium, and zinc are carried forward for development of Site-specific PRGs for mammalian wildlife.

## 5.3 Summary of Food Chain Models

The food chain models identified a potential for risk due to exposure to the following COPECs in soil:

- carbazole (mammalian insectivores)
- HMW PAHs (avian and mammalian insectivores)
- cadmium (avian and mammalian insectivores)
- copper (avian insectivores and herbivores; mammalian insectivores and carnivores)
- lead (avian insectivores, herbivores, and carnivores; mammalian insectivores and carnivores)
- mercury (avian insectivores and herbivores; mammalian insectivores)
- selenium (mammalian insectivores and carnivores)
- zinc (avian insectivores and herbivores; mammalian insectivores, herbivores, and carnivores)

Risk to the receptor groups exposed to the COPECs identified above is conservatively based on $HQ_{NOAEL}$s greater than 1. The only $HQ_{LOAEL}$ greater than 1.0 is for avian insectivores exposed to

lead ($HQ_{LOAEL}$ = 2.0). To facilitate risk management decisions, Site-specific ecological PRGs were calculated for carbazole, HMW PAHs, cadmium, copper, lead, mercury, selenium, and zinc. The methodology and values for the ecological PRGs are presented in Section 7.0.

## Section 6.0 Analysis of Uncertainties

Evaluation of risk to ecological receptors is typically associated with several areas of uncertainty. In the absence of data, assumptions must be made regarding exposure concentrations and responses of ecological receptors to COPECs. To avoid incorrectly dismissing the potential for risk, exposure concentrations and other assumptions are intentionally biased toward identifying risk. As a result of this bias, it can be concluded with a high level of certainty that chemical constituents with RQs and HQs below 1.0 do not pose an unacceptable potential for risk to ecological receptors. However, a RQ or HQ greater than 1.0 does not necessarily demonstrate that the risk actually exists; only that additional evaluation should be undertaken.

One major area of uncertainty is the actual concentration of COPECs in prey items consumed by avian and mammalian wildlife. Concentrations of COPECs were estimated for soil invertebrates, plants, and small mammals using equations identified in various guidance documents (U.S. EPA, 1999b, 2007a; Sample et al., 1998). Equations for soil-to-mammal uptake were not available for several COPECs. For these COPECs, concentrations in small mammals were assumed to be the higher of the concentrations in invertebrates and plants. For organic compounds with a log $K_{ow}$ less than 3.5, bioaccumulation was assumed to be negligible. The uncertainty of actual concentrations in the tissue of prey items could be significantly reduced by collecting and conducting chemical analysis of potential prey items.

Bioavailability of all COPECs was conservatively assumed to be 100 percent. The actual bioavailability of the chemicals evaluated is unknown, but is likely less than 100 percent. Accounting for bioavailability of the COPECs in food items and soil would reduce the HQs.

Indicator species were selected to represent the various trophic guilds evaluated in this risk assessment. The actual presence of these indicator species or other species within the trophic guilds evaluated is uncertain. The actual area use of the indicator species is also unknown, and was conservatively assumed to be 100 percent.

The TRVs for the food chain models is another significant source of uncertainty. Values for both NOAELs and LOAELs can vary by up to four orders of magnitude. This is not unexpected as studies utilize different species, different chemical forms of a contaminant, different age

groups, different durations of exposure, and different exposure routes (e.g., gavage and drinking water), to name a few. Despite the availability of TRVs from numerous published studies, the NOAELs and LOAELs approved for use by Region 5 (which are primarily Region 9 NOAELs and LOAELs) and those identified by Sample et al. (1996) are values selected from single studies. In general, the NOAELs and LOAELs used for the food chain models (Table 5.9) are among the lowest values. Consequently, uncertainty associated with the NOAELs and LOAELs are biased toward conservatism. The discussion of the NOAEL and LOAEL for lead for avian wildlife presented below demonstrates both the uncertainty and conservatism associated with TRVs.

The NOAEL and LOAEL for lead for avian receptors are those identified by U.S. EPA, Region 9 (U.S. EPA 2009). The NOAEL of 0.014 mg/kg/day is identified as a study published in Toxicology and Applied Pharmacology by Edens et al. (1967). This value is uncertain for several reasons. This source could not be verified in the citation (Volume 38; pages 307-314) identified by U.S. EPA (2009). Volume 38 does not appear to have been published in 1967. The value of 0.014 mg/kg/day is an order of magnitude lower than the lowest NOAEL of 0.194 mg/kg/day used to develop the ECO-SSL for avian wildlife (U.S. EPA, 2005f). In addition, Edens et al. (1967) is not identified in the ECO-SSL source document as either a study that met the criteria for development of ECO-SSLs or was rejected as not meeting the criteria (see Appendix 5.1 in U.S. EPA, 2005f). As another line of evidence, use of 0.014 mg/kg/day as a TRV produces a soil concentration of 0.039 mg/kg for protection of American woodcock. The background concentration of lead for the Michigan Glacial Lobe reported by MDEQ (2005) is 7.4 mg/kg, which is two orders of magnitude greater than a NOAEL-based protective concentration of 0.039 mg/kg.

The LOAEL of 8.75 mg/kg/day identified by Region 9 (U.S. EPA, 2009) is based on a study by Edens and Garlich (1983) that reports the effects of lead on reproduction of chickens. As is the case for the NOAEL, the LOAEL for this study is also questionable based on several lines of evidence. The ECO-SSL source document for lead (U.S. EPA, 2005f) does present the results of a study by Edens and Garlich (1983) for chicken, as well as Japanese quail. The LOAELs summarized in Appendix 5.1 of ECO-SSL source document (U.S. EPA, 2005f) are 10 mg/kg diet and 50 mg/kg diet for Japanese quail and chicken, respectively. The converted dose values are 1.94 mg/kg/day and 3.26 mg/kg/day for Japanese quail and chicken, respectively. The LOAEL of 8.75 mg/kg/day identified by U.S. EPA (2009) does not match the converted doses for either Japanese quail or chicken identified in U.S. EPA (2005f).

Assuming the LOAEL of 8.75 mg/kg/day identified by Region 9 is based on Edens and Garlich (1983), the form of lead used in the study is one that is not present under field conditions. The form tested is lead acetate. As identified in Table 3 of Attachment 4.3 of the guidelines for

developing ECO-SSLs (U.S. EPA, 2007a), "*No*" is entered for lead acetate under the column heading "*could be found in the soil environment.*" Lead acetate has a relatively high solubility (1,600 µg/L), as calculated using U.S. EPA's EPI-Suite program (U.S. EPA, 2012). Furthermore, Jones (2013) documented that LOAELs based on lead acetate are statistically lower than forms of lead that are expected to occur in the soil environment.

One additional line of evidence of the uncertainty associated with a LOAEL of 8.75 mg/kg/day is that this value is lower than both the geometric mean (10.9 mg/kg/day) and median (12.3 mg/kg/day) for NOAELs for reproduction and growth identified in the ECO-SSL for lead (U.S. EPA, 2005f). The LOAEL of 8.75 mg/kg/day is in the lower 35th percentile of NOAELs for reproduction and growth.

# Section 7.0 Ecological Preliminary Remediation Goals

## 7.1 Overview

The food chain models identified carbazole, HMW PAHs, cadmium, copper, lead, mercury, selenium, and zinc as potentially posing risk to avian and/or mammalian wildlife. To facilitate risk management decisions, ecological PRGs were developed for these eight COPECs. Ecological PRGs are 95 percent UCL concentrations of the eight COPECs in soil that are protective of avian and mammalian wildlife.

The exposure factors and assumptions for food chain models presented in Section 5.0 were intentionally conservative in order to minimize the probability of incorrectly dismissing the potential for risk. In contrast, the objective of ecological PRGs is to balance the protection of wildlife while avoiding unnecessary remedial measures.

## 7.2 Methodology

Many of the exposure parameters for the food chain models presented in Section 5.0 are conservative and intentionally overestimate the potential for risk. For example, the food ingestion rates of the indicator species ($IR_{food}$) are high end point estimates used to develop the ECO-SSLs (U.S. EPA, 2007a). Similarly, the $P_S$ values for incidental soil ingestion are 90th percentile values (U.S. EPA, 2007a). These high-end estimates are intended for use in screening for COPECs and should not be used for the development of PRGs upon which risk management decisions are made.

For development of the ecological PRGs, exposure parameters and ingestion rates were taken from the U.S. EPA's Wildlife Scenario Builder (WSB) program (U.S. EPA, 2013b). In this program,

ingestion is based on the metabolic requirements of free ranging organisms [free metabolic rate expressed as kilocalories (kcal) per day] and assimilation efficiencies for the various dietary components. Whereas the food chain models in Section 5.0 assumed a single food item for an indicator species (e.g. American woodcock eats only soil invertebrates), the WSB identifies a number of dietary items for an indicator species, each with distinct values for gross energy (kilocalorie per gram) and assimilation efficiencies. Body weights to normalize ingestion are based on values in the program that have been vetted by U.S. EPA (U.S. EPA, 2013b). The result is a more ecologically realistic modeling of ingestion and exposure.

American woodcock and short-tailed shrew, both insectivores, were modeled using the WSB. As concentrations in soil invertebrates are higher than in terrestrial plants and small mammals (see Table 5.8), the potential for risk to insectivores is greater than for herbivores or carnivores. As demonstrated by the results of the food chain models, the HQs are higher for insectivores than herbivores or carnivores for all eight COPECs. Table 7.1 identifies the exposure parameters identified in the WSB program for American woodcock and short-tailed shrew. As a conservative measure, the 90$^{th}$ percentiles for incidental soil ingestion were retained.

Similar to the food chain models in Section 5.0, the WSB approach calculates ingestion COPECs as mg/kg-day. The calculated ingestion is then divided by a TRV to produce a HQ. For development of the ecological PRGs, the TRVs are the LOAELs used for the food chain models in Section 5.0.

As discussed in Section 6.0, there is a very high degree of conservatism and uncertainty associated with the LOAEL for lead for avian wildlife (8.75 mg/kg-day). Due to the conservatism associated with the LOAEL of 8.75 mg/kg-day, the PRG based on this LOAEL represents a lower end PRG for lead. To provide a range PRGs for lead, which is the primary risk driver for ecological receptors, an upper end PRG was also developed for avian wildlife based on a LOAEL of 42.7 mg/kg-day. The latter LOAEL is the geometric mean of the 15 bounded LOAELs (i.e., a paired NOAEL is reported) identified in the source document for the ECO-SSL for lead (U.S. EPA, 2005f). This LOAEL is conservative as it is within the range of NOAELs (approximate 80$^{th}$ percentile of NOAELs) and within the lower 30$^{th}$ percentile of bounded LOAELs (U.S. EPA, 2005f).

PRGs were developed for American woodcock and short-tailed shrew by back-calculating a soil concentration that produced a HQ of 1.0. The ecological PRG was the lower of the avian and mammalian PRGs. The ecological PRGs were compared to the 95 percent UCL concentrations of the COPECs. A 95 percent UCL greater than an ecological PRG identifies a need for risk management. Because wildlife forage at numerous feeding locations rather than a single

location, concentrations of a COPEC may exceed its PRG at some sample locations and still be protective of wildlife.

## 7.3 Comparison of Ecological Preliminary Remediation Goals to Exposure Concentrations

Table 7.2 identifies the PRGs for avian and mammalian wildlife and the ecological PRGs. As discussed in the previous section, the ecological PRG is the lower of the PRGs for avian and mammalian wildlife.

Table 7.3 summarizes the comparison of the 95 percent UCL concentrations of the COPECs to their ecological PRGs. Table 7.3 also identifies the 95 percent UCL concentrations expressed as a percent of the PRGs. The 95 percent exposure concentrations for carbazole, HMW PAHs, cadmium, copper, mercury, selenium, and zinc are below their ecological PRGs. For these seven COPECs, the 95 percent UCL is less than 50 percent of the PRG. This result indicates that concentrations of carbazole, HMW PAHs, cadmium, copper, mercury, selenium, and zinc in soil of the corridor of the Kalamazoo River are protective of avian and mammalian wildlife for these COPECs.

For lead, the lower end and upper range PRGs are 140 mg/kg and 812 mg/kg, respectively. The 95 percent UCL of 181 mg/kg exceeds the lower end PRG of 140 mg/kg and is below the upper end PRG of 812 mg/kg. The 95 percent UCL is 22 percent of the upper end PRG.

## 7.4 Risk Management Considerations

The PRGs identify lead as the only COPEC requiring a risk management decision, because the 95 percent UCL is within the range of the lower end and upper end PRGs. The maximum detected concentration of lead in the dataset for the refinement process is 990 mg/kg. Removal of this sample from the dataset reduces the 95 percent UCL from 181 mg/kg to 126 mg/kg, an exposure concentration below the lower end PRG of 140 mg/kg. This result triggers a decision whether or not measures for risk management should be undertaken.

One consideration for risk management is the degree of uncertainty and level of conservatism associated with the LOAELs upon which the lower end and upper end PRGs are based. As discussed in Section 6.0, there is a high degree of uncertainty and conservatism associated with the LOAEL of 8.75 mg/kg-day, including verification of the value. Moreover, the LOAEL of 8.75 mg/kg-day is subjective, as it is based on a single (unverified) study. The alternative LOAEL of 42.7 mg/kg-day is a conservative value based on multiple studies vetted by U.S. EPA in development of ECO-SSLs for lead (U.S. EPA, 2005f).

A risk management decision is beyond the scope of this document. That decision is the responsibility of the risk manager. The risk management decision will be based on the data and analyses presented in this document, as well as consideration of the net environmental benefits of potential remedial actions. Regardless of the risk management decision, the ecological risk assessment process will not continue to the remaining steps of the BERA.

# Section 8.0 Complete Exposure Pathways and Ecosystems at Risk

## 8.1 Complete Exposure Pathways

The SLERA presented a Conceptual Site Model (CSM) that identified all potentially complete exposure pathways for ecological receptors. Although all the exposure pathways identified in the SLERA are potentially complete, the refinement step focused on exposure to avian and mammalian wildlife exposed to COPECs via ingestion of food and soil. The results of the refinement process and comparison of 95 percent UCL concentrations to ecological PRGs document that, although avian and mammalian wildlife are exposed to carbazole, HMW PAHs, cadmium, copper, mercury, selenium, and zinc in soil within the assessment area, the potential for risk for all receptors is below the threshold for concern. For lead, risk management will ensure that the potential for risk to ecological receptors is also below the threshold for concern.

## 8.2 Ecosystems at Risk

The assessment area for the refinement process is located within the riparian corridor of the Kalamazoo River. Based on the ecological PRGs for carbazole, HMW PAHs, cadmium, copper, mercury, selenium, and zinc, there are no known ecosystems at risk within the assessment area. For lead, risk management will ensure that the ecosystem of the Kalamazoo River corridor is not at risk

# Section 9.0 Selection of Assessment Endpoints

At this point in ecological risk assessment process, assessment endpoints for the BERA are selected. The assessment endpoints focus on those exposure pathways that are identified as complete and those constituents with concentrations that potentially pose risk to ecological receptors. As discussed in Section 7.0, the ecological risk assessment process is not advancing past the refinement process and development of ecological PRGs. Consequently, selection of assessment endpoints for the BERA is not required.

# Section 10.0 Conceptual Site Model and Risk Questions

## 10.1 Conceptual Site Model

If the risk assessment process were to advance to the next steps of the BERA, the CSM would be revised to identify those exposure pathways and ecological receptors exposed to the constituents retained as COPECs. Because the risk assessment process is not advancing, revision of the CSM is not required.

## 10.2 Risk Questions

The ecological risk assessment process is not advancing past the refinement process and development of ecological PRGs. Therefore, development of risk hypotheses and questions is not required.

# Section 11.0 Summary and Conclusions

Chemical constituents identified in the SLERA as COPECs were refined in accordance with U.S. EPA guidance for conducting ecological risk assessment (U.S. EPA, 1997). The refinement process is Step 3 of the 8-step process. Prior to refinement, the dataset used for the SLERA was modified by eliminating those samples collected from areas that are anticipated to be redeveloped, thus eliminating complete exposure pathways for ecological receptors. The revised dataset was then re-screened using the same methodology and ESVs as were used in the SLERA. The re-screening retained 2 VOCs (i.e., acetone and isopropylbenzene), 3 BTEX constituents (i.e., benzene, toluene, and m&p-xylene), 1 SVOC (i.e., carbazole), HMW PAHs, and 14 inorganic constituents [i.e., antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, selenium, vanadium, zinc, and cyanide (total)] as COPECs.

The refinement process focused on avian and mammalian wildlife. The constituents retained as COPECs were refined using a two phase process. In the first phase, 95 percent UCL concentrations, as calculated using ProUCL, Version 5.0 (U.S. EPA, 2013a), were compared to ecological benchmarks specific to avian and/or mammalian wildlife (RBs). Those constituents with 95 percent UCL concentrations greater than their RBs were carried forward to the second phase of the analysis. Those constituents that do not have a RB specific to avian and/or mammalian wildlife were also carried forward.

For the second phase of the refinement process, food chain models were used to evaluate the potential for risk to avian and mammalian wildlife. For lead, the food chain models identified a potential for risk to avian insectivores based on both the NOAEL and LOAEL. For mammalian

insectivores and carnivores, a potential for risk was identified for the NOAEL, but not the LOAEL. A potential for risk for one or more receptor groups was identified for carbazole, HMW PAHs, cadmium, copper, lead, mercury, selenium, and zinc to one or more receptor groups based on NOAELs, but not for LOAELs.

Ecological PRGs were developed for carbazole, HMW PAHs, cadmium, copper, lead, mercury, selenium, and zinc using food chain models and exposure parameters identified in the U.S. EPA's WSB (U.S. EPA, 2013b). The rationale is that the food chain models used for the refinement process include a number exposure parameters and assumptions that are overly conservative for development of PRGs, which trigger risk management if exceeded. The WSB methodology calculates ingestion of COPECs based on metabolic requirements of free ranging organisms and assimilation efficiencies for each dietary component. Whereas the food chain models for the refinement process assumed a single food item for an indicator species, the WSB identifies a number of dietary items for an indicator species.

LOAELs were used as the TRVs for development of the ecological PRGs. The LOAELs used in the refinement process were also used for the PRGs. As discussed in Section 6.0, there is a high degree of uncertainty and conservatism associated with the LOAEL for lead for avian wildlife. Due to the high level of conservatism, the PRG based on this LOEAL represents a lower end PRG. To provide an upper end value, a PRG was also developed for avian wildlife using a LOAEL based on the geometric mean of bounded LOAELs identified in the source document for the ECO-SSLs for lead (U.S. EPA, 2005f).

The 95 percent UCL of each COPEC was compared to its ecological PRG. For carbazole, HMW PAHs, cadmium, copper, mercury, selenium, and zinc, the 95 percent UCL concentration was below the ecological PRG. The 95 percent UCL concentrations were also less than 50 percent of the PRG for these seven COPECs. Consequently, it can be concluded that concentrations of carbazole, HMW PAHs, cadmium, copper, mercury, selenium, and zinc in soil within the corridor of the Kalamazoo River are protective of avian and mammalian wildlife and that risk management is not required to achieve RAOs.

For lead, the lower end PRG is greater than the 95 percent UCL whereas the upper end PRG is below the 95 percent UCL. Removal of the sample location with the highest concentration from the dataset reduces the 95 percent UCL concentration to a value below both the lower end and upper end PRGs. A risk management decision for lead will be made based on the data and analyses presented in this document as well as consideration of net environmental benefits of potential remedial actions.

The data and analyses presented in this document are sufficient for decisions to be made regarding the protection of ecological receptors within the corridor of the Kalamazoo River. Consequently, the ecological risk assessment process is not advancing to the next steps of the BERA.

## Section 12.0 References

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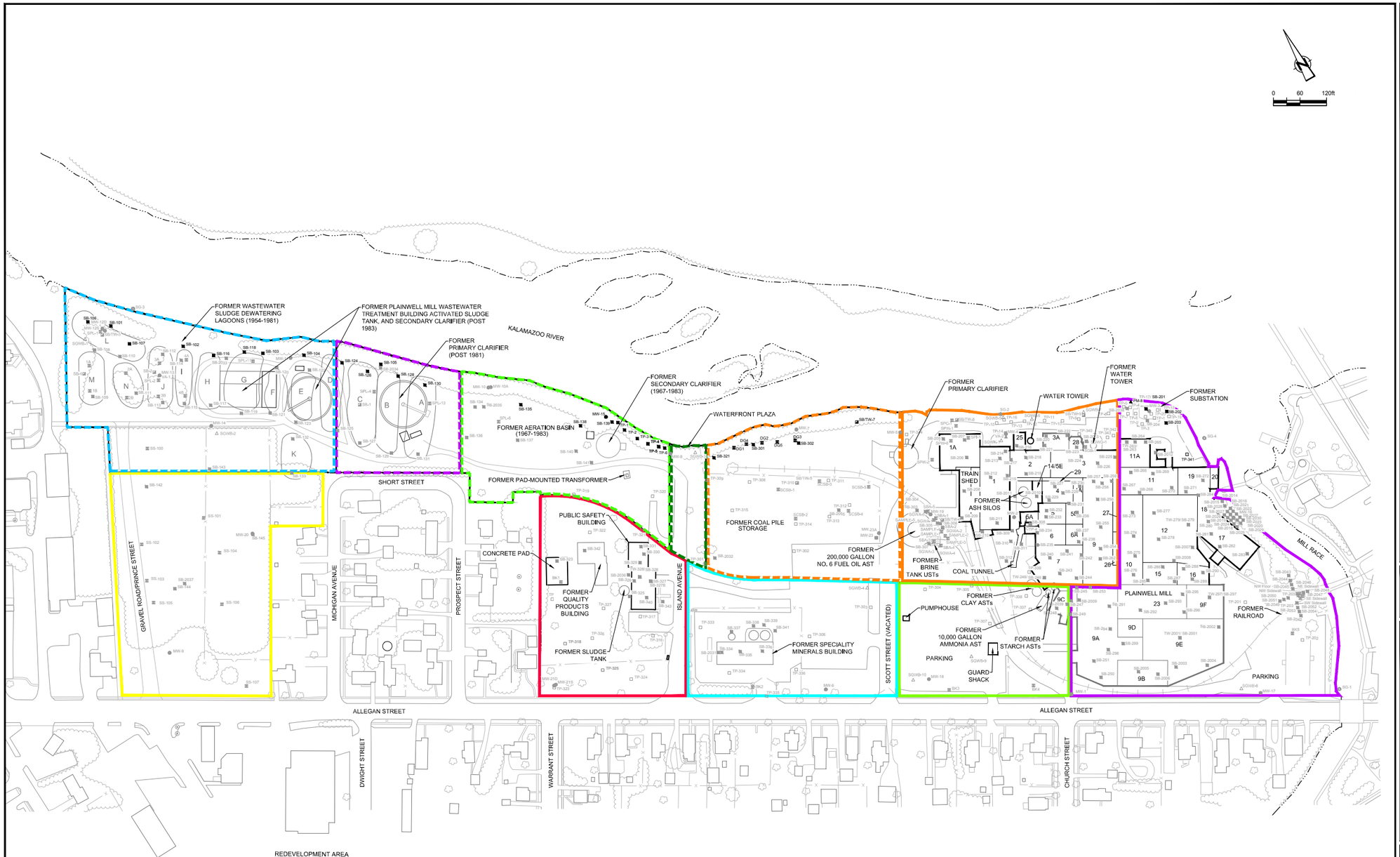
# Figures




REDEVELOPMENT AREA

- COMMERCIAL AREA 1
- COMMERCIAL AREA 2
- COMMERCIAL AREA 3
- MIXED RESIDENTIAL/COMMERCIAL AREA 1
- MIXED RESIDENTIAL/COMMERCIAL AREA 2
- COMMERCIAL AREA 4
- RESIDENTIAL AREA 1
- RESIDENTIAL AREA 2
- RESIDENTIAL AREA 3
- RESIDENTIAL AREA 4
- WATERFRONT PLAZA

| Nº | Revision | Date | Initial |
|---|---|---|---|
| 1 | UPDATE NOTES | 7/14/14 | J. D. |

LEGEND

- PROPERTY BOUNDARY (UP TO TOP OF BANK ALONG KALAMAZOO RIVER AND MILL RACE)
- FORMER FEATURE
- TREE LINE
- FENCE LINE
- RAILROAD
- SURFACE WATER
- SB-282 SOIL BORING LOCATION - PHASE II RI
- SB-2020 SOIL BORING LOCATION - ADDITIONAL RI (MARCH & AUG. 2012)
- TP-339 TEST PIT LOCATION - PHASE II RI
- TW-246 TEMPORARY WELL LOCATION - PHASE II RI
- MW-6 MONITORING WELL LOCATION - PHASE I, II, AND ADDITIONAL RI
- VA-1 VERTICAL AQUIFER SAMPLE LOCATION - PHASE II RI
- CTP-4 SOIL SAMPLE LOCATION - PHASE I RI
- TP-1 TEST PIT LOCATION - PHASE I RI
- SG-2 STAFF GAUGE - PHASE I RI
- PREVIOUS SOIL SAMPLE LOCATION (TAPLIN ENVIRONMENTAL SERVICES, 1999)
- PREVIOUS SOIL SAMPLE LOCATION (BBL, 1994)
- PREVIOUS SOIL SAMPLE LOCATION (ERM, 1997)
- PREVIOUS SOIL BORING LOCATION (FTC&H, 2006)
- PREVIOUS TEMPORARY WELL LOCATION (FTC&H, 2006)
- PREVIOUS GROUNDWATER SAMPLE LOCATION (ERM, 1997)
- PREVIOUS TEST PIT EXCAVATION LOCATION (RMT, 2008)
- SOIL BORING LOCATION - FANNIE PELL BRIDGE FOOTING
- PREVIOUS SOIL SAMPLE LOCATION (CDM, 2001)
- ABANDONED MONITORING WELL LOCATION
- DESTROYED MONITORING WELL LOCATION

NOTE:

THE FORMER SPECIALTY MINERALS BUILDING AND FORMER SLUDGE TANK (ADJACENT TO THE FORMER SLUDGE DEWATERING BUILDING) WAS DEMOLISHED IN DECEMBER 2011. THE FORMER QUALITY PRODUCTS BUILDING WAS DEMOLISHED IN OCTOBER 2011. THE RAILROAD WAS REMOVED BY THE CITY OF PLAINWELL IN THE FALL OF 2011.

THE FOLLOWING STRUCTURES WERE DEMOLISHED ON BEHALF OF THE CITY OF PLAINWELL BETWEEN MARCH & AUGUST 2012: BUILDING 3A, 9A, 9B, 9C, 9D, 9E, 9F, 23 AND 28, ONE 50,000-GALLON WATER TOWER, THE 200,000-GALLON FUEL OIL AST, THE BRINE TANKS, THE FORMER CLAY STARCH TANKS AND FORMER AMMONIA AST SECONDARY CONTAINMENT STRUCTURE.

THE FORMER WASTE WATER TREATMENT BUILDING, ASSOCIATED STRUCTURES AND BUILDING 25 WERE DEMOLISHED IN 2013.

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

Approved

DRAWING STATUS

| Status | Date | Initial |
|---|---|---|

# FORMER PLAINWELL, INC. MILL PROPERTY PLAINWELL, MICHIGAN

## ECOLOGICAL RISK ASSESSMENT - STEP 3

## LOCATIONS OF SURFACE SOIL SAMPLES

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

| Project Manager: | Reviewed By: | Date: | |
|---|---|---|---|
| J.Q. | S.J. | DECEMBER 2013 | |
| Scale: 1:120 | Project Nº: 056394-07 | Report Nº: 010 | Drawing Nº: figure 1.1 |

056394-07(010)GN-DE001 AUG 5/2014

# Tables

**TABLE 2.1**

**CONSTITUENTS OF POTENTIAL ECOLOGICAL CONCERN IDENTIFIED IN THE SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| COPECs | *Residential Area 1* | *Residential Area 2* | *Residential Area 3* | *Residential Area 4* | *Waterfront Plaza* | *Mixed Residential/ Commercial Area 1* | *Mixed Residential/ Commercial Area 2* | *Commercial Area 1* | *Commercial Area 2* | *Commercial Area 3* | *Commercial Area 4* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Volatile Organic Compounds (VOCs)*** | | | | | | | | | | | |
| 1,2-Dibromo-3-chloropropane (DBCP) | LOD > ESV | LOD > ESV | LOD > ESV | LOD > ESV | | LOD > ESV | LOD > ESV | LOD > ESV | LOD > ESV | LOD > ESV | LOD > ESV |
| 1,2,4-Trimethylbenzene | | | | | | | No ESV | | | | |
| 1,3,5-Trimethylbenzene | | | | | | | No ESV | | | | |
| 2-Phenylbutane (sec-Butylbenzene) | | | | | | | No ESV | | | | |
| Acetone | | | | SQ = 3.4 | | | SQ = 2.2 | | | | |
| Cymene | | | | | | | No ESV | | | | |
| Isopropyl benzene | No ESV | | | No ESV | | | No ESV | | | No ESV | No ESV |
| N-Propylbenzene | | | | | | | No ESV | | | | |
| N-Butylbenzene | | | | | | | No ESV | | | | |
| Tetrahydrofuran | | | | | | | No ESV | | | | |
| ***BTEX*** | | | | | | | | | | | |
| Benzene | | | | SQ = 13 | | | SQ = 2.8 | | | | SQ = 1.4 |
| Toluene | | | | SQ = 4.6 | | | SQ = 2.4 | | | | |
| o-Xylene | | | | SQ = 1.2 | | | SQ =1.1 | | | | |
| m&p-Xylenes | | | | SQ = 1.7 | | | SQ = 1.6 | | | | |
| ***Semi-Volatile Organic Compounds (SVOCs)*** | | | | | | | | | | | |
| 2,4-Dimethylphenol | | | | LOD > ESV | | LOD > ESV | LOD > ESV | LOD > ESV | LOD > ESV | | LOD > ESV |
| 2,4-Dinitrophenol | | | | LOD > ESV | | | | | | | |
| 2-Chlorophenol | LOD > ESV | LOD > ESV | LOD > ESV | LOD > ESV | | LOD > ESV | LOD > ESV | LOD > ESV | LOD > ESV | LOD > ESV | LOD > ESV |
| 4,6-Dinitro-2-methylphenol (4,6-Dinitro-o-cresol) | LOD > ESV | LOD > ESV | LOD > ESV | LOD > ESV | | LOD > ESV | LOD > ESV | LOD > ESV | LOD > ESV | LOD > ESV | LOD > ESV |
| bis(2-Ethylhexyl)phthalate (DEHP) | SQ = 3.8 | | | | | | | | | | |
| Carbazole | No ESV | | No ESV | No ESV | | No ESV | No ESV | No ESV | | | No ESV |
| Dibenzofuran | No ESV | | No ESV | No ESV | | --- | No ESV | No ESV | | No ESV | No ESV |
| Hexachlorobenzene | LOD > ESV | LOD > ESV | LOD > ESV | LOD > ESV | | LOD > ESV | LOD > ESV | LOD > ESV | LOD > ESV | LOD > ESV | LOD > ESV |
| Hexachlorobutadiene | LOD > ESV | LOD > ESV | LOD > ESV | LOD > ESV | | LOD > ESV | LOD > ESV | LOD > ESV | LOD > ESV | LOD > ESV | LOD > ESV |
| ***Polcyclic Aromatic Hydrocarbons (PAHs)*** | | | | | | | | | | | |
| Sum of LMW PAHs | | | | | | | SQ = 3.0 | | | | |
| Sum of HMW PAHs | SQ = 7.4 | SQ = 1.4 | SQ = 1.6 | SQ = 54 | | SQ = 3.5 | SQ = 57 | SQ = 7.5 | SQ = 4.1 | SQ = 1.2 | SQ = 18 |

**TABLE 2.1**

**CONSTITUENTS OF POTENTIAL ECOLOGICAL CONCERN IDENTIFIED IN THE SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| COPECs | *Residential Area 1* | *Residential Area 2* | *Residential Area 3* | *Residential Area 4* | *Waterfront Plaza* | *Mixed Residential/ Commercial Area 1* | *Mixed Residential/ Commercial Area 2* | *Commercial Area 1* | *Commercial Area 2* | *Commercial Area 3* | *Commercial Area 4* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Polychlorinated Biphenyls (PCBs)*** | | | | | | | | | | | |
| Aroclor-1016 (PCB-1016) | | | | | | | | | | | |
| Aroclor-1221 (PCB-1221) | | | | | | | | | | | |
| Aroclor-1242 (PCB-1242) | | | | | | | | | | | |
| Aroclor-1248 (PCB-1248) | | | | | | | | | | | |
| Aroclor-1254 (PCB-1254) | | | | | | | | | | | |
| Aroclor-1260 (PCB-1260) | | | | | | | | | | | |
| Total PCBs | SQ = 3,584 | SQ = 684 | SQ = 1,205 | SQ = 1,205 | | | SQ = 3,313 | SQ = 3,072 | SQ = 361 | | SQ = 33,133 |
| ***Inorganic Constituents*** | | | | | | | | | | | |
| Antimony | | | SQ = 1.5 | SQ = 5.6 | | | SQ = 202 | | | SQ = 1.1 | SQ = 32 |
| Arsenic | | | SQ = 1.1 | SQ = 1.2 | | SQ = 1.1 | SQ = 5.7 | | SQ = 1.9 | | SQ = 4.2 |
| Barium | | | | | | | SQ = 2.6 | | | | SQ = 1.5 |
| Cadmium | SQ = 3.1 | | | SQ = 11 | | SQ = 2.6 | SQ = 6.4 | | SQ = 3.6 | SQ = 3.1 | SQ = 4.7 |
| Chromium | | | SQ = 1.4 | SQ = 1.1 | | | SQ = 3.3 | | | | SQ = 1.5 |
| Cobalt | | | | | | SQ 2.3 | SQ = 2.9 | | | | |
| Copper | SQ = 1.8 | SQ = 1.6 | SQ = 1.3 | SQ = 7.9 | BCOC | | SQ = 91 | SQ = 1.1 | | | SQ = 11 |
| Iron | SQ = 116 | SQ = 76 | SQ = 129 | SQ = 94 | SQ = 23 | SQ = 51 | SQ = 313 | SQ = 71 | SQ = 70 | SQ = 74 | SQ = 426 |
| Lead | SQ = 6.1 | SQ = 4.1 | SQ = 5.8 | SQ = 90 | | SQ = 15 | SQ = 212 | SQ = 7.7 | SQ = 8.2 | SQ = 7.9 | SQ = 50 |
| Manganese | SQ = 4.5 | SQ = 3.2 | SQ = 3.2 | SQ = 3.2 | | SQ = 8.5 | SQ = 5.0 | SQ = 6.9 | SQ = 4.1 | SQ = 3.4 | SQ = 18 |
| Mercury | SQ = 3.3 | BCOC | SQ = 22 | SQ = 56 | | SQ = 1.6 | SQ = 40 | SQ = 2.4 | SQ = 1.9 | SQ > 47 | SQ = 8.0 |
| Nickel | BCOC | BCOC | BCOC | BCOC | BCOC | BCOC | SQ = 1.6 | BCOC | BCOC | BCOC | BCOC |
| Selenium | SQ = 3.1 | SQ = 1.5 | SQ = 2.1 | SQ = 8.7 | | SQ = 1.2 | SQ = 5.8 | SQ = 1.9 | SQ = 2.3 | SQ = 5.0 | SQ = 2.9 |
| Vanadium | SQ = 3.6 | SQ = 2.4 | SQ = 6.9 | SQ = 2.4 | | SQ = 1.8 | SQ = 5.0 | SQ = 2.6 | SQ = 2.7 | SQ = 2.3 | SQ = 6.3 |
| Zinc | SQ = 2.8 | SQ = 1.3 | SQ = 2.4 | SQ = 9.8 | | SQ = 2.3 | SQ = 100 | SQ = 1.6 | SQ = 1.9 | SQ = 1.5 | SQ = 17 |
| Cyanide (Total) | | | | SQ = 1.4 | | | SQ = 1.9 | | SQ = 1.8 | SQ = 1.7 | SQ = 1.8 |

***Notes :***
BCOC - Bioaccumulative Chemical of Concern
COPEC - Constituent of Potential Ecological Concern
ESV - Ecological Screening Value
LOD - Limit of Detection
SQ - Screening Quotient
BTEX - Benzene, toluene, ethylbenzene, and xylenes
LMW - Low Molecular Weight
HMW - High Molecular Weight

**TABLE 4.1**

**RE-SCREENING SUMMARY FOR REFINEMENT DATASET**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Constituent* | *Units* | *ESV* | *Source* | *No. Samples* | *No. Detects* | *FOD* | *Max Conc.* | *Area of Max. Conc.* | *Sample with Max. Conc.* | *SQ* | *BCOC* | *Retain as COPEC* | *Rationale for Retaining or Eliminating* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Volatile Organic Compounds (VOCs)*** | | | | | | | | | | | | | |
| **Acetone** | **µg/kg** | **2,500** | **a** | **3** | **3** | **100%** | **5,500** | **Residential Area 4** | **SB-302** | **2.2** | **No** | **Yes** | **SQ > 1** |
| **Isopropylbenzene** | **µg/kg** | **n/a** | **---** | **24** | **3** | 13% | **660** | **Residential Area 4** | **SB-302** | **-** | **No** | **Yes** | **No ESV** |
| ***BTEX*** | | | | | | | | | | | | | |
| **Benzene** | **µg/kg** | **255** | **a** | **24** | **7** | **29%** | **1,300** | **Residential Area 4** | **SB-302** | **5.1** | **No** | **Yes** | **SQ > 1** |
| **Toluene** | **µg/kg** | **5,450** | **a** | **24** | **10** | **42%** | **22,000** | **Residential Area 4** | **SB-302** | **4.0** | **No** | **Yes** | **SQ > 1** |
| o-Xylene | **µg/kg** | 10,000 | a | 24 | 10 | 42% | 7,400 | Residential Area 4 | SB-302 | 0.74 | No | No | SQ < 1 |
| **m&p-Xylenes** | **µg/kg** | **10,000** | **a** | **24** | **9** | **38%** | **11,000** | **Residential Area 4** | **SB-302** | **1.1** | **No** | **Yes** | **SQ > 1** |
| ***Semi-Volatile Organic Compounds (SVOCs)*** | | | | | | | | | | | | | |
| bis(2-Ethylhexyl)phthalate | **µg/kg** | 925 | a | 24 | 13 | 54% | 350 | Commercial Area 4 | SB-201 | 0.38 | No | No | SQ < 1 |
| **Carbazole** | **µg/kg** | **n/a** | **---** | **23** | **3** | 13% | **83** | **Residential Area 4** | **SB-302** | **-** | **No** | **Yes** | **No ESV** |
| ***Polcyclic Aromatic Hydrocarbons (PAHs)*** | | | | | | | | | | | | | |
| ***High Molecular Weight (HMW) PAHs*** | | | | | | | | | | | | | |
| Benzo(a)anthracene | **µg/kg** | | | 29 | 16 | 55% | 3,800 | Residential Area 4 | DG3 | | | | |
| Benzo(a)pyrene | **µg/kg** | | | 29 | 17 | 59% | 4,900 | Residential Area 4 | DG3 | | | | |
| Chrysene | **µg/kg** | | | 30 | 19 | 63% | 8,100 | Residential Area 4 | DG3 | | | | |
| Dibenz(a,h)anthracene | **µg/kg** | | | 30 | 11 | 37% | 6,400 | Residential Area 4 | DG4 | | | | |
| Fluoranthene | **µg/kg** | | | 30 | 17 | 57% | 7,700 | Commercial Area 4 | TP-341 | | | | |
| Pyrene | **µg/kg** | | | 26 | 15 | 58% | 6,000 | Residential Area 4 | DG3 | | | | |
| **Sum of HMW PAHs** | | **1,100** | **b** | **30** | **22** | **73%** | **26,500** | **Residential Area 4** | **DG3** | **24** | **No** | **Yes** | **SQ > 1** |
| ***Polychlorinated Biphenyls (PCBs)*** | | | | | | | | | | | | | |
| Aroclor-1248 | **µg/kg** | | | 17 | 1 | 5.9% | 52 | Residential Area 1 | SB-101 | | **Yes** | | |
| Aroclor-1254 | **µg/kg** | | | 17 | 14 | 82% | 230 | Residential Area 1 | SB-104 | | **Yes** | | |
| Aroclor-1260 | **µg/kg** | | | 17 | 12 | 71% | 200 | Residential Area 4 | SB-302 | | **Yes** | | |
| **Total PCBs** | **µg/kg** | **0.332** | **a** | **23** | **20** | **87%** | **400** | Residential Area 4 | SB-302 | **1,205** | **Yes** | **Yes** | **SQ > 1** |
| ***Inorganic Constituents*** | | | | | | | | | | | | | |
| **Antimony** | **mg/kg** | **0.27** | **c** | **24** | **8** | **33%** | **3.1** | **Commercial Area 4** | **TP-341** | **11** | **No** | **Yes** | **SQ > 1** |
| **Arsenic** | **mg/kg** | **18** | **d** | **30** | **29** | **97%** | **21.6** | **Residential Area 4** | **SB-301** | **1.2** | **No** | **Yes** | **SQ > 1** |
| **Barium** | **mg/kg** | **330** | **e** | **24** | **24** | **100%** | **500** | **Commercial Area 4** | **TP-341** | **1.5** | **No** | **Yes** | **SQ > 1** |
| **Cadmium** | **mg/kg** | **0.36** | **f** | **30** | **15** | **50%** | **3.9** | **Residential Area 4** | **DG4** | **11** | **Yes** | **Yes** | **SQ > 1** |
| **Chromium** | **mg/kg** | **26** | **g** | **30** | **30** | **100%** | **40** | **Commercial Area 4** | **TP-341** | **1.5** | **Yes** | **Yes** | **SQ > 1** |
| Cobalt | mg/kg | 13 | h | 24 | 24 | 100% | 7.7 | Commercial Area 4 | TP-341 | 0.59 | No | No | SQ < 1 |
| **Copper** | **mg/kg** | **28** | **i** | **30** | **29** | **97%** | **308** | **Commercial Area 4** | **TP-341** | **11** | **Yes** | **Yes** | **SQ > 1** |
| Iron | mg/kg | 200 | j | 24 | 24 | 100% | 22,200 | Commercial Area 4 | TP-341 | **111** | No | No | see text |
| **Lead** | **mg/kg** | **11** | **k** | **30** | **30** | **100%** | **990** | **Residential Area 4** | **DG4** | **90** | **Yes** | **Yes** | **SQ > 1** |
| **Manganese** | **mg/kg** | **220** | **l** | **24** | **24** | **100%** | **698** | **Residential Area 3** | **SB-138** | **3.2** | **No** | **Yes** | **SQ > 1** |
| **Mercury** | **mg/kg** | **0.1** | **m** | **30** | **24** | **80%** | **5.6** | **Residential Area 4** | **DG3** | **56** | **Yes** | **Yes** | **SQ > 1** |
| Nickel | mg/kg | 38 | n | 24 | 24 | 100% | 29.3 | Residential Area 3 | SB-138 | 0.77 | Yes | No | SQ < 1 |
| **Selenium** | **mg/kg** | **0.52** | **o** | **30** | **19** | **63%** | **1.8** | **Residential Area 4** | **SB-302** | **3.5** | **Yes** | **Yes** | **SQ > 1** |
| **Vanadium** | **mg/kg** | **7.8** | **p** | **24** | **24** | **100%** | **28** | **Residential Area 1** | **SB-102** | **3.6** | **No** | **Yes** | **SQ > 1** |
| **Zinc** | **mg/kg** | **46** | **q** | **30** | **27** | **90%** | **764** | **Commercial Area 4** | **TP-341** | **17** | **Yes** | **Yes** | **SQ > 1** |
| **Cyanide (Total)** | **mg/kg** | **1.33** | **a** | **6** | **6** | **81%** | **1.8** | **Residential Area 4** | **SB-321** | **1.4** | **No** | **Yes** | **SQ > 1** |

**TABLE 4.1**

**RE-SCREENING SUMMARY FOR REFINEMENT DATASET**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

***Notes:***

**Bold Font** identifies constituent identified as Constituent of Potential Ecological Concern (COPEC)
n/a - Ecological Screening Value (ESV) not available
BCOC - Bioaccumulative Chemical of Concern
COPEC - Constituent of Potential Ecological Concern
ESV - Ecological Screening Value
FOD - Frequency of Detection
SQ - Screening Quotient
BTEX - Benzene, toluene, ethylbenzene, and xylenes
µg/kg- micrograms per kilogram
mg/kg- milligrams per kilogram
LMW - Low Molecular Weight
HMW - High Molecular Weight

For LMW PAHs, constituents were summed for each sample, and the max was compared to the screening value for total LMW PAHs. The same was done for HWM PAHs. Non-detects were treated as 1/2 the detection limit.

**Rationale for Retaining or Eliminating**

No ESV - Constituent was detected; ESV not available
SQ < 1 - Maximum concentration is less than the ESV
SQ > 1 - Maximum concentration is greater than the ESV

***ESV Source:***

a - U.S. EPA Region 5 Ecological Soil Screening Level (U.S. EPA, 2003)
b - Ecological Soil Screening Level - Mammalian Wildlife (U.S. EPA, 2007e)
c - Ecological Soil Screening Level - Mammalian Wildlife (U.S. EPA, 2005a)
d - Ecological Soil Screening Level - Plants (U.S. EPA, 2005b)
e - Ecological Soil Screening Level - Invertebrates (U.S. EPA, 2005c)
f - Ecological Soil Screening Level - Mammalian Wildlife (U.S. EPA, 2005d)
g - Ecological Soil Screening Level - Avian Wildlife (U.S. EPA, 2008)
h - Ecological Soil Screening Level - Plants (U.S. EPA, 2005e)
i - Ecological Soil Screening Level - Avian Wildlife (U.S. EPA, 2007b)
j - Oak Ridge National Laboratory - Microbes (Efroymson et al., 1997b)
k - Ecological Soil Screening Level - Avian Wildlife (U.S. EPA, 2005f)
l - Ecological Soil Screening Level - Plants (U.S. EPA, 2007c)
m - Oak Ridge National Laboratory - Invertebrates (Efroymson et al., 1997b)
n - Ecological Soil Screening Level - Plants (U.S. EPA, 2007d)
o - Ecological Soil Screening Level - Plants (U.S. EPA, 2007f)
p - Ecological Soil Screening Level - Avian Wildlife (U.S. EPA, 2005g)
q - Ecological Soil Screening Level - Avian Wildlife (U.S. EPA, 2007g)

# TABLE 5.1

## REFINEMENT BENCHMARKS FOR AVIAN WILDLIFE
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| *Constituent* | *Background* | | *ECO-SSL* | *Effroymson et al. (1997a)* | *CCME* | *Refinement Benchmark* |
|---|---|---|---|---|---|---|
| | *MDEQ (2005)* | *U.S. EPA (2007a)* | | | | |
| ***Volatile Organic Compounds (VOCs) ( µg/kg)*** | | | | | | |
| **Acetone** | --- | --- | --- | --- | --- | n/a |
| **Isopropylbenzene** | --- | --- | --- | --- | --- | n/a |
| ***BTEX ( µg/kg)*** | | | | | | |
| **Benzene** | --- | --- | --- | --- | --- | n/a |
| **Toluene** | --- | --- | --- | --- | --- | n/a |
| **Xylene (Total)** | --- | --- | --- | --- | --- | n/a |
| ***Semi-Volatile Organic Compounds (SVOCs) ( µg/kg)*** | | | | | | |
| **Carbazole** | --- | --- | --- | | | n/a |
| ***Polcyclic Aromatic Hydrocarbons (PAHs) ( µg/kg)*** | | | | | | |
| ***High Molecular Weight (HMW) PAHs*** | --- | --- | --- | --- | 600 | 600 |
| ***Polychlorinated Biphenyls (PCBs) ( µg/kg)*** | | | | | | |
| **Total PCBs** | --- | --- | --- | 655 | 1,300 | 655 |
| ***Inorganic Constituents (mg/kg)*** | | | | | | |
| **Antimony** | --- | 1.3 | --- | --- | --- | 1.3 |
| **Arsenic** | 1.09 | 4.2 | 43 | 102 | 380 | 43 |
| **Barium** | 14.2 | 127 | --- | 283 | --- | 283 |
| **Cadmium** | < 2.0 | 0.90 | 0.77 | 4.2 | 3.8 | 0.90 |
| **Chromium** | 2.8 | 13.8 | 26 | 16.1 | --- | 26 |
| **Copper** | 2.7 | 12 | 28 | 515 | 300 | 28 |
| **Lead** | 7.4 | 9.2 | 11 | 40.5 | 70 | 11 |
| **Manganese** | 117 | 230 | 4,300 | --- | --- | 4,300 |
| **Mercury** | < 0.1 | --- | --- | 0.00051 | --- | 0.00051 |
| **Selenium** | < 0.5 | 0.30 | 1.2 | --- | 4.5 | 1.2 |
| **Vanadium** | --- | 44 | 7.8 | --- | --- | 44 |
| **Zinc** | 13 | 33 | 46 | 8.5 | 640 | 46 |
| **Cyanide (Total)** | --- | --- | --- | --- | 11 | 11 |

**TABLE 5.1**

**REFINEMENT BENCHMARKS FOR AVIAN WILDLIFE**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

***Notes:***

--- Ecological benchmark concentration is not available
CCME - Canadian Council of Ministers of the Environment
ECO-SSL - Ecological Soil Screening Level
MDEQ - Michigan Department of Environmental Quality
U.S. EPA - United States Environmental Protection Agency
BTEX - Benzene, toluene, ethylbenzene, and xylenes
µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram

# TABLE 5.2

## REFINEMENT OF CONSTITUENTS OF POTENTIAL ECOLOGICAL CONCERN - AVIAN WILDLIFE
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| *Constituent* | *Units* | *Refinement Benchmark* | *No. Samples* | *No. Detects* | *Minimum Detected* | *Maximum Detected* | *95% UCL* | *$RQ_{UCL}$* | *Retain as COPEC* | *Rationale* |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Volatile Organic Compounds (VOCs)*** | | | | | | | | | | |
| **Acetone** | **µg/kg** | **n/a** | **3** | **3** | **310** | **5,500** | **n/c** | **---** | **Yes** | **No RB** |
| **Isopropylbenzene** | **µg/kg** | **n/a** | **24** | **3** | **50** | **660** | **150** | **---** | **Yes** | **No RB** |
| ***BTEX*** | | | | | | | | | | |
| **Benzene** | **µg/kg** | **n/a** | **24** | **7** | **5.6** | **1,300** | **167** | | **Yes** | **No RB** |
| **Toluene** | **µg/kg** | **n/a** | **24** | **10** | **16** | **22,000** | **2,661** | | **Yes** | **No RB** |
| **Xylenes (Total)** | **µg/kg** | **na** | **24** | **10** | **27** | **18,400** | **2,343** | | **Yes** | **No RB** |
| ***Semi-Volatile Organic Compounds (SVOCs)*** | | | | | | | | | | |
| **Carbazole** | **µg/kg** | **n/a** | **23** | **3** | **40** | **83** | **83** | **---** | **Yes** | **No RB** |
| ***Polycyclic Aromatic Hydrocarbons (PAHs)*** | | | | | | | | | | |
| **High Molecular Weight PAHs** | **µg/kg** | **600** | **30** | **22** | **82.1** | **26,500** | **13,920** | **23** | **Yes** | **$RQ_{UCL} > 1$** |
| ***Polychlorinated Biphenyls (PCBs)*** | | | | | | | | | | |
| Total PCBs | µg/kg | 655 | 23 | 20 | 10 | 400 | 187 | 0.29 | No | $RQ_{UCL} < 1$ |
| ***Inorganic Constituents*** | | | | | | | | | | |
| Antimony | mg/kg | 1.3 | 24 | 8 | 0.30 | 3.1 | 0.944 | 0.73 | No | $RQ_{UCL} < 1$ |
| Arsenic | mg/kg | 43 | 30 | 29 | 3.3 | 21.6 | 11.0 | 0.25 | No | $RQ_{UCL} < 1$ |
| Barium | mg/kg | 283 | 24 | 24 | 17.2 | 500 | 171 | 0.60 | No | $RQ_{UCL} < 1$ |
| **Cadmium** | **mg/kg** | **0.90** | **30** | **15** | **0.27** | **3.9** | **0.948** | **1.1** | **No** | **$RQ_{UCL} < 1$** |
| Chromium | mg/kg | 26 | 30 | 30 | 5.5 | 40 | 16.7 | 0.64 | No | $RQ_{UCL} < 1$ |
| **Copper** | **mg/kg** | **28** | **30** | **29** | **3.8** | **308** | **143** | **5.1** | **Yes** | **$RQ_{UCL} > 1$** |
| **Lead** | **mg/kg** | **11** | **30** | **30** | **4.0** | **990** | **181** | **16** | **Yes** | **$RQ_{UCL} > 1$** |
| Manganese | mg/kg | 4,300 | 24 | 24 | 127 | 698 | 468 | 0.11 | No | $RQ_{UCL} < 1$ |
| **Mercury** | **mg/kg** | **0.00051** | **30** | **24** | **0.049** | **5.6** | **1.53** | **2,990** | **Yes** | **$RQ_{UCL} > 1$** |
| Selenium | mg/kg | 1.2 | 30 | 19 | 0.30 | 1.8 | 0.744 | 0.62 | No | $RQ_{UCL} < 1$ |
| Vanadium | mg/kg | 44 | 24 | 24 | 8.0 | 28 | 18.2 | 0.41 | No | $RQ_{UCL} < 1$ |
| **Zinc** | **mg/kg** | **46** | **30** | **27** | **18** | **764** | **333** | **7.2** | **Yes** | **$RQ_{UCL} > 1$** |
| Cyanide (Total) | mg/kg | 11 | 6 | 6 | 0.50 | 1.8 | 1.47 | 0.13 | Yes | $RQ_{UCL} < 1$ |

# TABLE 5.2

## REFINEMENT OF CONSITITUENTS OF POTENTIAL ECOLOGICAL CONCERN - AVIAN WILDLIFE
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

***Notes*** **:**

COPEC - Constituent of Potential Eecological Concern

RB - Refinement Benchmark

$RQ_{UCL}$ - Refinement quotient based on the 95% upper confidence limit

UCL - Upper Confidence Limit

µg/kg- micrograms per kilogram

mg/kg- milligrams per kilogram

# TABLE 5.3

## REFINEMENT BENCHMARKS FOR MAMMALIAN WILDLIFE
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| *Constituent* | *Background* | | *ECO-SSL* | *U.S. EPA 5 ESL* | *Effroymson et al. (1997a)* | *CCME* | *Refinement Benchmark* |
|---|---|---|---|---|---|---|---|
| | *MDEQ (2005)* | *U.S. EPA (2007a)* | | | | | |
| ***Volatile Organic Compounds (VOCs) (µg/kg)*** | | | | | | | |
| **Acetone** | --- | --- | --- | 2,500 | --- | --- | 2,500 |
| **Isopropylbenzene** | --- | --- | --- | --- | --- | --- | n/a |
| ***BTEX ( µg/kg)*** | | | | | | | |
| **Benzene** | --- | --- | --- | 255 | --- | --- | 255 |
| **Toluene** | --- | --- | --- | 5,450 | --- | --- | 5,450 |
| **Xylenes (Total)** | --- | --- | --- | --- | --- | --- | n/a |
| ***Semi-Volatile Organic Compounds (SVOCs) (µg/kg)*** | | | | | | | |
| **Carbazole** | --- | --- | --- | --- | --- | | n/a |
| ***Polcyclic Aromatic Hydrocarbons (PAHs) ( µg/kg)*** | | | | | | | |
| ***High Molecular Weight (HMW) PAHs*** | --- | --- | 1,100 | 0.332 | 391 | 1,300 | 1,100 |
| ***Polychlorinated Biphenyls (PCBs) (µg/kg)*** | | | | | | | |
| **Total PCBs** | --- | --- | --- | --- | --- | 1,300 | 1,300 |
| ***Inorganic Constituents (mg/kg)*** | | | | | | | |
| **Antimony** | --- | 1.3 | 0.27 | 0.142 | --- | --- | 1.3 |
| **Arsenic** | 1.09 | 4.2 | 46 | 5.7 | 9.9 | 380 | 46 |
| **Barium** | 14.2 | 127 | 2,000 | 1.04 | 329 | --- | 2,000 |
| **Cadmium** | < 2.0 | 0.90 | 0.36 | 0.0022 | 6.0 | 3.8 | 0.90 |
| **Chromium** | 2.8 | 13.8 | 34 | 0.40 | 110 | --- | 34 |
| **Copper** | 2.7 | 12 | 49 | 5.4 | 370 | 300 | 49 |
| **Lead** | 7.4 | 9.2 | 56 | 0.0537 | 740 | 70 | 56 |
| **Manganese** | 117 | 230 | 4,000 | --- | --- | --- | 4,000 |
| **Mercury** | < 0.1 | --- | --- | --- | 0.146 | --- | 0.146 |
| **Selenium** | < 0.5 | 0.30 | 0.63 | 0.0276 | --- | 4.5 | 0.63 |
| **Vanadium** | --- | 44 | 280 | 1.59 | 55 | --- | 280 |
| **Zinc** | 13 | 33 | 79 | --- | 1,600 | 640 | 79 |
| **Cyanide (Total)** | --- | --- | --- | 1.33 | --- | 11 | 1.33 |

# TABLE 5.3

## REFINEMENT BENCHMARKS FOR MAMMALIAN WILDLIFE
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

***Notes:***

--- Ecological benchmark concentration is not available
CCME - Canadian Council of Ministers of the Environment
ECO-SSL - Ecological Soil Screening Level
ESL - Ecological Screening Level
MDEQ - Michigan Department of Environmental Quality
U.S. EPA - United States Environmental Protection Agency
BTEX - Benzene, toluene, ethylbenzene, and xylenes
µg/kg- micrograms per kilogram
mg/kg- milligrams per kilogram

# TABLE 5.4

## REFINEMENT OF CONSTITUENTS OF POTENTIAL ECOLOGICAL CONCERN - MAMMALIAN WILDLIFE
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| *Constituent* | *Units* | *Refinement Benchmark* | *No. Samples* | *No. Detects* | *Minimum Detected* | *Maximum Detected* | *95% UCL* | *$RQ_{UCL}$* | *Retain as COPEC* | *Rationale* |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Volatile Organic Compounds (VOCs)*** | | | | | | | | | | |
| **Acetone** | **µg/kg** | **2,500** | **3** | **3** | **310** | **5,500** | **n/c** | **2.2** | **Yes** | **$RQ_{UCL}$ > 1** |
| **Isopropylbenzene** | **µg/kg** | **n/a** | **24** | **3** | **50** | **660** | **150** | **---** | **Yes** | **No RB** |
| ***BTEX*** | | | | | | | | | | |
| Benzene | µg/kg | 255 | **24** | **7** | 5.6 | 1,300 | 167 | 0.65 | No | $RQ_{UCL}$ < 1 |
| Toluene | µg/kg | 5,450 | **24** | **10** | 16 | 22,000 | 2,661 | 0.49 | No | $RQ_{UCL}$ < 1 |
| **Xylene (Total)** | **µg/kg** | **na** | **24** | **10** | **27** | **18,400** | **2,343** | **---** | **Yes** | **No RB** |
| ***Semi-Volatile Organic Compounds (SVOCs)*** | | | | | | | | | | |
| **Carbazole** | **µg/kg** | **n/a** | **23** | **3** | **40** | **83** | **83** | **---** | **Yes** | **No RB** |
| ***Polycyclic Aromatic Hydrocarbons (PAHs)*** | | | | | | | | | | |
| **High Molecular Weight PAHs** | **µg/kg** | **1,100** | **30** | **22** | **82.1** | **26,500** | **13,920** | **13** | **Yes** | **$RQ_{UCL}$ > 1** |
| ***Polychlorinated Biphenyls (PCBs)*** | | | | | | | | | | |
| Total PCBs | µg/kg | 1,300 | 23 | 20 | 10 | 400 | 187 | 0.14 | No | $RQ_{UCL}$ < 1 |
| ***Inorganic Constituents*** | | | | | | | | | | |
| Antimony | mg/kg | 1.3 | 24 | 8 | 0.30 | 3.1 | 0.944 | 0.73 | No | $RQ_{UCL}$ < 1 |
| Arsenic | mg/kg | 46 | 30 | 29 | 3.3 | 21.6 | 11.0 | 0.24 | No | $RQ_{UCL}$ < 1 |
| Barium | mg/kg | 2,000 | 24 | 24 | 17.2 | 500 | 171 | 0.085 | No | $RQ_{UCL}$ < 1 |
| **Cadmium** | **mg/kg** | **0.90** | **30** | **15** | **0.27** | **3.9** | **0.948** | **1.1** | **No** | **$RQ_{UCL}$ < 1** |
| Chromium | mg/kg | 34 | 30 | 30 | 5.5 | 40 | 16.7 | 0.49 | No | $RQ_{UCL}$ < 1 |
| **Copper** | **mg/kg** | **49** | **30** | **29** | **3.8** | **308** | **143** | **2.9** | **Yes** | **$RQ_{UCL}$ > 1** |
| **Lead** | **mg/kg** | **56** | **30** | **30** | **4.0** | **990** | **181** | **3.2** | **Yes** | **$RQ_{UCL}$ > 1** |
| Manganese | mg/kg | 4,000 | 24 | 24 | 127 | 698 | 468 | 0.12 | No | $RQ_{UCL}$ < 1 |
| **Mercury** | **mg/kg** | **0.146** | **30** | **24** | **0.049** | **5.6** | **1.53** | **10** | **Yes** | **$RQ_{UCL}$ > 1** |
| **Selenium** | **mg/kg** | **0.63** | **30** | **19** | **0.30** | **1.8** | **0.744** | **1.2** | **Yes** | **$RQ_{UCL}$ > 1** |
| Vanadium | mg/kg | 280 | 24 | 24 | 8.0 | 28 | 18.2 | 0.065 | No | $RQ_{UCL}$ < 1 |
| **Zinc** | **mg/kg** | **79** | **30** | **27** | **18** | **764** | **333** | **4.2** | **Yes** | **$RQ_{UCL}$ > 1** |
| **Cyanide (Total)** | **mg/kg** | **1.33** | 6 | 6 | 0.50 | 1.8 | 1.47 | **1.1** | **Yes** | **$RQ_{UCL}$ > 1** |

# TABLE 5.4

## REFINEMENT OF CONSTITUENTS OF POTENTIAL ECOLOGICAL CONCERN - MAMMALIAN WILDLIFE
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

***Notes*** **:**

COPEC - Constituent of potential ecological concern

RB - Refinement Benchmark

$RQ_{UCL}$ - Refinement quotient based on the 95% upper confidence limit

UCL - Upper Confidence Limit

µg/kg- micrograms per kilogram

mg/kg- milligrams per kilogram

**TABLE 5.5**

**EXPOSURE PARAMETERS FOR AVIAN INDICATOR SPECIES**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| ***Parameter*** | ***Units*** | ***American Woodcock*** | ***Mourning Dove*** | ***Red-Tailed Hawk*** |
|---|---|---|---|---|
| Body Weight | kg | 0.18 | 0.02 | 1.13 |
| Ingestion | | | | |
| $IR_{Food}$ | kg DW/kg BW/day | 0.214 | 0.190 | 0.0353 |
| $IR_{Water}$ | L/kg/day | Negligible | Negligible | Negligible |
| $P_s$ | Unitless | 0.164 | 0.139 | 0.057 |
| Diet | | | | |
| Terrestrial Invertebrates | Percent | 100 | 0 | 0 |
| Terrestrial Plants | Percent | 0 | 100 | 0 |
| Small Terrestrial Mammals | Percent | 0 | 0 | 100 |
| Area Use | | | | |
| Diet from Assessment Area | Unitless | 1 | 1 | 1 |
| Bioavailability | Percent | 100 | 100 | 100 |

***Notes :***

BW - Body Weight
Body Weight from Table 12A-1 of U.S. EPA (1999a)
DW - Dry Weight
$IR_{Food}$ - Ingestion Rate of Food
$IR_{Water}$ - Ingestion Rate of Water
$P_s$ - Proportion of Soil Ingested
$IR_{Food}$ from Table 4.1 of Attachment 4-1 of U.S. EPA (2007a)
$P_s$ from Table 4-1 of U.S. EPA (2007a)
kg - kilogram
mg - milligram
L - liter

# TABLE 5.6

## EXPOSURE PARAMETERS FOR MAMMALIAN INDICATOR SPECIES
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| *Parameter* | *Units* | *Short-Tailed Shrew* | *Meadow Vole* | *Long-Tailed Weasel* |
|---|---|---|---|---|
| Body Weight | kg | 0.02 | 0.02 | 0.19 |
| Ingestion | | | | |
| $IR_{Food}$ | kg DW/kg BW/day | 0.209 | 0.0875 | 0.13 |
| $IR_{Water}$ | L/kg/day | Negligible | Negligible | Negligible |
| $P_s$ | Unitless | 0.03 | 0.032 | 0.043 |
| Diet | | | | |
| Terrestrial Invertebrates | Percent | 100 | 0 | 0 |
| Terrestrial Plants | Percent | 0 | 100 | 0 |
| Small Terrestrial Mammals | Percent | 0 | 0 | 100 |
| Area Use | | | | |
| Diet from Assessment Area | Unitless | 1 | 1 | 1 |
| Bioavailability | Percent | 100 | 100 | 100 |

***Notes*** **:**

BW - Body Weight

Body Weight from Table 12A-1 of U.S. EPA (1999a)

$IR_{Food}$ - Ingestion Rate of Food

$IR_{Water}$ - Ingestion Rate of Water

$P_s$ - Proportion of Soil Ingested

$IR_{Food}$ from Table 4.1 of Attachment 4-1 of U.S. EPA (2007a)

$P_s$ from Table 4-1 of U.S. EPA (2007a)

kg - kilogram

mg - milligram

L - liter

# TABLE 5.7

## EQUATIONS FOR CALCULATING EXPOSURE CONCENTRATIONS IN DIETARY ITEMS
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| COPEC | Soil Invertebrates | | Terrestrial Plants | | Small Mammals | |
|---|---|---|---|---|---|---|
| | Equation | Source | Equation | Source | Equation | Source |
| ***Volatile Organic Compounds (VOCs)*** | | | | | | |
| Acetone | $C_I = 0 * C_S$ | a | $C_P = 0 * C_S$ | a | $C_M$ = Greater of $C_I$ and $C_P$ | e |
| Isopropylbenzene | $C_I = 71.05 * C_S * 5.99$ | c | $C_P = 0.30 * C_S$ | c | $C_M$ = Greater of $C_I$ and $C_P$ | e |
| ***BTEX*** | | | | | | |
| Benzene | $C_I = 0 * C_S$ | a | $C_P = 0 * C_S$ | a | $C_M$ = Greater of $C_I$ and $C_P$ | e |
| Toluene | $C_I = 0 * C_S$ | a | $C_P = 0 * C_S$ | a | $C_M$ = Greater of $C_I$ and $C_P$ | e |
| Xylenes (Total) | $C_I = 0 * C_S$ | a | $C_P = 0 * C_S$ | a | $C_M$ = Greater of $C_I$ and $C_P$ | e |
| ***Semi-Volatile Organic Compounds (SVOCs)*** | | | | | | |
| Carbazole | $C_I = 79.6 * C_S * 5.99$ | c | $C_P = 0.274 * C_S$ | c | $C_M$ = Greater of $C_I$ and $C_P$ | e |
| ***Polycyclic Aromatic Hydrocarbons (PAHs)*** | | | | | | |
| HMW PAHs | $C_I = 2.6 * C_S$ | c | $\ln(C_P) = 0.9469 * \ln(C_S) - 1.7026$ | c | $C_M = 0 * C_S$ | c |
| ***Inorganic Constituents*** | | | | | | |
| Cadmium | $\ln(C_I) = 0.795 * \ln(C_S) + 2.114$ | b | $\ln(C_P) = 0.546 * \ln(C_S) - 0.475$ | b | $\ln(C_M) = 0.4723 * \ln(C_S) - 1.2571$ | b |
| Copper | $C_I = 0.515 * C_S$ | b | $\ln(C_P) = 0.394 * \ln(C_S) + 0.668$ | b | $\ln(C_M) = 0.1444 * \ln(C_S) + 2.042$ | b |
| Lead | $\ln(C_I) = 0.807 * \ln(C_S) - 0.218$ | b | $\ln(C_P) = 0.561 * \ln(C_S) - 1.328$ | b | $\ln(C_M) = 0.4422 * \ln(C_S) + 0.0761$ | b |
| Mercury | $C_I = 0.04 * C_S * 5.99$ | c | $C_P = 0.0375 * C_S$ | c | $C_M = 0.0543 * C_S$ | d |
| Selenium | $\ln(C_I) = 0.733 * \ln(C_S) - 0.075$ | b | $\ln(C_P) = 1.104 * \ln(C_S) - 0.677$ | b | $\ln(C_M) = 0.3764 * \ln(C_S) - 0.4158$ | b |
| Zinc | $\ln(C_I) = 0.328 * \ln(C_S) -+ 4.449$ | b | $\ln(C_P) = 0.554 * \ln(C_S) + 1.575$ | b | $\ln(C_M) = 0.0706 * \ln(C_S) + 4.3632$ | b |
| Cyanide (Total) | $C_I = 1.12 * C_S * 5.99$ | c | $C_P = 1.0 * C_S$ | e | $C_M$ = Greater of $C_I$ and $C_P$ | e |

***Notes :***

$C_I$ - Concentration in soil invertebrates
$C_P$ - Concentration terrestrial plants
$C_S$ - Concentration in soil
$C_M$ - Concentration in small mammals
BTEX - Benzene, toluene, ethylbenzene, and xylenes
HMW - High Molecular Weight
PAH - Polycyclic Aromatic Hydrocarbon

***Source:***

a - U.S. EPA (2000)
b - U.S. EPA (2007a)
c - U.S. EPA (1999b)
d - Sample et al. (1998)
e - Data not available

# TABLE 5.8

## EXPOSURE CONCENTRATIONS FOR FOOD CHAIN MODELS
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| *Constituent* | *Water (mg/L)* | *Soil (mg/kg DW)* | *Soil Invertebrates (mg/kg DW)* | *Terrestrial Plants (mg/kg DW)* | *Small Mammals (mg/kg DW)* |
|---|---|---|---|---|---|
| ***Volatile Organic Compounds (VOCs)*** | | | | | |
| Acetone | 0 | 5.50 | 0 | 0 | 0 |
| Isopropylbenzene | 0 | 0.150 | 63.8 | 0.045 | 63.8 |
| ***BTEX*** | | | | | |
| Benzene | 0 | 0.167 | 0 | 0 | 0 |
| Toluene | 0 | 2.66 | 0 | 0 | 0 |
| Xylenes (Total) | 0 | 2.34 | 0 | 0 | 0 |
| ***Semi-Volatile Organic Compounds (SVOCs)*** | | | | | |
| Carbazole | 0 | 0.083 | 39.6 | 0.023 | 39.6 |
| ***Polycyclic Aromatic Hydrocarbons (PAHs)*** | | | | | |
| High Molecular Weight PAHs | 0 | 19.9 | 51.80 | 3.10 | 0 |
| ***Inorganic Compounds*** | | | | | |
| Cadmium | 0 | 0.948 | 7.94 | 0.604 | 0.277 |
| Copper | 0 | 143 | 73.6 | 13.8 | 15.8 |
| Lead | 0 | 181 | 53.4 | 4.90 | 10.7 |
| Mercury | 0 | 1.53 | 0.367 | 0.057 | 0.083 |
| Selenium | 0 | 0.744 | 0.747 | 0.367 | 0.590 |
| Zinc | 0 | 333 | 575 | 121 | 118 |
| Cyanide (Total) | 0 | 1.47 | 9.83 | 1.47 | 9.83 |

***Notes*** **:**

DW - Dry weight
BTEX - Benzene, toluene, ethylbenzene and xylenes
mg - milligram
kg - kilogram
L - liter

# TABLE 5.9

## TOXICITY REFERENCE VALUES FOR AVIAN AND MAMMALIAN WILDLIFE
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| *Constituent* | *Avian Wildlife* | | | | *Mammalian Wildlife* | | | |
|---|---|---|---|---|---|---|---|---|
| | *NOAEL* | *Source* | *LOAEL* | *Source* | *NOAEL* | *Source* | *LOAEL* | *Source* |
| ***Volatile Organic Compounds (VOCs)*** | | | | | | | | |
| Acetone | 5.2 | a | 52 | a | 10 | d | 50 | d |
| Isopropylbenzene | n/a | --- | n/a | --- | 154 | e | 462 | f |
| ***BTEX*** | | | | | | | | |
| Benzene | n/a | --- | n/a | --- | 26.36 | d | 263.6 | d |
| Toluene | n/a | --- | n/a | --- | 26 | d | 260 | d |
| Xylenes (Total) | n/a | --- | n/a | --- | 2.1 | d | 2.6 | d |
| ***Semi-Volatile Organic Compounds (SVOCs)*** | | | | | | | | |
| Carbazole | n/a | --- | n/a | --- | 5.2 | e | 57.3 | f |
| ***Polycyclic Aromatic Hydrocarbons (PAHs)*** | | | | | | | | |
| High Molecular Weight PAHs | 2.0 | b | 20 | b | 0.615 | b | 28.6 | b |
| ***Inorganic Constituents*** | | | | | | | | |
| Cadmium | 0.70 | c | 10.4 | c | 0.06 | c | 2.64 | e |
| Copper | 2.3 | c | 52.3 | c | 2.67 | c | 632 | e |
| Lead | 0.014 | c | 8.75 | c | 1.0 | c | 241 | e |
| Mercury | 0.039 | c | 0.18 | c | 0.027 | c | 4.0 | e |
| Selenium | 0.23 | c | 0.93 | c | 0.05 | c | 1.21 | e |
| Zinc | 17.2 | c | 172 | c | 9.6 | c | 411 | e |
| Cyanide (Total) | n/a | --- | n/a | --- | 68.7 | d | n/a | --- |

***Notes :***

LOAEL - Lowest Observed Adverse Effect Level
NOAEL - No Observed Adverse Effect Level
n/a -Value not available

***Source:***

a - U.S. EPA (1999b)
b - U.S. EPA (2007a)
c - U.S. EPA, Region 9 (2009)
d - Sample et al. (1996)
e - U.S. EPA, Region 9 (2002)
f - See text for derivation

# TABLE 5.10

## SUMMARY OF FOOD CHAIN MODEL FOR AMERICAN WOODCOCK
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| *CONSTITUENT* | *Ingestion (mg/kg/day)* | | | | *NOAEL (mg/kg/day)* | *$HQ_{NOAEL}$ (Unitless)* | *LOAEL (mg/kg/day)* | *$HQ_{LOAEL}$ (Unitless)* | *Develop Ecological PRG* |
|---|---|---|---|---|---|---|---|---|---|
| | *Food* | *Soil* | *Water* | *Total* | | | | | |
| ***Volatile Organic Compounds (VOCs)*** | | | | | | | | | |
| Acetone | 0 | 0.193 | 0 | 0.193 | 5.2 | 0.037 | --- | --- | No |
| Isopropylbenzene | 13.7 | 0.005 | 0 | 13.7 | n/a | --- | n/a | --- | --- |
| ***BTEX*** | | | | | | | | | |
| Benzene | 0 | 0.006 | 0 | 0.006 | n/a | --- | n/a | --- | --- |
| Toluene | 0 | 0.093 | 0 | 0.093 | n/a | --- | n/a | --- | --- |
| Xylenes (Total) | 0 | 0.082 | 0 | 0.082 | n/a | --- | n/a | --- | --- |
| ***Semi-Volatile Organic Compounds (SVOCs)*** | | | | | | | | | |
| Carbazole | 8.47 | 0.003 | 0 | 8.50 | n/a | --- | n/a | --- | --- |
| ***Polycyclic Aromatic Hydrocarbons (PAHs)*** | | | | | | | | | |
| High Molecular Weight PAHs | 11.1 | 0.699 | 0 | 11.8 | 2.0 | **5.9** | 20 | 0.59 | Yes |
| ***Inorganic Constituents*** | | | | | | | | | |
| Cadmium | 1.70 | 0.033 | 0 | 1.73 | 0.70 | **2.5** | 10.4 | 0.17 | Yes |
| Copper | 15.8 | 5.02 | 0 | 20.8 | 2.3 | **9.0** | 52.3 | 0.40 | Yes |
| Lead | 11.4 | 6.35 | 0 | 17.8 | 0.014 | **1,269** | 8.75 | **2.0** | Yes |
| Mercury | 0.078 | 0.054 | 0 | 0.132 | 0.039 | **3.4** | 0.18 | 0.73 | Yes |
| Zinc | 123 | 11.7 | 0 | 135 | 17.2 | **7.8** | 172 | 0.78 | Yes |

***Notes :***

**Bold Font** identifies hazard quotient greater than 1.0

n/a - Value not available

BTEX - Benzene, Toluene, Ethylbenzene, and Xylenes

mg - milligram

kg - kilogram

LOAEL - Lowest Observed Adverse Effect Level

NOAEL - No Observed Adverse Effect Level

$HQ_{LOAEL}$ - Hazard quotient based on LOAEL

$HQ_{NOAEL}$ - Hazard quotient based on NOAEL

PRG - Preliminary Remediation Goal

# TABLE 5.11

## SUMMARY OF FOOD CHAIN MODEL FOR MOURNING DOVE
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| *CONSTITUENT* | *Ingestion (mg/kg/day)* | | | | *NOAEL (mg/kg/day)* | *$HQ_{NOAEL}$ (Unitless)* | *LOAEL (mg/kg/day)* | *$HQ_{LOAEL}$ (Unitless)* | *Develop Ecological PRG* |
|---|---|---|---|---|---|---|---|---|---|
| | *Food* | *Soil* | *Water* | *Total* | | | | | |
| ***Volatile Organic Compounds (VOCs)*** | | | | | | | | | |
| Acetone | 0 | 0.145 | 0 | 0.145 | 5.2 | 0.028 | --- | --- | No |
| Isopropylbenzene | 0.009 | 0.004 | 0 | 0.013 | n/a | --- | n/a | --- | --- |
| ***BTEX*** | | | | | | | | | |
| Benzene | 0 | 0.004 | 0 | 0.004 | n/a | --- | n/a | --- | --- |
| Toluene | 0 | 0.070 | 0 | 0.070 | n/a | --- | n/a | --- | --- |
| Xylenes (Total) | 0 | 0.062 | 0 | 0.062 | n/a | --- | n/a | --- | --- |
| ***Semi-Volatile Organic Compounds (SVOCs)*** | | | | | | | | | |
| Carbazole | 0.004 | 0.002 | 0 | 0.007 | n/a | --- | n/a | --- | --- |
| ***Polycyclic Aromatic Hydrocarbons (PAHs)*** | | | | | | | | | |
| High Molecular Weight PAHs | 0.588 | 0.526 | 0 | 1.11 | 2.0 | 0.56 | --- | --- | No |
| ***Inorganic Constituents*** | | | | | | | | | |
| Cadmium | 0.115 | 0.025 | 0 | 0.140 | 0.70 | 0.20 | --- | --- | No |
| Copper | 2.62 | 3.78 | 0 | 6.40 | 2.3 | **2.8** | 52.3 | 0.12 | Yes |
| Lead | 0.930 | 4.78 | 0 | 5.71 | 0.014 | **408** | 8.75 | 0.65 | Yes |
| Mercury | 0.011 | 0.040 | 0 | 0.051 | 0.039 | **1.3** | 0.180 | 0.29 | Yes |
| Zinc | 22.9 | 8.79 | 0 | 31.7 | 17.2 | **1.8** | 172 | 0.18 | Yes |

***Notes :***

**Bold Font** identifies hazard quotient greater than 1.0

n/a - Value not available

BTEX - Benzene, Toluene, Ethylbenzene, and Xylenes

mg - milligram

kg - kilogram

LOAEL - Lowest Observed Adverse Effect Level

NOAEL - No Observed Adverse Effect Level

$HQ_{LOAEL}$ - Hazard quotient based on LOAEL

$HQ_{NOAEL}$ - Hazard quotient based on NOAEL

PRG - Preliminary Remediation Goal

# TABLE 5.12

## SUMMARY OF FOOD CHAIN MODEL FOR RED-TAILED HAWK
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| *CONSTITUENT* | *Ingestion (mg/kg/day)* | | | | *NOAEL (mg/kg/day)* | *$HQ_{NOAEL}$ (Unitless)* | *LOAEL (mg/kg/day)* | *$HQ_{LOAEL}$ (Unitless)* | *Develop Ecological PRG* |
|---|---|---|---|---|---|---|---|---|---|
| | *Food* | *Soil* | *Water* | *Total* | | | | | |
| ***Volatile Organic Compounds (VOCs)*** | | | | | | | | | |
| Acetone | 0 | 0.011 | 0 | 0.011 | 5.2 | 0.002 | --- | --- | No |
| Isopropylbenzene | 2.25 | 0.0003 | 0 | 2.25 | n/a | --- | n/a | --- | --- |
| ***BTEX*** | | | | | | | | | |
| Benzene | 0 | 0.0003 | 0 | 0.0003 | n/a | --- | n/a | --- | --- |
| Toluene | 0 | 0.005 | 0 | 0.005 | n/a | --- | n/a | --- | --- |
| Xylenes (Total) | 0 | 0.005 | 0 | 0.005 | n/a | --- | n/a | --- | --- |
| ***Semi-Volatile Organic Compounds (SVOCs)*** | | | | | | | | | |
| Carbazole | 1.40 | 0.0002 | 0 | 1.40 | n/a | --- | n/a | --- | --- |
| ***Polycyclic Aromatic Hydrocarbons (PAHs)*** | | | | | | | | | |
| High Molecular Weight PAHs | 0 | 0.040 | 0 | 0.040 | 2.0 | 0.020 | --- | --- | No |
| ***Inorganic Constituents*** | | | | | | | | | |
| Cadmium | 0.010 | 0.002 | 0 | 0.012 | 0.70 | 0.017 | --- | --- | No |
| Copper | 0.557 | 0.288 | 0 | 0.845 | 2.3 | 0.37 | --- | --- | No |
| Lead | 0.379 | 0.364 | 0 | 0.744 | 0.014 | **53** | 8.75 | 0.085 | Yes |
| Mercury | 0.003 | 0.003 | 0 | 0.006 | 0.039 | 0.15 | --- | --- | No |
| Zinc | 4.18 | 0.670 | 0 | 4.80 | 17.2 | 0.28 | --- | --- | No |

***Notes :***

**Bold Font** identifies hazard quotient greater than 1.0

n/a - Value not available

BTEX - Benzene, Toluene, Ethylbenzene, and Xylenes

mg - milligram

kg - kilogram

LOAEL - Lowest Observed Adverse Effect Level

NOAEL - No Observed Adverse Effect Level

$HQ_{LOAEL}$ - Hazard quotient based on LOAEL

$HQ_{NOAEL}$ - Hazard quotient based on NOAEL

PRG - Preliminary Remediation Goal

# TABLE 5.13

## SUMMARY OF FOOD CHAIN MODEL FOR SHORT-TAILED SHREW
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| *CONSTITUENT* | *Ingestion (mg/kg/day)* | | | | *NOAEL (mg/kg/day)* | *HQ $_{NOAEL}$ (Unitless)* | *LOAEL (mg/kg/day)* | *HQ $_{LOAEL}$ (Unitless)* | *Develop Ecological PRG* |
|---|---|---|---|---|---|---|---|---|---|
| | *Food* | *Soil* | *Water* | *Total* | | | | | |
| ***Volatile Organic Compounds (VOCs)*** | | | | | | | | | |
| Acetone | 0 | 0.034 | 0 | 0.034 | 10 | 0.003 | --- | --- | No |
| Isopropylbenzene | 13.3 | 0.0009 | 0 | 13.3 | 154 | 0.086 | --- | --- | No |
| ***BTEX*** | | | | | | | | | |
| Xylenes (Total) | 0 | 0.015 | 0 | 0.015 | 2.1 | 0.007 | --- | --- | No |
| ***Semi-Volatile Organic Compounds (SVOCs)*** | | | | | | | | | |
| Carbazole | 8.27 | 0.0005 | 0 | 8.27 | 5.2 | **1.6** | 57.3 | 0.14 | Yes |
| ***Polycyclic Aromatic Hydrocarbons (PAHs)*** | | | | | | | | | |
| High Molecular Weight PAHs | 10.8 | 0.125 | 0 | 10.9 | 0.615 | **18** | 28.6 | 0.38 | Yes |
| ***Inorganic Constituents*** | | | | | | | | | |
| Cadmium | 1.66 | 0.006 | 0 | 1.66 | 0.06 | **28** | 2.64 | 0.63 | Yes |
| Copper | 15.4 | 0.897 | 0 | 16.3 | 2.67 | **6.1** | 632 | 0.026 | Yes |
| Lead | 11.2 | 1.13 | 0 | 12.3 | 1.0 | **12** | 241 | 0.051 | Yes |
| Mercury | 0.077 | 0.010 | 0 | 0.086 | 0.027 | **3.2** | 4.0 | 0.022 | Yes |
| Selenium | 0.156 | 0.005 | 0 | 0.161 | 0.05 | **3.2** | 1.21 | 0.13 | Yes |
| Zinc | 120 | 2.09 | 0 | 122 | 9.6 | **13** | 411 | 0.30 | Yes |
| Cyanide (Total) | 2.05 | 0.009 | 0 | 2.06 | 68.7 | 0.030 | --- | --- | No |

***Notes*** **:**

**Bold Font** identifies hazard quotient greater than 1.0
BTEX - Benzene, Toluene, Ethylbenzene, and Xylenes
mg - milligram
kg - kilogram
LOAEL - Lowest Observed Adverse Effect Level
NOAEL - No Observed Adverse Effect Level
$HQ_{LOAEL}$ - Hazard quotient based on LOAEL
$HQ_{NOAEL}$ - Hazard quotient based on NOAEL
PRG - Preliminary Remediation Goal

# TABLE 5.14

## SUMMARY OF FOOD CHAIN MODEL FOR MEADOW VOLE
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| *CONSTITUENT* | *Ingestion (mg/kg/day)* | | | | *NOAEL (mg/kg/day)* | *HQ $_{NOAEL}$ (Unitless)* | *LOAEL (mg/kg/day)* | *HQ $_{LOAEL}$ (Unitless)* | *Develop Ecological PRG* |
|---|---|---|---|---|---|---|---|---|---|
| | *Food* | *Soil* | *Water* | *Total* | | | | | |
| ***Volatile Organic Compounds (VOCs)*** | | | | | | | | | |
| Acetone | 0 | 0.015 | 0 | 0.015 | 10 | 0.002 | --- | --- | No |
| Isopropylbenzene | 0.004 | 0.0004 | 0 | 0.004 | 154 | 0.00003 | --- | --- | No |
| ***BTEX*** | | | | | | | | | |
| Xylenes (Total) | 0 | 0.007 | 0 | 0.007 | 2.1 | 0.003 | --- | --- | No |
| ***Semi-Volatile Organic Compounds (SVOCs)*** | | | | | | | | | |
| Carbazole | 0.002 | 0.0002 | 0 | 0.002 | 5.2 | 0.0004 | --- | --- | No |
| ***Polycyclic Aromatic Hydrocarbons (PAHs)*** | | | | | | | | | |
| High Molecular Weight PAHs | 0.271 | 0.056 | 0 | 0.327 | 0.615 | 0.53 | --- | --- | No |
| ***Inorganic Constituents*** | | | | | | | | | |
| Cadmium | 0.053 | 0.003 | 0 | 0.06 | 0.06 | 0.93 | --- | --- | No |
| Copper | 1.21 | 0.400 | 0 | 1.61 | 2.67 | 0.60 | --- | --- | No |
| Lead | 0.428 | 0.507 | 0 | 0.940 | 1.0 | 0.94 | --- | --- | No |
| Mercury | 0.005 | 0.004 | 0 | 0.009 | 0.027 | 0.34 | --- | --- | No |
| Selenium | 0.032 | 0.002 | 0 | 0.034 | 0.05 | 0.68 | --- | --- | No |
| Zinc | 10.6 | 0.932 | 0 | 11.5 | 9.6 | **1.2** | 411 | 0.028 | Yes |
| Cyanide (Total) | 0.128 | 0.004 | 0 | 0.13 | 68.7 | 0.002 | --- | --- | No |

***Notes :***

**Bold Font** identifies hazard quotient greater than 1.0
BTEX - Benzene, Toluene, Ethylbenzene, and Xylenes
mg - milligram
kg - kilogram
LOAEL - Lowest Observed Adverse Effect Level
NOAEL - No Observed Adverse Effect Level
$HQ_{LOAEL}$ - Hazard quotient based on LOAEL
$HQ_{NOAEL}$ - Hazard quotient based on NOAEL
PRG - Preliminary Remediation Goal

# TABLE 5.15

## SUMMARY OF FOOD CHAIN MODEL FOR LONG-TAILED WEASEL
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| *CONSTITUENT* | *Ingestion (mg/kg/day)* | | | | *NOAEL (mg/kg/day)* | *$HQ_{NOAEL}$ (Unitless)* | *LOAEL (mg/kg/day)* | *$HQ_{LOAEL}$ (Unitless)* | *Develop Ecological PRG* |
|---|---|---|---|---|---|---|---|---|---|
| | *Food* | *Soil* | *Water* | *Total* | | | | | |
| ***Volatile Organic Compounds (VOCs)*** | | | | | | | | | |
| Acetone | 0 | 0.031 | 0 | 0.031 | 10 | 0.003 | --- | --- | No |
| Isopropylbenzene | 8.30 | 0.0008 | 0 | 8.30 | 154 | 0.054 | --- | --- | No |
| ***BTEX*** | | | | | | | | | |
| Xylenes (total) | 0 | 0.013 | 0 | 0.013 | 2.1 | 0.006 | --- | --- | No |
| ***Semi-Volatile Organic Compounds (SVOCs)*** | | | | | | | | | |
| Carbazole | 5.14 | 0.0005 | 0 | 5.15 | 5.2 | 0.99 | --- | --- | No |
| ***Polycyclic Aromatic Hydrocarbons (PAHs)*** | | | | | | | | | |
| High Molecular Weight PAHs | 0 | 0.111 | 0 | 0.111 | 0.615 | 0.18 | --- | --- | No |
| ***Inorganic Constituents*** | | | | | | | | | |
| Cadmium | 0.036 | 0.005 | 0 | 0.041 | 0.06 | 0.69 | --- | -- | No |
| Copper | 2.05 | 0.799 | 0 | 2.85 | 2.67 | **1.1** | 632 | 0.005 | Yes |
| Lead | 1.40 | 1.01 | 0 | 2.41 | 1.0 | **2.4** | 241 | 0.010 | Yes |
| Mercury | 0.011 | 0.009 | 0 | 0.019 | 0.027 | 0.72 | --- | --- | No |
| Selenium | 0.077 | 0.004 | 0 | 0.081 | 0.050 | **1.6** | 1.21 | 0.067 | Yes |
| Zinc | 15.4 | 1.86 | 0 | 17.2 | 9.6 | **1.8** | 411 | 0.042 | Yes |
| Cyanide (Total) | 1.28 | 0.008 | 0 | 1.29 | 68.7 | 0.019 | --- | --- | No |

***Notes*** **:**

**Bold Font** identifies hazard quotient greater than 1.0
BTEX - Benzene, Toluene, Ethylbenzene, and Xylenes
mg - milligram
kg - kilogram
LOAEL - Lowest Observed Adverse Effect Level
NOAEL - No Observed Adverse Effect Level
$HQ_{LOAEL}$ - Hazard quotient based on LOAEL
$HQ_{NOAEL}$ - Hazard quotient based on NOAEL
PRG - Preliminary Remediation Goal

# TABLE 7.1

## EXPOSURE PARAMETERS FOR AMERICAN WOODCOCK AND SHORT-TAILED SHREW FOR DEVELOPMENT OF PRELIMINARY REMEDIATION GOALS
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| *Parameter* | *Units* | *American Woodcock* | *Short-Tailed Shrew* |
|---|---|---|---|
| Body Weight | kg | 0.213 | 0.015 |
| Free Metabolic Rate | kcal/day | 96.65 | 8.4 |
| Assimilation Efficiency | Unitless | | |
| Soil Invertebrates | | 0.83 | 0.90 |
| Plant Material | | 0.76 | 0.91 |
| Weighted Average Metabolizable Energy | kcal/g | 2.93 | 2.27 |
| Normalized Daily Intake | kg DW/kg/day | 0.187 | 0.259 |
| Soil Ingestion | | | |
| $P_s$ | Unitless | 0.164 | 0.03 |
| Rate | kg DW/kg/day | 0.031 | 0.007 |
| Diet | Unitless | | |
| Soil Invertebrates | | 0.678 | 0.820 |
| Plant Material | | 0.322 | 0.180 |

***Notes*** **:**

DW - Dry Weight
kcal - kilocalories
kg - kilogram
g - gram
mg - milligram
$P_s$ - Proportion of Soil Ingested (from U.S. EPA, 2007a)
All other exposure parameters from Wildlife Scenario Builder (U.S. EPA, 2013b)

**TABLE 7.2**

**ECOLOGICAL PRELIMINARY REMEDIATION GOALS**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| ***COPEC*** | ***American Woodcock*** mg/kg | ***Short-Tailed Shrew*** mg/kg | ***Ecological PRG*** mg/kg |
|---|---|---|---|
| ***Semi-Volatile Organic Compounds (SVOCs)*** | | | |
| Carbazole | nc | 0.672 | 0.672 |
| ***Polycyclic Aromatic Hydrocarbons (PAHs)*** | | | |
| High Molecular Weight PAHs | 69.6 | 59.6 | 59.6 |
| ***Inorganic Compounds*** | | | |
| Cadmium | 23.0 | 2.01 | 2.01 |
| Copper | 634 | 6,334 | 634 |
| Lead | 140[a]/812[b] | 7,212 | 140[a]/812[b] |
| Mercury | 3.19 | 76.8 | 3.19 |
| Selenium | nc | 9.09 | 9.09 |
| Zinc | 1,705 | 9,142 | 1,705 |

***Notes :***

[a] - Lower end PRG based on LOAEL of 8.75 mg/kg-day (LOAEL identified by U.S. EPA for use in food chain model)
[b] - Upper end PRG based on LOAEL of 42.7 mg/kg-day (geometric mean of bounded LOAELs identified in U.S. EPA (2005f))
nc - Preliminary Remediation Goal not calculated
PRG - Preliminary Remediation Goal
mg/kg - milligrams per kilogram
COPEC - Constituent of Potential Ecological Concern

**TABLE 7.3**

**COMPARISION OF ECOLOGICAL PRELIMINARY REMEDIATION GOALS TO EXPOSURE CONCENTRATIONS**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *COPEC* | *Ecological PRG mg/kg* | *95% UCL mg/kg* | *95% UCL < PRG* | *UCL Percent of PRG [b]* | *Risk Management Required to Meet RAO* |
|---|---|---|---|---|---|
| ***Semi-Volatile Organic Compounds (SVOCs)*** | | | | | |
| Carbazole | 0.672 | 0.083 [a] | Yes | 12% | No |
| ***Polycyclic Aromatic Hydrocarbons (PAHs)*** | | | | | |
| High Molecular Weight PAHs | 59.6 | 19.9 | Yes | 33% | No |
| ***Inorganic Compounds*** | | | | | |
| Cadmium | 2.01 | 0.948 | Yes | 47% | No |
| Copper | 634 | 143 | Yes | 23% | No |
| Lead | 140[c]/812[d] | 181 | No[c]/Yes[d] | 129%[c]/22%[d] | **YES** |
| Mercury | 3.19 | 1.53 | Yes | 48% | No |
| Selenium | 9.09 | 0.744 | Yes | 8.2% | No |
| Zinc | 1,705 | 333 | Yes | 20% | No |

***Notes :***

[a] - Maximum concentration. Insufficient number of detects to calculate an Upper Confidence Limit (UCL)
[b] - Calculated as ((UCL/PRG)*100)
[c] - Lower end PRG based on LOAEL of 8.75 mg/kg-day (LOAEL identified by U.S. EPA for use in food chain model)
[d] - Upper end PRG based on LOAEL of 42.7 mg/kg-day (geometric mean of bounded LOAELs identified in U.S. EPA (2005f))
PRG - Preliminary Remediation Goal
RAO - Remedial Action Objective
mg/kg - milligrams per kilogram

# Appendix A

## Dataset for the Refinement Process

**APPENDIX A**

**DATASET FOR THE REFINEMENT PROCESS**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| ***Redevelopment Area*** | ***Residential Area 1*** | ***Residential Area 1*** | ***Residential Area 1*** | ***Residential Area 1*** | ***Residential Area 1*** | ***Residential Area 1*** | ***Residential Area 1*** | ***Residential Area 1*** |
|---|---|---|---|---|---|---|---|---|
| ***Sample Location*** | ***SB-101*** | ***SB-102*** | ***SB-103*** | ***SB-104*** | ***SB-106*** | ***SB-107*** | ***SB-116*** | ***SB-118*** |
| ***Sample Date*** | ***1/18/2010*** | ***1/20/2010*** | ***1/20/2010*** | ***1/21/2010*** | ***1/18/2010*** | ***1/18/2010*** | ***1/19/2010*** | ***1/20/2010*** |
| ***Sample Depth*** | ***(0-1) ft BGS*** | ***(0-1) ft BGS*** | ***(0-1) ft BGS*** | ***(0-1) ft BGS*** | ***(0-1) ft BGS*** | ***(0-1) ft BGS*** | ***(0-1) ft BGS*** | ***(0-1) ft BGS*** |
| ***Constituent*** | | | | | | | | |
| | | | | | | | | |
| ***Volatile Organic Compounds (VOCs)*** | | | | | | | | |
| Acetone | R | R | R | R | R | R | R | 0.82 J |
| Isopropylbenzene | 0.25 U | 0.60 U | 0.25 U | 0.26 U | 0.25 U | 0.26 U | 0.25 U | 0.050 J |
| ***BTEX*** | | | | | | | | |
| Benzene | 0.062 U | 0.15 U | 0.061 U | 0.0090 J | 0.062 U | 0.065 U | 0.061 U | 0.037 J |
| Toluene | 0.062 U | 0.37 | 0.061 U | 0.092 | 0.062 U | 0.023 J | 0.061 U | 0.67 |
| o-Xylene | 0.062 U | 0.31 | 0.061 U | 0.049 J | 0.062 U | 0.065 U | 0.061 U | 0.57 |
| m&p-Xylene | 0.062 U | 0.51 | 0.061 U | 0.073 | 0.062 U | 0.065 U | 0.061 U | 0.82 |
| ***SEMI-VOLATILE ORGANIC COMPOUNDS (SVOCs)*** | | | | | | | | |
| bis(2-Ethylhexyl)phthalate (DEHP) | 0.35 U | 0.4 U | 0.34 U | 0.14 J | 0.33 U | 0.32 U | 0.33 U | 0.041 J |
| Carbazole | 0.35 U | 0.4 U | 0.34 U | 0.36 U | 0.33 U | 0.32 U | 0.33 U | 0.38 U |
| ***POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)*** | | | | | | | | |
| **HMW PAHs** | 1.05 | 1.2 | 1.02 | 0.622 | 0.99 | 0.96 | 0.99 | 0.558 |
| Benzo(a)anthracene | 0.35 U | 0.4 U | 0.34 U | 0.067 J | 0.33 U | 0.32 U | 0.33 U | 0.05 J |
| Benzo(a)pyrene | 0.35 U | 0.4 U | 0.34 U | 0.085 J | 0.33 U | 0.32 U | 0.33 U | 0.082 J |
| Chrysene | 0.35 U | 0.4 U | 0.34 U | 0.08 J | 0.33 U | 0.32 U | 0.33 U | 0.067 J |
| Dibenz(a,h)anthracene | 0.35 U | 0.4 U | 0.34 U | 0.12 J | 0.33 U | 0.32 U | 0.33 U | 0.38 U |
| Fluoranthene | 0.35 U | 0.4 U | 0.34 U | 0.15 J | 0.33 U | 0.32 U | 0.33 U | 0.092 J |
| Pyrene | 0.35 U | 0.4 U | 0.34 U | 0.12 J | 0.33 U | 0.32 U | 0.33 U | 0.077 J |
| ***POLYCHLORINATED BIPHENYLS (PCBs)*** | | | | | | | | |
| **Total PCBs** | 0.136 J | 0.008 U | 0.32 J | 0.39 J | 0.0066 U | 0.031 J | 0.064 J | 0.25 J |
| Aroclor-1248 (PCB-1248) | 0.052 | 0.008 U | 0.0069 U | 0.0071 U | 0.0066 U | 0.0065 U | 0.0066 U | 0.0077 U |
| Aroclor-1254 (PCB-1254) | 0.049 J | 0.008 U | 0.17 J | 0.23 J | 0.0066 U | 0.018 J | 0.036 J | 0.13 J |
| Aroclor-1260 (PCB-1260) | 0.035 J | 0.008 U | 0.15 J | 0.16 J | 0.0066 U | 0.013 J | 0.028 J | 0.12 J |
| ***INORGANIC CONSTITUENTS*** | | | | | | | | |
| Anitmony | 0.6 UJ | 0.7 UJ | 0.6 UJ | 0.6 UJ | 0.5 UJ | 0.3 UJ | 0.5 UJ | 0.6 UJ |
| Arsenic | 10.3 | 16.2 | 10.6 J | 6.5 J | 3.3 | 3.7 | 7.0 | 5.7 J |
| Barium | 41.4 | 228 | 91.3 J | 53.9 J | 17.2 | 18.1 | 50.8 | 87.6 J |
| Cadmium | 0.6 U | 0.7 U | 0.3 U | 0.3 U | 0.2 U | 0.2 U | 0.5 U | 0.3 U |
| Chromium | 11 J | 9 | 18 | 9 | 8 | 8 J | 12 | 16 |
| Cobalt | 4.5 | 5.8 | 5.5 | 2.9 | 2.4 | 3.0 | 5.0 | 3.8 |
| Copper | 9 | 23 | 13 | 14 | 7 J | 6 | 12 J | 20 |
| Iron | 14100 | 9020 | 16700 | 9370 | 5820 | 12800 | 19600 | 8640 |
| Lead | 11.2 | 32.5 | 41.9 | 30.6 | 4.0 | 6.3 | 12.7 | 37.9 |
| Manganese | 654 | 127 | 469 | 339 | 157 | 326 | 548 | 162 |
| Mercury | 0.05 | 0.04 U | 0.17 | 0.24 | 0.05 U | 0.05 U | 0.05 | 0.26 |
| Nickel | 7.6 | 13.2 | 9.6 | 7.9 | 6.1 | 7.1 | 10.4 | 12.1 |
| Selenium | 0.6 U | 0.7 | 0.3 | 0.5 | 0.4 | 0.6 | 0.5 U | 0.7 |
| Vanadium | 17 | 28 | 22 | 13 | 8 | 13 | 18 | 13 |
| Zinc | 26 | 22 | 44 | 36 | 18 | 22 | 34 | 55 |
| Cyanide (Total) | 0.9 | | | 0.9 | | | | |

***Notes :***

All results in milligrams per kilogram (mg/kg)
Blank Cell - Constituent not analyzed
J - Estimated
R - Rejected
U - Not Detected at the indicated concentration
ft - feet
BGS - Below Ground Surface

**APPENDIX A**

**DATASET FOR THE REFINEMENT PROCESS**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| ***Redevelopment Area*** | ***Residential Area 2*** | ***Residential Area 2*** | ***Residential Area 2*** | ***Residential Area 2*** | ***Residential Area 2*** | ***Residential Area 3*** | ***Residential Area 3*** | ***Residential Area 3*** |
|---|---|---|---|---|---|---|---|---|
| ***Sample Location*** | ***SB-105*** | ***SB-124*** | ***SB-126*** | ***SB-128*** | ***SB-130*** | ***MW-15*** | ***SB-135*** | ***SB-138*** |
| ***Sample Date*** | ***1/21/2010*** | ***1/21/2010*** | ***1/21/2010*** | ***1/21/2010*** | ***1/25/2010*** | ***1/11/2010*** | ***1/26/2010*** | ***1/26/2010*** |
| ***Sample Depth*** | ***(0-1) ft BGS*** | ***(0-1) ft BGS*** | ***(0-1) ft BGS*** | ***(0-1) ft BGS*** | ***(0-1) ft BGS*** | ***(0-2) ft BGS*** | ***(0-1) ft BGS*** | ***(0-1) ft BGS*** |
| ***Constituent*** | | | | | | | | |
| | | | | | | | | |
| ***Volatile Organic Compounds (VOCs)*** | | | | | | | | |
| Acetone | 0.31 J | R | R | R | R | | | |
| Isopropylbenzene | 0.24 U | 0.27 U | 0.24 U | 0.23 U | 0.26 U | 0.25 U | 0.24 U | 0.24 U |
| ***BTEX*** | | | | | | | | |
| Benzene | 0.059 U | 0.067 U | 0.059 U | 0.056 U | 0.0089 J | 0.061 U | 0.060 U | 0.059 U |
| Toluene | 0.059 U | 0.067 U | 0.059 U | 0.056 U | 0.043 J | 0.061 U | 0.060 U | 0.016 J |
| o-Xylene | 0.059 U | 0.011 J | 0.059 U | 0.056 U | 0.029 J | 0.061 U | 0.060 U | 0.059 U |
| m&p-Xylene | 0.059 U | 0.016 J | 0.059 U | 0.056 U | 0.038 J | 0.061 U | 0.060 U | 0.059 U |
| ***SEMI-VOLATILE ORGANIC COMPOUNDS (SVOCs)*** | | | | | | | | |
| bis(2-Ethylhexyl)phthalate (DEHP) | 0.37 U | 0.33 J | 0.15 J | 0.33 U | 0.04 J | 0.051 J | 0.042 J | 0.051 J |
| Carbazole | 0.37 U | 0.36 U | 0.33 U | 0.33 U | 0.37 U | 0.37 U | 0.34 U | 0.35 U |
| ***POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)*** | | | | | | | | |
| **HMW PAHs** | 0.706 | 0.602 | 0.861 | 0.99 | 1.527 | 0.553 | 0.756 | 1.05 |
| Benzo(a)anthracene | 0.37 U | 0.36 U | 0.33 U | 0.33 U | 0.2 J | 0.054 J | 0.34 U | 0.35 U |
| Benzo(a)pyrene | 0.37 U | 0.07 J | 0.33 U | 0.33 U | 0.072 J | 0.043 J | 0.34 U | 0.35 U |
| Chrysene | 0.04 J | 0.04 J | 0.33 U | 0.33 U | 0.21 J | 0.06 J | 0.34 U | 0.35 U |
| Dibenz(a,h)anthracene | 0.37 U | 0.36 U | 0.33 U | 0.33 U | 0.37 U | 0.37 U | 0.34 U | 0.35 U |
| Fluoranthene | 0.064 J | 0.076 J | 0.036 J | 0.33 U | 0.48 | 0.12 J | 0.042 J | 0.35 U |
| Pyrene | 0.047 J | 0.056 J | 0.33 U | 0.33 U | 0.38 | 0.091 J | 0.034 J | 0.35 U |
| ***POLYCHLORINATED BIPHENYLS (PCBs)*** | | | | | | | | |
| **Total PCBs** | 0.227 J | 0.147 J | 0.089 J | 0.125 J | 0.072 J | | | |
| Aroclor-1248 (PCB-1248) | 0.0075 U | 0.0071 U | 0.0067 U | 0.0065 U | 0.0074 U | | | |
| Aroclor-1254 (PCB-1254) | 0.13 J | 0.081 J | 0.051 J | 0.067 J | 0.072 J | | | |
| Aroclor-1260 (PCB-1260) | 0.097 J | 0.066 J | 0.038 J | 0.058 J | 0.0074 U | | | |
| ***INORGANIC CONSTITUENTS*** | | | | | | | | |
| Anitmony | 0.6 U | 0.6 UJ | 0.6 U | 0.6 U | 0.6 UJ | 0.3 J | 0.5 U | 0.4 UJ |
| Arsenic | 9.6 | 8.4 J | 6.9 | 3.9 | 5.1 | 19.9 | 6.6 | 6.2 |
| Barium | 65.6 | 87.8 J | 50.8 | 21.6 | 53.2 | 115 J | 56.0 | 49.7 |
| Cadmium | 0.6 U | 0.3 U | 0.6 U | 0.6 U | 0.6 U | 0.3 | 0.5 U | 0.3 U |
| Chromium | 13 | 14 | 14 | 11 | 24 | 13 | 12 | 10 |
| Cobalt | 5.4 | 4.8 | 4.5 | 5.1 | 4.2 | 4.2 | 3.7 | 3.6 |
| Copper | 18 | 15 | 45 | 14 | 26 J | 28 | 23 | 10 |
| Iron | 12500 | 14100 | 15100 | 8100 | 9440 | 9820 | 11200 | 9220 J |
| Lead | 32.0 | 22.9 | 45.6 | 18.2 | 38.4 | 63.9 | 45.0 | 14.1 |
| Manganese | 402 | 697 | 410 | 183 | 359 | 543 | 489 | 698 J |
| Mercury | 0.07 | 0.10 | 0.08 | 0.05 | 0.09 | 0.10 | 0.21 | 0.29 |
| Nickel | 13.0 | 10.3 | 9.2 | 8.2 | 9.6 | 12.8 J | 8.0 | 7.4 |
| Selenium | 0.6 U | 0.6 | 0.6 U | 0.6 U | 0.5 | 0.8 | 0.5 U | 0.5 |
| Vanadium | 15 | 19 | 13 | 16 | 14 | 15 J | 15 | 12 |
| Zinc | 46 | 47 | 47 | 33 | 60 | 92 J | 53 | 30 J |
| Cyanide (Total) | | | | | | | 1.0 | |

***Notes :***

All results in milligrams per kilogram (mg/kg)
Blank Cell - Constituent not analyzed
J - Estimated
R - Rejected
U - Not Detected at the indicated concentration
ft - feet
BGS - Below Ground Surface

**APPENDIX A**

**DATASET FOR THE REFINEMENT PROCESS**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| ***Redevelopment Area*** | ***Residential Area 3*** | ***Residential Area 3*** | ***Residential Area 3*** | ***Residential Area 3*** | ***Residential Area 3*** | ***Residential Area 3*** | ***Residential Area 3*** | ***Residential Area 4*** |
|---|---|---|---|---|---|---|---|---|
| ***Sample Location*** | ***SB-139*** | ***TP-1*** | ***TP-2*** | ***TP-3*** | ***TP-4*** | ***TP-5*** | ***TP-6*** | ***DG1*** |
| ***Sample Date*** | ***1/27/2010*** | ***3/14/2008*** | ***3/14/2008*** | ***3/14/2008*** | ***3/14/2008*** | ***3/14/2008*** | ***3/14/2008*** | ***4/21/1997*** |
| ***Sample Depth*** | ***(0-1) ft BGS*** | - | - | - | - | - | - | ***(0-1.5) ft BGS*** |
| ***Constituent*** | | | | | | | | |
| | | | | | | | | |
| ***Volatile Organic Compounds (VOCs)*** | | | | | | | | |
| Acetone | | | | | | | | |
| Isopropylbenzene | 0.28 U | | | | | | | |
| ***BTEX*** | | | | | | | | |
| Benzene | 0.069 U | | | | | | | |
| Toluene | 0.069 U | | | | | | | |
| o-Xylene | 0.069 U | | | | | | | |
| m&p-Xylene | 0.069 U | | | | | | | |
| ***SEMI-VOLATILE ORGANIC COMPOUNDS (SVOCs)*** | | | | | | | | |
| bis(2-Ethylhexyl)phthalate (DEHP) | 0.35 U | | | | | | | |
| Carbazole | 0.35 U | | | | | | | |
| ***POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)*** | | | | | | | | |
| **HMW PAHs** | 0.837 | | | | | | | 0.0821 |
| Benzo(a)anthracene | 0.096 J | | | | | | | 0.0095 |
| Benzo(a)pyrene | 0.036 J | | | | | | | 0.013 |
| Chrysene | 0.11 J | | | | | | | 0.017 |
| Dibenz(a,h)anthracene | 0.35 U | | | | | | | 0.0056 |
| Fluoranthene | 0.22 J | | | | | | | 0.053 U |
| Pyrene | 0.2 J | | | | | | | 0.021 U |
| ***POLYCHLORINATED BIPHENYLS (PCBs)*** | | | | | | | | |
| **Total PCBs** | | 0.35 | 0.28 | 0.04 | 0.05 | 0.01 | 0.08 | |
| Aroclor-1248 (PCB-1248) | | | | | | | | |
| Aroclor-1254 (PCB-1254) | | | | | | | | |
| Aroclor-1260 (PCB-1260) | | | | | | | | |
| ***INORGANIC CONSTITUENTS*** | | | | | | | | |
| Anitmony | 0.4 J | | | | | | | |
| Arsenic | 12.5 | | | | | | | 3.6 |
| Barium | 94.2 | | | | | | | |
| Cadmium | 0.3 | | | | | | | 0.99 |
| Chromium | 36 | | | | | | | 5.9 |
| Cobalt | 5.5 | | | | | | | |
| Copper | 24 | | | | | | | 3.8 |
| Iron | 15100 J | | | | | | | |
| Lead | 55.3 | | | | | | | 7.4 |
| Manganese | 637 J | | | | | | | |
| Mercury | 0.42 | | | | | | | 0.043 U |
| Nickel | 29.3 | | | | | | | |
| Selenium | 0.5 | | | | | | | 0.53 U |
| Vanadium | 17 | | | | | | | |
| Zinc | 80 J | | | | | | | 27 U |
| Cyanide (Total) | | | | | | | | |

***Notes :***
All results in milligrams per kilogram (mg/kg)
Blank Cell - Constituent not analyzed
J - Estimated
R - Rejected
U - Not Detected at the indicated concentration
ft - feet
BGS - Below Ground Surface

**APPENDIX A**

**DATASET FOR THE REFINEMENT PROCESS**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| ***Redevelopment Area*** | ***Residential Area 4*** | ***Residential Area 4*** | ***Residential Area 4*** | ***Residential Area 4*** | ***Residential Area 4*** | ***Residential Area 4*** | ***Residential Area 4*** |
|---|---|---|---|---|---|---|---|
| ***Sample Location*** | ***DG2*** | ***DG3*** | ***DG4*** | ***DG5*** | ***SB-7*** | ***SB-301*** | ***SB-302*** |
| ***Sample Date*** | ***4/21/1997*** | ***4/21/1997*** | ***4/21/1997*** | ***4/21/1997*** | ***9/5/2006*** | ***1/27/2010*** | ***1/27/2010*** |
| ***Sample Depth*** | ***(0-1.5) ft BGS*** | ***(0-1.5) ft BGS*** | ***(0-1.5) ft BGS*** | ***(0-1.5) ft BGS*** | ***(0-0.5) ft BGS*** | ***(0-1) ft BGS*** | ***(0-1) ft BGS*** |
| ***Constituent*** | | | | | | | |
| | | | | | | | |
| ***Volatile Organic Compounds (VOCs)*** | | | | | | | |
| Acetone | | | | | | R | 5.5 J |
| Isopropylbenzene | | | | | | 0.087 J | 0.66 |
| ***BTEX*** | | | | | | | |
| Benzene | | | | | | 0.074 | 1.3 |
| Toluene | | | | | | 1.4 | 22 |
| o-Xylene | | | | | | 0.89 | 7.4 |
| m&p-Xylene | | | | | | 1.3 | 11 |
| ***SEMI-VOLATILE ORGANIC COMPOUNDS (SVOCs)*** | | | | | | | |
| bis(2-Ethylhexyl)phthalate (DEHP) | | | | | | 0.13 J | 0.08 J |
| Carbazole | | | | | | 0.98 U | 0.083 J |
| ***POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)*** | | | | | | | |
| **HMW PAHs** | 0.135 | 26.5 | 17.15 | 0.1077 | 4.346 | 2.16 | 2.43 |
| Benzo(a)anthracene | 0.02 | 3.8 | 0.47 | 0.013 | 0.56 J/0.44 J | 0.23 J | 0.38 |
| Benzo(a)pyrene | 0.03 | 4.9 | 0.58 | 0.02 | 0.35 J/0.34 J | 0.27 J | 0.36 J |
| Chrysene | 0.019 | 8.1 | 5.5 | 0.016 | 0.42 J/0.46 J | 0.36 J | 0.56 |
| Dibenz(a,h)anthracene | 0.0045 | 0.9 | 6.4 | 0.0052 | 0.071 J/0.076 J | 0.98 U | 0.08 J |
| Fluoranthene | 0.053 U | 5.6 U | 6 U | 0.053 U | 1.4/1.4 | 0.46 J | 0.52 |
| Pyrene | 0.035 | 6 | 2.4 U | 0.027 | 1.2/1.5 | 0.35 J | 0.53 |
| ***POLYCHLORINATED BIPHENYLS (PCBs)*** | | | | | | | |
| **Total PCBs** | | | | | | 0.066 U | 0.4 J |
| Aroclor-1248 (PCB-1248) | | | | | | 0.066 U | 0.072 U |
| Aroclor-1254 (PCB-1254) | | | | | | 0.066 U | 0.2 J |
| Aroclor-1260 (PCB-1260) | | | | | | 0.066 U | 0.2 J |
| ***INORGANIC CONSTITUENTS*** | | | | | | | |
| Anitmony | | | | | | 1.5 J | 1.2 J |
| Arsenic | 4.4 | 6.8 | 16 | 2.7 U | 5.8 | 21.6 | 6.9 |
| Barium | | | | | | 73.1 | 151 |
| Cadmium | 1.1 | 1.9 | 3.9 | 1 | 0.27 | 0.3 | 0.6 |
| Chromium | 5.5 | 11 | 28 | 6.3 | 7.6 | 10 | 12 |
| Cobalt | | | | | | 6 | 6 |
| Copper | 2.6 U | 120 | 220 | 5 | 22 | 40 | 71 |
| Iron | | | | | | 13100 J | 10900 J |
| Lead | 32 | 140 | 990 | 11 | 41 | 58.1 | 99.5 |
| Manganese | | | | | | 296 J | 351 J |
| Mercury | 0.049 | 5.6 | 1.1 | 0.043 U | 0.28 | 0.22 | 0.16 |
| Nickel | | | | | | 12.8 | 12.0 |
| Selenium | 0.53 U | 0.56 U | 0.6 U | 0.53 U | 0.5 | 1.1 | 1.8 |
| Vanadium | | | | | | 16 | 14 |
| Zinc | 26 U | 230 | 450 | 27 U | 64 | 75 J | 154 J |
| Cyanide (Total) | | | | | | | 0.5 |

***Notes :***

All results in milligrams per kilogram (mg/kg)
Blank Cell - Constituent not analyzed
J - Estimated
R - Rejected
U - Not Detected at the indicated concentration
ft - feet
BGS - Below Ground Surface

**APPENDIX A**

**DATASET FOR THE REFINEMENT PROCESS**
**FORMER PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| ***Redevelopment Area*** | ***Residential Area 4*** | ***Commercial Area 4*** | ***Commercial Area 4*** | ***Commercial Area 4*** | ***Commercial Area 4*** | ***Commercial Area 4*** |
|---|---|---|---|---|---|---|
| ***Sample Location*** | ***SB-321*** | ***PM8*** | ***SB-201*** | ***SB-202*** | ***SB-203*** | ***TP-341*** |
| ***Sample Date*** | ***1/27/2010*** | ***1/1/2009*** | ***1/27/2010*** | ***1/27/2010*** | ***1/27/2010*** | ***5/20/2010*** |
| ***Sample Depth*** | ***(0-1) ft BGS*** | ***(0.3-0.5) ft BGS*** | ***(0-1) ft BGS*** | ***(0-1) ft BGS*** | ***(0-1) ft BGS*** | ***(0.5-1.5) ft BGS*** |
| ***Constituent*** | | | | | | |
| | | | | | | |
| ***Volatile Organic Compounds (VOCs)*** | | | | | | |
| Acetone | R/R | | R | R | R | R |
| Isopropylbenzene | 0.22 U/0.25 U | | 0.19 U | 0.25 U | 0.22 U | 0.28 U |
| ***BTEX*** | | | | | | |
| Benzene | 0.054 U/0.061 U | | 0.0085 J | 0.061 U | 0.055 U | 0.0056 J |
| Toluene | 0.054 U/0.061 U | | 0.074 U | 0.022 J | 0.047 J | 0.070 U |
| o-Xylene | 0.054 U/0.061 U | | 0.045 J | 0.061 U | 0.082 | 0.057 J |
| m&p-Xylene | 0.054 U/0.061 U | | 0.071 U | 0.061 U | 0.096 | 0.078 |
| ***SEMI-VOLATILE ORGANIC COMPOUNDS (SVOCs)*** | | | | | | |
| bis(2-Ethylhexyl)phthalate (DEHP) | 0.34 U/0.35 U | | 0.35 | 0.14 J | 0.072 J | 0.37 U |
| Carbazole | 0.34 U/0.35 U | | R | 0.98 U | 0.34 UJ | |
| ***POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)*** | | | | | | |
| **HMW PAHs** | 0.791 | | 2.118 | 2.68 | 3.216 | 15.88 |
| Benzo(a)anthracene | 0.34 U/0.35 U | | 0.26 J | 0.37 J | 0.37 | |
| Benzo(a)pyrene | 0.34 U/0.35 U | | 0.15 J | 0.39 J | 0.37 | |
| Chrysene | 0.34 U/0.35 U | | 0.35 | 0.62 J | 0.68 | 2.5 |
| Dibenz(a,h)anthracene | 0.34 U/0.35 U | | 0.058 J | 0.98 U | 0.056 J | 0.88 |
| Fluoranthene | 0.048 J/0.044 J | | 0.78 | 0.42 J | 1 | 7.7 |
| Pyrene | 0.043 J/0.039 J | | | | | |
| ***POLYCHLORINATED BIPHENYLS (PCBs)*** | | | | | | |
| **Total PCBs** | 0.041 J/0.034 J | 0.113 | | | | |
| Aroclor-1248 (PCB-1248) | 0.0067 U/0.007 U | 0.0652 U | | | | |
| Aroclor-1254 (PCB-1254) | 0.023 J/0.02 J | 0.113 | | | | |
| Aroclor-1260 (PCB-1260) | 0.018 J/0.014 J | 0.0652 U | | | | |
| ***INORGANIC CONSTITUENTS*** | | | | | | |
| Anitmony | 0.4 UJ/0.3 UJ | | 2.8 J | 0.7 J | 0.8 J | 3.1 J |
| Arsenic | 7.2/8.1 | | 9.1 J | 9.8 J | 9.8 J | 20.1 |
| Barium | 65.1/69.7 | | 480 J | 167 J | 122 J | 500 J |
| Cadmium | 0.3 U/0.3 | | 1.2 | 0.4 | 0.3 | 1.7 |
| Chromium | 12/14 | | 13 | 19 | 13 | 40 |
| Cobalt | 3.9/4.4 | | 3.4 | 5.1 | 4.1 | 7.7 J |
| Copper | 17/21 | | 194 | 194 | 128 | 308 |
| Iron | 10600 J/12200 J | | 14200 J | 14700 J | 17300 J | 22200 J |
| Lead | 52.0/46.6 | | 359 | 98.3 | 182 | 555 |
| Manganese | 541 J/518 J | | 336 J | 354 J | 410 J | 364 J |
| Mercury | 0.18/0.13 | | 0.42 | 0.09 | 0.35 | 1.29 U |
| Nickel | 8.0/9.4 | | 8.6 J | 22.4 J | 12.0 J | 16.4 J |
| Selenium | 0.7/0.6 | | 0.6 | 1 | 0.8 | 1.5 |
| Vanadium | 15/18 | | 14 | 26 | 18 | 25 |
| Zinc | 110 J/87 J | | 668 J | 207 J | 151 J | 764 J |
| Cyanide (Total) | 1.7/1.8 | | 1.5 | | | |

***Notes:***

All results in milligrams per kilogram (mg/kg)
Blank Cell - Constituent not analyzed
J - Estimated
R - Rejected
U - Not Detected at the indicated concentration
ft - feet
BGS - Below Ground Surface

# Appendix B

## Food Chain Calculations for Refinement Process

# APPENDIX B.1

## FOOD CHAIN CALCULATIONS FOR REFINEMENT PROCESS - AMERICAN WOODCOCK
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

**AMERICAN WOODCOCK**

Bird

Insectivore

| | | |
|---|---|---|
| Body Weight | 0.180 | kg |
| Food Ingestion | 0.214 | kg dw/kd bw-day |
| Water Ingestion | 0 | L/kg bw-day |
| Soil Ingestion | | unitless |
| $P_s$ | 0.164 | unitless |
| Rate | 0.035 | kg dw/kd bw-day |

| | MEDIA CONCENTRATIONS | | | INGESTION | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Invert** | **Water** | **Soil** | **Invert** | **Water** | **Soil** | **Total** | **NOAEL** | **$HQ_{NOAEL}$** | **LOAEL** | **$HQ_{LOAEL}$** |
| | mg/kg WW | mg/L | mg/kg DW | mg/kg-day | mg/kg-day | mg/kg-day | mg/kg-day | mg/kg-day | | mg/kg-day | |
| **Proportion of Diet** | 1 | 1 | 1 | | | | | | | | |
| **Volatile Organic Compounds (VOCs)** | | | | | | | | | | | |
| Acetone | 0 | 0 | 5.50E+00 | 0 | 0 | 1.93E-01 | 1.93E-01 | 5.2 | 3.7E-02 | 52 | 3.71E-03 |
| Isopropylbenzene | 6.38E+01 | 0 | 1.50E-01 | 1.37E+01 | 0 | 5.30E-03 | 1.37E+01 | n/a | --- | n/a | --- |
| **BTEX** | | | | | | | | | | | |
| Benzene | 0 | 0 | 1.67E-01 | 0 | 0 | 5.90E-03 | 5.86E-03 | n/a | --- | n/a | --- |
| Toluene | 0 | 0 | 2.66E+00 | 0 | 0 | 9.30E-02 | 9.34E-02 | n/a | --- | n/a | --- |
| Xylenes (total) | 0 | 0 | 2.34E+00 | 0 | 0 | 8.20E-02 | 8.22E-02 | n/a | --- | n/a | --- |
| **Semi-Volatile Organic Compounds (SVOCs)** | | | | | | | | | | | |
| Carbazole | 3.96E+01 | 0 | 8.30E-02 | 8.47E+00 | 0 | 2.90E-03 | 8.47E+00 | n/a | --- | n/a | --- |
| **Polycyclic Aromatic Hydrocarbons (PAHs)** | | | | | | | | | | | |
| HMW PAHs | 5.18E+01 | 0 | 1.99E+01 | 1.11E+01 | 0 | 6.99E-01 | 1.18E+01 | 2.0 | **5.9E+00** | 20 | 5.9E-01 |
| **Inorganic Constituents** | | | | | | | | | | | |
| Cadmium | 7.94E+00 | 0 | 9.48E-01 | 1.70E+00 | 0 | 3.30E-02 | 1.73E+00 | 0.7 | **2.5E+00** | 10.4 | 1.7E-01 |
| Copper | 7.36E+01 | 0 | 1.43E+02 | 1.58E+01 | 0 | 5.02E+00 | 2.08E+01 | 2.3 | **9.0E+00** | 52.3 | 4.0E-01 |
| Lead | 5.34E+01 | 0 | 1.81E+02 | 1.14E+01 | 0 | 6.35E+00 | 1.78E+01 | 0.014 | **1.3E+03** | 8.75 | **2.0E+00** |
| Mercury | 3.67E-01 | 0 | 1.53E+00 | 7.80E-02 | 0 | 5.40E-02 | 1.32E-01 | 0.039 | **3.4E+00** | 0.18 | 7.3E-01 |
| Zinc | 5.75E+02 | 0 | 3.33E+02 | 1.23E+02 | 0 | 1.17E+01 | 1.35E+02 | 17.2 | **7.8E+00** | 172 | 7.8E-01 |

***Notes*** **:**

**Bold font** identifies a Hazard Quotient (HQ) greater than 1.0
BTEX - Benzene, Toluene, Ethylbenzene, and Xylenes
HMW - High Molecular Weight
LOAEL - Lowest Observed Adverse Effect Level
n/a - Value not available
NOAEL - No Observed Adverse Effect Level
kg - kilogram
dw - dry weight
bw - body weight
L - liter
WW - wet weight

# APPENDIX B.2

## FOOD CHAIN CALCULATIONS FOR REFINEMENT PROCESS - MOURNING DOVE
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

**MOURNING DOVE**
Bird
Herbivore

| | | |
|---|---|---|
| Body Weight | 0.020 | kg |
| Food Ingestion | 0.19 | kg dw/kd bw-day |
| Water Ingestion | 0 | L/kg bw-day |
| Soil Ingestion | | unitless |
| $P_s$ | 0.139 | unitless |
| Rate | 0.026 | kg dw/kd bw-day |

| | MEDIA CONCENTRATIONS | | | INGESTION | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Plants** | **Water** | **Soil** | **Plants** | **Water** | **Soil** | **Total** | **NOAEL** | **$HQ_{NOAEL}$** | **LOAEL** | **$HQ_{LOAEL}$** |
| | mg/kg WW | mg/L | mg/kg DW | mg/kg-day | mg/kg-day | mg/kg-day | mg/kg-day | mg/kg-day | | mg/kg-day | |
| **Proportion of Diet** | 1 | 1 | 1 | | | | | | | | |
| **Volatile Organic Compounds (VOCs)** | | | | | | | | | | | |
| Acetone | 0 | 0 | 5.50E+00 | 0 | 0 | 1.45E-01 | 1.45E-01 | 5.2 | 2.8E-02 | 52 | 2.8E-03 |
| Isopropylbenzene | 4.50E-02 | 0 | 1.50E-01 | 8.55E-03 | 0 | 3.96E-03 | 1.25E-02 | n/a | --- | n/a | --- |
| **BTEX** | | | | | | | | | | | |
| Benzene | 0 | 0 | 1.67E-01 | 0 | 0 | 4.41E-03 | 4.41E-03 | n/a | --- | n/a | --- |
| Toluene | 0 | 0 | 2.66E+00 | 0 | 0 | 7.03E-02 | 7.03E-02 | n/a | --- | n/a | --- |
| Xylenes (total) | 0 | 0 | 2.34E+00 | 0 | 0 | 6.19E-02 | 6.19E-02 | n/a | --- | n/a | --- |
| **Semi-Volatile Organic Compounds (SVOCs)** | | | | | | | | | | | |
| Carbazole | 2.30E-02 | 0 | 8.30E-02 | 4.30E-03 | 0 | 2.19E-03 | 6.51E-03 | n/a | --- | n/a | --- |
| **Polycyclic Aromatic Hydrocarbons (PAHs)** | | | | | | | | | | | |
| HMW PAHs | 3.10E+00 | 0 | 1.99E+01 | 5.88E-01 | 0 | 5.26E-01 | 1.11E+00 | 2.0 | 5.6E-01 | 20 | 5.6E-02 |
| **Inorganic Constituents** | | | | | | | | | | | |
| Cadmium | 6.04E-01 | 0 | 9.48E-01 | 1.15E-01 | 0 | 2.50E-02 | 1.40E-01 | 0.7 | 2.0E-01 | 10.4 | 1.3E-02 |
| Copper | 1.38E+01 | 0 | 1.43E+02 | 2.62E+00 | 0 | 3.78E+00 | 6.40E+00 | 2.3 | **2.8E+00** | 52.3 | 1.2E-01 |
| Lead | 4.90E+00 | 0 | 1.81E+02 | 9.30E-01 | 0 | 4.78E+00 | 5.71E+00 | 0.014 | **4.1E+02** | 8.75 | 6.5E-01 |
| Mercury | 5.70E-02 | 0 | 1.53E+00 | 1.10E-02 | 0 | 4.04E-02 | 5.13E-02 | 0.039 | **1.3E+00** | 0.18 | 2.9E-01 |
| Zinc | 1.21E+02 | 0 | 3.33E+02 | 2.29E+01 | 0 | 8.79E+00 | 3.17E+01 | 17.2 | **1.8E+00** | 172 | 1.8E-01 |

***Notes :***

**Bold font** identifies a Hazard Quotient (HQ) greater than 1.0
BTEX - Benzene, Toluene, Ethylbenzene, and Xylenes
HMW - High Molecular Weight
LOAEL - Lowest Observed Adverse Effect Level
n/a - Value not available
NOAEL - No Observed Adverse Effect Level
kg - kilogram
dw - dry weight
bw - body weight
L - liter
WW - wet weight

# APPENDIX B.3

## FOOD CHAIN CALCULATIONS FOR REFINEMENT PROCESS - RED-TAILED HAWK
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

**RED-TAILED HAWK**
Bird
Carnivore

| | | |
|---|---|---|
| Body Weight | 1.13 | kg |
| Food Ingestion | 0.0353 | kg dw/kd bw-day |
| Water Ingestion | 0 | L/kg bw-day |
| Soil Ingestion | | unitless |
| $P_s$ | 0.057 | unitless |
| Rate | 0.0020 | kg dw/kd bw-day |

| | MEDIA CONCENTRATIONS | | | INGESTION | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Mammals** | **Water** | **Soil** | **Mammals** | **Water** | **Soil** | **Total** | **NOAEL** | **$HQ_{NOAEL}$** | **LOAEL** | **$HQ_{LOAEL}$** |
| | mg/kg WW | mg/L | mg/kg DW | mg/kg-day | mg/kg-day | mg/kg-day | mg/kg-day | mg/kg-day | | mg/kg-day | |
| **Proportion of Diet** | 1 | 1 | 1 | | | | | | | | |
| **Volatile Organic Compounds (VOCs)** | | | | | | | | | | | |
| Acetone | 0 | 0 | 5.50E+00 | 0 | 0 | 1.11E-02 | 1.11E-02 | 5.2 | 2.1E-03 | 52 | 2.1E-04 |
| Isopropylbenzene | 6.38E+01 | 0 | 1.50E-01 | 2.25E+00 | 0 | 3.02E-04 | 2.25E+00 | n/a | --- | n/a | --- |
| **BTEX** | | | | | | | | | | | |
| Benzene | 0 | 0 | 1.67E-01 | 0 | 0 | 3.36E-04 | 3.40E-04 | n/a | --- | n/a | --- |
| Toluene | 0 | 0 | 2.66E+00 | 0 | 0 | 5.35E-03 | 5.35E-03 | n/a | --- | n/a | --- |
| Xylenes (total) | 0 | 0 | 2.34E+00 | 0 | 0 | 4.71E-03 | 4.71E-03 | n/a | --- | n/a | --- |
| **Semi-Volatile Organic Compounds (SVOCs)** | | | | | | | | | | | |
| Carbazole | 3.96E+01 | 0 | 8.30E-02 | 1.40E+00 | 0 | 1.67E-04 | 1.40E+00 | n/a | --- | n/a | --- |
| **Polycyclic Aromatic Hydrocarbons (PAHs)** | | | | | | | | | | | |
| HMW PAHs | 0 | 0 | 1.99E+01 | 0 | 0 | 4.01E-02 | 4.01E-02 | 2.0 | 2.0E-02 | 20 | 2.0E-03 |
| **Inorganic Constituents** | | | | | | | | | | | |
| Cadmium | 2.77E-01 | 0 | 9.48E-01 | 9.79E-03 | 0 | 1.91E-03 | 1.17E-02 | 0.7 | 1.7E-02 | 10.4 | 1.1E-03 |
| Copper | 1.58E+01 | 0 | 1.43E+02 | 5.57E-01 | 0 | 2.88E-01 | 8.45E-01 | 2.3 | 3.7E-01 | 52.3 | 1.6E-02 |
| Lead | 1.07E+01 | 0 | 1.81E+02 | 3.79E-01 | 0 | 3.64E-01 | 7.44E-01 | 0.014 | **5.3E+01** | 8.75 | 8.5E-02 |
| Mercury | 8.31E-02 | 0 | 1.53E+00 | 2.93E-03 | 0 | 3.08E-03 | 6.00E-03 | 0.039 | 1.5E-01 | 0.18 | 3.3E-02 |
| Zinc | 1.18E+02 | 0 | 3.33E+02 | 4.18E+00 | 0 | 6.70E-01 | 4.80E+00 | 17.2 | 2.8E-01 | 172 | 2.8E-02 |

***Notes :***

**Bold font** identifies a Hazard Quotient (HQ) greater than 1.0
BTEX - Benzene, Toluene, Ethylbenzene, and Xylenes
HMW - High Molecular Weight
LOAEL - Lowest Observed Adverse Effect Level
n/a - Value not available
NOAEL - No Observed Adverse Effect Level
kg - kilogram
dw - dry weight
bw - body weight
L - liter
WW - wet weight

# FOOD CHAIN CALCULATIONS FOR REFINEMENT PROCESS - SHORT-TAILED SHREW
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

**SHORT-TAILED SHREW**
Mammal
Insectivore

| | | |
|---|---|---|
| Body Weight | 0.020 | kg |
| Food Ingestion | 0.209 | kg dw/kd bw-day |
| Water Ingestion | 0 | L/kg bw-day |
| Soil Ingestion | | unitless |
| $P_s$ | 0.030 | unitless |
| Rate | 0.006 | kg dw/kd bw-day |

| | MEDIA CONCENTRATIONS | | | INGESTION | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Invert** | **Water** | **Soil** | **Invert** | **Water** | **Soil** | **Total** | **NOAEL** | **$HQ_{NOAEL}$** | **LOAEL** | **$HQ_{LOAEL}$** |
| | mg/kg WW | mg/L | mg/kg DW | mg/kg-day | mg/kg-day | mg/kg-day | mg/kg-day | mg/kg-day | | mg/kg-day | |
| **Proportion of Diet** | 1 | 1 | 1 | | | | | | | | |
| **Volatile Organic Compounds (VOCs)** | | | | | | | | | | | |
| Acetone | 0 | 0 | 5.50E+00 | 0 | 0 | 3.45E-02 | 3.45E-02 | 10 | 3.4E-03 | 50 | 6.9E-04 |
| Isopropylbenzene | 6.38E+01 | 0 | 1.50E-01 | 1.33E+01 | 0 | 9.40E-04 | 1.33E+01 | 154 | 8.7E-02 | 462 | 2.9E-02 |
| **BTEX** | | | | | | | | | | | |
| Benzene | 0 | 0 | 1.67E-01 | 0 | 0 | 1.05E-03 | 1.05E-03 | 26.36 | 4.0E-05 | 263.6 | 4.0E-06 |
| Toluene | 0 | 0 | 2.66E+00 | 0 | 0 | 1.67E-02 | 1.67E-02 | 26 | 6.4E-04 | 260 | 6.4E-05 |
| Xylenes (total) | 0 | 0 | 2.34E+00 | 0 | 0 | 1.47E-02 | 1.47E-02 | 2.1 | 7.0E-03 | 2.6 | 5.7E-03 |
| **Semi-Volatile Organic Compounds (SVOCs)** | | | | | | | | | | | |
| Carbazole | 3.96E+01 | 0 | 8.30E-02 | 8.27E+00 | 0 | 5.20E-04 | 8.27E+00 | 5.2 | **1.6E+00** | 57.3 | 1.4E-01 |
| **Polycyclic Aromatic Hydrocarbons (PAHs)** | | | | | | | | | | | |
| HMW PAHs | 5.18E+01 | 0 | 1.99E+01 | 1.08E+01 | 0 | 1.25E-01 | 1.09E+01 | 0.6 | **1.8E+01** | 28.6 | 3.8E-01 |
| **Inorganic Constituents** | | | | | | | | | | | |
| Cadmium | 7.94E+00 | 0 | 9.48E-01 | 1.66E+00 | 0 | 5.94E-03 | 1.66E+00 | 0.06 | **2.8E+01** | 2.64 | 6.3E-01 |
| Copper | 7.36E+01 | 0 | 1.43E+02 | 1.54E+01 | 0 | 8.97E-01 | 1.63E+01 | 2.67 | **6.1E+00** | 632 | 2.6E-02 |
| Lead | 5.34E+01 | 0 | 1.81E+02 | 1.12E+01 | 0 | 1.13E+00 | 1.23E+01 | 1.0 | **1.2E+01** | 241 | 5.1E-02 |
| Mercury | 3.67E-01 | 0 | 1.53E+00 | 7.70E-02 | 0 | 9.59E-03 | 8.62E-02 | 0.027 | **3.2E+00** | 4 | 2.2E-02 |
| Selenium | 7.47E-01 | | 7.44E-01 | 1.56E-01 | 0 | 4.66E-03 | 1.61E-01 | 0.05 | **3.2E+00** | 1.21 | 1.3E-01 |
| Zinc | 5.75E+02 | 0 | 3.33E+02 | 1.20E+02 | 0 | 2.09E+00 | 1.22E+02 | 9.6 | **1.3E+01** | 411 | 3.0E-01 |
| Cyanide (total) | 9.83E+00 | 0 | 1.47E+00 | 2.05E+00 | 0 | 9.19E-03 | 2.06E+00 | 68.7 | 3.0E-02 | n/a | --- |

***Notes*** **:**

**Bold font** identifies a Hazard Quotient (HQ) greater than 1.0
BTEX - Benzene, Toluene, Ethylbenzene, and Xylenes
HMW - High Molecular Weight
LOAEL - Lowest Observed Adverse Effect Level
n/a - Value not available
NOAEL - No Observed Adverse Effect Level
kg - kilogram
dw - dry weight
bw - body weight
L - liter
WW - wet weight

# APPENDIX B.5

## FOOD CHAIN CALCULATIONS FOR REFINEMENT PROCESS - MEADOW VOLE
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

**MEADOW VOLE**
Mammal
Herbivore

| | | |
|---|---|---|
| Body Weight | 0.020 | kg |
| Food Ingestion | 0.0875 | kg dw/kd bw-day |
| Water Ingestion | 0 | L/kg bw-day |
| Soil Ingestion | | unitless |
| $P_s$ | 0.320 | unitless |
| Rate | 0.028 | kg dw/kd bw-day |

| | MEDIA CONCENTRATIONS | | | INGESTION | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Plants** | **Water** | **Soil** | **Plants** | **Water** | **Soil** | **Total** | **NOAEL** | **$HQ_{NOAEL}$** | **LOAEL** | **$HQ_{LOAEL}$** |
| | mg/kg WW | mg/L | mg/kg DW | mg/kg-day | mg/kg-day | mg/kg-day | mg/kg-day | mg/kg-day | | mg/kg-day | |
| **Proportion of Diet** | 1 | 1 | 1 | | | | | | | | |
| **Volatile Organic Compounds (VOCs)** | | | | | | | | | | | |
| Acetone | 0 | 0 | 5.50E+00 | 0 | 0 | 1.54E-02 | 1.54E-02 | 10 | 1.5E-03 | 50 | 3.1E-04 |
| Isopropylbenzene | 4.50E-02 | 0 | 1.50E-01 | 3.94E-03 | 0 | 4.20E-04 | 4.36E-03 | 154 | 3.0E-05 | 462 | 9.0E-06 |
| **BTEX** | | | | | | | | | | | |
| Benzene | 0 | 0 | 1.67E-01 | 0 | 0 | 4.70E-04 | 4.70E-04 | 26.36 | 1.8E-05 | 263.6 | 2.0E-06 |
| Toluene | 0 | 0 | 2.66E+00 | 0 | 0 | 7.45E-03 | 7.45E-03 | 26 | 2.9E-04 | 260 | 2.9E-05 |
| Xylenes (total) | 0 | 0 | 2.34E+00 | 0 | 0 | 6.56E-03 | 6.56E-03 | 2.1 | 3.1E-03 | 2.6 | 2.5E-03 |
| **Semi-Volatile Organic Compounds (SVOCs)** | | | | | | | | | | | |
| Carbazole | 2.30E-02 | 0 | 8.30E-02 | 1.99E-03 | 0 | 2.30E-04 | 2.22E-03 | 5.2 | 4.3E-04 | 57.3 | 3.9E-05 |
| **Polycyclic Aromatic Hydrocarbons (PAHs)** | | | | | | | | | | | |
| HMW PAHs | 3.10E+00 | 0 | 1.99E+01 | 2.71E-01 | 0 | 5.58E-02 | 3.27E-01 | 0.6 | 5.3E-01 | 28.6 | 1.1E-02 |
| **Inorganic Constituents** | | | | | | | | | | | |
| Cadmium | 6.04E-01 | 0 | 9.48E-01 | 5.29E-02 | 0 | 2.65E-03 | 5.55E-02 | 0.06 | 9.3E-01 | 2.64 | 2.1E-02 |
| Copper | 1.38E+01 | 0 | 1.43E+02 | 1.21E+00 | 0 | 4.00E-01 | 1.61E+00 | 2.67 | 6.0E-01 | 632 | 2.5E-03 |
| Lead | 4.90E+00 | 0 | 1.81E+02 | 4.28E-01 | 0 | 5.07E-01 | 9.35E-01 | 1.0 | 9.4E-01 | 241 | 3.9E-03 |
| Mercury | 5.74E-02 | 0 | 1.53E+00 | 5.02E-03 | 0 | 4.28E-03 | 9.30E-03 | 0.027 | 3.4E-01 | 4 | 2.3E-03 |
| Selenium | 3.67E-01 | | 7.44E-01 | 3.21E-02 | 0 | 2.08E-03 | 3.42E-02 | 0.05 | 6.8E-01 | 1.21 | 2.8E-02 |
| Zinc | 1.21E+02 | 0 | 3.33E+02 | 1.06E+01 | 0 | 9.32E-01 | 1.15E+01 | 9.6 | **1.2E+00** | 411 | 2.8E-02 |
| Cyanide (total) | 1.47E+00 | 0 | 1.47E+00 | 1.28E-01 | 0 | 4.10E-03 | 1.32E-01 | 68.7 | 1.9E-03 | n/a | --- |

***Notes :***

**Bold font** identifies a Hazard Quotient (HQ) greater than 1.0
BTEX - Benzene, Toluene, Ethylbenzene, and Xylenes
HMW - High Molecular Weight
LOAEL - Lowest Observed Adverse Effect Level
n/a - Value not available
NOAEL - No Observed Adverse Effect Level
kg - kilogram
dw - dry weight
bw - body weight
L - liter
WW - wet weight

# FOOD CHAIN CALCULATIONS FOR REFINEMENT PROCESS - LONG-TAILED WEASEL
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

**LONG-TAILED WEASEL**
Mammal
Carnivore

| | | |
|---|---|---|
| Body Weight | 0.190 | kg |
| Food Ingestion | 0.130 | kg dw/kd bw-day |
| Water Ingestion | 0 | L/kg bw-day |
| Soil Ingestion | | unitless |
| $P_s$ | 0.043 | unitless |
| Rate | 0.006 | kg dw/kd bw-day |

| | MEDIA CONCENTRATIONS | | | INGESTION | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Mammals** | **Water** | **Soil** | **Mammals** | **Water** | **Soil** | **Total** | **NOAEL** | **$HQ_{NOAEL}$** | **LOAEL** | **$HQ_{LOAEL}$** |
| | mg/kg WW | mg/L | mg/kg DW | mg/kg-day | mg/kg-day | mg/kg-day | mg/kg-day | mg/kg-day | | mg/kg-day | |
| **Proportion of Diet** | 1 | 1 | 1 | | | | | | | | |
| **Volatile Organic Compounds (VOCs)** | | | | | | | | | | | |
| Acetone | 0 | 0 | 5.50E+00 | 0 | 0 | 3.08E-02 | 3.08E-02 | 10 | 3.1E-03 | 50 | 6.2E-04 |
| Isopropylbenzene | 6.38E+01 | 0 | 1.50E-01 | 8.30E+00 | 0 | 8.40E-04 | 8.30E+00 | 154 | 5.4E-02 | 462 | 1.8E-02 |
| **BTEX** | | | | | | | | | | | |
| Benzene | 0 | 0 | 1.67E-01 | 0 | 0 | 9.30E-04 | 9.30E-04 | 26.36 | 3.5E-05 | 263.6 | 4.0E-06 |
| Toluene | 0 | 0 | 2.66E+00 | 0 | 0 | 1.49E-02 | 1.49E-02 | 26 | 5.7E-04 | 260 | 5.7E-05 |
| Xylenes (total) | 0 | 0 | 2.34E+00 | 0 | 0 | 1.31E-02 | 1.31E-02 | 2.1 | 6.2E-03 | 2.6 | 5.0E-03 |
| **Semi-Volatile Organic Compounds (SVOCs)** | | | | | | | | | | | |
| Carbazole | 3.96E+01 | 0 | 8.30E-02 | 5.14E+00 | 0 | 4.60E-04 | 5.15E+00 | 5.2 | 9.9E-01 | 57.3 | 9.0E-02 |
| **Polycyclic Aromatic Hydrocarbons (PAHs)** | | | | | | | | | | | |
| HMW PAHs | 0 | 0 | 1.99E+01 | 0 | 0 | 1.11E-01 | 1.11E-01 | 0.6 | 1.8E-01 | 28.6 | 3.9E-03 |
| **Inorganic Constituents** | | | | | | | | | | | |
| Cadmium | 2.77E-01 | 0 | 9.48E-01 | 3.61E-02 | 0 | 5.30E-03 | 4.14E-02 | 0.06 | 6.9E-01 | 2.64 | 1.6E-02 |
| Copper | 1.58E+01 | 0 | 1.43E+02 | 2.05E+00 | 0 | 7.99E-01 | 2.85E+00 | 2.67 | **1.1E+00** | 632 | 4.5E-03 |
| Lead | 1.07E+01 | 0 | 1.81E+02 | 1.40E+00 | 0 | 1.01E+00 | 2.41E+00 | 1.0 | **2.4E+00** | 241 | 1.0E-02 |
| Mercury | 8.31E-02 | 0 | 1.53E+00 | 1.08E-02 | 0 | 8.55E-03 | 1.94E-02 | 0.027 | 7.2E-01 | 4 | 4.8E-03 |
| Selenium | 5.90E-01 | | 7.44E-01 | 7.67E-02 | 0 | 4.16E-03 | 8.09E-02 | 0.05 | **1.6E+00** | 1.21 | 6.7E-02 |
| Zinc | 1.18E+02 | 0 | 3.33E+02 | 1.54E+01 | 0 | 1.86E+00 | 1.72E+01 | 9.6 | **1.8E+00** | 411 | 4.2E-02 |
| Cyanide (total) | 9.83E+00 | 0 | 1.47E+00 | 1.28E+00 | 0 | 8.19E-03 | 1.29E+00 | 68.7 | 1.9E-02 | n/a | --- |

***Notes*:**

**Bold font** identifies a Hazard Quotient (HQ) greater than 1.0
BTEX - Benzene, Toluene, Ethylbenzene, and Xylenes
HMW - High Molecular Weight
LOAEL - Lowest Observed Adverse Effect Level
n/a - Value not available
NOAEL - No Observed Adverse Effect Level
kg - kilogram
dw - dry weight
bw - body weight
L - liter
WW - wet weight

# Appendix C

## Food Chain Calculations for Ecological Preliminary Remediation Goals

## APPENDIX C.1

## FOOD CHAIN CALCULATIONS FOR ECOLOGICAL PRELIMINARY REMEDIATION GOALS
## HMW PAHs - AMERICAN WOODCOCK
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| | | |
|---|---|---|
| **COPEC** | **High Molecular Weight PAHs** | |
| **Indicator Species** | **American Woodcock** | |
| **Class** | Bird | |
| **Trophic Level** | Insectivore | |
| **Body Weight** | kg | 0.213 |
| **Free Metabolic Rate** | kcal/day | 96.65 |
| **Water Ingestion** | L/day/day | 0 |
| **Soil Ingestion** | Proportion dry food ingestion | 0.164 |
| **LOAEL** | mg/kg/day | 20.0 |

| *Diet* | *Gross Energy* | *Assimilation Efficiency* | *Metabolizable Energy* | *Proportion of Diet* | *Weighted Average Metabolizable Energy* | *Itemized Daily Intake* | *Normalized Itemized Daily Intake* | $C_{Invert}$ | $C_{Plant}$ | $C_{Soil}$ | $C_{Water}$ | $IR_{Food}$ | $IR_{Soil}$ | $IR_{Water}$ | $IR_{Total}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *kcal/g DW* | *Unitless* | *kcal/g* | *Unitless* | *kcal/g* | *kg/day* | *kg/kg/day* | *mg/kg* | *mg/kg* | *mg/kg* | *mg/L* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* |
| Beetle Larvae | 5.83 | 0.83 | 4.84 | 0.077 | 0.3713 | 0.0015 | 0.0072 | 181 | | | | 1.30 | | | |
| Centipedes | 5.3 | 0.83 | 4.4 | 0.166 | 0.7283 | 0.0036 | 0.0171 | 181 | | | | 3.09 | | | |
| Earthworm | 3.16 | 0.83 | 2.62 | 0.341 | 0.8944 | 0.0126 | 0.0591 | 181 | | | | 10.7 | | | |
| Fly Larvae | 3.93 | 0.83 | 3.26 | 0.027 | 0.0871 | 0.0008 | 0.0037 | 181 | | | | 0.670 | | | |
| Grit | 1.98 | 0.76 | 1.5 | 0.256 | 0.3841 | 0.0164 | 0.0772 | | 10.1 | | | 0.780 | | | |
| Misc. Animal | 5.72 | 0.83 | 4.75 | 0.022 | 0.1024 | 0.0004 | 0.0021 | 181 | | | | 0.370 | | | |
| Seed | 4.3 | 0.76 | 3.27 | 0.022 | 0.0733 | 0.0007 | 0.0031 | | 10.1 | | | 0.030 | | | |
| Unknown Insect Parts | 5.72 | 0.83 | 4.75 | 0.047 | 0.2211 | 0.0009 | 0.0044 | 181 | | | | 0.810 | | | |
| Vegetable Matter | 1.99 | 0.76 | 1.51 | 0.043 | 0.0651 | 0.0028 | 0.0129 | | 10.1 | | | 0.130 | | | |
| **Sums/Totals** | | | **30.9** | **1.0** | **2.93** | **0.040** | **0.187** | | | **69.6** | **0** | **3.59** | **2.13** | **0** | **20.0** |

***Notes :***

COPEC - Contaminant of Potential Ecological Concern
g - gram
L - liter
mg - milligram
kcal - kilocalorie
kg - kilogram

$C_{Invert}$ - Concentration of COPEC in Soil Invertebrates
$C_{Plant}$ - Concentration of COPEC in Plants
$C_{Soil}$ - Concentration of COPEC in Soil
$C_{Water}$ - Concentration of COPEC in Surface Water

$IR_{Food}$ - Ingestion Rate of COPEC in Food
$IR_{Soil}$ - Ingestion Rate of COPEC in Soil
$IR_{Water}$ - Ingestion Rate of COPEC in Surface Water
$IR_{Total}$ - Total Rate of COEPC Ingestion

## APPENDIX C.2

## FOOD CHAIN CALCULATIONS FOR ECOLOGICAL PRELIMINARY REMEDIATION GOALS
## CADMIUM - AMERICAN WOODCOCK
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| | | |
|---|---|---|
| **COPEC** | **Cadmium** | |
| **Indicator Species** | **American Woodcock** | |
| **Class** | Bird | |
| **Trophic Level** | Insectivore | |
| **Body Weight** | kg | 0.213 |
| **Free Metabolic Rate** | kcal/day | 96.65 |
| **Water Ingestion** | L/day/day | 0 |
| **Soil Ingestion** | Proportion dry food ingestion | 0.164 |
| **LOAEL** | mg/kg/day | 10.4 |

| *Diet* | *Gross Energy* | *Assimilation Efficiency* | *Metabolizable Energy* | *Proportion of Diet* | *Weighted Average Metabolizable Energy* | *Itemized Daily Intake* | *Normalized Itemized Daily Intake* | $C_{Invert}$ | $C_{Plant}$ | $C_{Soil}$ | $C_{Water}$ | $IR_{Diet}$ | $IR_{Soil}$ | $IR_{Water}$ | $IR_{Total}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *kcal/g DW* | *Unitless* | *kcal/g* | *Unitless* | *kcal/g* | *kg/day* | *kg/kg/day* | *mg/kg* | *mg/kg* | *mg/kg* | *mg/L* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* |
| Beetle Larvae | 5.83 | 0.83 | 4.84 | 0.077 | 0.3713 | 0.0015 | 0.0072 | 100 | | | | 0.720 | | | |
| Centipedes | 5.3 | 0.83 | 4.4 | 0.166 | 0.7283 | 0.0036 | 0.0171 | 100 | | | | 1.71 | | | |
| Earthworm | 3.16 | 0.83 | 2.62 | 0.341 | 0.8944 | 0.0126 | 0.0591 | 100 | | | | 5.92 | | | |
| Fly Larvae | 3.93 | 0.83 | 3.26 | 0.027 | 0.0871 | 0.0008 | 0.0037 | 100 | | | | 0.370 | | | |
| Grit | 1.98 | 0.76 | 1.5 | 0.256 | 0.3841 | 0.0164 | 0.0772 | | 3.45 | | | 0.270 | | | |
| Misc. Animal | 5.72 | 0.83 | 4.75 | 0.022 | 0.1024 | 0.0004 | 0.0021 | 100 | | | | 0.210 | | | |
| Seed | 4.3 | 0.76 | 3.27 | 0.022 | 0.0733 | 0.0007 | 0.0031 | | 3.45 | | | 0.010 | | | |
| Unknown Insect Parts | 5.72 | 0.83 | 4.75 | 0.047 | 0.2211 | 0.0009 | 0.0044 | 100 | | | | 0.450 | | | |
| Vegetable Matter | 1.99 | 0.76 | 1.51 | 0.043 | 0.0651 | 0.0028 | 0.0129 | | 3.45 | | | 0.040 | | | |
| **Sums/Totals** | | | **30.9** | **1.0** | **2.93** | **0.040** | **0.187** | | | **23.0** | **0** | **9.69** | **0.705** | **0** | **10.4** |

***Notes*** **:**

COPEC - Contaminant of Potential Ecological Concern
g - gram
L - liter
mg - milligram
kcal - kilocalorie
kg - kilogram

$C_{Invert}$ - Concentration of COPEC in Soil Invertebrates
$C_{Plant}$ - Concentration of COPEC in Plants
$C_{Soil}$ - Concentration of COPEC in Soil
$C_{Water}$ - Concentration of COPEC in Surface Water

$IR_{Food}$ - Ingestion Rate of COPEC in Food
$IR_{Soil}$ - Ingestion Rate of COPEC in Soil
$IR_{Water}$ - Ingestion Rate of COPEC in Surface Water
$IR_{Total}$ - Total Rate of COEPC Ingestion

# FOOD CHAIN CALCULATIONS FOR ECOLOGICAL PRELIMINARY REMEDIATION GOALS
## COPPER - AMERICAN WOODCOCK
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| | | |
|---|---|---|
| **COPEC** | **Copper** | |
| **Indicator Species** | **American Woodcock** | |
| **Class** | Bird | |
| **Trophic Level** | Insectivore | |
| **Body Weight** | kg | 0.213 |
| **Free Metabolic Rate** | kcal/day | 96.65 |
| **Water Ingestion** | L/day/day | 0 |
| **Soil Ingestion** | Proportion dry food ingestion | 0.164 |
| **LOAEL** | mg/kg/day | 52.3 |

| ***Diet*** | ***Gross Energy*** | ***Assimilation Efficiency*** | ***Metabolizable Energy*** | ***Proportion of Diet*** | ***Weighted Average Metabolizable Energy*** | ***Itemized Daily Intake*** | ***Normalized Itemized Daily Intake*** | $C_{Invert}$ | $C_{Plant}$ | $C_{Soil}$ | $C_{Water}$ | $IR_{Diet}$ | $IR_{Soil}$ | $IR_{Water}$ | $IR_{Total}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *kcal/g DW* | *Unitless* | *kcal/g* | *Unitless* | *kcal/g* | *kg/day* | *kg/kg/day* | *mg/kg* | *mg/kg* | *mg/kg* | *mg/L* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* |
| Beetle Larvae | 5.83 | 0.83 | 4.84 | 0.077 | 0.3713 | 0.0015 | 0.0072 | 327 | | | | 2.350 | | | |
| Centipedes | 5.3 | 0.83 | 4.4 | 0.166 | 0.7283 | 0.0036 | 0.0171 | 327 | | | | 5.57 | | | |
| Earthworm | 3.16 | 0.83 | 2.62 | 0.341 | 0.8944 | 0.0126 | 0.0591 | 327 | | | | 19.3 | | | |
| Fly Larvae | 3.93 | 0.83 | 3.26 | 0.027 | 0.0871 | 0.0008 | 0.0037 | 327 | | | | 1.21 | | | |
| Grit | 1.98 | 0.76 | 1.5 | 0.256 | 0.3841 | 0.0164 | 0.0772 | | 24.8 | | | 1.91 | | | |
| Misc. Animal | 5.72 | 0.83 | 4.75 | 0.022 | 0.1024 | 0.0004 | 0.0021 | 327 | | | | 0.670 | | | |
| Seed | 4.3 | 0.76 | 3.27 | 0.022 | 0.0733 | 0.0007 | 0.0031 | | 24.8 | | | 0.080 | | | |
| Unknown Insect Parts | 5.72 | 0.83 | 4.75 | 0.047 | 0.2211 | 0.0009 | 0.0044 | 327 | | | | 1.45 | | | |
| Vegetable Matter | 1.99 | 0.76 | 1.51 | 0.043 | 0.0651 | 0.0028 | 0.0129 | | 24.8 | | | 0.320 | | | |
| **Sums/Totals** | | | **30.9** | **1.0** | **2.93** | **0.040** | **0.187** | | | **634** | **0** | **32.9** | **19.4** | **0** | **52.3** |

***Notes :***

COPEC - Contaminant of Potential Ecological Concern
g - gram
L - liter
mg - milligram
kcal - kilocalorie
kg - kilogram

$C_{Invert}$ - Concentration of COPEC in Soil Invertebrates
$C_{Plant}$ - Concentration of COPEC in Plants
$C_{Soil}$ - Concentration of COPEC in Soil
$C_{Water}$ - Concentration of COPEC in Surface Water

$IR_{Food}$ - Ingestion Rate of COPEC in Food
$IR_{Soil}$ - Ingestion Rate of COPEC in Soil
$IR_{Water}$ - Ingestion Rate of COPEC in Surface Water
$IR_{Total}$ - Total Rate of COEPC Ingestion

# APPENDIX C.4A

## FOOD CHAIN CALCULATIONS FOR ECOLOGICAL PRELIMINARY REMEDIATION GOALS
## LEAD - AMERICAN WOODCOCK - LOWER END PRG
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| | | |
|---|---|---|
| **COPEC** | **Lead** | |
| **Indicator Species** | **American Woodcock** | |
| **Class** | Bird | |
| **Trophic Level** | Insectivore | |
| **Body Weight** | kg | 0.213 |
| **Free Metabolic Rate** | kcal/day | 96.65 |
| **Water Ingestion** | L/day/day | 0 |
| **Soil Ingestion** | Proportion dry food ingestion | 0.164 |
| **LOAEL** | mg/kg/day | 8.75 |

| *Diet* | *Gross Energy* | *Assimilation Efficiency* | *Metabolizable Energy* | *Proportion of Diet* | *Weighted Average Metabolizable Energy* | *Itemized Daily Intake* | *Normalized Itemized Daily Intake* | *$Conc_{Invert}$* | *$Conc_{Plant}$* | *$Conc_{Soil}$* | *$Conc_{Water}$* | *$IR_{Food}$* | *$IR_{Soil}$* | *$IR_{Water}$* | *$IR_{Total}$* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *kcal/g DW* | *Unitless* | *kcal/g* | *Unitless* | *kcal/g* | *kg/day* | *kg/kg/day* | *mg/kg* | *mg/kg* | *mg/kg* | *mg/L* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* |
| Beetle Larvae | 5.83 | 0.83 | 4.84 | 0.077 | 0.3713 | 0.0015 | 0.0072 | 43.4 | | | | 0.31 | | | |
| Centipedes | 5.3 | 0.83 | 4.4 | 0.166 | 0.7283 | 0.0036 | 0.0171 | 43.4 | | | | 0.74 | | | |
| Earthworm | 3.16 | 0.83 | 2.62 | 0.341 | 0.8944 | 0.0126 | 0.0591 | 43.4 | | | | 2.6 | | | |
| Fly Larvae | 3.93 | 0.83 | 3.26 | 0.027 | 0.0871 | 0.0008 | 0.0037 | 43.4 | | | | 0.161 | | | |
| Grit | 1.98 | 0.76 | 1.5 | 0.256 | 0.3841 | 0.0164 | 0.0772 | | 4.24 | | | 0.327 | | | |
| Misc. Animal | 5.72 | 0.83 | 4.75 | 0.022 | 0.1024 | 0.0004 | 0.0021 | 43.4 | | | | 0.089 | | | |
| Seed | 4.3 | 0.76 | 3.27 | 0.022 | 0.0733 | 0.0007 | 0.0031 | | 4.24 | | | 0.013 | | | |
| Unknown Insect Parts | 5.72 | 0.83 | 4.75 | 0.047 | 0.2211 | 0.0009 | 0.0044 | 43.4 | | | | 0.193 | | | |
| Vegetable Matter | 1.99 | 0.76 | 1.51 | 0.043 | 0.0651 | 0.0028 | 0.0129 | | 4.24 | | | 0.055 | | | |
| **Sums/Totals** | | | **30.9** | **1.0** | **2.93** | **0.040** | **0.187** | | | **140** | **0** | **4.45** | **4.29** | **0** | **8.74** |

***Notes :***

COPEC - Contaminant of Potential Ecological Concern
g - gram
L - liter
mg - milligram
kcal - kilocalorie
kg - kilogram
DW-dry weight

$Conc_{Invert}$ - Concentration of COPEC in Soil Invertebrates
$Conc_{Plant}$ - Concentration of COPEC in Plants
$Conc_{Soil}$ - Concentration of COPEC in Soil
$Conc_{Water}$ - Concentration of COPEC in Surface Water

$IR_{Food}$ - Ingestion Rate of COPEC in Food
$IR_{Soil}$ - Ingestion Rate of COPEC in Soil
$IR_{Water}$ - Ingestion Rate of COPEC in Surface Water
$IR_{Total}$ - Total Rate of COEPC Ingestion

# FOOD CHAIN CALCULATIONS FOR ECOLOGICAL PRELIMINARY REMEDIATION GOALS
## LEAD - AMERICAN WOODCOCK - UPPER END PRG
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| | | |
|---|---|---|
| **COPEC** | **Lead** | |
| **Indicator Species** | **American Woodcock** | |
| **Class** | Bird | |
| **Trophic Level** | Insectivore | |
| **Body Weight** | kg | 0.213 |
| **Free Metabolic Rate** | kcal/day | 96.65 |
| **Water Ingestion** | L/day/day | 0 |
| **Soil Ingestion** | Proportion dry food ingestion | 0.164 |
| **LOAEL** | mg/kg/day | 42.7 |

| *Diet* | *Gross Energy* | *Assimilation Efficiency* | *Metabolizable Energy* | *Proportion of Diet* | *Weighted Average Metabolizable Energy* | *Itemized Daily Intake* | *Normalized Itemized Daily Intake* | *$Conc_{Invert}$* | *$Conc_{Plant}$* | *$Conc_{Soil}$* | *$Conc_{Water}$* | *$IR_{Food}$* | *$IR_{Soil}$* | *$IR_{Water}$* | $IR_{Total}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *kcal/g DW* | *Unitless* | *kcal/g* | *Unitless* | *kcal/g* | *kg/day* | *kg/kg/day* | *mg/kg* | *mg/kg* | *mg/kg* | *mg/L* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* |
| Beetle Larvae | 5.83 | 0.83 | 4.84 | 0.077 | 0.3713 | 0.0015 | 0.0072 | 179 | | | | 1.29 | | | |
| Centipedes | 5.3 | 0.83 | 4.4 | 0.166 | 0.7283 | 0.0036 | 0.0171 | 179 | | | | 3.06 | | | |
| Earthworm | 3.16 | 0.83 | 2.62 | 0.341 | 0.8944 | 0.0126 | 0.0591 | 179 | | | | 10.6 | | | |
| Fly Larvae | 3.93 | 0.83 | 3.26 | 0.027 | 0.0871 | 0.0008 | 0.0037 | 179 | | | | 0.670 | | | |
| Grit | 1.98 | 0.76 | 1.5 | 0.256 | 0.3841 | 0.0164 | 0.0772 | | 11.4 | | | 0.880 | | | |
| Misc. Animal | 5.72 | 0.83 | 4.75 | 0.022 | 0.1024 | 0.0004 | 0.0021 | 179 | | | | 0.370 | | | |
| Seed | 4.3 | 0.76 | 3.27 | 0.022 | 0.0733 | 0.0007 | 0.0031 | | 11.4 | | | 0.040 | | | |
| Unknown Insect Parts | 5.72 | 0.83 | 4.75 | 0.047 | 0.2211 | 0.0009 | 0.0044 | 179 | | | | 0.800 | | | |
| Vegetable Matter | 1.99 | 0.76 | 1.51 | 0.043 | 0.0651 | 0.0028 | 0.0129 | | 11.4 | | | 0.150 | | | |
| **Sums/Totals** | | | **30.9** | **1.0** | **2.93** | **0.040** | **0.187** | | | **812** | **0** | **17.8** | **24.9** | **0** | **42.7** |

***Notes :***

COPEC - Contaminant of Potential Ecological Concern
g - gram
L - liter
mg - milligram
kcal - kilocalorie
kg - kilogram
DW - dry weight

$Conc_{Invert}$ - Concentration of COPEC in Soil Invertebrates
$Conc_{Plant}$ - Concentration of COPEC in Plants
$Conc_{Soil}$ - Concentration of COPEC in Soil
$Conc_{Water}$ - Concentration of COPEC in Surface Water

$IR_{Food}$ - Ingestion Rate of COPEC in Food
$IR_{Soil}$ - Ingestion Rate of COPEC in Soil
$IR_{Water}$ - Ingestion Rate of COPEC in Surface Water
$IR_{Total}$ - Total Rate of COEPC Ingestion

# APPENDIX C.5

## FOOD CHAIN CALCULATIONSFOR ECOLOGICAL PRELIMINARY REMEDIATION GOALS
## MERCURY - AMERICAN WOODCOCK
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| | | |
|---|---|---|
| **COPEC** | **Mercury** | |
| **Indicator Species** | **American Woodcock** | |
| **Class** | Bird | |
| **Trophic Level** | Insectivore | |
| **Body Weight** | kg | 0.213 |
| **Free Metabolic Rate** | kcal/day | 96.65 |
| **Water Ingestion** | L/day/day | 0 |
| **Soil Ingestion** | Proportion dry food ingestion | 0.164 |
| **LOAEL** | mg/kg/day | 0.18 |

| ***Diet*** | ***Gross Energy*** | ***Assimilation Efficiency*** | ***Metabolizable Energy*** | ***Proportion of Diet*** | ***Weighted Average Metabolizable Energy*** | ***Itemized Daily Intake*** | ***Normalized Itemized Daily Intake*** | $C_{Invert}$ | $C_{Plant}$ | $C_{Soil}$ | $C_{Water}$ | $IR_{Diet}$ | $IR_{Soil}$ | $IR_{Water}$ | $IR_{Total}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *kcal/g DW* | *Unitless* | *kcal/g* | *Unitless* | *kcal/g* | *kg/day* | *kg/kg/day* | *mg/kg* | *mg/kg* | *mg/kg* | *mg/L* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* |
| Beetle Larvae | 5.83 | 0.83 | 4.84 | 0.077 | 0.3713 | 0.0015 | 0.0072 | 0.764 | | | | 0.0055 | | | |
| Centipedes | 5.3 | 0.83 | 4.4 | 0.166 | 0.7283 | 0.0036 | 0.0171 | 0.764 | | | | 0.0131 | | | |
| Earthworm | 3.16 | 0.83 | 2.62 | 0.341 | 0.8944 | 0.0126 | 0.0591 | 0.764 | | | | 0.0451 | | | |
| Fly Larvae | 3.93 | 0.83 | 3.26 | 0.027 | 0.0871 | 0.0008 | 0.0037 | 0.764 | | | | 0.0028 | | | |
| Grit | 1.98 | 0.76 | 1.5 | 0.256 | 0.3841 | 0.0164 | 0.0772 | | 0.114 | | | 0.0088 | | | |
| Misc. Animal | 5.72 | 0.83 | 4.75 | 0.022 | 0.1024 | 0.0004 | 0.0021 | 0.764 | | | | 0.0016 | | | |
| Seed | 4.3 | 0.76 | 3.27 | 0.022 | 0.0733 | 0.0007 | 0.0031 | | 0.114 | | | 0.0004 | | | |
| Unknown Insect Parts | 5.72 | 0.83 | 4.75 | 0.047 | 0.2211 | 0.0009 | 0.0044 | 0.764 | | | | 0.0034 | | | |
| Vegetable Matter | 1.99 | 0.76 | 1.51 | 0.043 | 0.0651 | 0.0028 | 0.0129 | | 0.114 | | | 0.0015 | | | |
| **Sums/Totals** | | | **30.9** | **1.0** | **2.93** | **0.040** | **0.187** | | | **3.19** | **0** | **0.082** | **0.098** | **0** | **0.180** |

***Notes :***

COPEC - Contaminant of Potential Ecological Concern
g - gram
L - liter
mg - milligram
kcal - kilocalorie
kg - kilogram

$C_{Invert}$ - Concentration of COPEC in Soil Invertebrates
$C_{Plant}$ - Concentration of COPEC in Plants
$C_{Soil}$ - Concentration of COPEC in Soil
$C_{Water}$ - Concentration of COPEC in Surface Water

$IR_{Food}$ - Ingestion Rate of COPEC in Food
$IR_{Soil}$ - Ingestion Rate of COPEC in Soil
$IR_{Water}$ - Ingestion Rate of COPEC in Surface Water
$IR_{Total}$ - Total Rate of COEPC Ingestion

# FOOD CHAIN CALCULATIONS FOR ECOLOGICAL PRELIMINARY REMEDIATION GOALS
## ZINC - AMERICAN WOODCOCK
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| | | |
|---|---|---|
| **COPEC** | **Zinc** | |
| **Indicator Species** | **American Woodcock** | |
| **Class** | Bird | |
| **Trophic Level** | Insectivore | |
| **Body Weight** | kg | 0.213 |
| **Free Metabolic Rate** | kcal/day | 96.65 |
| **Water Ingestion** | L/day/day | 0 |
| **Soil Ingestion** | Proportion dry food ingestion | 0.164 |
| **LOAEL** | mg/kg/day | 172 |

| *Diet* | *Gross Energy* | *Assimilation Efficiency* | *Metabolizable Energy* | *Proportion of Diet* | *Weighted Average Metabolizable Energy* | *Itemized Daily Intake* | *Normalized Itemized Daily Intake* | $C_{Invert}$ | $C_{Plant}$ | $C_{Soil}$ | $C_{Water}$ | $IR_{Diet}$ | $IR_{Soil}$ | $IR_{Water}$ | $IR_{Total}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *kcal/g DW* | *Unitless* | *kcal/g* | *Unitless* | *kcal/g* | *kg/day* | *kg/kg/day* | *mg/kg* | *mg/kg* | *mg/kg* | *mg/L* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* |
| Beetle Larvae | 5.83 | 0.83 | 4.84 | 0.077 | 0.3713 | 0.0015 | 0.0072 | 982 | | | | 7.07 | | | |
| Centipedes | 5.3 | 0.83 | 4.4 | 0.166 | 0.7283 | 0.0036 | 0.0171 | 982 | | | | 16.77 | | | |
| Earthworm | 3.16 | 0.83 | 2.62 | 0.341 | 0.8944 | 0.0126 | 0.0591 | 982 | | | | 58.01 | | | |
| Fly Larvae | 3.93 | 0.83 | 3.26 | 0.027 | 0.0871 | 0.0008 | 0.0037 | 982 | | | | 3.65 | | | |
| Grit | 1.98 | 0.76 | 1.5 | 0.256 | 0.3841 | 0.0164 | 0.0772 | | 298 | | | 23.02 | | | |
| Misc. Animal | 5.72 | 0.83 | 4.75 | 0.022 | 0.1024 | 0.0004 | 0.0021 | 982 | | | | 2.02 | | | |
| Seed | 4.3 | 0.76 | 3.27 | 0.022 | 0.0733 | 0.0007 | 0.0031 | | 298 | | | 0.93 | | | |
| Unknown Insect Parts | 5.72 | 0.83 | 4.75 | 0.047 | 0.2211 | 0.0009 | 0.0044 | 982 | | | | 4.37 | | | |
| Vegetable Matter | 1.99 | 0.76 | 1.51 | 0.043 | 0.0651 | 0.0028 | 0.0129 | | 298 | | | 3.86 | | | |
| **Sums/Totals** | | | **30.9** | **1.0** | **2.93** | **0.040** | **0.187** | | | **1,705** | **0** | **120** | **52.2** | **0** | **172** |

***Notes :***

COPEC - Contaminant of Potential Ecological Concern
g - gram
L - liter
mg - milligram
kcal - kilocalorie
kg - kilogram

$C_{Invert}$ - Concentration of COPEC in Soil Invertebrates
$C_{Plant}$ - Concentration of COPEC in Plants
$C_{Soil}$ - Concentration of COPEC in Soil
$C_{Water}$ - Concentration of COPEC in Surface Water

$IR_{Food}$ - Ingestion Rate of COPEC in Food
$IR_{Soil}$ - Ingestion Rate of COPEC in Soil
$IR_{Water}$ - Ingestion Rate of COPEC in Surface Water
$IR_{Total}$ - Total Rate of COEPC Ingestion

## APPENDIX C.7

## FOOD CHAIN CALCULATIONS FOR ECOLOGICAL PRELIMINARY REMEDIATION GOALS
## CARBAZOLE - SHORT-TAILED SHREW
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| | | |
|---|---|---|
| **COPEC** | **Carbazole** | |
| **Indicator Species** | **Short-Tailed Shrew** | |
| **Class** | Mammal | |
| **Trophic Level** | Insectivore | |
| **Body Weight** | kg | 0.015 |
| **Free Metabolic Rate** | kcal/day | 8.99 |
| **Water Ingestion** | L/day/day | 0 |
| **Soil Ingestion** | Proportion dry food ingestion | 0.03 |
| **LOAEL** | mg/kg/day | 57.3 |

| *Diet* | *Gross Energy* | *Assimilation Efficiency* | *Metabolizable Energy* | *Proportion of Diet* | *Weighted Average Metabolizable Energy* | *Itemized Daily Intake* | *Normalized Itemized Daily Intake* | $C_{Invert}$ | $C_{Plant}$ | $C_{Soil}$ | $C_{Water}$ | $IR_{Diet}$ | $IR_{Soil}$ | $IR_{Water}$ | $IR_{Total}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *kcal/g DW* | *Unitless* | *kcal/g* | *Unitless* | *kcal/g* | *kg/day* | *kg/kg/day* | *mg/kg* | *mg/kg* | *mg/kg* | *mg/L* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* |
| Chilopoda | 5.3 | 0.90 | 4.75 | 0.02 | 0.0944 | 0.00004 | 0.0025 | 320 | | | | 0.748 | | | |
| Coleoptera | 5.72 | 0.90 | 5.12 | 0.072 | 0.3664 | 0.00012 | 0.0083 | 320 | | | | 2.49 | | | |
| Beetle Larvae | 5.83 | 0.90 | 5.22 | 0.011 | 0.0571 | 0.00002 | 0.0012 | 320 | | | | 0.374 | | | |
| Diplopoda | 5.3 | 0.90 | 4.75 | 0.008 | 0.0378 | 0.00001 | 0.0010 | 320 | | | | 0.299 | | | |
| Dipterous Larve | 3.93 | 0.90 | 3.52 | 0.007 | 0.0245 | 0.00002 | 0.0012 | 320 | | | | 0.353 | | | |
| Dipterous Pupae | 3.93 | 0.90 | 3.52 | 0.003 | 0.0105 | 0.00001 | 0.0005 | 320 | | | | 0.151 | | | |
| Earthworm | 3.16 | 0.90 | 2.83 | 0.177 | 0.5007 | 0.00056 | 0.0373 | 320 | | | | 11.2 | | | |
| Endogone | 1.78 | 0.91 | 1.62 | 0.133 | 0.2158 | 0.00074 | 0.0493 | | 0.184 | | | 0.008 | | | |
| Grasshopper | 5.3 | 0.90 | 4.75 | 0.001 | 0.0047 | 0.00000 | 0.0001 | 320 | | | | 0.037 | | | |
| Hymenogaster | 1.78 | 0.91 | 1.62 | 0.002 | 0.0032 | 0.00001 | 0.0007 | | 0.184 | | | 0.0001 | | | |
| Hymenoptera | 5.42 | 0.90 | 4.86 | 0.005 | 0.0242 | 0.00001 | 0.0006 | 320 | | | | 0.183 | | | |
| Hymenopterous Larvae | 1.12 | 0.90 | 1.00 | 0.004 | 0.0040 | 0.00004 | 0.0024 | 320 | | | | 0.708 | | | |
| Leptidophorus Larvae | 3.93 | 0.90 | 3.52 | 0.051 | 0.1784 | 0.00013 | 0.0086 | 320 | | | | 2.57 | | | |
| Misc. Animal | 5.3 | 0.90 | 4.75 | 0.061 | 0.2880 | 0.00011 | 0.0076 | 320 | | | | 2.28 | | | |
| Misc. Vegetation | 4.3 | 0.91 | 3.91 | 0.042 | 0.1632 | 0.00010 | 0.0064 | | 0.184 | | | 0.001 | | | |
| Odonota | 5.7 | 0.90 | 5.10 | 0.003 | 0.0152 | 0.00001 | 0.0003 | 320 | | | | 0.104 | | | |
| Slugs and Snails | 2.02 | 0.90 | 1.81 | 0.389 | 0.7035 | 0.00192 | 0.1281 | 320 | | | | 38.4 | | | |
| Sowbugs | 2.96 | 0.90 | 2.65 | 0.009 | 0.0237 | 0.00003 | 0.0020 | 320 | | | | 0.603 | | | |
| Spider | 4.83 | 0.90 | 4.32 | 0.001 | 0.0043 | 0.00000 | 0.0001 | 320 | | | | 0.041 | | | |
| Unidentified Material | 4.3 | 0.91 | 3.91 | 0.003 | 0.0117 | 0.00001 | 0.0005 | | 0.184 | | | 0.00008 | | | |
| **Sums/Totals** | | | **63.66** | **1.0** | **2.27** | **0.0002** | **0.259** | | | **0.672** | **0** | **57.2** | **0.005** | **0** | **57.2** |

***Notes*** **:**

COPEC - Contaminant of Potential Ecological Concern
g - gram
L - liter
mg - milligram
kcal - kilocalorie
kg - kilogram

$C_{Invert}$ - Concentration of COPEC in Soil Invertebrates
$C_{Plant}$ - Concentration of COPEC in Plants
$C_{Soil}$ - Concentration of COPEC in Soil
$C_{Water}$ - Concentration of COPEC in Surface Water

$IR_{Food}$ - Ingestion Rate of COPEC in Food
$IR_{Soil}$ - Ingestion Rate of COPEC in Soil
$IR_{Water}$ - Ingestion Rate of COPEC in Surface Water
$IR_{Total}$ - Total Rate of COEPC Ingestion

## APPENDIX C.8

## FOOD CHAIN CALCULATIONS FOR ECOLOGICAL PRELIMINARY REMEDIATION GOALS
## HWM PAHS - SHORT-TAILED SHREW
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| | | |
|---|---|---|
| **COPEC** | **High Molecular Weight PAHs** | |
| **Indicator Species** | **Short-Tailed Shrew** | |
| **Class** | Mammal | |
| **Trophic Level** | Insectivore | |
| **Body Weight** | kg | 0.015 |
| **Free Metabolic Rate** | kcal/day | 8.99 |
| **Water Ingestion** | L/day/day | 0 |
| **Soil Ingestion** | Proportion dry food ingestion | 0.03 |
| **LOAEL** | mg/kg/day | 28.6 |

| *Diet* | *Gross Energy* | *Assimilation Efficiency* | *Metabolizable Energy* | *Proportion of Diet* | *Weighted Average Metabolizable Energy* | *Itemized Daily Intake* | *Normalized Itemized Daily Intake* | $C_{Invert}$ | $C_{Plant}$ | $C_{Soil}$ | $C_{Water}$ | $IR_{Diet}$ | $IR_{Soil}$ | $IR_{Water}$ | $IR_{Total}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *kcal/g DW* | *Unitless* | *kcal/g* | *Unitless* | *kcal/g* | *kg/day* | *kg/kg/day* | *mg/kg* | *mg/kg* | *mg/kg* | *mg/L* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* |
| Chilopoda | 5.3 | 0.90 | 4.75 | 0.02 | 0.0944 | 0.00004 | 0.0025 | 155 | | | | 0.362 | | | |
| Coleoptera | 5.72 | 0.90 | 5.12 | 0.072 | 0.3664 | 0.00012 | 0.0083 | 155 | | | | 1.21 | | | |
| Beetle Larvae | 5.83 | 0.90 | 5.22 | 0.011 | 0.0571 | 0.00002 | 0.0012 | 155 | | | | 0.181 | | | |
| Diplopoda | 5.3 | 0.90 | 4.75 | 0.008 | 0.0378 | 0.00001 | 0.0010 | 155 | | | | 0.145 | | | |
| Dipterous Larve | 3.93 | 0.90 | 3.52 | 0.007 | 0.0245 | 0.00002 | 0.0012 | 155 | | | | 0.171 | | | |
| Dipterous Pupae | 3.93 | 0.90 | 3.52 | 0.003 | 0.0105 | 0.00001 | 0.0005 | 155 | | | | 0.073 | | | |
| Earthworm | 3.16 | 0.90 | 2.83 | 0.177 | 0.5007 | 0.00056 | 0.0373 | 155 | | | | 5.40 | | | |
| Endogone | 1.78 | 0.91 | 1.62 | 0.133 | 0.2158 | 0.00074 | 0.0493 | | 8.74 | | | 0.403 | | | |
| Grasshopper | 5.3 | 0.90 | 4.75 | 0.001 | 0.0047 | 0.00000 | 0.0001 | 155 | | | | 0.018 | | | |
| Hymenogaster | 1.78 | 0.91 | 1.62 | 0.002 | 0.0032 | 0.00001 | 0.0007 | | 8.74 | | | 0.006 | | | |
| Hymenoptera | 5.42 | 0.90 | 4.86 | 0.005 | 0.0242 | 0.00001 | 0.0006 | 155 | | | | 0.088 | | | |
| Hymenopterous Larvae | 1.12 | 0.90 | 1.00 | 0.004 | 0.0040 | 0.00004 | 0.0024 | 155 | | | | 0.342 | | | |
| Leptidophorus Larvae | 3.93 | 0.90 | 3.52 | 0.051 | 0.1784 | 0.00013 | 0.0086 | 155 | | | | 1.24 | | | |
| Misc. Animal | 5.3 | 0.90 | 4.75 | 0.061 | 0.2880 | 0.00011 | 0.0076 | 155 | | | | 1.10 | | | |
| Misc. Vegetation | 4.3 | 0.91 | 3.91 | 0.042 | 0.1632 | 0.00010 | 0.0064 | | 8.74 | | | 0.052 | | | |
| Odonota | 5.7 | 0.90 | 5.10 | 0.003 | 0.0152 | 0.00001 | 0.0003 | 155 | | | | 0.050 | | | |
| Slugs and Snails | 2.02 | 0.90 | 1.81 | 0.389 | 0.7035 | 0.00192 | 0.1281 | 155 | | | | 18.6 | | | |
| Sowbugs | 2.96 | 0.90 | 2.65 | 0.009 | 0.0237 | 0.00003 | 0.0020 | 155 | | | | 0.291 | | | |
| Spider | 4.83 | 0.90 | 4.32 | 0.001 | 0.0043 | 0.00000 | 0.0001 | 155 | | | | 0.020 | | | |
| Unidentified Material | 4.3 | 0.91 | 3.91 | 0.003 | 0.0117 | 0.00001 | 0.0005 | | 8.74 | | | 0.004 | | | |
| **Sums/Totals** | | | **63.66** | **1.0** | **2.27** | **0.0002** | **0.259** | | | **59.6** | **0** | **28.1** | **0.432** | **0** | **28.6** |

***Notes*** **:**

COPEC - Contaminant of Potential Ecological Concern
g - gram
L - liter
mg - milligram
kcal - kilocalorie
kg - kilogram

$C_{Invert}$ - Concentration of COPEC in Soil Invertebrates
$C_{Plant}$ - Concentration of COPEC in Plants
$C_{Soil}$ - Concentration of COPEC in Soil
$C_{Water}$ - Concentration of COPEC in Surface Water

$IR_{Food}$ - Ingestion Rate of COPEC in Food
$IR_{Soil}$ - Ingestion Rate of COPEC in Soil
$IR_{Water}$ - Ingestion Rate of COPEC in Surface Water
$IR_{Total}$ - Total Rate of COEPC Ingestion

## APPENDIX C.9

## FOOD CHAIN CALCULATIONS FOR ECOLOGICAL PRELIMINARY REMEDIATION GOALS
## CADMIUM - SHORT-TAILED SHREW
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| | | |
|---|---|---|
| **COPEC** | **Cadmium** | |
| **Indicator Species** | **Short-Tailed Shrew** | |
| **Class** | Mammal | |
| **Trophic Level** | Insectivore | |
| **Body Weight** | kg | 0.015 |
| **Free Metabolic Rate** | kcal/day | 8.99 |
| **Water Ingestion** | L/day/day | 0 |
| **Soil Ingestion** | Proportion dry food ingestion | 0.03 |
| **LOAEL** | mg/kg/day | 2.64 |

| *Diet* | *Gross Energy* | *Assimilation Efficiency* | *Metabolizable Energy* | *Proportion of Diet* | *Weighted Average Metabolizable Energy* | *Itemized Daily Intake* | *Normalized Itemized Daily Intake* | $C_{Invert}$ | $C_{Plant}$ | $C_{Soil}$ | $C_{Water}$ | $IR_{Diet}$ | $IR_{Soil}$ | $IR_{Water}$ | $IR_{Total}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *kcal/g DW* | *Unitless* | *kcal/g* | *Unitless* | *kcal/g* | *kg/day* | *kg/kg/day* | *mg/kg* | *mg/kg* | *mg/kg* | *mg/L* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* |
| Chilopoda | 5.3 | 0.90 | 4.75 | 0.02 | 0.0944 | 0.00004 | 0.0025 | 14.4 | | | | 0.034 | | | |
| Coleoptera | 5.72 | 0.90 | 5.12 | 0.072 | 0.3664 | 0.00012 | 0.0083 | 14.4 | | | | 0.11 | | | |
| Beetle Larvae | 5.83 | 0.90 | 5.22 | 0.011 | 0.0571 | 0.00002 | 0.0012 | 14.4 | | | | 0.017 | | | |
| Diplopoda | 5.3 | 0.90 | 4.75 | 0.008 | 0.0378 | 0.00001 | 0.0010 | 14.4 | | | | 0.013 | | | |
| Dipterous Larve | 3.93 | 0.90 | 3.52 | 0.007 | 0.0245 | 0.00002 | 0.0012 | 14.4 | | | | 0.016 | | | |
| Dipterous Pupae | 3.93 | 0.90 | 3.52 | 0.003 | 0.0105 | 0.00001 | 0.0005 | 14.4 | | | | 0.007 | | | |
| Earthworm | 3.16 | 0.90 | 2.83 | 0.177 | 0.5007 | 0.00056 | 0.0373 | 14.4 | | | | 0.5 | | | |
| Endogone | 1.78 | 0.91 | 1.62 | 0.133 | 0.2158 | 0.00074 | 0.0493 | | 0.910 | | | 0.042 | | | |
| Grasshopper | 5.3 | 0.90 | 4.75 | 0.001 | 0.0047 | 0.00000 | 0.0001 | 14.4 | | | | 0.002 | | | |
| Hymenogaster | 1.78 | 0.91 | 1.62 | 0.002 | 0.0032 | 0.00001 | 0.0007 | | 0.910 | | | 0.0006 | | | |
| Hymenoptera | 5.42 | 0.90 | 4.86 | 0.005 | 0.0242 | 0.00001 | 0.0006 | 14.4 | | | | 0.008 | | | |
| Hymenopterous Larvae | 1.12 | 0.90 | 1.00 | 0.004 | 0.0040 | 0.00004 | 0.0024 | 14.4 | | | | 0.032 | | | |
| Leptidophorus Larvae | 3.93 | 0.90 | 3.52 | 0.051 | 0.1784 | 0.00013 | 0.0086 | 14.4 | | | | 0.12 | | | |
| Misc. Animal | 5.3 | 0.90 | 4.75 | 0.061 | 0.2880 | 0.00011 | 0.0076 | 14.4 | | | | 0.10 | | | |
| Misc. Vegetation | 4.3 | 0.91 | 3.91 | 0.042 | 0.1632 | 0.00010 | 0.0064 | | 0.910 | | | 0.005 | | | |
| Odonota | 5.7 | 0.90 | 5.10 | 0.003 | 0.0152 | 0.00001 | 0.0003 | 14.4 | | | | 0.005 | | | |
| Slugs and Snails | 2.02 | 0.90 | 1.81 | 0.389 | 0.7035 | 0.00192 | 0.1281 | 14.4 | | | | 1.7 | | | |
| Sowbugs | 2.96 | 0.90 | 2.65 | 0.009 | 0.0237 | 0.00003 | 0.0020 | 14.4 | | | | 0.027 | | | |
| Spider | 4.83 | 0.90 | 4.32 | 0.001 | 0.0043 | 0.00000 | 0.0001 | 14.4 | | | | 0.002 | | | |
| Unidentified Material | 4.3 | 0.91 | 3.91 | 0.003 | 0.0117 | 0.00001 | 0.0005 | | 0.910 | | | 0.00039 | | | |
| **Sums/Totals** | | | **63.66** | **1.0** | **2.27** | **0.0002** | **0.259** | | | **2.01** | **0** | **57.2** | **0.015** | **0** | **2.64** |

***Notes*** **:**

COPEC - Contaminant of Potential Ecological Concern
g - gram
L - liter
mg - milligram
kcal - kilocalorie
kg - kilogram

$C_{Invert}$ - Concentration of COPEC in Soil Invertebrates
$C_{Plant}$ - Concentration of COPEC in Plants
$C_{Soil}$ - Concentration of COPEC in Soil
$C_{Water}$ - Concentration of COPEC in Surface Water

$IR_{Food}$ - Ingestion Rate of COPEC in Food
$IR_{Soil}$ - Ingestion Rate of COPEC in Soil
$IR_{Water}$ - Ingestion Rate of COPEC in Surface Water
$IR_{Total}$ - Total Rate of COEPC Ingestion

# APPENDIX C.10

## FOOD CHAIN CALCULATIONS FOR ECOLOGICAL PRELIMINARY REMEDIATION GOALS
## COPPER - SHORT-TAILED SHREW
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| | | |
|---|---|---|
| **COPEC** | Copper | |
| **Indicator Species** | Short-Tailed Shrew | |
| **Class** | Mammal | |
| **Trophic Level** | Insectivore | |
| **Body Weight** | kg | 0.015 |
| **Free Metabolic Rate** | kcal/day | 8.99 |
| **Water Ingestion** | L/day/day | 0 |
| **Soil Ingestion** | Proportion dry food ingestion | 0.03 |
| **LOAEL** | mg/kg/day | 632 |

| *Diet* | *Gross Energy* | *Assimilation Efficiency* | *Metabolizable Energy* | *Proportion of Diet* | *Weighted Average Metabolizable Energy* | *Itemized Daily Intake* | *Normalized Itemized Daily Intake* | $C_{Invert}$ | $C_{Plant}$ | $C_{Soil}$ | $C_{Water}$ | $IR_{Diet}$ | $IR_{Soil}$ | $IR_{Water}$ | $IR_{Total}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *kcal/g DW* | *Unitless* | *kcal/g* | *Unitless* | *kcal/g* | *kg/day* | *kg/kg/day* | *mg/kg* | *mg/kg* | *mg/kg* | *mg/L* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* |
| Chilopoda | 5.3 | 0.90 | 4.75 | 0.02 | 0.0944 | 0.00004 | 0.0025 | 3,262 | | | | 7.61 | | | |
| Coleoptera | 5.72 | 0.90 | 5.12 | 0.072 | 0.3664 | 0.00012 | 0.0083 | 3,262 | | | | 25.4 | | | |
| Beetle Larvae | 5.83 | 0.90 | 5.22 | 0.011 | 0.0571 | 0.00002 | 0.0012 | 3,262 | | | | 3.81 | | | |
| Diplopoda | 5.3 | 0.90 | 4.75 | 0.008 | 0.0378 | 0.00001 | 0.0010 | 3,262 | | | | 3.05 | | | |
| Dipterous Larve | 3.93 | 0.90 | 3.52 | 0.007 | 0.0245 | 0.00002 | 0.0012 | 3,262 | | | | 3.59 | | | |
| Dipterous Pupae | 3.93 | 0.90 | 3.52 | 0.003 | 0.0105 | 0.00001 | 0.0005 | 3,262 | | | | 1.54 | | | |
| Earthworm | 3.16 | 0.90 | 2.83 | 0.177 | 0.5007 | 0.00056 | 0.0373 | 3,262 | | | | 114 | | | |
| Endogone | 1.78 | 0.91 | 1.62 | 0.133 | 0.2158 | 0.00074 | 0.0493 | | 61.4 | | | 2.83 | | | |
| Grasshopper | 5.3 | 0.90 | 4.75 | 0.001 | 0.0047 | 0.00000 | 0.0001 | 3,262 | | | | 0.381 | | | |
| Hymenogaster | 1.78 | 0.91 | 1.62 | 0.002 | 0.0032 | 0.00001 | 0.0007 | | 61.4 | | | 0.042 | | | |
| Hymenoptera | 5.42 | 0.90 | 4.86 | 0.005 | 0.0242 | 0.00001 | 0.0006 | 3,262 | | | | 1.86 | | | |
| Hymenopterous Larvae | 1.12 | 0.90 | 1.00 | 0.004 | 0.0040 | 0.00004 | 0.0024 | 3,262 | | | | 7.21 | | | |
| Leptidophorus Larvae | 3.93 | 0.90 | 3.52 | 0.051 | 0.1784 | 0.00013 | 0.0086 | 3,262 | | | | 26.2 | | | |
| Misc. Animal | 5.3 | 0.90 | 4.75 | 0.061 | 0.2880 | 0.00011 | 0.0076 | 3,262 | | | | 23.2 | | | |
| Misc. Vegetation | 4.3 | 0.91 | 3.91 | 0.042 | 0.1632 | 0.00010 | 0.0064 | | 61.4 | | | 0.367 | | | |
| Odonota | 5.7 | 0.90 | 5.10 | 0.003 | 0.0152 | 0.00001 | 0.0003 | 3,262 | | | | 1.06 | | | |
| Slugs and Snails | 2.02 | 0.90 | 1.81 | 0.389 | 0.7035 | 0.00192 | 0.1281 | 3,262 | | | | 391 | | | |
| Sowbugs | 2.96 | 0.90 | 2.65 | 0.009 | 0.0237 | 0.00003 | 0.0020 | 3,262 | | | | 6.14 | | | |
| Spider | 4.83 | 0.90 | 4.32 | 0.001 | 0.0043 | 0.00000 | 0.0001 | 3,262 | | | | 0.418 | | | |
| Unidentified Material | 4.3 | 0.91 | 3.91 | 0.003 | 0.0117 | 0.00001 | 0.0005 | | 61.4 | | | 0.026 | | | |
| **Sums/Totals** | | | **63.66** | **1.0** | **2.27** | **0.0002** | **0.259** | | | **6,334** | **0** | **586** | **46.0** | **0** | **632** |

***Notes*** **:**

COPEC - Contaminant of Potential Ecological Concern
g - gram
L - liter
mg - milligram
kcal - kilocalorie
kg - kilogram

$C_{Invert}$ - Concentration of COPEC in Soil Invertebrates
$C_{Plant}$ - Concentration of COPEC in Plants
$C_{Soil}$ - Concentration of COPEC in Soil
$C_{Water}$ - Concentration of COPEC in Surface Water

$IR_{Food}$ - Ingestion Rate of COPEC in Food
$IR_{Soil}$ - Ingestion Rate of COPEC in Soil
$IR_{Water}$ - Ingestion Rate of COPEC in Surface Water
$IR_{Total}$ - Total Rate of COEPC Ingestion

# APPENDIX C.11

## FOOD CHAIN CALCULATIONS FOR ECOLOGICAL PRELIMINARY REMEDIATION GOALS
## LEAD - SHORT-TAILED SHREW
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| | | |
|---|---|---|
| **COPEC** | **Lead** | |
| **Indicator Species** | **Short-Tailed Shrew** | |
| **Class** | Mammal | |
| **Trophic Level** | Insectivore | |
| | | |
| **Body Weight** | kg | 0.015 |
| **Free Metabolic Rate** | kcal/day | 8.99 |
| **Water Ingestion** | L/day/day | 0 |
| **Soil Ingestion** | Proportion dry food ingestion | 0.03 |
| **LOAEL** | mg/kg/day | 241 |

| *Diet* | *Gross Energy* | *Assimilation Efficiency* | *Metabolizable Energy* | *Proportion of Diet* | *Weighted Average Metabolizable Energy* | *Itemized Daily Intake* | *Normalized Itemized Daily Intake* | $C_{Invert}$ | $C_{Plant}$ | $C_{Soil}$ | $C_{Water}$ | $IR_{Diet}$ | $IR_{Soil}$ | $IR_{Water}$ | $IR_{Total}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *kcal/g DW* | *Unitless* | *kcal/g* | *Unitless* | *kcal/g* | *kg/day* | *kg/kg/day* | *mg/kg* | *mg/kg* | *mg/kg* | *mg/L* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* |
| Chilopoda | 5.3 | 0.90 | 4.75 | 0.02 | 0.0944 | 0.00004 | 0.0025 | 1,044 | | | | 2.44 | | | |
| Coleoptera | 5.72 | 0.90 | 5.12 | 0.072 | 0.3664 | 0.00012 | 0.0083 | 1,044 | | | | 8.13 | | | |
| Beetle Larvae | 5.83 | 0.90 | 5.22 | 0.011 | 0.0571 | 0.00002 | 0.0012 | 1,044 | | | | 1.22 | | | |
| Diplopoda | 5.3 | 0.90 | 4.75 | 0.008 | 0.0378 | 0.00001 | 0.0010 | 1,044 | | | | 0.975 | | | |
| Dipterous Larve | 3.93 | 0.90 | 3.52 | 0.007 | 0.0245 | 0.00002 | 0.0012 | 1,044 | | | | 1.15 | | | |
| Dipterous Pupae | 3.93 | 0.90 | 3.52 | 0.003 | 0.0105 | 0.00001 | 0.0005 | 1,044 | | | | 0.493 | | | |
| Earthworm | 3.16 | 0.90 | 2.83 | 0.177 | 0.5007 | 0.00056 | 0.0373 | 1,044 | | | | 36.4 | | | |
| Endogone | 1.78 | 0.91 | 1.62 | 0.133 | 0.2158 | 0.00074 | 0.0493 | | 38.7 | | | 1.78 | | | |
| Grasshopper | 5.3 | 0.90 | 4.75 | 0.001 | 0.0047 | 0.00000 | 0.0001 | 1,044 | | | | 0.122 | | | |
| Hymenogaster | 1.78 | 0.91 | 1.62 | 0.002 | 0.0032 | 0.00001 | 0.0007 | | 38.7 | | | 0.027 | | | |
| Hymenoptera | 5.42 | 0.90 | 4.86 | 0.005 | 0.0242 | 0.00001 | 0.0006 | 1,044 | | | | 0.596 | | | |
| Hymenopterous Larvae | 1.12 | 0.90 | 1.00 | 0.004 | 0.0040 | 0.00004 | 0.0024 | 1,044 | | | | 2.31 | | | |
| Leptidophorus Larvae | 3.93 | 0.90 | 3.52 | 0.051 | 0.1784 | 0.00013 | 0.0086 | 1,044 | | | | 8.38 | | | |
| Misc. Animal | 5.3 | 0.90 | 4.75 | 0.061 | 0.2880 | 0.00011 | 0.0076 | 1,044 | | | | 7.43 | | | |
| Misc. Vegetation | 4.3 | 0.91 | 3.91 | 0.042 | 0.1632 | 0.00010 | 0.0064 | | 38.7 | | | 0.231 | | | |
| Odonota | 5.7 | 0.90 | 5.10 | 0.003 | 0.0152 | 0.00001 | 0.0003 | 1,044 | | | | 0.340 | | | |
| Slugs and Snails | 2.02 | 0.90 | 1.81 | 0.389 | 0.7035 | 0.00192 | 0.1281 | 1,044 | | | | 125 | | | |
| Sowbugs | 2.96 | 0.90 | 2.65 | 0.009 | 0.0237 | 0.00003 | 0.0020 | 1,044 | | | | 1.96 | | | |
| Spider | 4.83 | 0.90 | 4.32 | 0.001 | 0.0043 | 0.00000 | 0.0001 | 1,044 | | | | 0.134 | | | |
| Unidentified Material | 4.3 | 0.91 | 3.91 | 0.003 | 0.0117 | 0.00001 | 0.0005 | | 38.7 | | | 0.017 | | | |
| **Sums/Totals** | | | **63.66** | **1.0** | **2.27** | **0.0002** | **0.259** | | | **7,212** | **0** | **189** | **52.3** | **0** | **241** |

***Notes*** **:**

COPEC - Contaminant of Potential Ecological Concern
g - gram
L - liter
mg - milligram
kcal - kilocalorie
kg - kilogram

$C_{Invert}$ - Concentration of COPEC in Soil Invertebrates
$C_{Plant}$ - Concentration of COPEC in Plants
$C_{Soil}$ - Concentration of COPEC in Soil
$C_{Water}$ - Concentration of COPEC in Surface Water

$IR_{Food}$ - Ingestion Rate of COPEC in Food
$IR_{Soil}$ - Ingestion Rate of COPEC in Soil
$IR_{Water}$ - Ingestion Rate of COPEC in Surface Water
$IR_{Total}$ - Total Rate of COEPC Ingestion

# APPENDIX C.12

## FOOD CHAIN CALCULATIONS FOR ECOLOGICAL PRELIMINARY REMEDIATION GOALS
## MERCURY - SHORT-TAILED SHREW
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| | | |
|---|---|---|
| **COPEC** | **Mercury** | |
| **Indicator Species** | **Short-Tailed Shrew** | |
| **Class** | Mammal | |
| **Trophic Level** | Insectivore | |
| **Body Weight** | kg | 0.015 |
| **Free Metabolic Rate** | kcal/day | 8.99 |
| **Water Ingestion** | L/day/day | 0 |
| **Soil Ingestion** | Proportion dry food ingestion | 0.03 |
| **LOAEL** | mg/kg/day | 4.0 |

| *Diet* | *Gross Energy* | *Assimilation Efficiency* | *Metabolizable Energy* | *Proportion of Diet* | *Weighted Average Metabolizable Energy* | *Itemized Daily Intake* | *Normalized Itemized Daily Intake* | $C_{Invert}$ | $C_{Plant}$ | $C_{Soil}$ | $C_{Water}$ | $IR_{Diet}$ | $IR_{Soil}$ | $IR_{Water}$ | $IR_{Total}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *kcal/g DW* | *Unitless* | *kcal/g* | *Unitless* | *kcal/g* | *kg/day* | *kg/kg/day* | *mg/kg* | *mg/kg* | *mg/kg* | *mg/L* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* |
| Chilopoda | 5.3 | 0.90 | 4.75 | 0.02 | 0.0944 | 0.00004 | 0.0025 | 18.4 | | | | 0.043 | | | |
| Coleoptera | 5.72 | 0.90 | 5.12 | 0.072 | 0.3664 | 0.00012 | 0.0083 | 18.4 | | | | 0.143 | | | |
| Beetle Larvae | 5.83 | 0.90 | 5.22 | 0.011 | 0.0571 | 0.00002 | 0.0012 | 18.4 | | | | 0.021 | | | |
| Diplopoda | 5.3 | 0.90 | 4.75 | 0.008 | 0.0378 | 0.00001 | 0.0010 | 18.4 | | | | 0.017 | | | |
| Dipterous Larve | 3.93 | 0.90 | 3.52 | 0.007 | 0.0245 | 0.00002 | 0.0012 | 18.4 | | | | 0.020 | | | |
| Dipterous Pupae | 3.93 | 0.90 | 3.52 | 0.003 | 0.0105 | 0.00001 | 0.0005 | 18.4 | | | | 0.009 | | | |
| Earthworm | 3.16 | 0.90 | 2.83 | 0.177 | 0.5007 | 0.00056 | 0.0373 | 18.4 | | | | 0.641 | | | |
| Endogone | 1.78 | 0.91 | 1.62 | 0.133 | 0.2158 | 0.00074 | 0.0493 | | 2.88 | | | 0.133 | | | |
| Grasshopper | 5.3 | 0.90 | 4.75 | 0.001 | 0.0047 | 0.00000 | 0.0001 | 18.4 | | | | 0.002 | | | |
| Hymenogaster | 1.78 | 0.91 | 1.62 | 0.002 | 0.0032 | 0.00001 | 0.0007 | | 2.88 | | | 0.002 | | | |
| Hymenoptera | 5.42 | 0.90 | 4.86 | 0.005 | 0.0242 | 0.00001 | 0.0006 | 18.4 | | | | 0.011 | | | |
| Hymenopterous Larvae | 1.12 | 0.90 | 1.00 | 0.004 | 0.0040 | 0.00004 | 0.0024 | 18.4 | | | | 0.041 | | | |
| Leptidophorus Larvae | 3.93 | 0.90 | 3.52 | 0.051 | 0.1784 | 0.00013 | 0.0086 | 18.4 | | | | 0.148 | | | |
| Misc. Animal | 5.3 | 0.90 | 4.75 | 0.061 | 0.2880 | 0.00011 | 0.0076 | 18.4 | | | | 0.131 | | | |
| Misc. Vegetation | 4.3 | 0.91 | 3.91 | 0.042 | 0.1632 | 0.00010 | 0.0064 | | 2.88 | | | 0.017 | | | |
| Odonota | 5.7 | 0.90 | 5.10 | 0.003 | 0.0152 | 0.00001 | 0.0003 | 18.4 | | | | 0.006 | | | |
| Slugs and Snails | 2.02 | 0.90 | 1.81 | 0.389 | 0.7035 | 0.00192 | 0.1281 | 18.4 | | | | 2.20 | | | |
| Sowbugs | 2.96 | 0.90 | 2.65 | 0.009 | 0.0237 | 0.00003 | 0.0020 | 18.4 | | | | 0.035 | | | |
| Spider | 4.83 | 0.90 | 4.32 | 0.001 | 0.0043 | 0.00000 | 0.0001 | 18.4 | | | | 0.002 | | | |
| Unidentified Material | 4.3 | 0.91 | 3.91 | 0.003 | 0.0117 | 0.00001 | 0.0005 | | 2.88 | | | 0.001 | | | |
| **Sums/Totals** | | | **63.66** | **1.0** | **2.27** | **0.0002** | **0.259** | | | **76.8** | **0** | **3.44** | **0.557** | **0** | **4.00** |

***Notes*** **:**

COPEC - Contaminant of Potential Ecological Concern
g - gram
L - liter
mg - milligram
kcal - kilocalorie
kg - kilogram

$C_{Invert}$ - Concentration of COPEC in Soil Invertebrates
$C_{Plant}$ - Concentration of COPEC in Plants
$C_{Soil}$ - Concentration of COPEC in Soil
$C_{Water}$ - Concentration of COPEC in Surface Water

$IR_{Food}$ - Ingestion Rate of COPEC in Food
$IR_{Soil}$ - Ingestion Rate of COPEC in Soil
$IR_{Water}$ - Ingestion Rate of COPEC in Surface Water
$IR_{Total}$ - Total Rate of COEPC Ingestion

# APPENDIX C.13

## FOOD CHAIN CALCULATIONS FOR ECOLOGICAL PRELIMINARY REMEDIATION GOALS
## SELENIUM - SHORT-TAILED SHREW
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| | | |
|---|---|---|
| **COPEC** | **Selenium** | |
| **Indicator Species** | **Short-Tailed Shrew** | |
| **Class** | Mammal | |
| **Trophic Level** | Insectivore | |
| | | |
| **Body Weight** | kg | 0.015 |
| **Free Metabolic Rate** | kcal/day | 8.99 |
| **Water Ingestion** | L/day/day | 0 |
| **Soil Ingestion** | Proportion dry food ingestion | 0.03 |
| **LOAEL** | mg/kg/day | 1.21 |

| *Diet* | *Gross Energy* | *Assimilation Efficiency* | *Metabolizable Energy* | *Proportion of Diet* | *Weighted Average Metabolizable Energy* | *Itemized Daily Intake* | *Normalized Itemized Daily Intake* | $C_{Invert}$ | $C_{Plant}$ | $C_{Soil}$ | $C_{Water}$ | $IR_{Diet}$ | $IR_{Soil}$ | $IR_{Water}$ | $IR_{Total}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *kcal/g DW* | *Unitless* | *kcal/g* | *Unitless* | *kcal/g* | *kg/day* | *kg/kg/day* | *mg/kg* | *mg/kg* | *mg/kg* | *mg/L* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* |
| Chilopoda | 5.3 | 0.90 | 4.75 | 0.02 | 0.0944 | 0.00004 | 0.0025 | 4.68 | | | | 0.011 | | | |
| Coleoptera | 5.72 | 0.90 | 5.12 | 0.072 | 0.3664 | 0.00012 | 0.0083 | 4.68 | | | | 0.036 | | | |
| Beetle Larvae | 5.83 | 0.90 | 5.22 | 0.011 | 0.0571 | 0.00002 | 0.0012 | 4.68 | | | | 0.005 | | | |
| Diplopoda | 5.3 | 0.90 | 4.75 | 0.008 | 0.0378 | 0.00001 | 0.0010 | 4.68 | | | | 0.004 | | | |
| Dipterous Larve | 3.93 | 0.90 | 3.52 | 0.007 | 0.0245 | 0.00002 | 0.0012 | 4.68 | | | | 0.005 | | | |
| Dipterous Pupae | 3.93 | 0.90 | 3.52 | 0.003 | 0.0105 | 0.00001 | 0.0005 | 4.68 | | | | 0.002 | | | |
| Earthworm | 3.16 | 0.90 | 2.83 | 0.177 | 0.5007 | 0.00056 | 0.0373 | 4.68 | | | | 0.163 | | | |
| Endogone | 1.78 | 0.91 | 1.62 | 0.133 | 0.2158 | 0.00074 | 0.0493 | | 5.81 | | | 0.268 | | | |
| Grasshopper | 5.3 | 0.90 | 4.75 | 0.001 | 0.0047 | 0.00000 | 0.0001 | 4.68 | | | | 0.0005 | | | |
| Hymenogaster | 1.78 | 0.91 | 1.62 | 0.002 | 0.0032 | 0.00001 | 0.0007 | | 5.81 | | | 0.004 | | | |
| Hymenoptera | 5.42 | 0.90 | 4.86 | 0.005 | 0.0242 | 0.00001 | 0.0006 | 4.68 | | | | 0.003 | | | |
| Hymenopterous Larvae | 1.12 | 0.90 | 1.00 | 0.004 | 0.0040 | 0.00004 | 0.0024 | 4.68 | | | | 0.010 | | | |
| Leptidophorus Larvae | 3.93 | 0.90 | 3.52 | 0.051 | 0.1784 | 0.00013 | 0.0086 | 4.68 | | | | 0.038 | | | |
| Misc. Animal | 5.3 | 0.90 | 4.75 | 0.061 | 0.2880 | 0.00011 | 0.0076 | 4.68 | | | | 0.033 | | | |
| Misc. Vegetation | 4.3 | 0.91 | 3.91 | 0.042 | 0.1632 | 0.00010 | 0.0064 | | 5.81 | | | 0.035 | | | |
| Odonota | 5.7 | 0.90 | 5.10 | 0.003 | 0.0152 | 0.00001 | 0.0003 | 4.68 | | | | 0.002 | | | |
| Slugs and Snails | 2.02 | 0.90 | 1.81 | 0.389 | 0.7035 | 0.00192 | 0.1281 | 4.68 | | | | 0.560 | | | |
| Sowbugs | 2.96 | 0.90 | 2.65 | 0.009 | 0.0237 | 0.00003 | 0.0020 | 4.68 | | | | 0.009 | | | |
| Spider | 4.83 | 0.90 | 4.32 | 0.001 | 0.0043 | 0.00000 | 0.0001 | 4.68 | | | | 0.0006 | | | |
| Unidentified Material | 4.3 | 0.91 | 3.91 | 0.003 | 0.0117 | 0.00001 | 0.0005 | | 5.81 | | | 0.002 | | | |
| **Sums/Totals** | | | **63.66** | **1.0** | **2.27** | **0.0002** | **0.259** | | | **9.09** | **0** | **1.14** | **0.066** | **0** | **1.21** |

***Notes*** **:**

COPEC - Contaminant of Potential Ecological Concern
g - gram
L - liter
mg - milligram
kcal - kilocalorie
kg - kilogram

$C_{Invert}$ - Concentration of COPEC in Soil Invertebrates
$C_{Plant}$ - Concentration of COPEC in Plants
$C_{Soil}$ - Concentration of COPEC in Soil
$C_{Water}$ - Concentration of COPEC in Surface Water

$IR_{Food}$ - Ingestion Rate of COPEC in Food
$IR_{Soil}$ - Ingestion Rate of COPEC in Soil
$IR_{Water}$ - Ingestion Rate of COPEC in Surface Water
$IR_{Total}$ - Total Rate of COEPC Ingestion

# APPENDIX C.14

## FOOD CHAIN CALCULATIONS FOR ECOLOGICAL PRELIMINARY REMEDIATION GOALS
## ZINC - SHORT-TAILED SHREW
## FORMER PLAINWELL, INC. MILL PROPERTY
## PLAINWELL, MICHIGAN

| | | |
|---|---|---|
| **COPEC** | **Zinc** | |
| **Indicator Species** | **Short-Tailed Shrew** | |
| **Class** | Mammal | |
| **Trophic Level** | Insectivore | |
| **Body Weight** | kg | 0.015 |
| **Free Metabolic Rate** | kcal/day | 8.99 |
| **Water Ingestion** | L/day/day | 0 |
| **Soil Ingestion** | Proportion dry food ingestion | 0.03 |
| **LOAEL** | mg/kg/day | 411 |

| *Diet* | *Gross Energy* | *Assimilation Efficiency* | *Metabolizable Energy* | *Proportion of Diet* | *Weighted Average Metabolizable Energy* | *Itemized Daily Intake* | *Normalized Itemized Daily Intake* | $C_{Invert}$ | $C_{Plant}$ | $C_{Soil}$ | $C_{Water}$ | $IR_{Diet}$ | $IR_{Soil}$ | $IR_{Water}$ | $IR_{Total}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *kcal/g DW* | *Unitless* | *kcal/g* | *Unitless* | *kcal/g* | *kg/day* | *kg/kg/day* | *mg/kg* | *mg/kg* | *mg/kg* | *mg/L* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* | *mg/kg/day* |
| Chilopoda | 5.3 | 0.90 | 4.75 | 0.02 | 0.0944 | 0.00004 | 0.0025 | 1,704 | | | | 3.98 | | | |
| Coleoptera | 5.72 | 0.90 | 5.12 | 0.072 | 0.3664 | 0.00012 | 0.0083 | 1,704 | | | | 13.3 | | | |
| Beetle Larvae | 5.83 | 0.90 | 5.22 | 0.011 | 0.0571 | 0.00002 | 0.0012 | 1,704 | | | | 1.99 | | | |
| Diplopoda | 5.3 | 0.90 | 4.75 | 0.008 | 0.0378 | 0.00001 | 0.0010 | 1,704 | | | | 1.59 | | | |
| Dipterous Larve | 3.93 | 0.90 | 3.52 | 0.007 | 0.0245 | 0.00002 | 0.0012 | 1,704 | | | | 1.88 | | | |
| Dipterous Pupae | 3.93 | 0.90 | 3.52 | 0.003 | 0.0105 | 0.00001 | 0.0005 | 1,704 | | | | 0.804 | | | |
| Earthworm | 3.16 | 0.90 | 2.83 | 0.177 | 0.5007 | 0.00056 | 0.0373 | 1,704 | | | | 59.4 | | | |
| Endogone | 1.78 | 0.91 | 1.62 | 0.133 | 0.2158 | 0.00074 | 0.0493 | | 756 | | | 34.8 | | | |
| Grasshopper | 5.3 | 0.90 | 4.75 | 0.001 | 0.0047 | 0.00000 | 0.0001 | 1,704 | | | | 0.199 | | | |
| Hymenogaster | 1.78 | 0.91 | 1.62 | 0.002 | 0.0032 | 0.00001 | 0.0007 | | 756 | | | 0.520 | | | |
| Hymenoptera | 5.42 | 0.90 | 4.86 | 0.005 | 0.0242 | 0.00001 | 0.0006 | 1,704 | | | | 0.972 | | | |
| Hymenopterous Larvae | 1.12 | 0.90 | 1.00 | 0.004 | 0.0040 | 0.00004 | 0.0024 | 1,704 | | | | 3.76 | | | |
| Leptidophorus Larvae | 3.93 | 0.90 | 3.52 | 0.051 | 0.1784 | 0.00013 | 0.0086 | 1,704 | | | | 13.7 | | | |
| Misc. Animal | 5.3 | 0.90 | 4.75 | 0.061 | 0.2880 | 0.00011 | 0.0076 | 1,704 | | | | 12.1 | | | |
| Misc. Vegetation | 4.3 | 0.91 | 3.91 | 0.042 | 0.1632 | 0.00010 | 0.0064 | | 756 | | | 4.52 | | | |
| Odonota | 5.7 | 0.90 | 5.10 | 0.003 | 0.0152 | 0.00001 | 0.0003 | 1,704 | | | | 0.555 | | | |
| Slugs and Snails | 2.02 | 0.90 | 1.81 | 0.389 | 0.7035 | 0.00192 | 0.1281 | 1,704 | | | | 204 | | | |
| Sowbugs | 2.96 | 0.90 | 2.65 | 0.009 | 0.0237 | 0.00003 | 0.0020 | 1,704 | | | | 3.20 | | | |
| Spider | 4.83 | 0.90 | 4.32 | 0.001 | 0.0043 | 0.00000 | 0.0001 | 1,704 | | | | 0.218 | | | |
| Unidentified Material | 4.3 | 0.91 | 3.91 | 0.003 | 0.0117 | 0.00001 | 0.0005 | | 756 | | | 0.323 | | | |
| **Sums/Totals** | | | **63.66** | **1.0** | **2.27** | **0.0002** | **0.259** | | | **9,142** | **0** | **344** | **66.3** | **0** | **411** |

***Notes*** **:**

COPEC - Contaminant of Potential Ecological Concern
g - gram
L - liter
mg - milligram
kcal - kilocalorie
kg - kilogram

$C_{Invert}$ - Concentration of COPEC in Soil Invertebrates
$C_{Plant}$ - Concentration of COPEC in Plants
$C_{Soil}$ - Concentration of COPEC in Soil
$C_{Water}$ - Concentration of COPEC in Surface Water

$IR_{Food}$ - Ingestion Rate of COPEC in Food
$IR_{Soil}$ - Ingestion Rate of COPEC in Soil
$IR_{Water}$ - Ingestion Rate of COPEC in Surface Water
$IR_{Total}$ - Total Rate of COEPC Ingestion

# Appendix C

## Feasibility Study Remedial Alternatives Cost Estimates

**TABLE C.2B**

**COST SUMMARY**
**REMEDIAL ALTERNATIVE 2B – EXCAVATION AND OFF-SITE DISPOSAL**
**WITH CONSOLIDATION AND CAPPING**
**TO MEET PART LAND USE AND PCB RISK-BASED LEVELS OF 2.5 MG/KG RESIDENTIAL AND 9.1 MG/KG COMMERCIAL AREAS**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Description* | | *Unit* | *Approx. Quantity* | *Unit Price* | *Estimated Cost* *Subtotal* | *Estimated Cost* *Total* |
|---|---|---|---|---|---|---|
| **CAPITAL COSTS** | | | | | | |
| **A.** | ***PRE-DESIGN INVESTIGATION*** | | | | | **$33,200** |
| **1.0** | Sampling and Analysis Work Plan (SAP) | LS | 1 | $25,000 | $25,000 | |
| | Survey top of banks at Site | LS | 1 | $2,000 | $2,000 | |
| | Health and Safety Plan Update | LS | 1 | $1,200 | $1,200 | |
| | Multi-Area Quality Assurance Project Plan | LS | 1 | $5,000 | $5,000 | |
| **2.0** | SAP Implementation | | | | | **$108,100** |
| | Project Set up (mark locations etc.) | LS | 1 | $6,570 | $6,600 | |
| | Private Utility Locate | LS | 1 | $8,000 | $8,000 | |
| | Field Activities | DA | 17 | $2,900 | $49,300 | |
| | *Field Technicians* | | | | | |
| | *Sampling Equipment (push probe technology)* | | | | | |
| | *Expendables (PPE etc)* | | | | | |
| | Temporary Lighting and Carbon Monoxide Control | LS | 1 | $3,000 | $3,000 | |
| | Concrete Coring | LS | 1 | $3,000 | $3,000 | |
| | Laboratory Analysis | LS | 1 | $37,330 | $37,300 | |
| | Investigation Derived Waste Disposal | DA | 17 | $50 | $900 | |
| **3.0** | Contingency on PDI | LS | 1 | $70,650 | $70,700 | **$70,700** |
| | *Based on 50 % of PDI costs* | | | | | |
| **4.0** | Remedial Action Plan | LS | 1 | $60,000 | $60,000 | **$60,000** |
| | **TOTAL PRE-DESIGN COSTS** | | | | | **$272,000** |
| ***B.*** | ***CONSTRUCTION*** | | | | | |
| **1.0** | **Mobilization and Set up** | | | | | **$234,600** |
| | Mobilization and Set up | LS | 1 | $51,500 | $51,500 | |
| | Health and Safety | Monthly | 4 | $28,450 | $113,800 | |
| | Erosion Control | LS | 1 | $18,700 | $18,700 | |
| | Site Facilities | | | | | |
| | *Temporary Facilities* | Monthly | 4 | $6,810 | $27,200 | |
| | *Decontamination Pad and Stations* | LS | 1 | $17,375 | $17,400 | |
| | *Staging Areas* | LS | 1 | $6,000 | $6,000 | |
| **2.0** | **Additional Preparation and/or Demolition (by Redevelopment Area)** | | | | | **$138,000** |
| | Residential 1 | LS | 1 | $12,680 | $12,700 | |
| | Residential 2 | LS | 1 | - | - | |
| | Residential 3 | LS | 1 | $1,225 | $1,200 | |
| | Residential 4 | LS | 1 | $850 | $900 | |
| | Waterfront Plaza | LS | 1 | - | - | |
| | Mixed Residential/Commercial Area 1 | LS | 1 | $600 | $600 | |
| | Mixed Residential/Commercial Area 2 | LS | 1 | $56,625 | $56,600 | |
| | Commercial Area 1 | LS | 1 | - | - | |
| | Commercial Area 2 | LS | 1 | - | - | |
| | Commercial Area 3 | LS | 1 | - | - | |
| | Commercial Area 4 | LS | 1 | $65,980 | $66,000 | |
| **3.0** | **Excavation (by Redevelopment Area)** | | | | | **$279,900** |

**TABLE C.2B**

**COST SUMMARY**
**REMEDIAL ALTERNATIVE 2B – EXCAVATION AND OFF-SITE DISPOSAL**
**WITH CONSOLIDATION AND CAPPING**
**TO MEET PART LAND USE AND PCB RISK-BASED LEVELS OF 2.5 MG/KG RESIDENTIAL AND 9.1 MG/KG COMMERCIAL AREAS**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Description* | | *Unit* | *Approx. Quantity* | *Unit Price* | *Estimated Cost* *Subtotal* | *Estimated Cost* *Total* |
|---|---|---|---|---|---|---|
| | Residential 1 | CY | 910 | $12 | $11,100 | |
| | Residential 2 | CY | 25 | $88 | $2,200 | |
| | Residential 3 | CY | 1,495 | $7 | $10,800 | |
| | Residential 4 | CY | 5,340 | $3 | $16,500 | |
| | Waterfront Plaza | CY | - | - | - | |
| | Mixed Residential/Commercial Area 1 | CY | 40 | $90 | $3,600 | |
| | Mixed Residential/Commercial Area 2 | CY | 5,800 | $33 | $189,300 | |
| | Commercial Area 1 | CY | 12 | $104 | $1,300 | |
| | Commercial Area 2 | CY | - | - | - | |
| | Commercial Area 3 | CY | - | - | - | |
| | Commercial Area 4 | CY | 7,185 | $6 | $45,100 | |
| **4.0** | **Transportation and Disposal (by Redevelopment Area)** | | | | | **$1,543,370** |
| | Residential 1 - Non Haz Non TSCA Soils | Ton | 1,365 | $22 | $30,000 | |
| | Residential 2 - Non Haz Non TSCA Soils | Ton | - | - | - | |
| | Residential 3 - Non Haz Non TSCA Soils | Ton | 240 | $22 | $5,300 | |
| | Residential 4 - Non Haz Non TSCA Soils | Ton | 8,010 | $22 | $176,200 | |
| | Residential 4 - Misc Debris | LS | 1 | | $600 | |
| | Waterfront Plaza - Non Haz Non TSCA Soils | Ton | - | $22 | - | |
| | Mixed Residential/Commercial Area 1 - Non Haz Non TSCA Soils | Ton | 18 | $22 | $400 | |
| | Mixed Residential/Commercial Area 1 - Misc. Debris | LS | - | $125 | $1,675 | |
| | Mixed Residential/Commercial Area 2 - Non Haz Non TSCA Soils | Ton | 7,133 | $22 | $156,500 | |
| | Mixed Residential/Commercial Area 2 - Misc. Debris | LS | 1 | | $8,245 | |
| | Commercial Area 1 - Non Haz Non TSCA Soils | Ton | 18 | $22 | $400 | |
| | Commercial Area 2 - Non Haz Non TSCA Soils | Ton | - | - | - | |
| | Commercial Area 2 - Misc. Debris | LS | - | - | - | |
| | Commercial Area 3 - Non Haz Non TSCA Soils | Ton | - | - | - | |
| | Commercial Area 3 - Misc. Debris | LS | - | - | - | |
| | Commercial Area 4 - Non Haz Non TSCA | Ton | 2,000 | $22 | $44,000 | |
| | Commercial Area 4 - Misc. Debris | LS | - | | $3,550 | |
| | Commercial Area 4 - TSCA | Ton | 7,000 | $160 | $1,116,500 | |
| **5.0** | **Consolidation of Soils on Site** | | | | | **$34,500** |
| | Preparation of Consolidation Area (south of Mill Buildings) | LS | 1 | $27,110 | $27,100 | |
| | Consolidation of On Site Soils (Placement of Material) | CY | 3,668 | $2 | $7,400 | |
| **6.0** | **Capping of Soils On Site** | LS | 1 | $61,700 | $61,700 | **$61,700** |
| **7.0** | **Restoration (by Redevelopment Area)** | | | | | **$400,325** |
| | Residential 1 | LS | 1 | | $22,500 | |
| | Residential 2 | LS | 1 | | $5,070 | |
| | Residential 3 | LS | 1 | | $30,275 | |
| | Residential 4 | LS | 1 | | $80,800 | |
| | Waterfront Plaza | LS | - | | - | |
| | Mixed Residential/Commercial Area 1 | LS | 1 | | $7,425 | |
| | Mixed Residential/Commercial Area 2 | LS | 1 | | $139,455 | |
| | Commercial Area 1 | LS | 1 | | $1,650 | |
| | Commercial Area 2 | LS | - | | - | |
| | Commercial Area 3 | LS | - | | - | |
| | Commercial Area 4 | LS | 1 | | $113,150 | |

**TABLE C.2B**

**COST SUMMARY**
**REMEDIAL ALTERNATIVE 2B – EXCAVATION AND OFF-SITE DISPOSAL**
**WITH CONSOLIDATION AND CAPPING**
**TO MEET PART LAND USE AND PCB RISK-BASED LEVELS OF 2.5 MG/KG RESIDENTIAL AND 9.1 MG/KG COMMERCIAL AREAS**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Description* | | *Unit* | *Approx. Quantity* | *Unit Price* | *Estimated Cost* *Subtotal* | *Total* |
|---|---|---|---|---|---|---|
| **8.0** | **Demobilization** | LS | 1 | $32,300 | $33,000 | **$32,300** |
| | Decontamination and Demobilization | | | | | |
| | **TOTAL CONSTRUCTION COST** | | | | | **$2,724,695** |
| ***C.*** | ***ENGINEERING/OVERSIGHT*** | | | | | |
| **1.0** | **Institutional Controls** | | | | | **$50,000** |
| **2.0** | **Engineering/ Design (15 % of Construction Costs)** | | | | | **$408,700** |
| **3.0** | **Construction Oversight (10 % of Construction Costs)** | | | | | **$272,500** |
| | **TOTAL ENGINEERING/OVERSIGHT COSTS** | | | | | **$731,200** |
| | **CONTINGENCY ON CAPITAL COSTS (25 %)** | | | | | **$863,974** |
| | ***TOTAL CAPITAL COSTS*** | | | | | **$4,319,869** |
| **OPERATION, MAINTENANCE, & MONITORING COSTS** | | | | | | |
| ***A.*** | ***ANNUAL MONITORING AND MAINTENANCE*** | | | | | **$9,600** |
| | Monthly Operation and Maintenance of System | Month | 12 | $800 | $9,600 | |
| | **CONTINGENCY ON OM & M COSTS (20 %)** | | | | | **$1,920** |
| | **TOTAL CAPITAL COSTS** | | | | | **$4,319,869** |
| | **NET PRESENT VALUE OF OM & M (30 YEARS @ 7 % DISCOUNT RATE)** | | | | | **$142,952** |
| | **TOTAL COST** | | | | | **$4,462,820** |

**Table C.2B**

**COST SUMMARY NOTES**
**REMEDIAL ALTERNATIVE 2B – EXCAVATION AND OFF-SITE DISPOSAL**
**WITH CONSOLIDATION AND CAPPING**
**TO MEET PART 201 LAND USE CRITERIA AND PCB RISK-BASED LEVELS**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

**GENERAL NOTES**

A. Estimate for Remedial Alternative 2B - Excavation, Off-Site Disposal with On-Site Consolidation and Capping to meet Part 201 Land Use Criteria and a Site specific PCB Risk-Based Levels (2.5 mg/kg for Residential and 9.1 mg/kg for Commercial Areas, has been prepared based on available information at the time of this document. Redevelopment activities conducted, being conducted and anticipated for the Site by the City of Plainwell may affect the remediation costs. Costs presented in the Feasibility Study (FS) Report have taken into consideration anticipated redevelopment plans by the City of Plainwell. Redevelopment plans include demolition of non-historical buildings to the concrete slab as well as specific land use restrictions/designations for the Site as presented on Figure 1.4 of the FS Report. This cost estimate is expected to be within -30 percent to +50 percent of the actual remedial costs in accordance with United States Environmental Protection Agency (U.S. EPA) guidance.

B. Remediation activities for each of the 11 proposed redevelopment areas were estimated separately; however, the estimate assumes one mobilization and demobilization effort to conduct the work.

C. The cost estimate assumes that new structures have not been constructed in areas that are planned for soil excavation and existing structures remain in place.

D. Costs assume that additional soil investigation will not be conducted under building slabs unless otherwise noted in the pre-design notes below.

E. Areas targeted for soil removal and off-Site disposal were determined based on an iterative/risk-based approach for arsenic and Site specific calculated levels for PCBs as detailed in Appendix A of the FS Revision 2.

F. The estimated costs assume that excavation of impacted soils under the building slabs will not be conducted.

G. The cost estimate includes abandonment and replacement costs of groundwater monitoring wells within excavation areas.

H. Figure 4.1 of the FS Report shows the conceptual area for consolidation of on Site materials in Commercial Area 4 south of the former Mill Buildings in the area formerly occupied by Buildings 9A, 9B, 9D, 9E and 23.

I. Material was considered for consolidation on Site if the following conditions are met:
   1. Soil that was reported with an arsenic concentration of below 37 milligrams per kilogram (mg/kg)
   2. The soil was not reported with an inhalation exceedance
   3. The soil did not contain PCBs (above the Site specific level of 2.5 mg/kg)
   4. The soil does not contain coal
   5. The soil does not contain semi-volatile organic compounds (SVOCs), volatile organic compounds (VOCs) above Part 201 Residential Criteria

J. Costs are based on 2014 dollars.

K. All volumes are based on in-place measures unless otherwise stated.

L. Abbreviations used in the "Unit" column in the Cost Estimate Table are as follows:
- CY = Cubic Yard
- EA = Each
- LS = Lump Sum
- TN = Ton
- LF= linear foot

**TASK NOTES:**

***CAPITAL COSTS***

**A. INVESTIGATION/CONSTRUCTION**

**1.0 Pre-Design Investigation (PDI) Activities**

The following assumptions were made relative to the PDI activities in each of the redevelopment areas and reflected in the cost estimate.

- Generation of a Sampling and Analysis Plan (SAP).
- Update the Health and Safety Plan as necessary.
- Update the Multi-Area Quality Assurance Project Plan as necessary.
- Completion of the SAP - soil boring installation and soil sample collection to delineate the vertical and horizontal extent of impact. Soil borings are assumed to be collected via direct push method. PDI samples will be collected and submitted for laboratory analysis for specific parameters determined to exceed Preliminary Remediation Goals (PRGs) during the Remedial Investigation (RI). Delineation samples will not be collected in areas that were not selected for excavation activities (i.e., under building slabs, etc.)
- Quality Assurance/Quality Control samples are included on a 1 per 10 basis.
- A survey of the "top of bank" is included in the PDI cost estimate.
- All areas where subsurface work is to be conducted will be cleared through a public utility locate (i.e., MISS Dig), a private utility locate, review of available drawings, and discussions with individuals knowledgeable of the Site and utilities located thereon.

**Residential Area 1**
PRGs exceeded in Residential Area 1 include Part 201 non-residential and residential direct contact criteria for arsenic. Soil samples will be collected to delineate the extent of soil impacted with PCBs adjacent to the storm sewer line installed by the Michigan Department of Transportation (MDOT) in 2012.

- Allowance for 30 soil samples for PCBs
- Allowance for 12 soil samples for arsenic

**Residential Area 2**
The PRG exceeded in Residential Area 2 is Part 201 residential direct contact criteria for arsenic.

- Allowance for 24 soil samples for arsenic

**Residential Area 3**
The PRG exceeded in Residential Area 3 is Part 201 residential direct contact criteria for arsenic.

- Allowance for 56 soil samples for arsenic

**Residential Area 4**
PRGs exceeded in Residential Area 4 include Part 201 non-residential direct contact criteria for arsenic, lead and PCBs. Residential direct contact criteria is exceeded at locations within Residential Area 4 for arsenic, benzo(a)pyrene, cyanide, dibenz(a,h)anthracene, lead and PCBs. Residential soil volatilization to indoor air inhalation criteria (SVIIC) was exceeded at one location for benzene.

- An allowance for 36 soil samples for arsenic
- Benzene above the residential SVIIC at TP-308
    - An allowance for 4 soil samples for benzene was included in the estimate.
- Cyanide was above residential direct contact criteria at SB-302 in the shallow (0-1 foot) interval
    - Four samples for cyanide were included in the estimate
- An allowance for 20 samples for lead was included in the estimate
- PCBs were above the Site specific calculated level at TP-313 and SB-301
    - An allowance for 45 soil samples for PCBs was included in the estimate
- The PNA parameters were identified in shallow samples (0-1.5 feet) below grade at DG3, DG4 and TP-302
    - Allowance for 12 PNA samples

**Waterfront Plaza**
PDI activities will not be specifically conducted within the Waterfront Plaza area.

**Mixed Residential/Commercial Area 1**
PRGs exceeded in Mixed Residential/Commercial Area 1 include Part 201 non-residential inhalation criteria for manganese and residential direct contact criteria for arsenic.

- Delineation samples will be collected around 2 locations (TP-306 and TP-334)
- A total of 12 soil samples for arsenic will be collected
- Four samples for manganese will be collected and analyzed around TP-334

**Mixed Residential/Commercial Area 2**
PRGs exceeded in Mixed Residential/Commercial Area 2 include Part 201 non-residential direct contact criteria for arsenic, benzo(a)pyrene, and lead. Residential direct contact criteria is exceeded at locations within Mixed Residential/Commercial Area 2 for arsenic, benzo(a)pyrene, dibenz(a,h)anthracene; benzo(a)anthracene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene and lead.

Soil delineation by work area as follows:

**<u>Arsenic ONLY locations</u>**:
Building 25
- Allowance for 8 samples
- A portion of the concrete slab was removed during demolition

Building 28
- Allowance for 8 samples
- A portion of the concrete slab was removed during demolition

Train Shed
- Allowance for 4 samples

Coal Tunnel Area
- Allowance for 30 samples

Former Ash Silo Area (SB-2010 and SB-2011)
- Allowance for 12 samples

Former clarifier area (TP-344)
- Allowance for 8 samples

Area north of Building 3/Former Water Tower Area (TP-340, TP-342, TP-343)

- Allowance for 16 samples

**Arsenic and Lead sample locations:**

Area around SB-2013

- Allowance for 12 samples

**Arsenic, PNAs and Lead sample locations:**

Building 3A

- Allowance for 12 samples

Building 6A

- Allowance for 18 samples
- Technicians will be required to don respirators for this work
- The floor in the majority of this building is exposed soil

**Arsenic and PNAs sample locations**

Fuel Oil AST Area

- Allowance for 24 PNA soil samples
- Allowance for 12 arsenic samples

A total of 140 samples will be collected and analyzed for arsenic.
A total of 54 samples will be collected and analyzed for PNAs.
A total of 42 samples will be collected and analyzed for lead.

**Commercial Area 1**

PRGs exceeded in Commercial Area 1 include Part 201 non-residential inhalation criteria for manganese and the residential direct contact for arsenic.

- Delineation samples will be collected around SS-105
- Four soil samples will be collected from the 0-2 foot below grade interval and analyzed for arsenic and manganese

**Commercial Area 2**

Delineation efforts will not be conducted in Commercial Area 2.

**Commercial Area 3**

Delineation efforts will not be conducted in Commercial Area 2.

**Commercial Area 4**

PRGs exceeded in Commercial Area 4 include Part 201 non-residential direct contact criteria for arsenic, and PCBs. Residential direct contact criteria is exceeded at locations within Commercial Area 4 for arsenic, benzo(a)pyrene, lead and PCBs.

Soil delineation by building / work area as follows:

**Arsenic ONLY locations**:

SB-2012

- Allowance for 4 samples

Parking lot area south of Building 17

- Allowance for 60 samples

**Arsenic and Lead sample locations:**
TP-341
- Allowance for 4 samples

**Arsenic, PNAs and Lead sample locations:**

**Former Substation Area/North of Mill Buildings**
- Allowance for 30 samples

**PCBs and Arsenic sample locations:**
MW-16 Area
- Allowance for 18 samples

A total of 116 samples will be collected and analyzed for arsenic.
A total of 30 samples will be collected and analyzed for PNAs.
A total of 18 samples will be collected and analyzed for PCBs.
A total of 34 samples will be collected and analyzed for lead.

## 2.0 Mobilization/Set-Up

The following assumptions were made relative to the mobilization/set-up in each of the redevelopment areas and reflected in the cost estimate.

- Mobilization and set-up includes: mobilization of personnel and equipment (including liner crew and equipment); construction survey work (e.g., excavation layout and verification sample locations); and geotechnical and chemical testing on backfill materials.
  - An allowance of $8,000 to mobilize personnel and equipment was included in the estimate.
  - $30,000 for survey work was included in the estimate.
  - Geotechnical and chemical analysis for imported materials was included in the estimate. One set of chemical analysis [Target Analyte List Metals, Target Compound List (TCL) for volatile organic compounds, TCL for semi-volatile compounds, and polychlorinated biphenyl (PCBs) per material (topsoil, general fill and 21AA/gravel]. The topsoil sample will also be analyzed for pH, phosphorous, organic content, pesticides and herbicides.
- Health and Safety includes an on-Site Health and Safety Officer (HSO) for 4 months. Also included in the costs are: air monitoring equipment and calibration gases; a decontamination trailer; and disposable personal protection equipment (PPE).
- Air monitoring assumes real-time air monitoring will be conducted during all excavation work utilizing a photoionization detector (11.7 electronVolt [eV] lamp) and fugitive dust monitor(s). Air monitoring does not include the collection of samples for laboratory analysis or laboratory analytical costs.
- Erosion control includes an allowance for silt fence (4,000 LF) and geofabric to cover catch basins on the Site. Costs for erosion control measures specific to individual redevelopment areas (i.e., turbidity curtains, etc.) are included in individual redevelopment area estimates (e.g., Commercial Area 4). Erosion control (visqueen, hay bales etc.) for the staged consolidation pile(s) of soil and the relocated and staged gravel material area included here.
- Site facility costs include electrical hookup and electricity for two office trailers (one for the contractor and one for the U.S. EPA) for 4 months. Other temporary facilities include portable sanitary services, a drinking water allowance and a small dumpster for worker general refuse. The expense of one Site truck for the duration of the services was included.
- Site facility costs include materials and construction of temporary decontamination pads and decontamination stations for workers. It was assumed that potable water could be obtained from the City of Plainwell for use during the project.

- Site facility costs include $6,000 to for the installation and maintenance of a staging area for waste.
- A perimeter fence currently exists around the majority of the Site. The cost estimate assumes the fence will remain and can be utilized as a security measure to prevent access to the Site during construction activities.

## 3.0 Preparation/Pre-Excavation Work by Redevelopment Area

The following assumptions were made relative to the preparation/pre-excavation work in each of the redevelopment areas and reflected in the cost estimate.

- A Soil Erosion and Sedimentation Control Permit will be obtained from Allegan County. All other necessary permits will also be obtained prior to intrusive work at the Site.
- All areas where subsurface work is to be conducted will be cleared through a public utility locate (i.e., MISS Dig), a private utility locate, review of available drawings, and discussions with individuals knowledgeable of the Site and utilities located thereon.

**Residential Area 1**
Specific assumptions for preparation/pre-excavation work in Residential Area 1 under Remedial Alternative 2B are presented below.

- Trees and shrubs in the excavation areas will need to be cleared and grubbed.
- Turbidity curtain will be temporally installed in the Kalamazoo River during excavation and backfill activities.
- One power pole will need to be relocated for the excavation work around SB-104.

**Residential Area 2**
No specific assumptions for preparation/pre-excavation work in Residential Area 2 under Remedial Alternative 2B were utilized.

**Residential Area 3**
Specific assumptions for preparation/pre-excavation work in Residential Area 3 under Remedial Alternative 2B are presented below.

- MW-15 will be abandoned.
- Clearing will be required in the area around MW-15.

**Residential Area 4**
Specific assumptions for preparation/pre-excavation work in Residential Area 4 under Remedial Alternative 2B are presented below.

- Clearing will be required in the area around SB-301/SG-4.
- Pavement by TP-302 will be saw cut.

**Waterfront Plaza**
No specific assumptions for preparation/pre-excavation work in Waterfront Plaza under Remedial Alternative 2B were utilized.

**Mixed Residential/Commercial Area 1**
The specific assumption for preparation/pre-excavation work in Mixed Residential/Commercial Area 1 under Remedial Alternative 2B is presented below.

- Pavement in the work areas will be saw cut prior to excavation to leave a clean line for restoration activities.

**Mixed Residential/Commercial Area 2**
Specific assumptions for preparation/pre-excavation work in Mixed Residential/Commercial Area 2 under Remedial Alternative 2B are presented below.

- The loading dock at the south end of Building 1 will be evaluated by a structural engineering evaluation to ensure excavation of the fuel oil line will not damage either the loading dock or Building 1. Excavation will not occur within Building 1.
- A demolition notice will be submitted to the State of Michigan for the demolition of Building 5A/part of the coal tunnel. Asbestos abatement may be necessary on pipe wrap found outside of Building 5A.
- Excavation of soils under the concrete slabs of the demolished buildings (3A, 25 and 28) will require the relocation of the backfill (less than 3 feet thick) prior to excavation.
- Fuel Oil No. 6 within the former coal tunnel will be removed from the tunnel before the tunnel itself is removed.
- The piping run from the former Fuel Oil No. 6 AST and Building 5 will be exposed at one end and drained of any residual fuel oil prior to removing the line.
- Monitoring well MW-19 will be abandoned prior to excavation activities in this area.
- Monitoring well MW-22 will be abandoned prior to removal of the former fuel oil line.
- Monitoring well MW-2 will be abandoned prior to excavation activities at SB-2010 and SB-2011.
- The concrete floor (Buildings 25 and 3A) will be saw cut prior to excavation (concrete will be broke out during excavation – but saw cut first to create clean lines for restoration).

**Commercial Area 1**
No specific assumptions for preparation/pre-excavation work Commercial Area 1 under Remedial Alternative 2B were utilized.

**Commercial Area 2**
No specific assumptions for preparation/pre-excavation work Commercial Area 2 under Remedial Alternative 2B were utilized.

**Commercial Area 3**
No specific assumptions for preparation/pre-excavation work Commercial Area 3 under Remedial Alternative 2B were utilized.

**Commercial Area 4**
Specific assumptions for preparation/pre-excavation work in Commercial Area 4 under Remedial Alternative 2B are presented below.

- Excavation of soils under the concrete slabs of the demolished buildings will require the relocation of backfill placed within the former basement cavities to surrounding grade (up to 9 feet thick) prior to excavation. An allowance for five working days to complete this work was included in the estimate at a cost of $20,400.
- Turbidity curtain will be installed in the Mill Race in the area by MW-16 (along the Mill Race) and in the area of MW-3 prior to excavation activities.

- Monitoring of the Mill Race and Kalamazoo River for turbidity will be conducted during excavation activities.
- MW-16 will be abandoned prior to excavation work in that area.
- Protection of MW-3 (barriers) will be installed.
- A structural engineering evaluation of the pedestrian bridge for stability during excavation activities will be conducted. The evaluation will determine if shoring of the bridge is necessary. An allowance of $5,000 is included in the estimate to conduct the evaluation. Shoring costs have not been included in the estimate.
- The water flow of the Mill Race will be diverted in the excavation area. The methodology for this work to be determined in the pre-design phase of the project.
- Rip rap along the Mill Race will be removed and staged for re-use.
- Pavement in the work areas will be saw cut prior to excavation to allow for restoration activities.

## 4.0 Excavation by Redevelopment Area

Conceptual excavation areas for each of the Redevelopment areas are shown of Figures 3.12 through 3.23 of the FS Report (Revision 2).

The following assumptions were made relative to excavation in each of the redevelopment areas and reflected in the cost estimate.

- Excavation estimates assume dewatering will not be necessary and that all work can be completed in Level D PPE except Building 6A which will be conducted with supplied air (Level B) PPE.
- Standby time was not added to account for the time for laboratory analysis of verification samples. It was assumed that the project would proceed across the Site allowing for laboratory analysis to be conducted while another redevelopment area was being excavated or restored.

Specific assumptions to each redevelopment area, in addition to those presented above globally, are provided below.

**Residential Area 1**

Residential Area 1 is located at the far west end of the Site, where the majority of the former sludge dewatering lagoons were located. The former Mill wastewater treatment building, activated sludge tank and secondary clarifier were constructed over the lagoons. The wastewater treatment structures were demolished on behalf of the City of Plainwell in November and December 2013. The specific assumption for excavation in Residential Area 1 under Remedial Alternative 2B is presented below.

- Overburden present beyond the target excavation area that must be removed to achieve the full depth of excavation will be disposed of off Site.
- The rip rap at the Kalamazoo River outfall from the storm sewer line does not need to be removed.

**Residential Area 2**

Residential Area 2 is located between Residential Area 1 and Residential Area 3 and is positioned along the Kalamazoo River. This area was historically occupied by sludge dewatering lagoons (A, B, C) and a primary clarifier. The primary clarifier was demolished to the concrete slab in November 2013. No specific assumptions for excavation in Residential Area 2 under Remedial Alternative 2B are presented.

**Residential Area 3**

Residential Area 3 is located near the center of the Site. The former aeration basin location occupies the majority of the area. A former secondary clarifier was historically present in this area, which was

demolished in November 2013 with the floor of the former clarifier remaining. Specific assumptions for excavation in Residential Area 3 under Remedial Alternative 2B are presented below.

- Material removed from the bottom of the aeration basin will require double handling due to the slopes of the former aeration basin and the depth of the excavation.

**Residential Area 4**

Residential Area 4 is positioned along the Kalamazoo River between Residential Area 3 and Mixed Residential Area 2. No aboveground structures are currently present on this area. A portion of this area was historically utilized by the Mill as a coal storage area. No specific assumptions for excavation in Residential Area 4 under Remedial Alternative 2B were made.

**Waterfront Plaza**

No excavation activities are anticipated in the Waterfront Plaza Area.

**Mixed Residential/Commercial Area 1**

Mixed Residential/Commercial Area 1 is located between Commercial Area 2 and Commercial Area 3 on the southern property line along Allegan Street. This area was once occupied by the former Specialty Minerals Building and associated above ground storage tanks. The Specialty Minerals building and ASTs were demolished to the concrete slab in December 2011. The specific assumption for excavation in Mixed Residential/Commercial Area 1 under Remedial Alternative 2B is presented below.

- Underground utilities encountered (TP-306) between the former Specialty Minerals Building and the main Mill Buildings will be capped at either end of the excavation.

**Mixed Residential and Commercial Area 2**

Mixed Residential and Commercial Area 2 is located between Residential Area 4 and Commercial Area 4 at the northern end of the Site along the Kalamazoo River. The majority of the area is occupied by Mill Buildings and pavement. Buildings 3A, 25 and 28 along with the eastern water tower, 200,000-gallon Fuel Oil AST, and the brine USTs, were demolished on behalf of the City of Plainwell. The majority of the concrete slabs were left in place for Buildings 3A and 28. Building 25 was part of the Site's historical wastewater treatment system and had a subsurface vault and system to pump the waste water from the Mill to the on-Site WWTP at the west end of the Site. The vault under the northern portion of Building 25 was not removed. The vault floor was cracked and the sidewalls removed to 4 feet below grade, then the vault was filled with imported general fill. The concrete slab under the remaining portion of Building 25 was left in place.

Specific assumptions for excavation in Mixed Residential/Commercial Area 2 under Remedial Alternative 2B are presented below.

- A storm sewer was installed through the west side of Mixed Residential/Commercial Area 2 in 2012 by the Michigan Department of Transportation (MDOT). The approximate location of the storm sewer is shown on Figure 3.18. Before conducting excavation work to remove the former fuel oil AST line and excavate the east side of the former fuel AST, the exact location of the storm sewer line will be determined, shoring of the line may be necessary during the removal of the fuel oil AST line.
- Soils in Building 6A will be removed using a vacuum extraction system.

**Commercial Area 1**

Commercial Area 1 is located in the far southwest portion of the Site. No structures or paved areas are currently present in this area that would require unique equipment or procedures to conduct the proposed remedial activities. This area of the Site has not been developed and was not part of historic Mill operations. The area specific assumption for excavation in Commercial Area 1 under Remedial Alternative 2B is presented below.

- A storm sewer was installed through this area in 2012 by the Michigan Department of Transportation (MDOT). The approximate location of the storm sewer is shown on Figure 3.19. Before conducting excavation work in the area of SS-105, the exact location of the line will be determined.

**Commercial Area 2**

Commercial Area 2 is located in the southwest central portion of the Site. Structures on this portion of the Site include the City of Plainwell Public Safety Building and associated paved parking and egress/ingress areas.

Excavation activities are not anticipated in the Commercial Area 2 for Remedial Alternative 2B.

**Commercial Area 3**

Commercial Area 3 is located adjacent to the former southwest corner of the Mill Buildings along Allegan Street. Structures on this area include a pump house and a former guard shack. Other historical features within this area have been demolished on behalf of the City of Plainwell. The Clay ASTs, Ammonia AST secondary containment structure, the Starch ASTs and Building 9C were demolished in 2012. The concrete slabs for all demolished features were left in place. Specific assumptions for excavation in Commercial Area 3 under Remedial Alternative 2B are presented below.

Excavation activities are not anticipated in the Commercial Area 3 for Remedial Alternative 2B.

**Commercial Area 4**

Commercial Area 4 is located on the eastern side of the Site. The majority of this area is covered with either pavement, buildings (vacant and occupied) or former building concrete slabs. Buildings (9A, 9B, 9C, 9D, 9E, 9F, and 23) were demolished on behalf of the City of Plainwell in 2012, with the majority of the former building concrete slabs left in place and backfilled to surrounding grade. The basement areas were backfilled with a combination of crushed concrete (from the buildings on Site), soil from an adjacent retaining wall that was removed, and imported gravel material and vary in thickness from 6 feet to 9 feet. Specific assumptions for excavation in Commercial Area 4 under Remedial Alternative 2B are presented below.

- Access to both the former substation area and around MW-16 will be restricted due to the distance between existing structures and either the Kalamazoo River or the Mill Race. Excavated soils will likely need to be double handled.

## 5.0 Transportation and Disposal by Redevelopment Area

The following assumptions were made relative to the transportation and disposal of materials in each of the redevelopment areas and reflected in the cost estimate.

- Soil volumes were converted to tonnage assuming a ratio of 1.5 tons per cubic yard for soils. Tonnage for concrete was based on 1.65 tons per cubic yard of material. Waste has been categorized as non-hazardous and non-TSCA soils; TSCA soil; TSCA debris; and miscellaneous debris.
- Transportation and disposal pricing is based on the non-hazardous, non-TSCA material being accepted at Waste Management Autumn Hills Landfill in Zeeland, Michigan. A cost of $22.00 per ton for both transportation and disposal of non-hazardous, non-TSCA waste was used for the estimates.
- A disposal price of $135.00 per ton was used for TSCA soils. For estimation purposes it was assumed that the TSCA soils would be transported to the Environmental Quality Company/U.S. Ecology Company Wayne Disposal Landfill #2, Belleville, Michigan for direct landfill disposal. Transportation of the soils was assumed to be conducted in lined 50 ton gravel trains. Transportation of each load of 50 tons was assumed to cost $500.00.

- Transportation costs assume fuel prices for diesel will not exceed $4.00 per gallon.
- Organic material generated from clearing activities was assumed to be chipped and left on Site.
- Concrete and asphalt will be disposed of off Site, not recycled.

**Residential Area 1**
The specific assumption for transportation and disposal work in Residential Area 1 under Remedial Alternative 2B is presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 910 CY.

**Residential Area 2**
The specific assumption for transportation and disposal work in Residential Area 2 under Remedial Alternative 2B is presented below.

- Waste was assumed suitable for on-Site consolidation (25 CY).

**Residential Area 3**
The specific assumption for transportation and disposal work in Residential Area 2 under Remedial Alternative 2B is presented below.

- Waste was assumed suitable for on-Site consolidation (1,495 CY).

**Residential Area 4**
The specific assumption for transportation and disposal work in Residential Area 3 under Remedial Alternative 2B is presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 5,340 CY.
- Allowance of $600 for asphalt.

**Waterfront Plaza**
No specific assumptions for transportation and disposal work in Waterfront Plaza under Remedial Alternative 2B were utilized. Excavation activities will not be conducted within the Waterfront Plaza area.

**Mixed Residential/Commercial Area 1**
Specific assumptions for transportation and disposal work in Mixed Residential/Commercial Area 1 under Remedial Alternative 2B are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 12 CY for off-Site disposal.
- The remaining 28 CY of waste targeted for excavation was assumed suitable for on-Site consolidation.
- Allowance of 50 CY for asphalt disposal.

**Mixed Residential/Commercial Area 2**
Specific assumptions for transportation and disposal work in Mixed Residential/Commercial Area 2 under Remedial Alternative 2B are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil from Building 6A with a volume of 200 CY.
- Waste from the Train Shed was assumed suitable for on-Site consolidation (205 CY).
- Waste was assumed to be non-hazardous, non-TSCA soil from the coal tunnel area with a volume of 1,270 CY.
- Allowance of $3,500 for miscellaneous debris from the coal tunnel area (bricks, concrete)

- Waste was assumed to be non-hazardous, non-TSCA soil from the fuel oil line with a volume of 525 CY.
- Allowance of $600 for disposal of the fuel oil line piping
- Waste was assumed to be non-hazardous, non-TSCA soil from the fuel oil No. 6 AST area with a volume of 2,500 CY.
- Allowance of $1,200 for the concrete ring the fuel oil tank had sat upon and buried concrete and asphalt.
- Waste was assumed to be non-hazardous, non-TSCA soil from the north end of the Mill Buildings (test pits- TP-342 and TP-343) with a volume of 260 CY.
- Waste was assumed to suitable for on-site consolidation from the north end of the Mill Buildings (Buildings-3A, 25, 28, test pits-TP-340 and SB-2013) with a volume of 730 CY.
- Allowance of $6,000 for miscellaneous debris from these areas at the north end of the Mill Building.

**Commercial Area 1**
Specific assumptions for transportation and disposal work in Commercial Area 1 under Remedial Alternative 2B are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 12 CY.

**Commercial Area 2**
Waste will not be transported off Site from Commercial Area 2 for Remedial Alternative 2B.

**Commercial Area 3**
Waste will not be transported off Site from Commercial Area 2 for Remedial Alternative 2B.

**Commercial Area 4**
Specific assumptions for transportation and disposal work in Commercial Area 4 under Remedial Alternative 2B are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil from the former substation area with a volume of 1,325 CY.
- Waste was assumed to be suitable for on-Site consolidation from the area north of the Mill Buildings with a volume of 1,185 CY
- Waste was assumed to be TSCA soil from the area around MW-16 with a volume of 4,660 CY.
- Waste was assumed to be non-hazardous, non-TSCA soil from the area around boring BK5 with a volume of 15 CY.
- Allowance of $250 for asphalt transportation and disposal

## 6.0 Preparation of Consolidation Area and Consolidation of On-Site Soils

The conceptual area selected for on-Site consolidation of suitable soils is located in Commercial Area 4 (Figure 4.1). The Buildings in this area were demolished in 2011 and the concrete floors were generally left in place (Building 9A has a section of its concrete floor removed). The basement areas were then backfilled with gravel to match the grade to the west and south of the buildings. The thickness of the gravel varies from 6-7 feet (near Allegan Street) to 9 feet (adjacent to the existing Buildings). The gravel material would be excavated to achieve a receiving area for the consolidated soils. Gravel will be staged nearby on the asphalt parking area within Commercial Areas 2 and 3. This area will not generally require remedial excavation activities and is close by to reduce efforts of relocating the gravel material. Erosion control around the relocated gravel will be established. Erosion control costs for this activity were included in the Mobilization Erosion Control Costs.

Based on the conditions identified in the General Notes, 3,668 CY of soil would be available for consolidation under Alternative 2B. Based on the assumptions below, the area selected for consolidation would accept approximately 8,500 CY of soil. The cost estimate for Remedial Alternative 2B assumes 3,668 CY of material will be consolidated on Site. Material will come from Residential Area 2, Residential Area 3 Mixed Area 1, Mixed Area 2 and Commercial Area 1. It was assumed that the material would all be excavated and staged together so that the time the receiving excavation would need to be left open was minimized.

The following specific assumptions for the consolidation area were utilized for the cost estimate:

- The consolidation area was 150 feet by 150 feet in size
- A set back of greater than 20 feet was included on all four sides of the consolidation area
- An average thickness of 5 feet of consolidated soils was allowed
- The relocated / consolidated material would be compacted in place to 95 percent of the proctor
- The gravel material left over after consolidation would be utilized by the City of Plainwell for redevelopment activities.

**7.0 Capping On-Site Soils**

The area utilized for consolidation of the on-Site soils was assumed to be 150 feet by 150 feet. The estimate allows for 10 percent waste of capping materials (liner and geotextile).

- A three foot cover system was assumed:
  1. A 40 mil LLDPE liner with 12 ounce geotextile will be placed over the material
     a. 25,000 SF of liner and geotextile was included in the estimate
  2. General fill would be placed over the geotextile up to 6 inches of the surface
  3. The existing gravel material would be placed on top (6 inches)
- The liner will not be anchored in
- The general fill would be compacted to 95 -98 percent if the proctor
- The gravel would be compacted to 98 percent of the proctor

**8.0 Restoration by Redevelopment Area**

The following assumption was made relative to Site restoration in each of the redevelopment areas and reflected in the cost estimate.

- Restoration activities include backfill (material and placement), compaction, compaction testing and any other location specific restoration that may be deemed necessary at this time.
- General fill from a local gravel pit at a delivered material cost of $4.58 ton was used for the estimates. Unprocessed topsoil at a delivered price of $18.98 cubic yard was also used where appropriate.
- A six-inch layer of unscreened topsoil will be placed over the compacted general fill in areas that were previously pervious (i.e., not paved or impervious). Topsoil will be hydroseeded including mulch.
- Restoration for excavation areas under pavement will be backfilled with general fill and compacted to 95 percent of the proctor.
- A six-inch layer of 21AA or equivalent will be placed on the compacted general fill and compacted to 95 percent or greater of the proctor where restoration includes replacing the pavement.
- Concrete will be replaced where removed during excavation activities (sidewalk along Building 17).
- Asphalt will be replaced where removed during excavation activities.

- Permanent markers will be installed to designate areas on Site where impacted soils above Part 201 clean up criteria, based on land use, remain in place.

**Residential Area 1**
Specific assumptions for Site restoration in Residential Area 1 under Remedial Alternative 2B are presented below.

- Rip rap at the Kalamazoo River around the storm sewer does not need to be replaced.

**Residential Area 2**
No specific assumptions for Site restoration in Residential Area 2 under Remedial Alternative 2B were utilized.

**Residential Area 3**
Specific assumptions for Site restoration in Residential Area 3 under Remedial Alternative 2B are presented below.

- Backfill material will be imported general fill and overburden material removed to achieve excavation depth requirements but beyond the area exceeding cleanup criteria.
- MW-15 will be replaced.

**Residential Area 4**
No specific assumptions for Site restoration in Residential Area 4 under Remedial Alternative 2B were utilized.

**Waterfront Plaza**
No specific assumptions for Site restoration in Waterfront Plaza under Remedial Alternative 2B were utilized. Restoration will not be required in the Waterfront Plaza area.

**Mixed Residential/Commercial Area 1**
No specific assumptions for Site restoration in Mixed Residential/Commercial Area 1 under Remedial Alternative 2B were utilized.

**Mixed Residential/Commercial Area 2**
Specific assumptions for Site restoration in Mixed Residential/Commercial Area 2 under Remedial Alternative 2B are presented below.

- Building 6A currently has a dirt floor; restoration would not include a concrete floor.
- Concrete (former ash silos) will not be replaced at SB-2010.
- Concrete around the former 200,000 gallon fuel oil AST will not be replaced.
- Concrete removed for excavations at SB-216, SB-220, SB-222 and SB-223 will not be replaced.
- Additional backfill will be required to fill in the void space of the coal tunnel.
- MW-2, MW-19 and MW-22 will be replaced.

**Commercial Area 1**
No specific assumptions for Site restoration in Commercial Area 1 under Remedial Alternative 2B were utilized.

**Commercial Area 2**
No specific assumptions for Site restoration in Commercial Area 2 under Remedial Alternative 2B were utilized.

**Commercial Area 3**
No specific assumptions for Site restoration in Commercial Area 3 under Remedial Alternative 2B were utilized.

**Commercial Area 4**
Specific assumptions for Site restoration in Commercial Area 4 under Remedial Alternative 2B are presented below.

- Asphalt will be 3 inches thick.
- Geotextile and Rip rap will be installed along the Mill Race.
- The Mill Race will be returned to its normal flow path.
- The turbidity curtain will be removed from the Mill Race and Kalamazoo River.
- MW-16 will be replaced.

### 9.0 Demobilization

The following assumptions were made relative to the demobilization from the Site and reflected in the cost estimate.

- Costs included in the demobilization task include time for Site tear down and final decontamination of equipment, and demobilization of equipment and personnel. Demobilization activities were assumed to take five working days.

## B. ENGINEERING/OVERSIGHT

### 1.0 Engineering/Design

The following assumption was made relative to the installation of engineering/design and reflected in the cost estimate.

- Engineering and project design/specifications were estimated to be 15 percent of the Construction Costs.

### 2.0 Construction Oversight

The following assumption was made relative to the construction oversight and reflected in the cost estimate.

- Construction oversight was estimated to be 10 percent of the Construction Costs.

**TABLE C.2C**

**COST SUMMARY**
**REMEDIAL ALTERNATIVE 2C – EXCAVATION AND OFF-SITE DISPOSAL**
**WITH CONSOLIDATION AND CAPPING**
**TO MEET LAND USE FOR PART 201, $10^{-5}$ RISK LEVEL FOR ARSENIC (6.4 MG/KG RESIDENTIAL AND 27 MG/KG FOR NON-RESIDENTIAL),**
**AND PCB RISK-BASED LEVEL (2.5 MG/KG RESIDENTIAL AND 9.1 MG/KG COMMERCIAL AREAS)**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Description* | | *Unit* | *Approx. Quantity* | *Unit Price* | *Estimated Cost* *Subtotal* | *Total* |
|---|---|---|---|---|---|---|
| **CAPITAL COSTS** | | | | | | |
| **A.** | ***PRE-DESIGN INVESTIGATION*** | | | | | **$33,200** |
| **1.0** | Sampling and Analysis Work Plan (SAP) | LS | 1 | $25,000 | $25,000 | |
| | Survey top of banks at Site | LS | 1 | $2,000 | $2,000 | |
| | Health and Safety Plan Update | LS | 1 | $1,200 | $1,200 | |
| | Multi-Area Quality Assurance Project Plan | LS | 1 | $5,000 | $5,000 | |
| **2.0** | SAP Implementation | | | | | **$123,900** |
| | Project Set up (mark locations etc.) | LS | 1 | $8,790 | $8,800 | |
| | Private Utility Locate | LS | 1 | $8,000 | $8,000 | |
| | Field Activities | DA | 20 | $2,900 | $58,000 | |
| | *Field Technicians* | | | | | |
| | *Sampling Equipment (push probe technology)* | | | | | |
| | *Expendables (PPE etc)* | | | | | |
| | Temporary Lighting and Carbon Monoxide Control | LS | 1 | $3,000 | $3,000 | |
| | Concrete Coring | LS | 1 | $6,000 | $6,000 | |
| | Laboratory Analysis | LS | 1 | $39,055 | $39,100 | |
| | Investigation Derived Waste Disposal | DA | 20 | $50 | $1,000 | |
| **3.0** | Contingency on PDI | LS | 1 | $78,550 | $78,600 | **$78,600** |
| | *Based on 50 % of SAP costs* | | | | | |
| **4.0** | Remedial Action Plan | LS | 1 | $60,000 | $60,000 | **$60,000** |
| | **TOTAL PRE-DESIGN COSTS** | | | | | **$295,700** |
| **B.** | ***CONSTRUCTION*** | | | | | |
| **1.0** | **Mobilization and Set up** | | | | | **$270,000** |
| | Mobilization and Set up | LS | 1 | $51,500 | $51,500 | |
| | Health and Safety | Monthly | 5 | $28,450 | $142,300 | |
| | Erosion Control | LS | 1 | $18,700 | $18,700 | |
| | Site Facilities | | | | | |
| | *Temporary Facilities* | Monthly | 5 | $6,810 | $34,100 | |
| | *Decontamination Pad and Stations* | LS | 1 | $17,375 | $17,400 | |
| | *Staging Areas* | LS | 1 | $6,000 | $6,000 | |
| **2.0** | **Additional Preparation and/or Demolition (by Redevelopment Area)** | | | | | **$139,400** |
| | Residential 1 | LS | 1 | $14,700 | $14,700 | |
| | Residential 2 | LS | 1 | - | - | |
| | Residential 3 | LS | 1 | $1,195 | $1,200 | |
| | Residential 4 | LS | 1 | $850 | $900 | |
| | Waterfront Plaza | LS | 1 | - | - | |
| | Mixed Residential/Commercial Area 1 | LS | 1 | - | - | |
| | Mixed Residential/Commercial Area 2 | LS | 1 | $56,625 | $56,600 | |
| | Commercial Area 1 | LS | 1 | - | - | |
| | Commercial Area 2 | LS | 1 | - | - | |
| | Commercial Area 3 | LS | 1 | - | - | |
| | Commercial Area 4 | LS | 1 | $65,980 | $66,000 | |
| **3.0** | **Excavation (by Redevelopment Area)** | | | | | **$293,100** |

**TABLE C.2C**

**COST SUMMARY**
**REMEDIAL ALTERNATIVE 2C – EXCAVATION AND OFF-SITE DISPOSAL**
**WITH CONSOLIDATION AND CAPPING**
**TO MEET LAND USE FOR PART 201, $10^{-5}$ RISK LEVEL FOR ARSENIC (6.4 MG/KG RESIDENTIAL AND 27 MG/KG FOR NON-RESIDENTIAL),**
**AND PCB RISK-BASED LEVEL (2.5 MG/KG RESIDENTIAL AND 9.1 MG/KG COMMERCIAL AREAS)**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Description* | | *Unit* | *Approx. Quantity* | *Unit Price* | *Estimated Cost* | |
|---|---|---|---|---|---|---|
| | | | | | *Subtotal* | *Total* |
| | Residential 1 | CY | 935 | $14 | $12,900 | |
| | Residential 2 | CY | 620 | $12 | $7,300 | |
| | Residential 3 | CY | 1,895 | $9 | $16,800 | |
| | Residential 4 | CY | 9,390 | $4 | $33,000 | |
| | Waterfront Plaza | CY | - | - | - | |
| | Mixed Residential/Commercial Area 1 | CY | 70 | $61 | $4,300 | |
| | Mixed Residential/Commercial Area 2 | CY | 6,396 | $27 | $171,200 | |
| | Commercial Area 1 | CY | 12 | $106 | $1,300 | |
| | Commercial Area 2 | CY | 12 | $106 | $1,300 | |
| | Commercial Area 3 | CY | - | - | - | |
| | Commercial Area 4 | CY | 7,175 | $6 | $45,000 | |
| **4.0** | **Transportation and Disposal (by Redevelopment Area)** | | | | | **$1,696,670** |
| | Residential 1 - Non Haz Non TSCA Soils | Ton | 1,403 | $22 | $30,900 | |
| | Residential 2 - Non Haz Non TSCA Soils | Ton | - | - | - | |
| | Residential 3 - Non Haz Non TSCA Soils | Ton | 240 | - | - | |
| | Residential 4 - Non Haz Non TSCA Soils | Ton | 14,085 | $22 | $309,900 | |
| | Residential 4 - Misc Debris | LS | 1 | | $600 | |
| | Waterfront Plaza - Non Haz Non TSCA Soils | Ton | - | - | - | |
| | Mixed Residential/Commercial Area 1 - Non Haz Non TSCA Soils | Ton | 18 | $22 | $400 | |
| | Mixed Residential/Commercial Area 1 - Misc. Debris | LS | - | $125 | $1,675 | |
| | Mixed Residential/Commercial Area 2 - Non Haz Non TSCA Soils | Ton | 8,242 | $22 | $180,800 | |
| | Mixed Residential/Commercial Area 2 - Misc. Debris | LS | 1 | | $8,245 | |
| | Commercial Area 1 - Non Haz Non TSCA Soils | Ton | 18 | $22 | $400 | |
| | Commercial Area 2 - Non Haz Non TSCA Soils | Ton | 18 | $22 | $400 | |
| | Commercial Area 2 - Misc. Debris | LS | - | - | - | |
| | Commercial Area 3 - Non Haz Non TSCA Soils | Ton | - | - | - | |
| | Commercial Area 3 - Misc. Debris | LS | - | - | - | |
| | Commercial Area 4 - Non Haz Non TSCA Soils | Ton | 1,970 | $22 | $43,300 | |
| | Commercial Area 4 - Misc. Debris | LS | - | | $3,550 | |
| | Commercial Area 4 - TSCA | Ton | 7,000 | $160 | $1,116,500 | |
| **5.0** | **Consolidation of Soils on Site** | | | | | **$53,900** |
| | *Preparation of Consolidation Area (south of Mill Buildings)* | LS | 1 | $44,450 | $44,500 | |
| | *Consolidation of On Site Soils (Placement of Material)* | CY | 4,700 | $2 | $9,400 | |
| **6.0** | **Capping of Soils On Site** | LS | 1 | $96,525 | $96,500 | **$96,500** |
| **7.0** | **Restoration (by Redevelopment Area)** | | | | | **$485,525** |
| | Residential 1 | LS | 1 | | $25,000 | |
| | Residential 2 | LS | 1 | | $18,260 | |
| | Residential 3 | LS | 1 | | $34,785 | |
| | Residential 4 | LS | 1 | | $146,380 | |
| | Waterfront Plaza | LS | - | | - | |
| | Mixed Residential/Commercial Area 1 | LS | 1 | | $8,625 | |
| | Mixed Residential/Commercial Area 2 | LS | 1 | | $134,220 | |
| | Commercial Area 1 | LS | 1 | | $1,670 | |
| | Commercial Area 2 | LS | - | | $1,670 | |
| | Commercial Area 3 | LS | - | | - | |
| | Commercial Area 4 | LS | 1 | | $114,915 | |

**TABLE C.2C**

**COST SUMMARY**
**REMEDIAL ALTERNATIVE 2C – EXCAVATION AND OFF-SITE DISPOSAL**
**WITH CONSOLIDATION AND CAPPING**
**TO MEET LAND USE FOR PART 201, $10^{-5}$ RISK LEVEL FOR ARSENIC (6.4 MG/KG RESIDENTIAL AND 27 MG/KG FOR NON-RESIDENTIAL),**
**AND PCB RISK-BASED LEVEL (2.5 MG/KG RESIDENTIAL AND 9.1 MG/KG COMMERCIAL AREAS)**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Description* | | *Unit* | *Approx. Quantity* | *Unit Price* | *Estimated Cost* *Subtotal* | *Estimated Cost* *Total* |
|---|---|---|---|---|---|---|
| **8.0** | **Demobilization** | LS | 1 | $32,300 | $33,000 | **$32,300** |
| | Decontamination and Demobilization | | | | | |
| | **TOTAL CONSTRUCTION COST** | | | | | **$3,067,395** |
| ***C.*** | ***ENGINEERING/OVERSIGHT*** | | | | | |
| **1.0** | **Institutional Controls** | | | | | **$50,000** |
| **2.0** | **Engineering/ Design (15 % of Construction Costs)** | | | | | **$460,100** |
| **3.0** | **Construction Oversight (10 % of Construction Costs)** | | | | | **$306,700** |
| | **TOTAL ENGINEERING/OVERSIGHT COSTS** | | | | | **$816,800** |
| | **CONTINGENCY ON CAPITAL COSTS (25 %)** | | | | | **$971,049** |
| | ***TOTAL CAPITAL COSTS*** | | | | | **$4,855,244** |
| **OPERATION, MAINTENANCE, & MONITORING COSTS** | | | | | | |
| ***A.*** | ***ANNUAL MONITORING AND MAINTENANCE*** | | | | | **$9,600** |
| | Monthly Operation and Maintenance of System | Month | 12 | $800 | $9,600 | |
| | **CONTINGENCY ON OM & M COSTS (20 %)** | | | | | **$1,920** |
| | **TOTAL CAPITAL COSTS** | | | | | **$4,855,244** |
| | **NET PRESENT VALUE OF OM&M (30 YEARS @ 7 % DISCOUNT RATE)** | | | | | **$142,952** |
| | **TOTAL COST** | | | | | **$4,998,195** |

**Table C.2C**

**COST SUMMARY NOTES**
**REMEDIAL ALTERNATIVE 2C – EXCAVATION AND OFF-SITE DISPOSAL**
**WITH CONSOLIDATION AND CAPPING**
**TO MEET LAND USE FOR PART 201, $10^{-5}$ RISK LEVEL FOR ARSENIC AND PCB RISK-BASED LEVEL**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

**GENERAL NOTES**

A. The estimate for Remedial Alternative 2C - Excavation and Off-Site Disposal with on-Site Consolidation and Capping, to meet Land Use Criteria for Part 201 with Risk Based Approach of $10^{-5}$ for Arsenic and Site specific calculated PCB Risk-Based Level has been prepared based on available information at the time of this document. Arsenic risk-based criteria are 6.4 milligrams per kilogram (mg/kg) for Residential and Mixed Residential/Commercial Areas and 27 mg/kg for Commercial Areas. Calculated PCB levels of 2.5 mg/kg (Residential Areas) and 9.1 mg/kg (for Commercial areas) were utilized. Redevelopment activities conducted, being conducted and anticipated for the Site by the City of Plainwell may affect the remediation costs. Costs presented in the Feasibility Study (FS) Report have taken into consideration anticipated redevelopment plans by the City of Plainwell. Redevelopment plans include demolition of non-historical buildings to the concrete slab as well as specific land use restrictions/designations for the Site as presented on Figure 1.4 of the FS Report. This cost estimate is expected to be within -30 percent to +50 percent of the actual remedial costs in accordance with United States Environmental Protection Agency (U.S. EPA) guidance.

B. Remediation activities for each of the 11 proposed redevelopment areas were estimated separately; however, the estimate assumes one mobilization and demobilization effort to conduct the work.

C. Costs assume that additional soil investigation will not be conducted under building slabs unless otherwise noted in the pre-design notes below.

D. Areas targeted for soil removal and off-Site disposal were determined based on an iterative/risk-based approach for arsenic and Site specific calculated levels for PCBs as detailed in Appendix A of the FS Revision 2.

E. The cost estimate assumes that new structures have not been constructed in areas that are planned for soil excavation and existing structures remain in place.

F. The cost estimate includes abandonment and replacement costs of groundwater monitoring wells within excavation areas.

G. Figure 4.1 of the FS Report shows the conceptual area for consolidation of on Site materials in Commercial Area 4 south of the former Mill Buildings in the area formerly occupied by Buildings 9A, 9B, 9D, 9E and 23.

H. Material was considered for consolidation on Site if the following conditions are met:
   1. Soil that was reported with an arsenic concentration of below 27 milligrams per kilogram (mg/kg)
   2. The soil was not reported with an inhalation exceedance
   3. The soil did not contain PCBs above 2.5 mg/kg
   4. The soil does not contain coal

I. The soil does not contain semi-volatile organic compounds (SVOCs), volatile organic compounds (VOCs) above Part 201 Residential Criteria.

J. Costs are based on 2014 dollars.

K. All volumes are based on in-place measures unless otherwise stated.

L. Abbreviations used in the "Unit" column in the Cost Estimate Table are as follows:
- CY = Cubic Yard
- EA = Each
- LS = Lump Sum
- TN = Ton
- LF= linear foot

**TASK NOTES:**

***CAPITAL COSTS***

**A. INVESTIGATION/CONSTRUCTION**

**1.0 Pre-Design Investigation (PDI) Activities**

The following assumptions were made relative to the PDI activities in each of the redevelopment areas and reflected in the cost estimate.

- Generation of a Sampling and Analysis Plan (SAP).
- Update the Health and Safety Plan as necessary.
- Update the Multi-Area Quality Assurance Project Plan as necessary.
- Completion of the SAP - soil boring installation and soil sample collection to delineate the vertical and horizontal extent of impact. Soil borings are assumed to be collected via direct push method. PDI samples will be collected and submitted for laboratory analysis for specific parameters determined to exceed Preliminary Remediation Goals (PRGs) during the Remedial Investigation (RI). Delineation samples will not be collected in areas that were not selected for excavation activities (i.e., under building slabs, etc.)
- Quality Assurance/Quality Control samples are included on a 1 per 10 basis.
- A survey of the "top of bank" is included in the PDI cost estimate.
- All areas where subsurface work is to be conducted will be cleared through a public utility locate (i.e., MISS Dig), a private utility locate, review of available drawings, and discussions with individuals knowledgeable of the Site and utilities located thereon.

**Residential Area 1**
PRGs exceeded in Residential Area 1 include the risked based criteria for arsenic of 6.4 milligrams per kilogram (mg/kg). Soil samples will be collected to delineate the extent of soil impacted with PCBs adjacent to the storm sewer line installed by the Michigan Department of Transportation (MDOT) in 2012.

- Allowance for 30 soil samples for PCBs
- Allowance for 28 soil samples for arsenic

**Residential Area 2**
PRGs exceeded in Residential Area 2 include the risked based criteria for arsenic of 6.4 mg/kg.

- Allowance for 36 soil samples for arsenic

**Residential Area 3**
PRGs exceeded in Residential Area 3 include the risked based criteria for arsenic of 6.4 mg/kg.

- Allowance for 60 soil samples for arsenic

**Residential Area 4**
PRGs exceeded in Residential Area 4 include the risked based criteria for arsenic of 6.4 mg/kg. Part 201 residential direct contact criteria is exceeded at locations within Residential Area 4 for benzo(a)pyrene, cyanide, dibenz(a,h)anthracene and lead. Residential soil volatilization to indoor air inhalation criteria (SVIIC) was exceeded at one location for benzene. The Part 201 non-residential direct contact criterion for lead was exceeded within Residential Area 4. PCBs were above the Site specific calculated PRG of 2.5 mg/kg within Residential Area 4.

- An allowance for 56 soil samples for arsenic
- Benzene above the residential SVIIC at TP-308
    - An allowance for 4 soil samples for benzene was included in the estimate.
- Cyanide was above residential direct contact criteria at SB-302 in the shallow (0-1 foot) interval
    - Four samples for cyanide were included in the estimate
- An allowance for 20 samples for lead was included in the estimate
- The PNA parameters were identified in shallow samples (0-1.5 feet) below grade at DG3, DG4 and TP-302
    - Allowance for 12 PNA samples
- PCBs were above the calculated Site specific level of 2.5 mg/kg at TP-313 and SB-301
    - An allowance for 45 soil samples for PCBs was included in the estimate

**Waterfront Plaza**
PDI activities will not be specifically conducted within the Waterfront Plaza area.

**Mixed Residential/Commercial Area 1**
PRGs exceeded in Mixed Residential/Commercial Area 1 include Part 201 non-residential inhalation criteria for manganese and the risked based PRG for arsenic of 6.4 mg/kg.

- A total of 24 soil samples for arsenic will be collected.
- Soil samples will be collected from borings around TP-334 for manganese. Eight samples will be collected for manganese analysis.

**Mixed Residential/Commercial Area 2**
PRGs exceeded in Mixed Residential/Commercial Area 2 include Part 201 non-residential direct contact criteria for benzo(a)pyrene, and lead. Residential direct contact criteria is exceeded at locations within Mixed Residential/Commercial Area 2 for benzo(a)pyrene, dibenz(a,h)anthracene; benzo(a)anthracene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene and lead. The risked based PRG for arsenic of 6.4 mg/kg is also exceeded at locations within Mixed Residential/Commercial Area 2.

Soil delineation by work area as follows:

**<u>Arsenic ONLY locations</u>**:
Building 25
- Allowance for 8 samples

Building 28
- Allowance for 8 samples

Train Shed
- Allowance for 4 samples

Coal Tunnel Area
- Allowance for 30 samples

Former Ash Silo Area (SB-2011)

- Allowance for 8 samples

Former clarifier area (TP-344)

- Allowance for 8 samples

Area north of Building 3/Former Water Tower Area (TP-340, TP-342, TP-343)

- Allowance for 16 samples

**Arsenic and Lead sample locations:**

Area around SB-2013

- Allowance for 12 samples

**Arsenic, PNAs and Lead sample locations:**

Building 3A

- Allowance for 12 samples

Building 6A

- Allowance for 18 samples
- Technicians will be required to don respirators for this work
- The floor in the majority of this building is exposed soil

**Arsenic and PNAs sample locations**

Fuel Oil AST Area

- Allowance for 24 PNA soil samples
- Allowance for 12 arsenic samples

A total of 140 samples will be collected and analyzed for arsenic.
A total of 54 samples will be collected and analyzed for PNAs.
A total of 42 samples will be collected and analyzed for lead.

**Commercial Area 1**

PRGs exceeded in Commercial Area 1 include Part 201 non-residential inhalation criteria for manganese.

- Delineation samples (4) will be collected around SS-105 for manganese.

**Commercial Area2**

Arsenic above the PRG of 27 mg/kg was exceeded in Commercial Area 2 at TP-321

- Four samples will be collected around TP-321 for arsenic.

**Commercial Area3**

PRGs are not exceeded in Commercial Area 3.

**Commercial Area 4**

Part 201 Residential direct contact criteria is exceeded at locations within Commercial Area 4 for benzo(a)pyrene and lead. The risked based PRG criterion for arsenic of 27 mg/kg was exceeded within Commercial Area 4. PCBs above the Site specific calculated PRG of 9.1 mg/kg was identified in the area around MW-16.

Soil delineation by area as follows:

**Arsenic ONLY locations**:
SB-2012
- Allowance for 4 samples

Parking lot area south of Building 17
- Allowance for 60 samples

**Arsenic and Lead sample locations:**
TP-341
- Allowance for 4 samples

**Arsenic, PNAs and Lead sample locations:**
Former Substation Area/North of Mill Buildings
- Allowance for 30 samples

**PCBs and Arsenic sample locations:**
MW-16 Area
- Allowance for 18 samples

A total of 116 samples will be collected and analyzed for arsenic.
A total of 30 samples will be collected and analyzed for PNAs.
A total of 18 samples will be collected and analyzed for PCBs.
A total of 34 samples will be collected and analyzed for lead.

## 2.0 Mobilization/Set-Up

The following assumptions were made relative to the mobilization/set-up in each of the redevelopment areas and reflected in the cost estimate.

- Mobilization and set-up includes: mobilization of personnel and equipment (including liner crew and equipment); construction survey work (e.g., excavation layout and verification sample locations); and geotechnical and chemical testing on backfill materials.
  - An allowance of $8,000 to mobilize personnel and equipment was included in the estimate.
  - $30,000 for survey work was included in the estimate.
  - Geotechnical and chemical analysis for imported materials was included in the estimate. One set of chemical analysis [Target Analyte List Metals, Target Compound List (TCL) for volatile organic compounds, TCL for semi-volatile compounds, and polychlorinated biphenyl (PCBs) per material (topsoil, general fill and 21AA/gravel]. The topsoil sample will also be analyzed for pH, phosphorous, organic content, pesticides and herbicides.
- Health and Safety includes an on-Site Health and Safety Officer (HSO) for 4 months, the HSO will not stay on Site during all restoration activities. Also included in the costs are: air monitoring equipment and calibration gases; a decontamination trailer; and disposable personal protection equipment (PPE) for the duration of the project (5 months).
- Air monitoring assumes real-time air monitoring will be conducted during all excavation work utilizing a photoionization detector (11.7 electronVolt [eV] lamp) and fugitive dust monitor(s). Air monitoring does not include the collection of samples for laboratory analysis or laboratory analytical costs.
- Erosion control includes an allowance for silt fence (4,000 LF) and geofabric to cover catch basins on the Site. Costs for erosion control measures specific to individual redevelopment areas (i.e., turbidity curtains, etc.) are included in individual redevelopment area estimates (e.g., Commercial Area 4).

Erosion control (visqueen, hay bales etc.) for the staged consolidation pile(s) of soil and the relocated and staged gravel material area included here.

- Site facility costs include electrical hookup and electricity for two office trailers (one for the contractor and one for the U.S. EPA) for 5 months. Other temporary facilities include portable sanitary services, a drinking water allowance and a small dumpster for worker general refuse. The expense of one Site truck for the duration of the services was included.
- Site facility costs include materials and construction of temporary decontamination pads and decontamination stations for workers. It was assumed that potable water could be obtained from the City of Plainwell for use during the project.
- Site facility costs include $6,000 to for the installation and maintenance of a staging area for waste.
- A perimeter fence currently exists around the majority of the Site. The cost estimate assumes the fence will remain and can be utilized as a security measure to prevent access to the Site during construction activities.

## 3.0 Preparation/Pre-Excavation Work by Redevelopment Area

The following assumptions were made relative to the preparation/pre-excavation work in each of the redevelopment areas and reflected in the cost estimate.

- A Soil Erosion and Sedimentation Control Permit will be obtained from Allegan County. All other necessary permits will also be obtained prior to intrusive work at the Site.
- All areas where subsurface work is to be conducted will be cleared through a public utility locate (i.e., MISS Dig), a private utility locate, review of available drawings, and discussions with individuals knowledgeable of the Site and utilities located thereon.

**Residential Area 1**

Specific assumptions for preparation/pre-excavation work in Residential Area 1 under Remedial Alternative 2C are presented below.

- Trees and shrubs in the excavation areas will need to be cleared and grubbed.
- Turbidity curtain will be temporally installed in the Kalamazoo River during excavation and backfill activities.
- One power pole will need to be relocated for the excavation work around SB-104.

**Residential Area 2**

No specific assumptions for preparation/pre-excavation work in Residential Area 2 under Remedial Alternative 2C were utilized.

**Residential Area 3**

Specific assumptions for preparation/pre-excavation work in Residential Area 3 under Remedial Alternative 2C are presented below.

- MW-15 will be abandoned.
- Clearing will be required in the area around MW-15.

**Residential Area 4**

Specific assumptions for preparation/pre-excavation work in Residential Area 4 under Remedial Alternative 2C are presented below.

- Clearing will be required in the area around SB-301/SG-4.
- Pavement by TP-302 will be saw cut.

**Waterfront Plaza**
No specific assumptions for preparation/pre-excavation work in Waterfront Plaza under Remedial Alternative 2C were utilized.

**Mixed Residential/Commercial Area 1**
The specific assumption for preparation/pre-excavation work in Mixed Residential/Commercial Area 1 under Remedial Alternative 2C is presented below.

- Pavement in the work areas will be saw cut prior to excavation to leave a clean line for restoration activities.

**Mixed Residential/Commercial Area 2**
Specific assumptions for preparation/pre-excavation work in Mixed Residential/Commercial Area 2 under Remedial Alternative 2C are presented below.

- The loading dock at the south end of Building 1 will be evaluated by a structural engineering assessment to ensure excavation of the fuel oil line will not damage either the loading dock or Building 1.
- The pavement and concrete will be saw cut prior to excavation to create clean lines for restoration.
- A demolition notice will be submitted to the State of Michigan for the demolition of Building 5A/part of the coal tunnel. Asbestos abatement may be necessary on pipe wrap found outside of Building 5A.
- Excavation of soils under the concrete slabs of the demolished buildings (3A, 25 and 28) will require the relocation of the backfill (less than 3 feet thick) prior to excavation.
- Fuel Oil No. 6 within the former coal tunnel will be removed from the tunnel before the tunnel itself is removed.
- The piping run from the former Fuel Oil No. 6 AST and Building 5 will be exposed at one end and drained of any residual fuel oil prior to removing the line.
- Monitoring well MW-19 will be abandoned prior to excavation activities in this area.
- Monitoring well MW-22 will be abandoned prior to removal of the former fuel oil line.
- Monitoring well MW-2 will be abandoned prior to excavation activities at SB-2010 and SB-2011.

**Commercial Area 1**
No specific assumptions for preparation/pre-excavation work in Commercial Area 1 under Remedial Alternative 2C were utilized.

**Commercial Area 2**
No specific assumptions for preparation/pre-excavation work in Commercial Area 2 under Remedial Alternative 2C were utilized.

**Commercial Area 3**
No specific assumptions for preparation/pre-excavation work in Commercial Area 3 under Remedial Alternative 2C were utilized. Excavation work will not be conducted in Commercial Area 3 for Remedial Alternative 2C.

**Commercial Area 4**
Specific assumptions for preparation/pre-excavation work in Commercial Area 4 under Remedial Alternative 2C are presented below.

- Turbidity curtain will be installed in the Mill Race in the area by MW-16 (along the Mill Race) and in the area of MW-3 prior to excavation activities.
- Monitoring of the Mill Race and Kalamazoo River for turbidity will be conducted during excavation activities.
- MW-16 will be abandoned prior to excavation work in that area.
- Protection of MW-3 (barriers) will be installed.
- A structural engineering evaluation of the pedestrian bridge for stability during excavation activities will be conducted. The evaluation will determine if shoring of the bridge is necessary. An allowance of $5,000 is included in the estimate to conduct the evaluation. Shoring costs have not been included in the estimate.
- The water flow of the Mill Race will be diverted in the excavation area. The methodology for this work to be determined in the pre-design phase of the project.
- Rip rap along the Mill Race will be removed and staged for re-use.
- Pavement in the work areas will be saw cut prior to excavation to allow for restoration activities.

## 4.0 Excavation by Redevelopment Area

Conceptual excavation areas for each of the Redevelopment areas are shown of Figures 3.23 through 3.33 of the FS Report (Revision 2).

The following assumptions were made relative to excavation in each of the redevelopment areas and reflected in the cost estimate.

- Soil excavation was not conducted inside of the buildings (see exception for Building 6A – which does not have a concrete floor).
- Excavation estimates assume dewatering will not be necessary and that all work can be completed in Level D PPE except Building 6A which will be conducted with supplied air (Level B) PPE.
- Standby time was not added to account for the time for laboratory analysis of verification samples. It was assumed that the project would proceed across the Site allowing for laboratory analysis to be conducted while another redevelopment area was being excavated or restored.

Specific assumptions to each redevelopment area, in addition to those presented above globally, are provided below.

**Residential Area 1**

Residential Area 1 is located at the far west end of the Site, where the majority of the former sludge dewatering lagoons were located. The former Mill wastewater treatment building, activated sludge tank and secondary clarifier were constructed over the lagoons. The wastewater treatment structures were demolished on behalf of the City of Plainwell in November and December 2013. The specific assumption for excavation in Residential Area 1 under Remedial Alternative 2C is presented below.

- Overburden present beyond the target excavation area that must be removed to achieve the full depth of excavation will be disposed of off Site.

**Residential Area 2**

Residential Area 2 is located between Residential Area 1 and Residential Area 3 and is positioned along the Kalamazoo River. This area was historically occupied by sludge dewatering lagoons (A, B, C) and a primary clarifier. The primary clarifier was demolished to the concrete slab in November 2013. No

specific assumptions for excavation work in Residential Area 2 under Remedial Alternative 2C were utilized.

**Residential Area 3**

Residential Area 3 is located near the center of the Site. The former aeration basin location occupies the majority of the area. A former secondary clarifier was historically present in this area, which was demolished in November 2013 with the floor of the former clarifier remaining. Specific assumptions for excavation in Residential Area 3 under Remedial Alternative 2C are presented below.

- Material removed from the bottom of the aeration basin will require double handling due to the slopes of the former aeration basin and the depth of the excavation.

**Residential Area 4**

Residential Area 4 is positioned along the Kalamazoo River between Residential Area 3 and Mixed Residential Area 2. No aboveground structures are currently present on this area. A portion of this area was historically utilized by the Mill as a coal storage area. No specific assumptions for excavation in Residential Area 4 under Remedial Alternative 2C were made.

**Waterfront Plaza**

No excavation activities are anticipated in the Waterfront Plaza Area.

**Mixed Residential/Commercial Area 1**

Mixed Residential/Commercial Area 1 is located between Commercial Area 2 and Commercial Area 3 on the southern property line along Allegan Street. This area was once occupied by the former Specialty Minerals Building and associated above ground storage tanks. The Specialty Minerals building and ASTs were demolished to the concrete slab in December 2011.

- Underground utilities encountered (TP-303 and TP-306) between the former Specialty Minerals Building and the main Mill Buildings will be capped at either end of the excavation.

**Mixed Residential and Commercial Area 2**

Mixed Residential and Commercial Area 2 is located between Residential Area 4 and Commercial Area 4 at the northern end of the Site along the Kalamazoo River. The majority of the area is occupied by Mill Buildings and pavement. Buildings 3A, 25 and 28 along with the eastern water tower, 200,000-gallon Fuel Oil AST, and the brine USTs, were demolished on behalf of the City of Plainwell. The concrete slabs were left in place for Buildings 3A and 28. Building 25 was part of the Site's historical wastewater treatment system and had a subsurface vault and system to pump the waste water from the Mill to the on-Site WWTP at the west end of the Site. The vault under the northern portion of Building 25 was not removed. The vault floor was cracked and the sidewalls removed to 4 feet below grade, then the vault was filled with imported general fill. The concrete slab under the remaining portion of Building 25 was left in place.

Specific assumptions for excavation in Mixed Residential/Commercial Area 2 under Remedial Alternative 2C are presented below.

- A storm sewer was installed through the west side of Mixed Residential/Commercial Area 2 in 2012 by the Michigan Department of Transportation (MDOT). The approximate location of the storm sewer is shown on Figure 3.29. Before conducting excavation work to remove the former fuel oil AST line and excavate the east side of the former fuel AST, the exact location of the storm sewer line will be determined, shoring of the line may be necessary during the removal of the fuel oil AST line.
- Soils in Building 6A will be removed using a vacuum extraction system.

**Commercial Area 1**
Commercial Area 1 is located in the far southwest portion of the Site. No structures or paved areas are currently present in this area that would require unique equipment or procedures to conduct the proposed remedial activities. This area of the Site has not been developed and was not part of historic Mill operations.

- A storm sewer was installed through this area in 2012 by the Michigan Department of Transportation (MDOT). The approximate location of the storm sewer is shown on Figure 3.30. Before conducting excavation work in the area of SS-105, the exact location of the line will be determined.

**Commercial Area 2**
Commercial Area 2 is located in the southwest central portion of the Site. Structures on this portion of the Site include the City of Plainwell Public Safety Building and associated paved parking and egress /ingress areas. Excavation activities will not take place under the existing building or paved surfaces. No specific assumptions for excavation in Commercial Area 2 under Remedial Alternative 2C were made.

**Commercial Area 3**
Excavation work will not be conducted in Commercial Area 3 for Remedial Alternative 2C.

**Commercial Area 4**
Commercial Area 4 is located on the eastern side of the Site. The majority of this area is covered with either pavement, buildings (vacant and occupied) or former building concrete slabs. Buildings (9A, 9B, 9C, 9D, 9E, 9F, and 23) were demolished on behalf of the City of Plainwell in 2012, with the majority of the former building concrete slabs left in place and backfilled to surrounding grade. The basement areas were backfilled with a combination of crushed concrete (from the buildings on Site), soil from an adjacent retaining wall that was removed, and imported gravel material and vary in thickness from 6 feet to 9 feet. Specific assumptions for excavation in Commercial Area 4 under Remedial Alternative 2C are presented below.

- Access to both the former substation area and around MW-16 will be restricted due to the distance between existing structures and either the Kalamazoo River or the Mill Race. Excavated soils will likely need to be double handled.

## 5.0 Transportation and Disposal by Redevelopment Area

The following assumptions were made relative to the transportation and disposal of materials in each of the redevelopment areas and reflected in the cost estimate.

- Soil volumes were converted to tonnage assuming a ratio of 1.5 tons per cubic yard for soils. Tonnage for concrete was based on 1.65 tons per cubic yard of material. Waste has been categorized as non-hazardous and non-TSCA soils; TSCA soil; TSCA debris; and miscellaneous debris.
- Transportation and disposal pricing is based on the non-hazardous, non-TSCA material being accepted at Waste Management Autumn Hills Landfill in Zeeland, Michigan. A cost of $22.00 per ton for both transportation and disposal of non-hazardous, non-TSCA waste was used for the estimates.
- A disposal price of $135.00 per ton was used for TSCA soils. For estimation purposes it was assumed that the TSCA soils would be transported to the Environmental Quality Company/U.S. Ecology Company Wayne Disposal Site #2 Landfill, Belleville, Michigan for direct landfill disposal. Transportation of the soils was assumed to be conducted in lined 50 ton gravel trains. Transportation of each load of 50 tons was assumed to cost $500.00.
- Transportation costs assume fuel prices for diesel will not exceed $4.00 per gallon.
- Organic material generated from clearing activities was assumed to be chipped and left on Site.

- Concrete and asphalt will be disposed of off-Site, not recycled.

**Residential Area 1**
The specific assumption for transportation and disposal work in Residential Area 1 under Remedial Alternative 2C is presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 935 CY.

**Residential Area 2**
The specific assumption for transportation and disposal work in Residential Area 2 under Remedial Alternative 2C is presented below.

- Waste was assumed suitable for on-Site consolidation (620 CY).

**Residential Area 3**
The specific assumption for transportation and disposal work in Residential Area 2 under Remedial Alternative 2C is presented below.

- Waste was assumed suitable for on-Site consolidation (1,735 CY).
- 160 CY of material was assumed to be unsuitable for on-Site consolidation due to buried debris.

**Residential Area 4**
The specific assumption for transportation and disposal work in Residential Area 3 under Remedial Alternative 2C is presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 9,390 CY.
- Allowance of $600 for asphalt.

**Waterfront Plaza**
No specific assumptions for transportation and disposal work in Waterfront Plaza under Remedial Alternative 2C were utilized. Excavation activities will not be conducted within the Waterfront Plaza area.

**Mixed Residential/Commercial Area 1**
Specific assumptions for transportation and disposal work in Mixed Residential/Commercial Area 1 under Remedial Alternative 2C are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 12 CY.
- Remaining waste targeted for excavation assumed suitable for on-Site consolidation (58 CY).
- Allowance of 50 CY for asphalt disposal.

**Mixed Residential/Commercial Area 2**
Specific assumptions for transportation and disposal work in Mixed Residential/Commercial Area 2 under Remedial Alternative 2C are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil from Building 6A with a volume of 200 CY.
- Waste was assumed to be non-hazardous, non-TSCA soil from the coal tunnel area with a volume of 1,270 CY.
- Allowance of $3,500 for miscellaneous debris from the coal tunnel area (bricks, concrete).
- Waste was assumed to be non-hazardous, non-TSCA soil from the fuel oil line with a volume of 525 CY.
- Allowance of $600 for disposal of the fuel oil line piping.

- Waste was assumed to be non-hazardous, non-TSCA soil from the fuel oil No. 6 AST area with a volume of 2,500 CY.
- Allowance of $1,200 for the concrete ring the Fuel Oil AST was sitting on and buried concrete and asphalt.
- Waste from the Train Shed was assumed to be suitable for on-Site consolidation (205 CY).
- Waste was assumed to be non-hazardous, non-TSCA soil from the north end of the Mill Buildings (test pits-TP-340, TP-342 and TP-343 and Building 3A borings) with a volume of 1,000 CY.
- Waste was assumed to be suitable for on-Site consolidation from Buildings 25 and 28 plus the area around SB-2010 and SB-2011 (696 CY).
- Allowance of $6,000 for miscellaneous debris from these areas at the north end of the Mill Building.

**Commercial Area 1**
Specific assumptions for transportation and disposal work in Commercial Area 1 under Remedial Alternative 2C are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 12 CY.

**Commercial Area 2**
Specific assumptions for transportation and disposal work in Commercial Area 2 under Remedial Alternative 2C are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 12 CY.

**Commercial Area 3**
No specific assumptions for transportation and disposal work in Commercial Area 3 under Remedial Alternative 2C were utilized. Excavation activities will not be conducted within the Commercial Area 3.

**Commercial Area 4**
Specific assumptions for transportation and disposal work in Commercial Area 4 under Remedial Alternative 2C are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil from the former substation area and north of the Mill Buildings with a volume of 1,300 CY.
- Waste was assumed to be suitable for on-Site consolidation from north of the Mill Buildings 11, 11A and 19 (1,200 CY).
- Waste was assumed to be TSCA soil from the area around MW-16 with a volume of 4,660 CY.
- Waste was assumed to suitable for consolidation on-Site from the area around BK5 (15 CY).
- Allowance of 400 CY of asphalt.

## 6.0 Preparation of Consolidation Area and Consolidation of On-Site Soils

The conceptual area selected for on-Site consolidation of suitable soils is located in Commercial Area 4 (Figure 4.1). The Buildings in this area were demolished in 2011 and the concrete floors were generally left in place (Building 9A has a section of its concrete floor removed). The basement areas were then backfilled with gravel to match the grade to the west and south of the buildings. The thickness of the gravel varies from 6-7 feet (near Allegan Street) to 9 feet (adjacent to the existing Buildings). The gravel material would be excavated to achieve a receiving area for the consolidated soils. Gravel will be staged nearby on the asphalt parking area within Commercial Areas 2 and 3. This area will not generally require remedial excavation activities and is close by to reduce efforts of relocating the gravel material. Erosion control around the

relocated gravel will be established. Erosion control costs for this activity were included in the Mobilization Erosion Control Costs.

Based on the conditions identified in the General Notes, 4,700 CY of soil would be available for consolidation under Alternative 2C. The area selected for consolidation could accept approximately 8,500 CY of soil (using a 180 foot by 260 foot area). Material will come from Residential Area 2, Residential Area 3, Mixed Area 1, Mixed Area 2 and Commercial Area 4. It was assumed that the material would all be excavated and staged together so that the time the receiving excavation would need to be left open was minimized.

The following specific assumptions for the consolidation area were utilized for the cost estimate:

- The consolidation area was 150 feet by 200 feet in size
- A set back of greater than 20 feet was included on all four sides of this consolidation area
- An average thickness of 5 feet of consolidated soils was allowed
- The relocated / consolidated material would be compacted in place to 95 percent of the proctor
- The gravel material left over after consolidation would be utilized by the City of Plainwell for redevelopment activities

**7.0 Capping On-Site Soils**

The area utilized for consolidation of the on-Site soils was assumed to be 150 feet by 200 feet. The estimate allows for 10 percent waste of capping materials (liner and geotextile).

- A three foot cover system was assumed:
  1. A 40 mil LLDPE liner with 12 ounce geotextile will be placed over the material
     a. 33,000 SF of liner was included in the estimate
  2. General fill would be placed over the geotextile up to 6 inches of the surface
- 3. The existing gravel material would be placed on top (6 inches)
- The liner will not be anchored in
- The general fill would be compacted to 95 -98 percent of the proctor
- The gravel would be compacted to 98 percent of the proctor

**8.0 Restoration by Redevelopment Area**

The following assumption was made relative to Site restoration in each of the redevelopment areas and reflected in the cost estimate.

- Restoration activities include backfill (material and placement), compaction, compaction testing and any other location specific restoration that may be deemed necessary at this time (e.g. replacing a floor).
- General fill from a local gravel pit at a delivered material cost of $4.58 ton was used for the estimates. Unprocessed topsoil at a delivered price of $18.98 cubic yard was also used where appropriate.
- Restoration for the excavation areas include general fill backfill compacted to 92-95 percent of the proctor.
- A 6-inch layer of unscreened topsoil will be placed over the compacted general fill in areas that were previously pervious (i.e., not paved or impervious). Topsoil will be hydroseeded including mulch.
- Restoration for excavation areas under pavement will be backfilled with general fill and compacted to 95 percent of the proctor.

- A six-inch layer of 21AA or equivalent will be placed on the compacted general fill and compacted to 95 percent or greater of the proctor where pavement will be installed.
- Asphalt will be replaced where removed during excavation activities.
- Permanent markers will be installed to designate areas on Site where impacted soils above Part 201 clean up criteria, based on land use, remain in place.

**Residential Area 1**
Specific assumptions for Site restoration in Residential Area 1 under Remedial Alternative 2C are presented below.

- Backfill material will be imported general fill and overburden material removed to achieve excavation depth requirements but beyond the area exceeding PRGs.

**Residential Area 2**
No specific assumptions for Site restoration in Residential Area 2 under Remedial Alternative 2C were utilized.

**Residential Area 3**
Specific assumptions for Site restoration in Residential Area 3 under Remedial Alternative 2C are presented below.

- Backfill material will be imported general fill and overburden material removed to achieve excavation depth requirements but beyond the area exceeding cleanup criteria.
- MW-15 will be replaced.

**Residential Area 4**
No specific assumptions for Site restoration in Mixed Residential/Commercial Area 1 under Remedial Alternative 2C were utilized.

**Waterfront Plaza**
No specific assumptions for Site restoration in Waterfront Plaza under Remedial Alternative 2C were utilized. Restoration will not be required in the Waterfront Plaza area.

**Mixed Residential/Commercial Area 1**
No specific assumptions for Site restoration in Mixed Residential/Commercial Area 1 under Remedial Alternative 2C were utilized.

**Mixed Residential/Commercial Area 2**
Specific assumptions for Site restoration in Mixed Residential/Commercial Area 2 under Remedial Alternative 2C are presented below.

- Building 6A currently has a dirt floor; restoration would not include a concrete floor.
- Concrete (former ash silos) will not be replaced at SB-2010.
- Concrete around the former 200,000 gallon fuel oil AST will not be replaced.
- Concrete removed for excavations at SB-216, SB-220, SB-222 and SB-223 will not be replaced.
- Additional backfill will be required to fill in the void space of the coal tunnel.
- MW-2, MW-19 and MW-22 will be replaced.

**Commercial Area 1**
No specific assumptions for Site restoration in Commercial Area 1 under Remedial Alternative 2C were utilized.

**Commercial Area 2**
No specific assumptions for Site restoration in Commercial Area 2 under Remedial Alternative 2C were utilized.

**Commercial Area 3**
No specific assumptions for Site restoration in Commercial Area 3 under Remedial Alternative 2C were utilized.

**Commercial Area 4**
Specific assumptions for Site restoration in Commercial Area 4 under Remedial Alternative 2C are presented below.

- Asphalt will be 3 inches thick.
- Geotextile and Rip rap will be installed along the Mill Race.
- The Mill Race will be returned to its normal flow path.
- The turbidity curtain will be removed from the Mill Race and Kalamazoo River.
- MW-16 will be replaced.

### 9.0 Demobilization

The following assumptions were made relative to the demobilization from the Site and reflected in the cost estimate.

- Costs included in the demobilization task include time for Site tear down and final decontamination of equipment, and demobilization of equipment and personnel. Demobilization activities were assumed to take 5 working days.

## B. ENGINEERING/OVERSIGHT

### 1.0 Engineering/Design

The following assumption was made relative to the installation of engineering/design and reflected in the cost estimate.

- Engineering and project design/specifications were estimated to be 15 percent of the Construction Costs.

### 2.0 Construction Oversight

The following assumption was made relative to the construction oversight and reflected in the cost estimate.

- Construction oversight was estimated to be 10 percent of the Construction Costs.

**TABLE C.3A**

**COST SUMMARY**
**REMEDIAL ALTERNATIVE 3A – EXCAVATION AND OFF-SITE DISPOSAL**
**TO MEET PART 201 RESIDENTIAL AND TSCA UNRESTRICTED HIGH OCCUPANCY LEVEL**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Description* | | *Unit* | *Approx. Quantity* | *Unit Price* | *Estimated Cost* *Subtotal* | *Total* |
|---|---|---|---|---|---|---|
| **CAPITAL COSTS** | | | | | | |
| **A.** | ***PRE-DESIGN INVESTIGATION*** | | | | | **$33,200** |
| **1.0** | Sampling and Analysis Work Plan (SAP) | LS | 1 | $25,000 | $25,000 | |
| | Survey top of banks at Site | LS | 1 | $2,000 | $2,000 | |
| | Health and Safety Plan Update | LS | 1 | $1,200 | $1,200 | |
| | Multi-Area Quality Assurance Project Plan Update | LS | 1 | $5,000 | $5,000 | |
| **2.0** | SAP Implementation | | | | | **$245,500** |
| | Project Set up (mark locations etc.) | LS | 1 | $10,530 | $10,500 | |
| | Private Utility Locate | LS | 1 | $9,000 | $9,000 | |
| | Field Activities | DA | 50 | $2,900 | $145,000 | |
| | *Field Technicians* | | | | | |
| | *Sampling Equipment (push probe technology)* | | | | | |
| | *Expendables (PPE etc)* | | | | | |
| | Temporary Lighting and Carbon Monoxide Control | LS | 1 | $6,000 | $6,000 | |
| | Concrete Coring | LS | 1 | $7,000 | $7,000 | |
| | Laboratory Analysis | LS | 1 | $65,540 | $65,500 | |
| | Investigation Derived Waste Disposal | EA | 50 | $50 | $2,500 | |
| **3.0** | Contingency on PDI | LS | 1 | $139,350 | $139,400 | **$139,400** |
| | *Based on 50 % of PDI costs* | | | | | |
| **4.0** | Remedial Action Plan | LS | 1 | $60,000 | $60,000 | **$60,000** |
| | **TOTAL PRE-DESIGN COSTS** | | | | | **$478,100** |
| ***B.*** | ***CONSTRUCTION*** | | | | | |
| **1.0** | **Mobilization and Set up** | | | | | **$483,500** |
| | Mobilization and Set up | LS | 1 | $45,700 | $45,700 | |
| | Health and Safety | Monthly | 11 | $28,450 | $313,000 | |
| | Erosion Control | LS | 1 | $23,040 | $23,000 | |
| | Site Facilities | | | | | |
| | *Temporary Facilities* | Monthly | 11 | $7,125 | $78,400 | |
| | *Decontamination Pad and Stations* | LS | 1 | $17,375 | $17,400 | |
| | *Staging Areas* | LS | 1 | $6,000 | $6,000 | |
| **2.0** | **Additional Preparation and/or Demolition (by Redevelopment Area)** | | | | | **$372,700** |
| | Residential 1 | LS | 1 | $17,641 | $17,600 | |
| | Residential 2 | LS | 1 | - | - | |
| | Residential 3 | LS | 1 | $1,225 | $1,200 | |
| | Residential 4 | LS | 1 | $850 | $900 | |
| | Waterfront Plaza | LS | 1 | - | - | |
| | Mixed Residential/Commercial Area 1 | LS | 1 | $2,970 | $3,000 | |
| | Mixed Residential/Commercial Area 2 | LS | 1 | $189,617 | $189,600 | |
| | Commercial Area 1 | LS | 1 | $1,981 | $2,000 | |
| | Commercial Area 2 | LS | 1 | $16,170 | - | |
| | Commercial Area 3 | LS | 1 | $1,165 | - | |
| | Commercial Area 4 | LS | 1 | $158,447 | $158,400 | |

**TABLE C.3A**

**COST SUMMARY**
**REMEDIAL ALTERNATIVE 3A – EXCAVATION AND OFF-SITE DISPOSAL**
**TO MEET PART 201 RESIDENTIAL AND TSCA UNRESTRICTED HIGH OCCUPANCY LEVEL**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Description* | | *Unit* | *Approx. Quantity* | *Unit Price* | *Estimated Cost* *Subtotal* | *Total* |
|---|---|---|---|---|---|---|
| **3.0** | **Excavation (by Redevelopment Area)** | | | | | **$981,200** |
| | Residential 1 | CY | 4,905 | $8 | $39,200 | |
| | Residential 2 | CY | 3,585 | $4 | $14,300 | |
| | Residential 3 | CY | 1,895 | $9 | $16,800 | |
| | Residential 4 | CY | 10,535 | $4 | $38,700 | |
| | Waterfront Plaza | CY | - | - | - | |
| | Mixed Residential/Commercial Area 1 | CY | 1,060 | $18 | $18,600 | |
| | Mixed Residential/Commercial Area 2 | CY | 7,916 | $32 | $251,500 | |
| | Commercial Area 1 | CY | 2,215 | $6 | $13,000 | |
| | Commercial Area 2 | CY | 3,000 | $52 | $156,900 | |
| | Commercial Area 3 | CY | 5,765 | $5 | $27,100 | |
| | Commercial Area 4 | CY | 16,115 | $25 | $405,100 | |
| **4.0** | **Transportation and Disposal (by Redevelopment Area)** | | | | | **$2,895,765** |
| | Residential 1 - Non Haz Non TSCA Soils | Ton | 7,358 | $22 | $161,900 | |
| | Residential 2 - Non Haz Non TSCA Soils | Ton | 5,378 | $22 | $118,300 | |
| | Residential 3 - Non Haz Non TSCA Soils | Ton | 2,843 | $22 | $62,500 | |
| | Residential 4 - Non Haz Non TSCA Soils | Ton | 15,803 | $22 | $347,700 | |
| | Residential 4 - Misc Debris | LS | 1 | | $600 | |
| | Waterfront Plaza - Non Haz Non TSCA Soils | Ton | - | $22 | - | |
| | Mixed Residential/Commercial Area 1 - Non Haz Non TSCA Soils | Ton | 1,590 | $22 | $35,000 | |
| | Mixed Residential/Commercial Area 1 - Misc. Debris | LS | - | $1,675 | $1,675 | |
| | Mixed Residential/Commercial Area 2 - Non Haz Non TSCA Soils | Ton | 11,874 | $22 | $260,500 | |
| | Mixed Residential/Commercial Area 2 - Misc. Debris | LS | 1 | | $19,995 | |
| | Commercial Area 1 - Non Haz Non TSCA Soils | Ton | 3,325 | $22 | $73,200 | |
| | Commercial Area 2 - Non Haz Non TSCA Soils | Ton | 4,500 | $22 | $99,000 | |
| | Commercial Area 2 - Misc. Debris | LS | 1 | | $5,825 | |
| | Commercial Area 3 - Non Haz Non TSCA Soils | Ton | 8,645 | $22 | $190,200 | |
| | Commercial Area 3 - Misc. Debris | LS | 1 | | $1,750 | |
| | Commercial Area 4 - Non Haz Non TSCA Soils | Ton | 17,185 | $22 | $378,100 | |
| | Commercial Area 4 - Misc. Debris | LS | - | | $23,020 | |
| | Commercial Area 4 - TSCA | Ton | 7,000 | $160 | $1,116,500 | |
| **7.0** | **Restoration (by Redevelopment Area)** | | | | | **$1,209,030** |
| | Residential 1 | LS | 1 | | $86,590 | |
| | Residential 2 | LS | 1 | | $53,000 | |
| | Residential 3 | LS | 1 | | $31,975 | |
| | Residential 4 | LS | 1 | | $163,000 | |
| | Waterfront Plaza | LS | - | | - | |
| | Mixed Residential/Commercial Area 1 | LS | 1 | | $41,140 | |
| | Mixed Residential/Commercial Area 2 | LS | 1 | | $210,800 | |
| | Commercial Area 1 | LS | 1 | | $32,950 | |
| | Commercial Area 2 | LS | 1 | | $104,275 | |
| | Commercial Area 3 | LS | 1 | | $132,210 | |
| | Commercial Area 4 | LS | 1 | | $353,090 | |

**TABLE C.3A**

**COST SUMMARY**
**REMEDIAL ALTERNATIVE 3A – EXCAVATION AND OFF-SITE DISPOSAL**
**TO MEET PART 201 RESIDENTIAL AND TSCA UNRESTRICTED HIGH OCCUPANCY LEVEL**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Description* | | *Unit* | *Approx. Quantity* | *Unit Price* | *Estimated Cost* *Subtotal* | *Total* |
|---|---|---|---|---|---|---|
| **8.0** | **Demobilization** | LS | 1 | $26,550 | | **$26,600** |
| | Decontamination and Demobilization | | | | | |
| | **TOTAL CONSTRUCTION COST** | | | | | **$5,968,795** |
| ***C.*** | ***ENGINEERING/OVERSIGHT*** | | | | | |
| **1.0** | **Institutional Controls** | | | | | **$50,000** |
| **2.0** | **Engineering/ Design (15 % of Construction Costs)** | | | | | **$895,300** |
| **3.0** | **Construction Oversight (10 % of Construction Costs)** | | | | | **$596,900** |
| | **TOTAL ENGINEERING/OVERSIGHT COSTS** | | | | | **$1,542,200** |
| | **CONTINGENCY ON CAPITAL COSTS (25 %)** | | | | | **$1,877,749** |
| | ***TOTAL CAPITAL COSTS*** | | | | | **$9,388,744** |
| **OPERATION, MAINTENANCE, & MONITORING COSTS** | | | | | | |
| ***A.*** | ***ANNUAL MONITORING AND MAINTENANCE*** | | | | | **$2,400** |
| | Monthly Operation and Maintenance | Month | 12 | $200 | $2,400 | |
| | **CONTINGENCY ON OM & M COSTS (20 %)** | | | | | **$480** |
| | **TOTAL CAPITAL COSTS** | | | | | **$9,388,744** |
| | **NET PRESENT VALUE OF OM & M (30 YEARS @ 7 % DISCOUNT RATE)** | | | | | **$35,738** |
| | **TOTAL COST** | | | | | **$9,424,482** |

**Table C.3A**

**COST SUMMARY NOTES**
**REMEDIAL ALTERNATIVE 3A – EXCAVATION AND OFF-SITE DISPOSAL**
**TO MEET PART 201 RESIDENTIAL CRITERIA AND TSCA UNRESTRICTED HIGH OCCUPANCY LEVEL**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

**GENERAL NOTES**

A. Estimate for Remedial Alternative 3A - Excavation and Off-Site Disposal to Part 201 Residential Criteria and TSCA Unrestricted High Occupancy Level has been prepared based on available information at the time of this document. Redevelopment activities conducted and anticipated for the Site by the City of Plainwell may affect the remediation costs. Costs presented in the Feasibility Study (FS) Report have taken into consideration anticipated redevelopment plans by the City of Plainwell. Redevelopment plans include demolition of non-historical buildings to the concrete slab as well as specific land use restrictions/designations for the Site as presented on Figure 1.4 of the FS Report. This cost estimate is expected to be within -30 percent to +50 percent of the actual remedial costs in accordance with United States Environmental Protection Agency (USEPA) guidance.
B. Remediation activities for each of the 11 proposed redevelopment areas were estimated separately; however, the estimate assumes one mobilization and demobilization effort to conduct the work.
C. The cost estimate assumes that new structures have not been constructed in areas that are planned for soil excavation and existing structures remain in place.
D. The cost estimate includes abandonment and replacement costs of groundwater monitoring wells within excavation areas.
E. Costs are based on 2014 dollars.
F. All volumes are based on in-place measures unless otherwise stated.
G. Abbreviations used in the "Unit" column in the Cost Estimate Table are as follows:
   - CY = Cubic Yard
   - EA = Each
   - LS = Lump Sum
   - TN = Ton
   - LF= linear foot

**TASK NOTES:**

***CAPITAL COSTS***

**A. INVESTIGATION/CONSTRUCTION**

**1.0 Pre-Design Investigation (PDI) Activities**

The following assumptions were made relative to the PDI activities in each of the redevelopment areas and reflected in the cost estimate.

- Generation of a Sampling and Analysis Plan (SAP).
- Update the Health and Safety Plan as necessary.
- Update the Multi-Area Quality Assurance Project Plan as necessary.

- Completion of the SAP - soil boring installation and soil sample collection to delineate the horizontal and vertical extent of impact. Soil borings are assumed to be collected via direct push method. PDI samples will be collected and submitted for laboratory analysis for specific parameters determined to exceed Preliminary Remediation Goals (PRGs) during the Remedial Investigation (RI).
- Quality Assurance/Quality Control samples are included on a 1 per 10 basis.
- A survey of the "top of bank" is included in the PDI cost estimate.
- All areas where subsurface work is to be conducted will be cleared through a public utility locate (i.e., MISS Dig), a private utility locate, review of available drawings, and discussions with individuals knowledgeable of the Site and utilities located thereon.

**Residential Area 1**
PRGs exceeded in Residential Area 1 include Part 201 non-residential and residential direct contact criteria for arsenic and TSCA unrestricted high occupancy for PCBs. Soil samples will be collected to delineate the extent of soil impacted with PCBs adjacent to the storm sewer line installed by the Michigan Department of Transportation (MDOT) in 2012. Soil samples will also be collected to delineate exceedances of the PCB PRG identified in former lagoon areas.

- Allowance for 132 soil samples for arsenic
- Allowance for 150 soil samples for PCBs (north ends of Lagoon G and K and around MDOT storm sewer)

**Residential Area 2**
The PRGs exceeded in Residential Area 2 are Part 201 residential direct contact criteria for arsenic and TSCA unrestricted high occupancy criteria.

- Allowance for 48 soil samples for arsenic
- Allowance for 76 samples for PCBs

**Residential Area 3**
The PRG exceeded in Residential Area 3 is Part 201 residential direct contact criteria for arsenic.

- Allowance for 60 soil samples for arsenic

**Residential Area 4**
PRGs exceeded in Residential Area 4 include Part 201 non-residential direct contact criteria for arsenic and lead. In addition, the PRG for PCBs of TSCA unrestricted high occupancy was also exceeded within Residential Area 4. Residential direct contact criteria is exceeded at locations within Residential Area 4 for arsenic, benzo(a)pyrene, cyanide, dibenz(a,h)anthracene and lead. Residential soil volatilization to indoor air inhalation criteria (SVIIC) was exceeded at one location for benzene.

- An allowance for 56 soil samples for arsenic
- Benzene above the residential SVIIC at TP-308
- An allowance for 4 soil samples for benzene was included in the estimate.
- Cyanide was above residential direct contact criteria at SB-302 in the shallow (0-1 foot) interval
    - Four samples for cyanide were included in the estimate
- An allowance for 20 samples for lead was included in the estimate
- PCBs were above criteria at TP-313 and SB-301
    - Allowance for 60 soil samples for PCBs was included in the estimate
- The PNA parameters were identified in shallow samples (0-1.5 feet) below grade at DG3, DG4 and TP-302
    - Allowance for 12 PNA samples

**Waterfront Plaza**
PDI activities will not be specifically conducted within the Waterfront Plaza area.

**Mixed Residential/Commercial Area 1**
PRGs exceeded in Mixed Residential/Commercial Area 1 include Part 201 non-residential inhalation criteria for manganese and residential direct contact criteria for arsenic.

- Delineation samples will be collected around eight locations (SB-334, SB-336, SB-337, SB-338, SB-339, TP-303, TP-306, TP-334).
- A total of 62 soil samples for arsenic will be collected.
- Soil samples will be collected from 3 depth intervals from 22 of the 30 borings proposed for this area.
- Soil samples for arsenic analysis will be collected from two depth intervals from four borings around TP-334 for manganese (8 samples).

**Mixed Residential/Commercial Area 2**
PRGs exceeded in Mixed Residential/Commercial Area 2 include Part 201 non-residential direct contact criteria for arsenic, benzo(a)pyrene, and lead. The PRG for PCBs was also exceeded within Mixed Residential /Commercial Area 2 within the former Mill Buildings and north of the buildings around TP-8. Residential direct contact criteria is exceeded at locations within Mixed Residential/Commercial Area 2 for arsenic, benzo(a)pyrene, dibenz(a,h)anthracene; benzo(a)anthracene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene and lead.

Soil delineation by Building/work area as follows:

**Arsenic ONLY locations**:
Building 1
- Allowance for 13 samples

Building 1A
- Allowance for 8 samples

Building 2
- Allowance for 8 samples

Building 3
- Allowance for 8 samples

Building 4A
- Allowance for 4 samples

Building 5
- Allowance for 8 samples

Building 5B
- Allowance for 7 samples
- Soil borings around SB-231 will be completed manually

Building 6
- Allowance for 8 samples

Building 25
- Allowance for 8 samples

Building 28
- Allowance for 8 samples

Train Shed
- Allowance for 4 samples

Coal Tunnel Area
- Allowance for 30 samples

Former Ash Silo Area (SB-2010 and SB-2011)

- Allowance for 12 samples

Former clarifier area (TP-344)

- Allowance for 8 samples

Area north of Building 3/Former Water Tower Area (TP-340, TP-342, TP-343)

- Allowance for 16 samples

**Arsenic and Lead sample locations:**

Building 7

- Allowance for 6 samples for lead
- Allowance for 8 samples for arsenic

Area around SB-2013

- Allowance for 12 samples

**Arsenic, PNAs and Lead sample locations:**

Building 3A

- Allowance for 12 samples

**Arsenic and PNAs sample locations**

Fuel Oil AST Area

- Allowance for 24 PNA soil samples
- Allowance for 12 arsenic samples

**Arsenic, PNAs, Lead and PCBs**

Building 6A (assumes entire dirt floor area will be removed to achieve PRGs for metals which would remove PCB impacted soils)

- Allowance for 20 samples for arsenic, PNAs, lead and PCBs
- Technicians will be required to don respirators for this work

**PCBs only**

SB-217, SPI-1, and TP-8

- Allowance for 44 samples

A total of 200 samples will be collected and analyzed for arsenic.
A total of 54 samples will be collected and analyzed for PNAs.
A total of 48 samples will be collected and analyzed for lead.
A total of 64 samples will be collected and analyzed for PCBs.

**Commercial Area 1**

PRGs exceeded in Commercial Area 1 include Part 201 non-residential inhalation criteria for manganese and the residential direct contact for arsenic.

- Delineation samples will be collected around 5 locations (SB-133, SB-144, SS-103, SS-105 and SS-106).
- Soil samples will be collected from the 0-2 foot below grade interval at SS-103, SS-105 and SS-106 and analyzed for arsenic. Samples from SS-105 will also be analyzed for manganese.
- Soil samples will be collected from the 0-2 and 7-9 foot interval for SB-133 and SB-144 and analyzed for arsenic.

**Commercial Area 2**

PRGs exceeded in Residential Area 1 include Part 201 non-residential and residential direct contact criteria for arsenic.

- Delineation samples were note proposed for indoor exceedances (SB-326, SB-237, SB-340) because this portion of the building is in operation as the Plainwell Public Safety Building.
- Four borings within the garage portion of the Public Safety Building were included in the estimate – 12 samples for arsenic included in the estimate.
- 24 additional samples would be collected for arsenic from areas outside of the building footprint (around TP-316, TP-321, TP-324 and TP-325).

**Commercial Area 3**
The PRG exceeded in Commercial Area 3 is Part 201 residential direct contact criteria for arsenic.

- Allowance for 48 soil samples for arsenic

**Commercial Area 4**
PRGs exceeded in Commercial Area 4 include Part 201 non-residential direct contact criterion for arsenic. Residential direct contact criteria is exceeded at locations within Commercial Area 4 for arsenic, benzo(a)pyrene and lead. The non-residential inhalation criterion for manganese is exceeded at one location. PCBs above the PRG of 1 mg/kg were reported in Commercial Area.

Soil delineation by Building / work area as follows:

**Arsenic ONLY locations**:
Building 9A
- Allowance for 40 samples

Building 9B
- Allowance for 8 samples

Building 9E
- Allowance for 8 samples

Building 9F
- Allowance for 16 samples

Building 10
- Allowance for 8 samples

Building 11A
- Allowance for 24 samples

Building 12
- Allowance for 23 samples
- Can only get three borings in position around SB-2008

Building 15
- Allowance for 4 samples

Building 16
- Allowance for 11 samples
- SB-289 and SB-290 close together and shallow interval

Building 17
- Allowance for 20 samples

Building 19
- Allowance for 4 samples

Building 23
- Allowance for 16 samples

Parking lot area south of Building 17
- Allowance for 60 samples

**Arsenic and Lead sample locations:**
TP-341
- Allowance for 4 samples

**Arsenic and Manganese sample locations:**
Building 10
- Allowance for 8 samples

**Arsenic, PNAs and Lead sample locations:**
Former Substation Area/North of Mill Buildings
- Allowance for 22 samples

**Arsenic, PNAs, Lead and PCB sample locations:**
TP-5 Area
- Allowance for 8 samples

**PCBs and Arsenic sample locations:**
MW-16 Area
- Allowance for 18 samples

SB-2012
- Allowance for 4 samples for arsenic and 8 samples for PCBs

A total of 306 samples will be collected and analyzed for arsenic.
A total of 30 samples will be collected and analyzed for PNAs.
A total of 34 samples will be collected and analyzed for PCBs.
A total of 8 samples will be collected and analyzed for manganese.
A total of 34 samples will be collected and analyzed for lead.

## 2.0 Mobilization/Set-Up

The following assumptions were made relative to the mobilization/set-up in each of the redevelopment areas and reflected in the cost estimate.

- Mobilization and set-up includes: mobilization of personnel and equipment; construction survey work (e.g., excavation layout and verification sample locations); and geotechnical and chemical testing on backfill materials.
  - An allowance of $8,000 to mobilize personnel and equipment was included in the estimate.
  - $30,000 for survey work was included in the estimate.
  - Geotechnical and chemical analysis for imported materials was included in the estimate. One set of chemical analysis [Target Analyte List Metals, Target Compound List (TCL) for volatile organic compounds, TCL for semi-volatile compounds, and polychlorinated biphenyl (PCBs) per material (topsoil, general fill and 21AA/gravel]. The topsoil sample will also be analyzed for pH, phosphorous, organic content, pesticides and herbicides.
- Health and Safety includes an on-Site Health and Safety Officer (HSO) for the duration of the services (11 months). Also included in the costs are: air monitoring equipment and calibration gases; a decontamination trailer; and disposable personal protection equipment (PPE).
- Air monitoring assumes real-time air monitoring will be conducted during all excavation work utilizing a photoionization detector (11.7 electronVolt [eV] lamp) and fugitive dust monitor(s). Air monitoring does not include the collection of samples for laboratory analysis or laboratory analytical costs.

- Erosion control includes an allowance for silt fence (5,760 LF) and geofabric to cover catch basins on the Site. Costs for erosion control measures specific to individual redevelopment areas (i.e., turbidity curtains, etc.) are included in individual redevelopment area estimates (e.g., Commercial Area 4).
- Site facility costs include electrical hookup and electricity for two office trailers (one for the contractor and one for the USEPA) for 11 months. Other temporary facilities include portable sanitary services, a drinking water allowance and a small dumpster for worker general refuse. The expense of one Site truck for the duration of the services was included.
- Site facility costs include materials and construction of temporary decontamination pads and decontamination stations for workers. It was assumed that potable water could be obtained from the City of Plainwell for use during the project.
- Site facility costs include $6,000 to for the installation and maintenance of a staging area for waste.
- A perimeter fence currently exists around the majority of the Site. The cost estimate assumes the fence will remain and can be utilized as a security measure to prevent access to the Site during construction activities.

## 3.0 Preparation/Pre-Excavation Work by Redevelopment Area

The following assumptions were made relative to the preparation/pre-excavation work in each of the redevelopment areas and reflected in the cost estimate.

- A Soil Erosion and Sedimentation Control Permit will be obtained from Allegan County. All other necessary permits will also be obtained prior to intrusive work at the Site.
- All areas where subsurface work is to be conducted will be cleared through a public utility locate (i.e., MISS Dig), a private utility locate, review of available drawings, and discussions with individuals knowledgeable of the Site and utilities located thereon.

**Residential Area 1**
Specific assumptions for preparation/pre-excavation work in Residential Area 1 under Remedial Alternative 3A are presented below.

- MW-14 will be abandoned.
- The fence adjacent to MW-14 will need to be removed and replaced after restoration activities are complete.
- Trees and shrubs in the excavation areas will need to be cleared and grubbed.
- Turbidity curtain will be temporally installed in the Kalamazoo River during excavation and backfill activities.
- One power pole will need to be relocated for the excavation work around SB-104.

**Residential Area 2**
No specific assumptions for preparation/pre-excavation work in Residential Area 2 under Remedial Alternative 3A were utilized.

**Residential Area 3**
Specific assumptions for preparation/pre-excavation work in Residential Area 3 under Remedial Alternative 3A are presented below.

- MW-15 will be abandoned.
- Clearing will be required in the area around MW-15.

**Residential Area 4**

Specific assumptions for preparation/pre-excavation work in Residential Area 4 under Remedial Alternative 3A are presented below.

- Clearing will be required in the area around SB-301/SG-4.
- Pavement by TP-302 will be saw cut.

**Waterfront Plaza**

No specific assumptions for preparation/pre-excavation work in Waterfront Plaza under Remedial Alternative 3A were utilized.

**Mixed Residential/Commercial Area 1**

The specific assumption for preparation/pre-excavation work in Mixed Residential/Commercial Area 1 under Remedial Alternative 3A is presented below.

- Pavement and concrete in the work areas will be saw cut prior to excavation to leave a clean line for restoration activities.

**Mixed Residential/Commercial Area 2**

Specific assumptions for preparation/pre-excavation work in Mixed Residential/Commercial Area 2 under Remedial Alternative 3A are presented below.

Inside the Buildings:

- A renovation notice will be submitted to the State of Michigan to comply with Federal Clean Air Act National Emission Standards for Hazardous Air Pollutants (NESHAP) requirements. The notice will include all areas/asbestos within the Mill Buildings scheduled for removal during the remediation efforts.
- Asbestos abatement will need to be conducted primarily due to thermal system insulation on the piping within Buildings 5, 6 and 6A. Asbestos is also present on the boilers housed within Buildings 5 and 6. The asbestos is in poor, heavily damaged condition throughout these buildings.
- A structural engineering evaluation of the elevator in Building 1 will be conducted to ensure that the soil (SB-212) can be removed without compromising the elevator shaft.
- A structural engineering evaluation of the northeast corner of Building 1 will be completed before conducting excavation work in this area (SB-214).
- The loading dock at the south end of Building 1 will be evaluated by a structural engineering evaluation to ensure excavation of the fuel oil line will not damage either the loading dock or Building 1.
- A structural engineering evaluation of the historical western wall of Building 9 will be conducted to ensure excavation activities near this wall will not jeopardize the integrity of the wall.
- A structural engineering evaluation will be completed before conducting the excavation work in Buildings 5 and 6. The evaluation will determine a shoring methodology for ensuring the boiler footing/supports are not compromised during excavation activities.
- Excavations within Buildings 2, 3 and 7 will require the removal of structures within the buildings (e.g., equipment pads).
- Abandoned mill equipment (various chemical tanks [biocides, water softener, etc.], compressors and pumps, will need to be removed from Buildings 1A, 2, 5, 6, and 7 prior to excavation activities. Liquids remaining in the vessels will be removed, containerized, characterized and prepared for off-Site disposal at a licensed facility as appropriate.
- The concrete floor will be saw cut prior to excavation (concrete will be broke out during excavation – but saw cut first to create clean lines for restoration).

Outdoor Areas:

- A demolition notice will be submitted to the State of Michigan for the demolition of Building 5A/part of the coal tunnel. Asbestos abatement may be necessary on pipe wrap found outside of Building 5A.
- Excavation of soils under the concrete slabs of the demolished buildings (3A, 25 and 28) will require the relocation of the backfill (less than 3 feet thick) prior to excavation.
- Fuel Oil No. 6 within the former coal tunnel will be removed from the tunnel before the tunnel itself is removed.
- The piping run from the former Fuel Oil No. 6 AST and Building 5 will be exposed at one end and drained of any residual fuel oil prior to removing the line.
- Monitoring well MW-19 will be abandoned prior to excavation activities in this area.
- Monitoring well MW-22 will be abandoned prior to removal of the former fuel oil line.
- Monitoring well MW-2 will be abandoned prior to excavation activities at SB-2010 and SB-2011.

**Commercial Area 1**

Specific assumptions for preparation/pre-excavation work in Commercial Area 1 under Remedial Alternative 3A are presented below.

- Limited clearing and grubbing will be performed in the area around SS-106 and SB-144.

**Commercial Area 2**

Specific assumptions for preparation/pre-excavation work in Commercial Area 2 under Remedial Alternative 3A are presented below.

- Significant pre-excavation preparation is required due to the presence of the City of Plainwell Public Safety Building above the areas to be excavated, including relocating cabinetry, furnishings and flooring.
- Saw cutting of the concrete floor is required to gain access to the soils.

**Commercial Area 3**

Specific assumptions for preparation/pre-excavation work in Commercial Area 3 under Remedial Alternative 3A are presented below.

- Monitoring well MW-18 will be abandoned prior to excavation activities in this area.
- Pavement within the work area around MW-18 will be saw cut.

**Commercial Area 4**

Specific assumptions for preparation/pre-excavation work in Commercial Area 4 under Remedial Alternative 3A are presented below.

Inside the Buildings:

- A renovation notice will be submitted to the State of Michigan to comply with Federal Clean Air Act National Emission Standards for Hazardous Air Pollutants (NESHAP) requirements. The notice will include all areas/asbestos within the Mill Buildings scheduled for removal during the remediation efforts.
- Limited asbestos abatement will need to be conducted within the excavation areas/surrounding areas due to thermal system insulation on the piping.
- Excavations within Buildings 10, 11A, and 15 will require the removal of structures within the buildings (e.g., electrical panel, paper stock tanks, and internal walls).

- Abandoned mill equipment will need to be removed from Buildings 16 and 12 prior to excavation activities. Oil in the equipment in both areas contains polychlorinated biphenyls (PCBs). The waste would be disposed of at a licensed TSCA facility.
- The concrete floor will be saw cut prior to excavation.

Outdoor Areas:

- Excavation of soils under the concrete slabs of the demolished buildings will require the relocation of backfill placed within the former basement cavities to surrounding grade (up to 9 feet thick) prior to excavation. An allowance for 5 working days to complete this work was included in the estimate at a cost of $20,400.
- Turbidity curtain will be installed in the Mill Race in the area by MW-16 (along the Mill Race) and in the area of MW-3 prior to excavation activities.
- Monitoring of the Mill Race and Kalamazoo River for turbidity will be conducted during excavation activities.
- MW-16 will be abandoned prior to excavation work in that area.
- Protection of MW-3 (barriers) will be installed.
- A structural engineering evaluation of the pedestrian bridge for stability during excavation activities will be conducted. The evaluation will determine if shoring of the bridge is necessary. An allowance of $5,000 is included in the estimate to conduct the evaluation. Shoring costs have not been included in the estimate.
- The water flow of the Mill Race will be diverted in the excavation area. The methodology for this work to be determined in the pre-design phase of the project.
- Rip rap along the Mill Race will be removed and staged for re-use.
- Pavement in the work areas will be saw cut prior to excavation to allow for restoration activities.

## 4.0 Excavation by Redevelopment Area

Conceptual excavation areas for each of the Redevelopment areas are shown of Figures 3.1 through 3.11 of the FS Report (Revision 2).

The following assumptions were made relative to excavation in each of the redevelopment areas and reflected in the cost estimate.

- Soil excavation quantities within the buildings are based on excavating horizontally by 5 feet in each direction and 1-foot vertically beyond the sample location exceeding criteria.
- Excavation estimates assume dewatering will not be necessary and that all work can be completed in Level D PPE except Building 6A which will be conducted with supplied air (Level B) PPE.
- Standby time was not added to account for the time for laboratory analysis of verification samples. It was assumed that the project would proceed across the Site allowing for laboratory analysis to be conducted while another redevelopment area was being excavated or restored.
- All work conducted within Site buildings will require an independent power supply, with the exception of Buildings 17 and 19.

Specific assumptions to each redevelopment area, in addition to those presented above globally, are provided below.

**Residential Area 1**

Residential Area 1 is located at the far west end of the Site, where the majority of the former sludge dewatering lagoons were located. The former Mill wastewater treatment building, activated sludge tank and secondary clarifier were constructed over the lagoons. The wastewater treatment structures were

demolished on behalf of the City of Plainwell in November and December 2013. The specific assumption for excavation in Residential Area 1 under Remedial Alternative 3A is presented below.

- Overburden present beyond the target excavation area that must be removed to achieve the full depth of excavation will be disposed of off Site.

**Residential Area 2**

Residential Area 2 is located between Residential Area 1 and Residential Area 3 and is positioned along the Kalamazoo River. This area was historically occupied by sludge dewatering lagoons (A, B, C) and a primary clarifier. The primary clarifier was demolished to the concrete slab in November 2013. The specific assumption for excavation in Residential Area 2 under Remedial Alternative 3A is presented below.

- Overburden present above the target excavation area that must be removed to achieve the full depth of excavation can be staged and used for backfill from the area around SB-1.

**Residential Area 3**

Residential Area 3 is located near the center of the Site. The former aeration basin location occupies the majority of the area. A former secondary clarifier was historically present in this area, which was demolished in November 2013 with the floor of the former clarifier remaining. Specific assumptions for excavation in Residential Area 3 under Remedial Alternative 3A are presented below.

- Material removed from the bottom of the aeration basin will require double handling due to the slopes of the former aeration basin and the depth of the excavation.

**Residential Area 4**

Residential Area 4 is positioned along the Kalamazoo River between Residential Area 3 and Mixed Residential Area 2. No aboveground structures are currently present on this area. A portion of this area was historically utilized by the Mill as a coal storage area. No specific assumptions for excavation in Residential Area 4 under Remedial Alternative 3A were made.

**Waterfront Plaza**

No excavation activities are anticipated in the Waterfront Plaza Area.

**Mixed Residential/Commercial Area 1**

Mixed Residential/Commercial Area 1 is located between Commercial Area 2 and Commercial Area 3 on the southern property line along Allegan Street. This area was once occupied by the former Specialty Minerals Building and associated above ground storage tanks. The Specialty Minerals building and ASTs were demolished to the concrete slab in December 2011.

- Underground utilities encountered (TP-303, TP-306) between the former Specialty Minerals Building and the main Mill Buildings will be capped at either end of the excavation.

**Mixed Residential and Commercial Area 2**

Mixed Residential and Commercial Area 2 is located between Residential Area 4 and Commercial Area 4 at the northern end of the Site along the Kalamazoo River. The majority of the area is occupied by Mill Buildings and pavement. Buildings 3A, 25 and 28 along with the eastern water tower, 200,000-gallon Fuel Oil AST, and the brine USTs, were demolished on behalf of the City of Plainwell. The concrete slabs were left in place for Buildings 3A and 28. Building 25 was part of the Site's historical wastewater treatment system and had a subsurface vault and system to pump the waste water from the Mill to the on-Site WWTP at the west end of the Site. The vault under the northern portion of Building 25 was not removed. The vault floor was cracked and the sidewalls removed to 4 feet below grade, then the vault was filled with imported general fill. The concrete slab under the remaining portion of Building 25 was left in place.

Redevelopment plans by the City of Plainwell include the demolition of Buildings 1A, 4, 4A, 5, 5A, 5B, 6, 6A, 7 and the Train Shed; however, there are no plans currently to implement this work. Therefore excavation costs assume the buildings will be in place during this work. Specific assumptions for excavation in Mixed Residential/Commercial Area 2 under Remedial Alternative 3A are presented below.

- A storm sewer was installed through the west side of Mixed Residential/Commercial Area 2 in 2012 by the Michigan Department of Transportation (MDOT). The approximate location of the storm sewer is shown on Figure 3.6. Before conducting excavation work to remove the former fuel oil AST line and excavate the east side of the former fuel AST, the exact location of the storm sewer line will be determined, shoring of the line may be necessary during the removal of the fuel oil AST line.
- Excavations within Buildings 1, 1A, 2, 3, 4A, 5, 5B, 6, 7 and 9 will require mini-equipment.
- Soils in Building 6A will be removed using a vacuum extraction system.
- Removal of the soils in Building 4A/5B at SB-231 will require manual labor.
- Excavation work within the buildings will require temporary lighting and mechanical means to remove carbon dioxide generated by running equipment from the work areas/building.
- All waste removed from the excavation areas within the buildings will need to be double handled.

**Commercial Area 1**

Commercial Area 1 is located in the far southwest portion of the Site. No structures or paved areas are currently present in this area that would require unique equipment or procedures to conduct the proposed remedial activities. This area of the Site has not been developed and was not part of historic Mill operations.

- Any excavation work conducted in the vicinity of SB-133 will require oversight by Michigan Gas Utilities due to proximity of the soil boring to the 6-inch high pressure natural gas line/working within the gas company easement.
- A storm sewer was installed through this area in 2012 by the Michigan Department of Transportation (MDOT). The approximate location of the storm sewer is shown on Figure 3.8. Before conducting excavation work in the area of SS-103 and SS-105, the exact location of the line will be determined.

**Commercial Area 2**

Commercial Area 2 is located in the southwest central portion of the Site. Structures on this portion of the Site include the City of Plainwell Public Safety Building and associated paved parking and egress/ingress areas. The specific assumption for excavation in Commercial Area 2 under Remedial Alternative 3A is presented below.

- Excavation work with Commercial Area 2 would require mini-equipment to access the soil exceedances above the PRGs within the current City of Plainwell Public Safety Building.

**Commercial Area 3**

Commercial Area 3 is located adjacent to the former southwest corner of the Mill Buildings along Allegan Street. Structures on this area include a pump house and a former guard shack. Other historical features within this area have been demolished on behalf of the City of Plainwell. The Clay ASTs, Ammonia AST secondary containment structure, the Starch ASTs and Building 9C were demolished in 2012. The concrete slabs for all demolished features were left in place. Specific assumptions for excavation in Commercial Area 3 under Remedial Alternative 3A are presented below.

- The majority of Building 9C did not include a basement. The area where SB-248 was completed was located on the ground floor; however, this area was elevated from the surrounding ground surface by approximately 4 feet. As a result of the demolition of Building 9C the upper 4 feet of the sample interval was relocated (as part of a Soil Relocation Plan (June, 2012) generated on behalf of the City of Plainwell) and placed under imported fill in the general area of Buildings 9A, 9E.

- MDOT installed a storm sewer through this area in 2012. The approximate location of the storm sewer is shown on Figure 3.10. Before conducting excavation work in the area of TP-305 the exact location of the line will be determined.

**Commercial Area 4**

Commercial Area 4 is located on the eastern side of the Site. The majority of this area is covered with either pavement, buildings (vacant and occupied) or former building concrete slabs. Buildings (9A, 9B, 9C, 9D, 9E, 9F, and 23) were demolished on behalf of the City of Plainwell in 2012, with the majority of the former building concrete slabs left in place and backfilled to surrounding grade. The basement areas were backfilled with a combination of crushed concrete (from the buildings on Site), soil from an adjacent retaining wall that was removed, and imported gravel material and vary in thickness from 6 feet to 9 feet. Specific assumptions for excavation in Commercial Area 4 under Remedial Alternative 3A are presented below.

- Excavations within Buildings 10, 11A, 11, 12, 15, 16, 17 and 19 will require mini-equipment.
- All excavation work within the buildings will require temporary lighting and mechanical means to remove carbon dioxide generated by running equipment from the work areas/building.
- All waste removed from the excavation areas will need to be double handled.

## 5.0 Transportation and Disposal by Redevelopment Area

The following assumptions were made relative to the transportation and disposal of materials in each of the redevelopment areas and reflected in the cost estimate.

- Soil volumes were converted to tonnage assuming a ratio of 1.5 tons per cubic yard for soils. Tonnage for concrete was based on 1.65 tons per cubic yard of material. Waste has been categorized as non-hazardous and non-TSCA soils; TSCA soil; TSCA debris; and miscellaneous debris.
- Transportation and disposal pricing is based on the non-hazardous, non-TSCA material being accepted at Waste Management Autumn Hills Landfill in Zeeland, Michigan. A cost of $22.00 per ton for both transportation and disposal of non-hazardous, non-TSCA waste was used for the estimates.
- A disposal price of $135.00 per ton was used for TSCA soils. For estimation purposes it was assumed that the TSCA soils would be transported to the Environmental Quality Company/US Ecology Company Wayne Disposal Facility Site #2 landfill located in Belleville, Michigan for direct landfill disposal. Transportation of the soils was assumed to be conducted in lined 50 ton gravel trains. Transportation of each load of 50 tons was assumed to cost $500.00.
- An allowance for the PCB impacted equipment removed as part of the project was included in the estimate since the weight and size of what will need to be removed has not been determined at this time. An allowance of $10,000 for transportation and disposal of the waste to the Environmental Quality Company/US Ecology Company Wayne Disposal Facility Site #2 in Belleville, Michigan.
- Transportation costs assume fuel prices for diesel will not exceed $4.00 per gallon.
- Organic material generated from clearing activities was assumed to be chipped and left on Site.
- Concrete and asphalt will be disposed of off Site, not recycled.

**Residential Area 1**

The specific assumption for transportation and disposal work in Residential Area 1 under Remedial Alternative 3A is presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 4,905 CY.

**Residential Area 2**
The specific assumption for transportation and disposal work in Residential Area 2 under Remedial Alternative 3A is presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 3,585 CY.

**Residential Area 3**
The specific assumption for transportation and disposal work in Residential Area 2 under Remedial Alternative 3A is presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 1,895 CY.

**Residential Area 4**
The specific assumption for transportation and disposal work in Residential Area 3 under Remedial Alternative 3A is presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 10,535 CY.
- Allowance of $600 for asphalt.

**Waterfront Plaza**
No specific assumptions for transportation and disposal work in Waterfront Plaza under Remedial Alternative 3A were utilized. Excavation activities will not be conducted within the Waterfront Plaza area.

**Mixed Residential/Commercial Area 1**
Specific assumptions for transportation and disposal work in Mixed Residential/Commercial Area 1 under Remedial Alternative 3A are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 1,060 CY.
- Allowance of 50 tons of concrete from within the various buildings.
- Allowance of 50 CY for asphalt disposal.

**Mixed Residential/Commercial Area 2**
Specific assumptions for transportation and disposal work in Mixed Residential/Commercial Area 2 under Remedial Alternative 3A are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil from Building 5 with a volume of 30 CY.
- Allowance of $3,100 for miscellaneous equipment from Building 5
- Allowance of 25 tons of concrete from Building 5.
- Waste was assumed to be non-hazardous, non-TSCA soil from Building 6A with a volume of 200 CY.
- Waste was assumed to be non-hazardous, non-TSCA soil from the coal tunnel area with a volume of 1,270 CY.
- Allowance of $3,500 for miscellaneous debris from the coal tunnel area (bricks, concrete)
- Waste was assumed to be non-hazardous, non-TSCA soil from the fuel oil line with a volume of 525 CY.
- Allowance of $600 for disposal of the fuel oil line piping
- Waste was assumed to be non-hazardous, non-TSCA soil from the fuel oil No. 6 AST area with a volume of 2,500 CY.
- Allowance of $1,200 for the concrete ring the tank was sitting on and buried concrete and asphalt.

- Waste was assumed to be non-hazardous, non-TSCA soil from Buildings 1, 1A, 2, 4A, 5B, 7, 9 and Train Shed with a volume of 861 CY.
- Waste was assumed to be non-hazardous, non-TSCA soil from the north end of the Mill Buildings (Buildings-3A, 25, 28, test pits-TP-340, TP-342,TP-343 and SB-2013) with a volume of 2,520 CY.
- Allowance of $6,000 for miscellaneous debris from these areas at the north end of the Mill Building.

**Commercial Area 1**
Specific assumptions for transportation and disposal work in Commercial Area 1 under Remedial Alternative 3A are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 2,215 CY.

**Commercial Area 2**
Specific assumptions for transportation and disposal work in Commercial Area 2 under Remedial Alternative 3A are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 2,455 CY.
- Allowance of $6,000 for construction debris (concrete, flooring, etc.) generated during the preparation activities.

**Commercial Area 3**
Specific assumptions for transportation and disposal work in Commercial Area 3 under Remedial Alternative 3A are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 5,765 CY.
- Allowance of $900 for the transport and disposal of asphalt and/or concrete from the excavation areas.

**Commercial Area 4**
Specific assumptions for transportation and disposal work in Commercial Area 4 under Remedial Alternative 3A are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil from inside Buildings 10, 11A, 12, 15, 16, 17, and 19 with a volume of 412 CY.
- Waste was assumed to be non-hazardous, non-TSCA soil from inside building footprints/demolished Buildings 9A, 9B, 9E, 9F, and 23 with a volume of 325CY.
- Waste was assumed to be non-hazardous, non-TSCA soil from the former substation area and north of the Mill Buildings with a volume of 3,050CY.
- Waste was assumed to be TSCA soil from the area around MW-16 with a volume of 4,660 CY.
- Waste was assumed to be non-hazardous, non-TSCA soil from the parking lot area south of Building 17 with a volume of 7,665 CY.
- Allowance of $12,000 for equipment from Buildings 15 and 16 (PCB impacted).
- Allowance of 1,575 tons of concrete from within the various buildings.
- Allowance of 400 CY of asphalt

## 6.0 Restoration by Redevelopment Area

The following assumption was made relative to Site restoration in each of the redevelopment areas and reflected in the cost estimate.

- Restoration activities include backfill (material and placement), compaction, compaction testing and any other location specific restoration that may be deemed necessary at this time (e.g., replacing a floor).
- General fill from a local gravel pit at a delivered material cost of $4.58 ton was used for the estimates. Unprocessed topsoil at a delivered price of $18.98 cubic yard was also used where appropriate.
- Restoration for the excavation areas outside of building footprints include general fill backfill compacted to 92-95 percent of the proctor.
- A six-inch layer of unscreened topsoil will be placed over the compacted general fill in areas that were previously pervious (i.e. not paved or impervious). Topsoil will be hydroseeded, including mulch.
- Restoration for excavation areas under pavement, existing or former building slabs will be backfilled with general fill and compacted to 95 percent of the proctor.
- A six-inch layer of 21AA or equivalent will be placed on the compacted general fill and compacted to 95% or greater of the proctor.
- Concrete will be replaced where removed during excavation activities inside of existing buildings.
- Asphalt will be replaced where removed during excavation activities.
- Concrete removed during excavation activities under former building slabs will not be replaced.

**Residential Area 1**
Specific assumptions for Site restoration in Residential Area 1 under Remedial Alternative 3A are presented below.

- Backfill material will be imported general fill and overburden material removed to achieve excavation depth requirements but beyond the area exceeding PRGs.
- MW-14 will be replaced.

**Residential Area 2**
Specific assumptions for Site restoration in Residential Area 2 under Remedial Alternative 3A are presented below.

- Backfill material will be imported general fill and overburden material removed to achieve excavation depth requirements but beyond the area exceeding cleanup criteria.
- MW-15 will be replaced.

**Residential Area 3**
No specific assumptions for Site restoration in Residential Area 3 under Remedial Alternative 3A were utilized.

**Residential Area 4**
No specific assumptions for Site restoration in Mixed Residential/Commercial Area 1 under Remedial Alternative 3A were utilized.

**Waterfront Plaza**
No specific assumptions for Site restoration in Waterfront Plaza under Remedial Alternative 3A were utilized. Restoration will not be required in the Waterfront Plaza area.

**Mixed Residential/Commercial Area 1**
Specific assumptions for Site restoration in Mixed Residential/Commercial Area 1 under Remedial Alternative 3A are presented below.

- Concrete replaced inside the buildings will be 6 inches thick.

**Mixed Residential/Commercial Area 2**
Specific assumptions for Site restoration in Mixed Residential/Commercial Area 2 under Remedial Alternative 3A are presented below.

- Building 6A currently has a dirt floor; restoration would not include a concrete floor.
- Concrete replaced inside the buildings will be 6 inches thick
- Concrete (former ash silos) will not be replaced at SB-2010 and SB-2011.
- Concrete around the former 200,000 gallon fuel oil AST will not be replaced.
- Concrete removed for excavations at SB-216, SB-220, SB-222 and SB-223 will not be replaced.
- Additional backfill will be required to fill in the void space of the coal tunnel.
- MW-2, MW-19 and MW-22 will be replaced.

**Commercial Area 1**
No specific assumptions for Site restoration in Commercial Area 1 under Remedial Alternative 3A were utilized.

**Commercial Area 2**
Specific assumptions for Site restoration in Commercial Area 2 under Remedial Alternative 3A are presented below.

- Areas within the current Public Safety Building will be restored to the previous condition including the replacement of all removed flooring, cabinetry, interior walls, repainting, etc. An allowance of $40,000 was included in the estimate for the restoration inside of the building for these items.
- Concrete replaced will match existing floor conditions and will vary within the building from 4 to 8 inches thick.

**Commercial Area 3**
No specific assumptions for Site restoration in Commercial Area 3 under Remedial Alternative 3A were utilized.

**Commercial Area 4**
Specific assumptions for Site restoration in Commercial Area 4 under Remedial Alternative 3A are presented below.

- Concrete replaced inside the buildings will be 6 inches thick.
- Backfill placed in the parking lot will be 2 feet lower than current grade to achieve the desired grade requested by the current property owner.
- Asphalt will be 3 inches thick.
- Geotextile and Rip rap will be installed along the Mill Race.
- The Mill Race will be returned to its normal flow path.
- The turbidity curtain will be removed from the Mill Race and Kalamazoo River.
- MW-16 will be replaced.

### 7.0 Demobilization

The following assumptions were made relative to the demobilization from the Site and reflected in the cost estimate.

- Costs included in the demobilization task include time for Site tear down and final decontamination of equipment, and demobilization of equipment and personnel. Demobilization activities were assumed to take five working days.

## B. ENGINEERING/OVERSIGHT

### 1.0 Engineering/Design

The following assumption was made relative to the installation of engineering/design and reflected in the cost estimate.

- Engineering and project design/specifications were estimated to be 15 percent of the Construction Costs.

### 2.0 Construction Oversight

The following assumption was made relative to the construction oversight and reflected in the cost estimate.

- Construction oversight was estimated to be 10 percent of the Construction Costs.

**TABLE C.3B**

**COST SUMMARY**
**REMEDIAL ALTERNATIVE 3B – EXCAVATION AND OFF-SITE DISPOSAL**
**TO MEET PART 201 LAND USE AND PCB RISK-BASED LEVELS OF 2.5 MG/KG RESIDENTIAL AND 9.1 MG/KG COMMERCIAL AREAS**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Description* | | *Unit* | *Approx. Quantity* | *Unit Price* | *Estimated Cost* *Subtotal* | *Estimated Cost* *Total* |
|---|---|---|---|---|---|---|
| **CAPITAL COSTS** | | | | | | |
| **A.** | ***PRE-DESIGN INVESTIGATION*** | | | | | **$33,200** |
| **1.0** | Sampling and Analysis Work Plan (SAP) | LS | 1 | $25,000 | $25,000 | |
| | Survey top of banks at Site | LS | 1 | $2,000 | $2,000 | |
| | Health and Safety Plan Update | LS | 1 | $1,200 | $1,200 | |
| | Multi-Area Quality Assurance Project Plan | LS | 1 | $5,000 | $5,000 | |
| **2.0** | SAP Implementation | | | | | **$108,100** |
| | Project Set up (mark locations etc.) | LS | 1 | $6,570 | $6,600 | |
| | Private Utility Locate | LS | 1 | $8,000 | $8,000 | |
| | Field Activities | DA | 17 | $2,900 | $49,300 | |
| | *Field Technicians* | | | | | |
| | *Sampling Equipment (push probe technology)* | | | | | |
| | *Expendables (PPE etc)* | | | | | |
| | Temporary Lighting and Carbon Monoxide Control | LS | 1 | $3,000 | $3,000 | |
| | Concrete Coring | LS | 1 | $3,000 | $3,000 | |
| | Laboratory Analysis | LS | 1 | $37,330 | $37,300 | |
| | Investigation Derived Waste Disposal | DA | 17 | $50 | $900 | |
| **3.0** | Contingency on PDI | LS | 1 | $70,650 | $70,700 | **$70,700** |
| | *Based on 50 % of SAP costs* | | | | | |
| **4.0** | Remedial Action Plan | LS | 1 | $60,000 | $60,000 | **$60,000** |
| | **TOTAL PRE-DESIGN COSTS** | | | | | **$272,000** |
| ***B.*** | ***CONSTRUCTION*** | | | | | |
| **1.0** | **Mobilization and Set up** | | | | | **$226,200** |
| | Mobilization and Set up | LS | 1 | $45,700 | $45,700 | |
| | Health and Safety | Monthly | 4 | $28,450 | $113,800 | |
| | Erosion Control | LS | 1 | $16,060 | $16,100 | |
| | Site Facilities | | | | | |
| | *Temporary Facilities* | Monthly | 4 | $6,810 | $27,200 | |
| | *Decontamination Pad and Stations* | LS | 1 | $17,375 | $17,400 | |
| | *Staging Areas* | LS | 1 | $6,000 | $6,000 | |
| **2.0** | **Additional Preparation and/or Demolition (by Redevelopment Area)** | | | | | **$138,000** |
| | Residential 1 | LS | 1 | $12,680 | $12,700 | |
| | Residential 2 | LS | 1 | - | - | |
| | Residential 3 | LS | 1 | $1,225 | $1,200 | |
| | Residential 4 | LS | 1 | $850 | $900 | |
| | Waterfront Plaza | LS | 1 | - | - | |
| | Mixed Residential/Commercial Area 1 | LS | 1 | $600 | $600 | |
| | Mixed Residential/Commercial Area 2 | LS | 1 | $56,625 | $56,600 | |
| | Commercial Area 1 | LS | 1 | - | - | |
| | Commercial Area 2 | LS | 1 | - | - | |
| | Commercial Area 3 | LS | 1 | - | - | |
| | Commercial Area 4 | LS | 1 | $65,980 | $66,000 | |

**TABLE C.3B**

**COST SUMMARY**
**REMEDIAL ALTERNATIVE 3B – EXCAVATION AND OFF-SITE DISPOSAL**
**TO MEET PART 201 LAND USE AND PCB RISK-BASED LEVELS OF 2.5 MG/KG RESIDENTIAL AND 9.1 MG/KG COMMERCIAL AREAS**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Description* | | *Unit* | *Approx. Quantity* | *Unit Price* | *Estimated Cost* *Subtotal* | *Estimated Cost* *Total* |
|---|---|---|---|---|---|---|
| **3.0** | **Excavation (by Redevelopment Area)** | | | | | **$279,900** |
| | Residential 1 | CY | 910 | $12 | $11,100 | |
| | Residential 2 | CY | 25 | $88 | $2,200 | |
| | Residential 3 | CY | 1,495 | $7 | $10,800 | |
| | Residential 4 | CY | 5,340 | $3 | $16,500 | |
| | Waterfront Plaza | CY | - | - | - | |
| | Mixed Residential/Commercial Area 1 | CY | 40 | $90 | $3,600 | |
| | Mixed Residential/Commercial Area 2 | CY | 5,800 | $33 | $189,300 | |
| | Commercial Area 1 | CY | 12 | $104 | $1,300 | |
| | Commercial Area 2 | CY | - | - | - | |
| | Commercial Area 3 | CY | - | - | - | |
| | Commercial Area 4 | CY | 7,185 | $6 | $45,100 | |
| **4.0** | **Transportation and Disposal (by Redevelopment Area)** | | | | | **$1,658,970** |
| | Residential 1 - Non Haz Non TSCA Soils | Ton | 1,365 | $22 | $30,000 | |
| | Residential 2 - Non Haz Non TSCA Soils | Ton | 38 | $22 | $800 | |
| | Residential 3 - Non Haz Non TSCA Soils | Ton | 2,243 | $22 | $49,300 | |
| | Residential 4 - Non Haz Non TSCA Soils | Ton | 8,010 | $22 | $176,200 | |
| | Residential 4 - Misc Debris | LS | 1 | | $600 | |
| | Waterfront Plaza - Non Haz Non TSCA Soils | Ton | - | $22 | - | |
| | Mixed Residential/Commercial Area 1 - Non Haz Non TSCA Soils | Ton | 60 | $22 | $1,300 | |
| | Mixed Residential/Commercial Area 1 - Misc. Debris | LS | - | $125 | $1,675 | |
| | Mixed Residential/Commercial Area 2 - Non Haz Non TSCA Soils | Ton | 8,535 | $22 | $187,200 | |
| | Mixed Residential/Commercial Area 2 - Misc. Debris | LS | 1 | | $8,245 | |
| | Commercial Area 1 - Non Haz Non TSCA Soils | Ton | 18 | $22 | $400 | |
| | Commercial Area 2 - Non Haz Non TSCA Soils | Ton | - | - | - | |
| | Commercial Area 2 - Misc. Debris | LS | - | - | - | |
| | Commercial Area 3 - Non Haz Non TSCA Soils | Ton | - | - | - | |
| | Commercial Area 3 - Misc. Debris | LS | - | - | - | |
| | Commercial Area 4 - Non Haz Non TSCA Soils | Ton | 3,782 | $22 | $83,200 | |
| | Commercial Area 4 - Misc. Debris | LS | - | | $3,550 | |
| | Commercial Area 4 - TSCA | Ton | 7,000 | $160 | $1,116,500 | |
| **7.0** | **Restoration (by Redevelopment Area)** | | | | | **$400,325** |
| | Residential 1 | LS | 1 | | $22,500 | |
| | Residential 2 | LS | 1 | | $5,070 | |
| | Residential 3 | LS | 1 | | $30,275 | |
| | Residential 4 | LS | 1 | | $80,800 | |
| | Waterfront Plaza | LS | - | | - | |
| | Mixed Residential/Commercial Area 1 | LS | 1 | | $7,425 | |
| | Mixed Residential/Commercial Area 2 | LS | 1 | | $139,455 | |
| | Commercial Area 1 | LS | 1 | | $1,650 | |
| | Commercial Area 2 | LS | - | | - | |
| | Commercial Area 3 | LS | - | | - | |
| | Commercial Area 4 | LS | 1 | | $113,150 | |

**TABLE C.3B**

**COST SUMMARY**
**REMEDIAL ALTERNATIVE 3B – EXCAVATION AND OFF-SITE DISPOSAL**
**TO MEET PART 201 LAND USE AND PCB RISK-BASED LEVELS OF 2.5 MG/KG RESIDENTIAL AND 9.1 MG/KG COMMERCIAL AREAS**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Description* | | *Unit* | *Approx. Quantity* | *Unit Price* | *Subtotal* | *Estimated Cost Total* |
|---|---|---|---|---|---|---|
| **8.0** | **Demobilization** | LS | 1 | $26,550 | | **$26,600** |
| | Decontamination and Demobilization | | | | | |
| | **TOTAL CONSTRUCTION COST** | | | | | **$2,729,995** |
| ***C.*** | ***ENGINEERING/OVERSIGHT*** | | | | | |
| **1.0** | **Institutional Controls** | | | | | **$50,000** |
| **2.0** | **Engineering/ Design (15 % of Construction Costs)** | | | | | **$409,500** |
| **3.0** | **Construction Oversight (10 % of Construction Costs)** | | | | | **$273,000** |
| | **TOTAL ENGINEERING/OVERSIGHT COSTS** | | | | | **$732,500** |
| | **CONTINGENCY ON CAPITAL COSTS (25 %)** | | | | | **$865,624** |
| | ***TOTAL CAPITAL COSTS*** | | | | | **$4,328,119** |
| **OPERATION, MAINTENANCE, & MONITORING COSTS** | | | | | | |
| ***A.*** | ***ANNUAL MONITORING AND MAINTENANCE*** | | | | | **$2,400** |
| | Monthly Operation and Maintenance | Month | 12 | $200 | $2,400 | |
| | **CONTINGENCY ON OM & M COSTS (20 %)** | | | | | **$480** |
| | **TOTAL CAPITAL COSTS** | | | | | **$4,328,119** |
| | **NET PRESENT VALUE OF OM & M (30 YEARS @ 7 % DISCOUNT RATE)** | | | | | **$35,738** |
| | **TOTAL COST** | | | | | **$4,363,857** |

**Table C.3B**

**COST SUMMARY NOTES**
**REMEDIAL ALTERNATIVE 3B – EXCAVATION AND OFF-SITE DISPOSAL**
**TO PART 201 LAND USE CRITERIA AND SITE SPECIFIC PCB RISK-BASED LEVELS**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

**GENERAL NOTES**

A. Estimate for Remedial Alternative 3B - Excavation and Off-Site Disposal to Part 201 Land Use Criteria and Site specific calculated PCB Risk-Based Levels [2.5 milligrams/kilogram (mg/kg) for Residential Areas and 9.1 mg/kg for Commercial Areas] has been prepared based on available information at the time of this document. Redevelopment activities conducted, being conducted and anticipated for the Site by the City of Plainwell may affect the remediation costs. Costs presented in the Feasibility Study (FS) Report have taken into consideration anticipated redevelopment plans by the City of Plainwell. Redevelopment plans include demolition of non-historical buildings to the concrete slab as well as specific land use restrictions/designations for the Site as presented on Figure 1.4 of the FS Report. This cost estimate is expected to be within -30 percent to +50 percent of the actual remedial costs in accordance with United States Environmental Protection Agency (USEPA) guidance.

B. Remediation activities for each of the 11 proposed redevelopment areas were estimated separately; however, the estimate assumes one mobilization and demobilization effort to conduct the work.

C. The cost estimate assumes that new structures have not been constructed in areas that are planned for soil excavation and existing structures remain in place.

D. Costs assume that additional soil investigation will not be conducted under building slabs unless otherwise noted in the pre-design notes below.

E. Areas targeted for soil removal and off-Site disposal were determined based on an iterative/risk-based approach for arsenic and Site specific calculated levels for PCBs as detailed in Appendix A of the FS Revision 2.

F. The estimated costs assume that excavation of impacted soils under the building slabs will not be conducted.

G. The cost estimate includes abandonment and replacement costs of groundwater monitoring wells within excavation areas.

H. Costs are based on 2014 dollars.

I. All volumes are based on in-place measures unless otherwise stated.

J. Abbreviations used in the "Unit" column in the Cost Estimate Table are as follows:
   - CY = Cubic Yard
   - EA = Each
   - LS = Lump Sum
   - TN = Ton
   - LF= linear foot

**TASK NOTES:**

***CAPITAL COSTS***

**A. INVESTIGATION/CONSTRUCTION**

**1.0 Pre-Design Investigation (PDI) Activities**

The following assumptions were made relative to the PDI activities in each of the redevelopment areas and reflected in the cost estimate.

- Generation of a Sampling and Analysis Plan (SAP).
- Update the Health and Safety Plan as necessary.
- Update the Multi-Area Quality Assurance Project Plan as necessary.
- Completion of the SAP - soil boring installation and soil sample collection to delineate the vertical and horizontal extent of impact. Soil borings are assumed to be collected via direct push method. PDI samples will be collected and submitted for laboratory analysis for specific parameters determined to exceed Preliminary Remediation Goals (PRGs) during the Remedial Investigation (RI). Delineation samples will not be collected in areas that were not selected for excavation activities (i.e., under building slabs, etc.)
- Quality Assurance/Quality Control samples are included on a 1 per 10 basis.
- A survey of the "top of bank" is included in the PDI cost estimate.
- All areas where subsurface work is to be conducted will be cleared through a public utility locate (i.e., MISS Dig), a private utility locate, review of available drawings, and discussions with individuals knowledgeable of the Site and utilities located thereon.

**Residential Area 1**
PRGs exceeded in Residential Area 1 include Part 201 non-residential and residential direct contact criteria for arsenic. Soil samples will be collected to delineate the extent of soil impacted with PCBs adjacent to the storm sewer line installed by the Michigan Department of Transportation (MDOT) in 2012.

- Allowance for 30 soil samples for PCBs
- Allowance for 12 soil samples for arsenic

**Residential Area 2**
The PRG exceeded in Residential Area 2 is Part 201 residential direct contact criteria for arsenic.

- Allowance for 24 soil samples for arsenic

**Residential Area 3**
The PRG exceeded in Residential Area 3 is Part 201 residential direct contact criteria for arsenic.

- Allowance for 56 soil samples for arsenic

**Residential Area 4**
PRGs exceeded in Residential Area 4 include Part 201 non-residential direct contact criteria for arsenic and lead. Residential direct contact criteria is exceeded at locations within Residential Area 4 for arsenic, benzo(a)pyrene, cyanide, dibenz(a,h)anthracene, lead and PCBs. Residential soil volatilization to indoor air inhalation criteria (SVIIC) was exceeded at one location for benzene.

- An allowance for 36 soil samples for arsenic
- Benzene above the residential SVIIC at TP-308
- An allowance for 4 soil samples for benzene was included in the estimate
- Cyanide was above residential direct contact criteria at SB-302 in the shallow (0-1 foot) interval
    - Four samples for cyanide were included in the estimate
- An allowance for 20 samples for lead was included in the estimate
- The PNA parameters were identified in shallow samples (0-1.5 feet) below grade at DG3, DG4 and TP 302
    - Allowance for 12 PNA samples

PCBs were above the Site specific calculated level for Residential areas at TP-313 and SB-301

- An allowance for 16 soil samples for PCBs was included in the estimate

**Waterfront Plaza**
PDI activities will not be specifically conducted within the Waterfront Plaza area.

**Mixed Residential/Commercial Area 1**
PRGs exceeded in Mixed Residential/Commercial Area 1 include Part 201 non-residential inhalation criteria for manganese and residential direct contact criteria for arsenic.

- Delineation samples will be collected around 2 locations (TP-306 and TP-334)
- A total of 12 soil samples for arsenic will be collected
- Four samples for manganese will be collected and analyzed around TP-334

**Mixed Residential/Commercial Area 2**
PRGs exceeded in Mixed Residential/Commercial Area 2 include Part 201 non-residential direct contact criteria for arsenic, benzo(a)pyrene, and lead. Residential direct contact criteria is exceeded at locations within Mixed Residential/Commercial Area 2 for arsenic, benzo(a)pyrene, dibenz(a,h)anthracene; benzo(a)anthracene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene and lead.

Soil delineation by work area as follows:

**Arsenic ONLY locations**:
Building 25
- Allowance for 8 samples
- A portion of the concrete slab was removed during demolition

Building 28
- Allowance for 8 samples
- A portion of the concrete slab was removed during demolition

Train Shed
- Allowance for 4 samples

Coal Tunnel Area
- Allowance for 30 samples

Former Ash Silo Area (SB-2010 and SB-2011)
- Allowance for 12 samples

Former clarifier area (TP-344)
- Allowance for 8 samples

Area north of Building 3/Former Water Tower Area (TP-340, TP-342, TP-343)
- Allowance for 16 samples

**Arsenic and Lead sample locations:**
Area around SB-2013
- Allowance for 12 samples

**Arsenic, PNAs and Lead sample locations:**
Building 3A
- Allowance for 12 samples

Building 6A
- Allowance for 18 samples
- Technicians will be required to don respirators for this work
- The floor in the majority of this building is exposed soil

**Arsenic and PNAs sample locations**
Fuel Oil AST Area
- Allowance for 24 PNA soil samples
- Allowance for 12 arsenic samples

A total of 140 samples will be collected and analyzed for arsenic.
A total of 54 samples will be collected and analyzed for PNAs.
A total of 42 samples will be collected and analyzed for lead.

**Commercial Area 1**
PRGs exceeded in Commercial Area 1 include Part 201 non-residential inhalation criteria for manganese and the residential direct contact for arsenic.

- Delineation samples will be collected around SS-105
- Four soil samples will be collected from the 0-2 foot below grade interval and analyzed for arsenic and manganese

**Commercial Area 2**
Delineation efforts will not be conducted in Commercial Area 2.

**Commercial Area 3**
Delineation efforts will not be conducted in Commercial Area 2.

**Commercial Area 4**
Arsenic exceeds the Part 201 non-residential direct contact criteria PRG in Commercial Area 4. Residential direct contact criteria is exceeded at locations within Commercial Area 4 for arsenic, benzo(a)pyrene, and lead. PCBs are above the calculated risk-based PRG of 9.1 mg/kg in the area around MW-16.

Soil delineation by building / work area as follows:

**Arsenic ONLY locations**:
SB-2012
- Allowance for 4 samples

Parking lot area south of Building 17
- Allowance for 60 samples

**Arsenic and Lead sample locations:**
TP-341
- Allowance for 4 samples

**Arsenic, PNAs and Lead sample locations:**

**Former Substation Area/North of Mill Buildings**

- Allowance for 30 samples

**PCBs and Arsenic sample locations:**

MW-16 Area

- Allowance for 18 samples

A total of 116 samples will be collected and analyzed for arsenic.
A total of 30 samples will be collected and analyzed for PNAs.
A total of 18 samples will be collected and analyzed for PCBs.
A total of 34 samples will be collected and analyzed for lead.

## 2.0 Mobilization/Set-Up

The following assumptions were made relative to the mobilization/set-up in each of the redevelopment areas and reflected in the cost estimate.

- Mobilization and set-up includes: mobilization of personnel and equipment; construction survey work (e.g., excavation layout and verification sample locations); and geotechnical and chemical testing on backfill materials.
  - An allowance of $8,000 to mobilize personnel and equipment was included in the estimate.
  - $30,000 for survey work was included in the estimate.
  - Geotechnical and chemical analysis for imported materials was included in the estimate. One set of chemical analysis [Target Analyte List Metals, Target Compound List (TCL) for volatile organic compounds, TCL for semi-volatile compounds, and polychlorinated biphenyl (PCBs) per material (topsoil, general fill and 21AA/gravel]. The topsoil sample will also be analyzed for pH, phosphorous, organic content, pesticides and herbicides.
- Health and Safety includes an on-Site Health and Safety Officer (HSO) for 4 months. Also included in the costs are: air monitoring equipment and calibration gases; a decontamination trailer; and disposable personal protection equipment (PPE).
- Air monitoring assumes real-time air monitoring will be conducted during all excavation work utilizing a photoionization detector (11.7 electronVolt [eV] lamp) and fugitive dust monitor(s). Air monitoring does not include the collection of samples for laboratory analysis or laboratory analytical costs.
- Erosion control includes an allowance for silt fence (4,000 LF) and geofabric to cover catch basins on the Site. Costs for erosion control measures specific to individual redevelopment areas (i.e., turbidity curtains, etc.) are included in individual redevelopment area estimates (e.g., Commercial Area 4).
- Site facility costs include electrical hookup and electricity for two office trailers (one for the contractor and one for the U.S. EPA) for 4 months. Other temporary facilities include portable sanitary services, a drinking water allowance and a small dumpster for worker general refuse. The expense of one Site truck for the duration of the services was included.
- Site facility costs include materials and construction of temporary decontamination pads and decontamination stations for workers. It was assumed that potable water could be obtained from the City of Plainwell for use during the project.
- Site facility costs include $6,000 to for the installation and maintenance of a staging area for waste.
- A perimeter fence currently exists around the majority of the Site. The cost estimate assumes the fence will remain and can be utilized as a security measure to prevent access to the Site during construction activities.

## 3.0 Preparation/Pre-Excavation Work by Redevelopment Area

The following assumptions were made relative to the preparation/pre-excavation work in each of the redevelopment areas and reflected in the cost estimate.

- A Soil Erosion and Sedimentation Control Permit will be obtained from Allegan County. All other necessary permits will also be obtained prior to intrusive work at the Site.

- All areas where subsurface work is to be conducted will be cleared through a public utility locate (i.e., MISS Dig), a private utility locate, review of available drawings, and discussions with individuals knowledgeable of the Site and utilities located thereon.

**Residential Area 1**
Specific assumptions for preparation/pre-excavation work in Residential Area 1 under Remedial Alternative 3B are presented below.

- Trees and shrubs in the excavation areas will need to be cleared and grubbed.
- Turbidity curtain will be temporally installed in the Kalamazoo River during excavation and backfill activities.
- One power pole will need to be relocated for the excavation work around SB-104.

**Residential Area 2**
No specific assumptions for preparation/pre-excavation work in Residential Area 2 under Remedial Alternative 3B were utilized.

**Residential Area 3**
Specific assumptions for preparation/pre-excavation work in Residential Area 3 under Remedial Alternative 3B are presented below.

- MW-15 will be abandoned.
- Clearing will be required in the area around MW-15.

**Residential Area 4**
Specific assumptions for preparation/pre-excavation work in Residential Area 4 under Remedial Alternative 3B are presented below.

- Clearing will be required in the area around SB-301/SG-4.
- Pavement by TP-302 will be saw cut.

**Waterfront Plaza**
No specific assumptions for preparation/pre-excavation work in Waterfront Plaza under Remedial Alternative 3B were utilized.

**Mixed Residential/Commercial Area 1**
The specific assumption for preparation/pre-excavation work in Mixed Residential/Commercial Area 1 under Remedial Alternative 3B is presented below.

- Pavement in the work areas will be saw cut prior to excavation to leave a clean line for restoration activities.

**Mixed Residential/Commercial Area 2**

Specific assumptions for preparation/pre-excavation work in Mixed Residential/Commercial Area 2 under Remedial Alternative 3B are presented below.

- The loading dock at the south end of Building 1 will be evaluated by a structural engineering evaluation to ensure excavation of the fuel oil line will not damage either the loading dock or Building 1. Excavation will not occur within Building 1.
- A demolition notice will be submitted to the State of Michigan for the demolition of Building 5A/part of the coal tunnel. Asbestos abatement may be necessary on pipe wrap found outside of Building 5A.
- Excavation of soils under the concrete slabs of the demolished buildings (3A, 25 and 28) will require the relocation of the backfill (less than 3 feet thick) prior to excavation.
- Fuel Oil No. 6 within the former coal tunnel will be removed from the tunnel before the tunnel itself is removed.
- The piping run from the former Fuel Oil No. 6 AST and Building 5 will be exposed at one end and drained of any residual fuel oil prior to removing the line.
- Monitoring well MW-19 will be abandoned prior to excavation activities in this area.
- Monitoring well MW-22 will be abandoned prior to removal of the former fuel oil line.
- Monitoring well MW-2 will be abandoned prior to excavation activities at SB-2010 and SB-2011.
- The concrete floor (Buildings 25 and 3A) will be saw cut prior to excavation (concrete will be broken out during excavation – but saw cut first to create clean lines for restoration).

**Commercial Area 1**

No specific assumptions for preparation/pre-excavation work Commercial Area 1 under Remedial Alternative 3B were utilized.

**Commercial Area 2**

No specific assumptions for preparation/pre-excavation work Commercial Area 2 under Remedial Alternative 3B were utilized.

**Commercial Area 3**

No specific assumptions for preparation/pre-excavation work Commercial Area 3 under Remedial Alternative 3B were utilized.

**Commercial Area 4**

Specific assumptions for preparation/pre-excavation work in Commercial Area 4 under Remedial Alternative 3B are presented below.

- Excavation of soils under the concrete slabs of the demolished buildings will require the relocation of backfill placed within the former basement cavities to surrounding grade (up to 9 feet thick) prior to excavation. An allowance for 5 working days to complete this work was included in the estimate at a cost of $20,400.
- Turbidity curtain will be installed in the Mill Race in the area by MW-16 (along the Mill Race) and in the area of MW-3 prior to excavation activities.
- Monitoring of the Mill Race and Kalamazoo River for turbidity will be conducted during excavation activities.
- MW-16 will be abandoned prior to excavation work in that area.
- Protection of MW-3 (barriers) will be installed.
- A structural engineering evaluation of the pedestrian bridge for stability during excavation activities will be conducted. The evaluation will determine if shoring of the bridge is necessary. An allowance

of $5,000 is included in the estimate to conduct the evaluation. Shoring costs have not been included in the estimate.

- The water flow of the Mill Race will be diverted in the excavation area. The methodology for this work to be determined in the pre-design phase of the project.
- Rip rap along the Mill Race will be removed and staged for re-use.
- Pavement in the work areas will be saw cut prior to excavation to allow for restoration activities.

## 4.0 Excavation by Redevelopment Area

Conceptual excavation areas for each of the Redevelopment areas are shown of Figures 3.12 through 3.23 of the FS Report (Revision 2).

The following assumptions were made relative to excavation in each of the redevelopment areas and reflected in the cost estimate.

- Excavation estimates assume dewatering will not be necessary and that all work can be completed in Level D PPE except Building 6A which will be conducted with supplied air (Level B) PPE.
- Standby time was not added to account for the time for laboratory analysis of verification samples. It was assumed that the project would proceed across the Site allowing for laboratory analysis to be conducted while another redevelopment area was being excavated or restored.

Specific assumptions to each redevelopment area, in addition to those presented above globally, are provided below.

**Residential Area 1**

Residential Area 1 is located at the far west end of the Site, where the majority of the former sludge dewatering lagoons were located. The former Mill wastewater treatment building, activated sludge tank and secondary clarifier were constructed over the lagoons. The wastewater treatment structures were demolished on behalf of the City of Plainwell in November and December 2013. The specific assumption for excavation in Residential Area 1 under Remedial Alternative 3B is presented below.

- Overburden present beyond the target excavation area that must be removed to achieve the full depth of excavation will be disposed of off Site.
- The rip rap at the Kalamazoo River outfall from the storm sewer line does not need to be removed.

**Residential Area 2**

Residential Area 2 is located between Residential Area 1 and Residential Area 3 and is positioned along the Kalamazoo River. This area was historically occupied by sludge dewatering lagoons (A, B, C) and a primary clarifier. The primary clarifier was demolished to the concrete slab in November 2013. No specific assumptions for excavation in Residential Area 2 under Remedial Alternative 3B are presented.

**Residential Area 3**

Residential Area 3 is located near the center of the Site. The former aeration basin location occupies the majority of the area. A former secondary clarifier was historically present in this area, which was demolished in November 2013 with the floor of the former clarifier remaining. Specific assumptions for excavation in Residential Area 3 under Remedial Alternative 3B are presented below.

- Material removed from the bottom of the aeration basin will require double handling due to the slopes of the former aeration basin and the depth of the excavation.

**Residential Area 4**

Residential Area 4 is positioned along the Kalamazoo River between Residential Area 3 and Mixed Residential Area 2. No aboveground structures are currently present on this area. A portion of this area was historically utilized by the Mill as a coal storage area. No specific assumptions for excavation in Residential Area 4 under Remedial Alternative 3B were made.

**Waterfront Plaza**

No excavation activities are anticipated in the Waterfront Plaza Area.

**Mixed Residential/Commercial Area 1**

Mixed Residential/Commercial Area 1 is located between Commercial Area 2 and Commercial Area 3 on the southern property line along Allegan Street. This area was once occupied by the former Specialty Minerals Building and associated above ground storage tanks. The Specialty Minerals building and ASTs were demolished to the concrete slab in December 2011. The specific assumption for excavation in Mixed Residential/Commercial Area 1 under Remedial Alternative 3B is presented below.

- Underground utilities encountered (TP-306) between the former Specialty Minerals Building and the main Mill Buildings will be capped at either end of the excavation.

**Mixed Residential and Commercial Area 2**

Mixed Residential and Commercial Area 2 is located between Residential Area 4 and Commercial Area 4 at the northern end of the Site along the Kalamazoo River. The majority of the area is occupied by Mill Buildings and pavement. Buildings 3A, 25 and 28 along with the eastern water tower, 200,000-gallon Fuel Oil AST, and the brine USTs, were demolished on behalf of the City of Plainwell. The majority of the concrete slabs were left in place for Buildings 3A and 28. Building 25 was part of the Site's historical wastewater treatment system and had a subsurface vault and system to pump the waste water from the Mill to the on-Site WWTP at the west end of the Site. The vault under the northern portion of Building 25 was not removed. The vault floor was cracked and the sidewalls removed to 4 feet below grade, then the vault was filled with imported general fill. The concrete slab under the remaining portion of Building 25 was left in place.

Specific assumptions for excavation in Mixed Residential/Commercial Area 2 under Remedial Alternative 3B are presented below.

- A storm sewer was installed through the west side of Mixed Residential/Commercial Area 2 in 2012 by the Michigan Department of Transportation (MDOT). The approximate location of the storm sewer is shown on Figure 3.18. Before conducting excavation work to remove the former fuel oil AST line and excavate the east side of the former fuel AST, the exact location of the storm sewer line will be determined, shoring of the line may be necessary during the removal of the fuel oil AST line.
- Soils in Building 6A will be removed using a vacuum extraction system.

**Commercial Area 1**

Commercial Area 1 is located in the far southwest portion of the Site. No structures or paved areas are currently present in this area that would require unique equipment or procedures to conduct the proposed remedial activities. This area of the Site has not been developed and was not part of historic Mill operations. The area specific assumption for excavation in Commercial Area 1 under Remedial Alternative 3B is presented below.

- A storm sewer was installed through this area in 2012 by the Michigan Department of Transportation (MDOT). The approximate location of the storm sewer is shown on Figure 3.19. Before conducting excavation work in the area of SS-105, the exact location of the line will be determined.

**Commercial Area 2**
Commercial Area 2 is located in the southwest central portion of the Site. Structures on this portion of the Site include the City of Plainwell Public Safety Building and associated paved parking and egress/ingress areas.

Excavation activities are not anticipated in the Commercial Area 2 for Remedial Alternative 3B.

**Commercial Area 3**
Commercial Area 3 is located adjacent to the former southwest corner of the Mill Buildings along Allegan Street. Structures on this area include a pump house and a former guard shack. Other historical features within this area have been demolished on behalf of the City of Plainwell. The Clay ASTs, Ammonia AST secondary containment structure, the Starch ASTs and Building 9C were demolished in 2012. The concrete slabs for all demolished features were left in place. Specific assumptions for excavation in Commercial Area 3 under Remedial Alternative 3B are presented below.

Excavation activities are not anticipated in the Commercial Area 3 for Remedial Alternative 3B.

**Commercial Area 4**
Commercial Area 4 is located on the eastern side of the Site. The majority of this area is covered with either pavement, buildings (vacant and occupied) or former building concrete slabs. Buildings (9A, 9B, 9C, 9D, 9E, 9F, and 23) were demolished on behalf of the City of Plainwell in 2012, with the majority of the former building concrete slabs left in place and backfilled to surrounding grade. The basement areas were backfilled with a combination of crushed concrete (from the buildings on Site), soil from an adjacent retaining wall that was removed, and imported gravel material and vary in thickness from 6 feet to 9 feet. Specific assumptions for excavation in Commercial Area 4 under Remedial Alternative 3B are presented below.

- Access to both the former substation area and around MW-16 will be restricted due to the distance between existing structures and either the Kalamazoo River or the Mill Race. Excavated soils will likely need to be double handled.

## 5.0 Transportation and Disposal by Redevelopment Area

The following assumptions were made relative to the transportation and disposal of materials in each of the redevelopment areas and reflected in the cost estimate.

- Soil volumes were converted to tonnage assuming a ratio of 1.5 tons per cubic yard for soils. Tonnage for concrete was based on 1.65 tons per cubic yard of material. Waste has been categorized as non-hazardous and non-TSCA soils; TSCA soil; TSCA debris; and miscellaneous debris.
- Transportation and disposal pricing is based on the non-hazardous, non-TSCA material being accepted at Waste Management Autumn Hills Landfill in Zeeland, Michigan. A cost of $22.00 per ton for both transportation and disposal of non-hazardous, non-TSCA waste was used for the estimates.
- A disposal price of $135.00 per ton was used for TSCA soils. For estimation purposes it was assumed that the TSCA soils would be transported to the Environmental Quality Company/U.S. Ecology Company Wayne Disposal Landfill #2, Belleville, Michigan for direct landfill disposal. Transportation of the soils was assumed to be conducted in lined 50 ton gravel trains. Transportation of each load of 50 tons was assumed to cost $500.00.
- Transportation costs assume fuel prices for diesel will not exceed $4.00 per gallon.
- Organic material generated from clearing activities was assumed to be chipped and left on Site.
- Concrete and asphalt will be disposed of off Site, not recycled.

**Residential Area 1**
The specific assumption for transportation and disposal work in Residential Area 1 under Remedial Alternative 3B is presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 910 CY.

**Residential Area 2**
The specific assumption for transportation and disposal work in Residential Area 2 under Remedial Alternative 3B is presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 25 CY.

**Residential Area 3**
The specific assumption for transportation and disposal work in Residential Area 2 under Remedial Alternative 3B is presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 1,495 CY.

**Residential Area 4**
The specific assumption for transportation and disposal work in Residential Area 3 under Remedial Alternative 3B is presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 5,340 CY.
- Allowance of $600 for asphalt.

**Waterfront Plaza**
No specific assumptions for transportation and disposal work in Waterfront Plaza under Remedial Alternative 3B were utilized. Excavation activities will not be conducted within the Waterfront Plaza area.

**Mixed Residential/Commercial Area 1**
Specific assumptions for transportation and disposal work in Mixed Residential/Commercial Area 1 under Remedial Alternative 3B are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 40 CY.
- Allowance of 50 CY for asphalt disposal.

**Mixed Residential/Commercial Area 2**
Specific assumptions for transportation and disposal work in Mixed Residential/Commercial Area 2 under Remedial Alternative 3B are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil from Building 6A with a volume of 200 CY.
- Waste was assumed to be non-hazardous, non-TSCA soil from the Train Shed with a volume of 205 CY.
- Waste was assumed to be non-hazardous, non-TSCA soil from the coal tunnel area with a volume of 1,270 CY.
- Allowance of $3,500 for miscellaneous debris from the coal tunnel area (bricks, concrete).
- Waste was assumed to be non-hazardous, non-TSCA soil from the fuel oil line with a volume of 525 CY.
- Allowance of $600 for disposal of the fuel oil line piping.

- Waste was assumed to be non-hazardous, non-TSCA soil from the fuel oil No. 6 AST area with a volume of 2,500 CY.
- Allowance of $1,200 for the concrete ring the tank was sitting on and buried concrete and asphalt.
- Waste was assumed to be non-hazardous, non-TSCA soil from the north end of the Mill Buildings (Buildings-3A, 25, 28, test pits-TP-340, TP-342,TP-343 and SB-2013) with a volume of 990 CY.
- Allowance of $6,000 for miscellaneous debris from these areas at the north end of the Mill Building.

**Commercial Area 1**
Specific assumptions for transportation and disposal work in Commercial Area 1 under Remedial Alternative 3B are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 12 CY.

**Commercial Area 2**
Waste will not be transported off Site from Commercial Area 2 for Remedial Alternative 3B.

**Commercial Area 3**
Waste will not be transported off Site from Commercial Area 2 for Remedial Alternative 3B.

**Commercial Area 4**
Specific assumptions for transportation and disposal work in Commercial Area 4 under Remedial Alternative 3B are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil from the former substation area and north of the Mill Buildings with a volume of 2,510 CY.
- Waste was assumed to be TSCA soil from the area around MW-16 with a volume of 4,660 CY.
- Waste was assumed to be non-hazardous, non-TSCA soil from the area around boring BK5 with a volume of 15 CY.
- Allowance of $250 for asphalt transportation and disposal.

## 6.0 Restoration by Redevelopment Area

The following assumption was made relative to Site restoration in each of the redevelopment areas and reflected in the cost estimate.

- Restoration activities include backfill (material and placement), compaction, compaction testing and any other location specific restoration that may be deemed necessary at this time.
- General fill from a local gravel pit at a delivered material cost of $4.58 ton was used for the estimates. Unprocessed topsoil at a delivered price of $18.98 cubic yard was also used where appropriate.
- A six-inch layer of unscreened topsoil will be placed over the compacted general fill in areas that were previously pervious (i.e., not paved or impervious). Topsoil will be hydroseeded, including mulch.
- Restoration for excavation areas under pavement will be backfilled with general fill and compacted to 95 percent of the proctor.
- A 6-inch layer of 21AA or equivalent will be placed on the compacted general fill and compacted to 95 percent or greater of the proctor where restoration includes replacing the pavement.
- Concrete will be replaced where removed during excavation activities (sidewalk along Building 17).
- Asphalt will be replaced where removed during excavation activities.

- Permanent markers will be installed to designate areas on Site where impacted soils above Part 201 clean up criteria based on land use, remain in place.

**Residential Area 1**
Specific assumptions for Site restoration in Residential Area 1 under Remedial Alternative 3B are presented below.

- Rip rap at the Kalamazoo River around the storm sewer does not need to be replaced.

**Residential Area 2**
No specific assumptions for Site restoration in Residential Area 2 under Remedial Alternative 3B were utilized.

**Residential Area 3**
Specific assumptions for Site restoration in Residential Area 3 under Remedial Alternative 3B are presented below.

- Backfill material will be imported general fill and overburden material removed to achieve excavation depth requirements but beyond the area exceeding cleanup criteria.
- MW-15 will be replaced.

**Residential Area 4**
No specific assumptions for Site restoration in Residential Area 4 under Remedial Alternative 3B were utilized.

**Waterfront Plaza**
No specific assumptions for Site restoration in Waterfront Plaza under Remedial Alternative 3B were utilized. Restoration will not be required in the Waterfront Plaza area.

**Mixed Residential/Commercial Area 1**
No specific assumptions for Site restoration in Mixed Residential/Commercial Area 1 under Remedial Alternative 3B were utilized.

**Mixed Residential/Commercial Area 2**
Specific assumptions for Site restoration in Mixed Residential/Commercial Area 2 under Remedial Alternative 3B are presented below.

- Building 6A currently has a dirt floor; restoration would not include a concrete floor.
- Concrete (former ash silos) will not be replaced at SB-2010.
- Concrete around the former 200,000 gallon fuel oil AST will not be replaced.
- Concrete removed for excavations at SB-216, SB-220, SB-222 and SB-223 will not be replaced.
- Additional backfill will be required to fill in the void space of the coal tunnel.
- MW-2, MW-19 and MW-22 will be replaced.

**Commercial Area 1**
No specific assumptions for Site restoration in Commercial Area 1 under Remedial Alternative 3B were utilized.

**Commercial Area 2**
No specific assumptions for Site restoration in Commercial Area 2 under Remedial Alternative 3B were utilized.

**Commercial Area 3**
No specific assumptions for Site restoration in Commercial Area 3 under Remedial Alternative 3B were utilized.

**Commercial Area 4**
Specific assumptions for Site restoration in Commercial Area 4 under Remedial Alternative 3B are presented below.

- Asphalt will be 3 inches thick.
- Geotextile and Rip rap will be installed along the Mill Race.
- The Mill Race will be returned to its normal flow path.
- The turbidity curtain will be removed from the Mill Race and Kalamazoo River.
- MW-16 will be replaced.

### 7.0 Demobilization

The following assumptions were made relative to the demobilization from the Site and reflected in the cost estimate.

- Costs included in the demobilization task include time for Site tear down and final decontamination of equipment, and demobilization of equipment and personnel. Demobilization activities were assumed to take five working days.

## B. ENGINEERING/OVERSIGHT

### 1.0 Engineering/Design

The following assumption was made relative to the installation of engineering/design and reflected in the cost estimate.

- Engineering and project design/specifications were estimated to be 15 percent of the Construction Costs.

### 2.0 Construction Oversight

The following assumption was made relative to the construction oversight and reflected in the cost estimate.

- Construction oversight was estimated to be 10 percent of the Construction Costs.

**TABLE C.3C**

**COST SUMMARY**
**REMEDIAL ALTERNATIVE 3C – EXCAVATION AND OFF-SITE DISPOSAL**
**TO MEET LAND USE FOR PART 201, $10^{-5}$ RISK LEVEL FOR ARSENIC (6.4 MG/KG RESIDENTIAL AND 27 MG/KG FOR NON-RESIDENTIAL),**
**AND PCB RISK-BASED LEVEL (2.5 MG/KG RESIDENTIAL AND 9.1 MG/KG COMMERCIAL AREAS)**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Description* | | *Unit* | *Approx. Quantity* | *Unit Price* | *Estimated Cost* *Subtotal* | *Total* |
|---|---|---|---|---|---|---|
| **CAPITAL COSTS** | | | | | | |
| **A.** | ***PRE-DESIGN INVESTIGATION*** | | | | | **$33,200** |
| **1.0** | Sampling and Analysis Work Plan (SAP) | LS | 1 | $25,000 | $25,000 | |
| | Survey top of banks at Site | LS | 1 | $2,000 | $2,000 | |
| | Health and Safety Plan Update | LS | 1 | $1,200 | $1,200 | |
| | Multi-Area Quality Assurance Project Plan | LS | 1 | $5,000 | $5,000 | |
| **2.0** | SAP Implementation | | | | | **$123,900** |
| | Project Set up (mark locations etc.) | LS | 1 | $8,790 | $8,800 | |
| | Private Utility Locate | LS | 1 | $8,000 | $8,000 | |
| | Field Activities | DA | 20 | $2,900 | $58,000 | |
| | *Field Technicians* | | | | | |
| | *Sampling Equipment (push probe technology)* | | | | | |
| | *Expendables (PPE etc)* | | | | | |
| | Temporary Lighting and Carbon Monoxide Control | LS | 1 | $3,000 | $3,000 | |
| | Concrete Coring | LS | 1 | $6,000 | $6,000 | |
| | Laboratory Analysis | LS | 1 | $39,055 | $39,100 | |
| | Investigation Derived Waste Disposal | DA | 20 | $50 | $1,000 | |
| **3.0** | Contingency on PDI | LS | 1 | $78,550 | $78,600 | **$78,600** |
| | *Based on 50 % of SAP costs* | | | | | |
| **4.0** | Remedial Action Plan | LS | 1 | $60,000 | $60,000 | **$60,000** |
| | **TOTAL PRE-DESIGN COSTS** | | | | | **$295,700** |
| ***B.*** | ***CONSTRUCTION*** | | | | | |
| **1.0** | **Mobilization and Set up** | | | | | **$261,600** |
| | Mobilization and Set up | LS | 1 | $45,700 | $45,700 | |
| | Health and Safety | Monthly | 5 | $28,450 | $142,300 | |
| | Erosion Control | LS | 1 | $16,060 | $16,100 | |
| | Site Facilities | | | | | |
| | *Temporary Facilities* | Monthly | 5 | $6,810 | $34,100 | |
| | *Decontamination Pad and Stations* | LS | 1 | $17,375 | $17,400 | |
| | *Staging Areas* | LS | 1 | $6,000 | $6,000 | |
| **2.0** | **Additional Preparation and/or Demolition (by Redevelopment Area)** | | | | | **$139,400** |
| | Residential 1 | LS | 1 | $14,700 | $14,700 | |
| | Residential 2 | LS | 1 | - | - | |
| | Residential 3 | LS | 1 | $1,195 | $1,200 | |
| | Residential 4 | LS | 1 | $850 | $900 | |
| | Waterfront Plaza | LS | 1 | - | - | |
| | Mixed Residential/Commercial Area 1 | LS | 1 | - | - | |
| | Mixed Residential/Commercial Area 2 | LS | 1 | $56,625 | $56,600 | |
| | Commercial Area 1 | LS | 1 | - | - | |
| | Commercial Area 2 | LS | 1 | - | - | |
| | Commercial Area 3 | LS | 1 | - | - | |
| | Commercial Area 4 | LS | 1 | $65,980 | $66,000 | |

**TABLE C.3C**

**COST SUMMARY**
**REMEDIAL ALTERNATIVE 3C – EXCAVATION AND OFF-SITE DISPOSAL**
**TO MEET LAND USE FOR PART 201, $10^{-5}$ RISK LEVEL FOR ARSENIC (6.4 MG/KG RESIDENTIAL AND 27 MG/KG FOR NON-RESIDENTIAL),**
**AND PCB RISK-BASED LEVEL (2.5 MG/KG RESIDENTIAL AND 9.1 MG/KG COMMERCIAL AREAS)**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Description* | | *Unit* | *Approx. Quantity* | *Unit Price* | *Estimated Cost* | |
|---|---|---|---|---|---|---|
| | | | | | *Subtotal* | *Total* |
| **3.0** | **Excavation (by Redevelopment Area)** | | | | | **$293,100** |
| | Residential 1 | CY | 935 | $14 | $12,900 | |
| | Residential 2 | CY | 620 | $12 | $7,300 | |
| | Residential 3 | CY | 1,895 | $9 | $16,800 | |
| | Residential 4 | CY | 9,390 | $4 | $33,000 | |
| | Waterfront Plaza | CY | - | - | - | |
| | Mixed Residential/Commercial Area 1 | CY | 70 | $61 | $4,300 | |
| | Mixed Residential/Commercial Area 2 | CY | 6,396 | $27 | $171,200 | |
| | Commercial Area 1 | CY | 12 | $106 | $1,300 | |
| | Commercial Area 2 | CY | 12 | $106 | $1,300 | |
| | Commercial Area 3 | CY | - | - | - | |
| | Commercial Area 4 | CY | 7,175 | $6 | $45,000 | |
| **4.0** | **Transportation and Disposal (by Redevelopment Area)** | | | | | **$1,851,070** |
| | Residential 1 - Non Haz Non TSCA Soils | Ton | 1,403 | $22 | $30,900 | |
| | Residential 2 - Non Haz Non TSCA Soils | Ton | 930 | $22 | $20,500 | |
| | Residential 3 - Non Haz Non TSCA Soils | Ton | 2,843 | $22 | $62,500 | |
| | Residential 4 - Non Haz Non TSCA Soils | Ton | 14,085 | $22 | $309,900 | |
| | Residential 4 - Misc Debris | LS | 1 | | $600 | |
| | Waterfront Plaza - Non Haz Non TSCA Soils | Ton | - | $22 | - | |
| | Mixed Residential/Commercial Area 1 - Non Haz Non TSCA Soils | Ton | 105 | $22 | $2,300 | |
| | Mixed Residential/Commercial Area 1 - Misc. Debris | LS | - | $125 | $1,675 | |
| | Mixed Residential/Commercial Area 2 - Non Haz Non TSCA Soils | Ton | 9,594 | $22 | $210,500 | |
| | Mixed Residential/Commercial Area 2 - Misc. Debris | LS | 1 | | $8,245 | |
| | Commercial Area 1 - Non Haz Non TSCA Soils | Ton | 18 | $22 | $400 | |
| | Commercial Area 2 - Non Haz Non TSCA Soils | Ton | 18 | $22 | $400 | |
| | Commercial Area 2 - Misc. Debris | LS | - | - | - | |
| | Commercial Area 3 - Non Haz Non TSCA Soils | Ton | - | - | - | |
| | Commercial Area 3 - Misc. Debris | LS | - | - | - | |
| | Commercial Area 4 - Non Haz Non TSCA Soils | Ton | 3,775 | $22 | $83,100 | |
| | Commercial Area 4 - Misc. Debris | LS | - | | $3,550 | |
| | Commercial Area 4 - TSCA | Ton | 7,000 | $160 | $1,116,500 | |
| **7.0** | **Restoration (by Redevelopment Area)** | | | | | **$485,525** |
| | Residential 1 | LS | 1 | | $25,000 | |
| | Residential 2 | LS | 1 | | $18,260 | |
| | Residential 3 | LS | 1 | | $34,785 | |
| | Residential 4 | LS | 1 | | $146,380 | |
| | Waterfront Plaza | LS | - | | - | |
| | Mixed Residential/Commercial Area 1 | LS | 1 | | $8,625 | |
| | Mixed Residential/Commercial Area 2 | LS | 1 | | $134,220 | |
| | Commercial Area 1 | LS | 1 | | $1,670 | |
| | Commercial Area 2 | LS | - | | $1,670 | |
| | Commercial Area 3 | LS | - | | - | |
| | Commercial Area 4 | LS | 1 | | $114,915 | |

**TABLE C.3C**

**COST SUMMARY**
**REMEDIAL ALTERNATIVE 3C – EXCAVATION AND OFF-SITE DISPOSAL**
**TO MEET LAND USE FOR PART 201, $10^{-5}$ RISK LEVEL FOR ARSENIC (6.4 MG/KG RESIDENTIAL AND 27 MG/KG FOR NON-RESIDENTIAL),**
**AND PCB RISK-BASED LEVEL (2.5 MG/KG RESIDENTIAL AND 9.1 MG/KG COMMERCIAL AREAS)**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Description* | | *Unit* | *Approx. Quantity* | *Unit Price* | *Estimated Cost* *Subtotal* | *Total* |
|---|---|---|---|---|---|---|
| **8.0** | **Demobilization** | LS | 1 | $26,550 | | **$26,600** |
| | ***Decontamination and Demobilization*** | | | | | |
| | **TOTAL CONSTRUCTION COST** | | | | | **$3,057,295** |
| ***C.*** | ***ENGINEERING/OVERSIGHT*** | | | | | |
| **1.0** | **Institutional Controls** | | | | | **$50,000** |
| **2.0** | **Engineering/ Design (15 % of Construction Costs)** | | | | | **$458,600** |
| **3.0** | **Construction Oversight (10 % of Construction Costs)** | | | | | **$305,700** |
| | **TOTAL ENGINEERING/OVERSIGHT COSTS** | | | | | **$814,300** |
| | **CONTINGENCY ON CAPITAL COSTS (25 %)** | | | | | **$967,899** |
| | ***TOTAL CAPITAL COSTS*** | | | | | **$4,839,494** |

**OPERATION, MAINTENANCE, & MONITORING COSTS**

| | | | | | | |
|---|---|---|---|---|---|---|
| ***A.*** | ***ANNUAL MONITORING AND MAINTENANCE*** | | | | | **$2,400** |
| | Monthly Operation and Maintenance | Month | 12 | $200 | $2,400 | |
| | **CONTINGENCY ON OM & M COSTS (20 %)** | | | | | **$480** |
| | **TOTAL CAPITAL COSTS** | | | | | **$4,839,494** |
| | **NET PRESENT VALUE OF OM & M (30 YEARS @ 7 % DISCOUNT RATE)** | | | | | **$35,738** |
| | **TOTAL COST** | | | | | **$4,875,232** |

**Table C.3C**

**COST SUMMARY NOTES**
**REMEDIAL ALTERNATIVE 3C – EXCAVATION AND OFF-SITE DISPOSAL**
**TO MEET LAND USE FOR PART 201, $10^{-5}$ RISK LEVEL FOR ARSENIC AND PCB RISK-BASED LEVEL**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

**GENERAL NOTES**

A. Estimate for Remedial Alternative 3C - Excavation and Off-Site Disposal Land Use Criteria with Risk Based Approach of $10^{-5}$ for Arsenic and Site specific calculated PCB Risk-Based Level has been prepared based on available information at the time of this document. Arsenic risk-based criteria are 6.4 milligrams per kilogram (mg/kg) for Residential and Mixed Residential/Commercial Areas and 27 mg/kg for Commercial Areas. Calculated PCB levels of 2.5 mg/kg (Residential Areas) and 9.1 mg/kg (for Commercial Areas) were utilized. Redevelopment activities conducted, being conducted and anticipated for the Site by the City of Plainwell may affect the remediation costs. Costs presented in the Feasibility Study (FS) Report have taken into consideration anticipated redevelopment plans by the City of Plainwell. Redevelopment plans include demolition of non-historical buildings to the concrete slab as well as specific land use restrictions/designations for the Site as presented on Figure 1.4 of the FS Report. This cost estimate is expected to be within -30 percent to +50 percent of the actual remedial costs in accordance with United States Environmental Protection Agency (U.S. EPA) guidance.

B. Remediation activities for each of the 11 proposed redevelopment areas were estimated separately; however, the estimate assumes one mobilization and demobilization effort to conduct the work.

C. Costs assume that additional soil investigation will not be conducted under building slabs unless otherwise noted in the pre-design notes below.

D. Areas targeted for soil removal and off-Site disposal were determined based on an iterative risk-based approach for arsenic and Site specific calculated levels for PCBs as detailed in Appendix A of the FS Revision 2.

E. The cost estimate assumes that new structures have not been constructed in areas that are planned for soil excavation and existing structures remain in place.

F. The cost estimate includes abandonment and replacement costs of groundwater monitoring wells within excavation areas.

G. Costs are based on 2014 dollars.

H. All volumes are based on in-place measures unless otherwise stated.

I. Abbreviations used in the "Unit" column in the Cost Estimate Table are as follows:
   - CY = Cubic Yard
   - EA = Each
   - LS = Lump Sum
   - TN = Ton
   - LF= linear foot

**TASK NOTES:**

***CAPITAL COSTS***

**A. INVESTIGATION/CONSTRUCTION**

**1.0 Pre-Design Investigation (PDI) Activities**

The following assumptions were made relative to the PDI activities in each of the redevelopment areas and reflected in the cost estimate.

- Generation of a Sampling and Analysis Plan (SAP).
- Update the Health and Safety Plan as necessary.
- Update the Multi-Area Quality Assurance Project Plan as necessary.
- Completion of the SAP - soil boring installation and soil sample collection to delineate the vertical and horizontal extent of impact. Soil borings are assumed to be collected via direct push method. PDI samples will be collected and submitted for laboratory analysis for specific parameters determined to exceed Preliminary Remediation Goals (PRGs) during the Remedial Investigation (RI). Delineation samples will not be collected in areas that were not selected for excavation activities (i.e., under building slabs, etc.).
- Quality Assurance/Quality Control samples are included on a 1 per 10 basis.
- A survey of the "top of bank" is included in the PDI cost estimate.
- All areas where subsurface work is to be conducted will be cleared through a public utility locate (i.e., MISS Dig), a private utility locate, review of available drawings, and discussions with individuals knowledgeable of the Site and utilities located thereon.

**Residential Area 1**
PRGs exceeded in Residential Area 1 include the risked based criteria for arsenic of 6.4 milligrams per kilogram (mg/kg). Soil samples will be collected to delineate the extent of soil impacted with PCBs adjacent to the storm sewer line installed by the Michigan Department of Transportation (MDOT) in 2012.

- Allowance for 30 soil samples for PCBs
- Allowance for 28 soil samples for arsenic

**Residential Area 2**
PRGs exceeded in Residential Area 2 include the risked based criteria for arsenic of 6.4 mg/kg.

- Allowance for 36 soil samples for arsenic

**Residential Area 3**
PRGs exceeded in Residential Area 3 include the risked based criteria for arsenic of 6.4 mg/kg.

- Allowance for 60 soil samples for arsenic

**Residential Area 4**
PRGs exceeded in Residential Area 4 include the risked based criteria for arsenic of 6.4 mg/kg. Part 201 residential direct contact criteria is exceeded at locations within Residential Area 4 for benzo(a)pyrene, cyanide, dibenz(a,h)anthracene and lead. Residential soil volatilization to indoor air inhalation criteria (SVIIC) was exceeded at one location for benzene. The Part 201 non-residential direct contact criterion for lead was also exceeded in Residential Area 4. PCBs were above the Site specific calculated PRG of 2.5 mg/kg within Residential Area 4.

- An allowance for 56 soil samples for arsenic
- Benzene above the residential SVIIC at TP-308
    - An allowance for 4 soil samples for benzene was included in the estimate.
- Cyanide was above residential direct contact criteria at SB-302 in the shallow (0-1 foot) interval
    - Four samples for cyanide were included in the estimate
- An allowance for 20 samples for lead was included in the estimate
- The PNA parameters were identified in shallow samples (0-1.5 feet) below grade at DG3, DG4 and TP-302
    - Allowance for 12 PNA samples
- PCBs were above the calculated Site specific level of 2.5 mg/kg at TP-313 and SB-301
    - An allowance for 45 soil samples for PCBs was included in the estimate

**Waterfront Plaza**
PDI activities will not be specifically conducted within the Waterfront Plaza area.

**Mixed Residential/Commercial Area 1**
PRGs exceeded in Mixed Residential/Commercial Area 1 include Part 201 non-residential inhalation criteria for manganese and the risked based PRG for arsenic of 6.4 mg/kg.

- A total of 24 soil samples for arsenic will be collected.
- Soil samples will be collected from borings around TP-334 for manganese. Eight samples will be collected for manganese analysis.

**Mixed Residential/Commercial Area 2**
PRGs exceeded in Mixed Residential/Commercial Area 2 include Part 201 non-residential direct contact criteria for benzo(a)pyrene, and lead. Residential direct contact criteria is exceeded at locations within Mixed Residential/Commercial Area 2 for benzo(a)pyrene, dibenz(a,h)anthracene; benzo(a)anthracene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene and lead. The risked based PRG for arsenic of 6.4 mg/kg is also exceeded at locations within Mixed Residential/Commercial Area 2.

Soil delineation by work area as follows:

**<u>Arsenic ONLY locations</u>**:
Building 25
- Allowance for 8 samples

Building 28
- Allowance for 8 samples

Train Shed
- Allowance for 4 samples

Coal Tunnel Area
- Allowance for 30 samples

Former Ash Silo Area (SB-2011)
- Allowance for 8 samples

Former clarifier area (TP-344)
- Allowance for 8 samples

Area north of Building 3/Former Water Tower Area (TP-340, TP-342, TP-343)
- Allowance for 16 samples

**<u>Arsenic and Lead sample locations:</u>**
Area around SB-2013
- Allowance for 12 samples

**Arsenic, PNAs and Lead sample locations:**
Building 3A
- Allowance for 12 samples

Building 6A
- Allowance for 18 samples
- Technicians will be required to don respirators for this work
- The floor in the majority of this building is exposed soil

**Arsenic and PNAs sample locations**
Fuel Oil AST Area
- Allowance for 24 PNA soil samples
- Allowance for 12 arsenic samples

A total of 140 samples will be collected and analyzed for arsenic.
A total of 54 samples will be collected and analyzed for PNAs.
A total of 42 samples will be collected and analyzed for lead.

**Commercial Area 1**
PRGs exceeded in Commercial Area 1 include Part 201 non-residential inhalation criteria for manganese.

- Delineation samples (4) will be collected around SS-105 for manganese.

**Commercial Area2**
Arsenic was reported above the PRG of 27 mg/kg in Commercial Area 2 at TP-321.

- Four samples will be collected around TP-321 for arsenic.

**Commercial Area3**
PRGs are not exceeded in Commercial Area 3.

**Commercial Area 4**
Residential direct contact criteria is exceeded at locations within Commercial Area 4 for benzo(a)pyrene, and lead. The risked based PRG criteria for arsenic of 27 mg/kg was exceeded within Commercial Area 4. PCBs above the Site specific calculated PRG of 9.1 mg/kg were identified in Commercial Area 4 around MW-16.

Soil delineation by area as follows:

**Arsenic ONLY locations**:
SB-2012
- Allowance for 4 samples

Parking lot area south of Building 17
- Allowance for 60 samples

**Arsenic and Lead sample locations:**
TP-341
- Allowance for 4 samples

**Arsenic, PNAs and Lead sample locations:**
Former Substation Area/North of Mill Buildings
- Allowance for 30 samples

**PCBs and Arsenic sample locations:**
MW-16 Area
- Allowance for 18 samples

A total of 116 samples will be collected and analyzed for arsenic.
A total of 30 samples will be collected and analyzed for PNAs.
A total of 18 samples will be collected and analyzed for PCBs.
A total of 34 samples will be collected and analyzed for lead.

## 2.0 Mobilization/Set-Up

The following assumptions were made relative to the mobilization/set-up in each of the redevelopment areas and reflected in the cost estimate.

- Mobilization and set-up includes: mobilization of personnel and equipment; construction survey work (e.g., excavation layout and verification sample locations); and geotechnical and chemical testing on backfill materials.
  - An allowance of $8,000 to mobilize personnel and equipment was included in the estimate.
  - $30,000 for survey work was included in the estimate.
  - Geotechnical and chemical analysis for imported materials was included in the estimate. One set of chemical analysis [Target Analyte List Metals, Target Compound List (TCL) for volatile organic compounds, TCL for semi-volatile compounds, and polychlorinated biphenyl (PCBs) per material (topsoil, general fill and 21AA/gravel]. The topsoil sample will also be analyzed for pH, phosphorous, organic content, pesticides and herbicides.
- Health and Safety includes an on-Site Health and Safety Officer (HSO) for 4 months, the HSO will not stay on Site during all restoration activities. Also included in the costs are: air monitoring equipment and calibration gases; a decontamination trailer; and disposable personal protection equipment (PPE).
- Air monitoring assumes real-time air monitoring will be conducted during all excavation work utilizing a photoionization detector (11.7 electronVolt [eV] lamp) and fugitive dust monitor(s). Air monitoring does not include the collection of samples for laboratory analysis or laboratory analytical costs.
- Erosion control includes an allowance for silt fence (4,000 LF) and geofabric to cover catch basins on the Site. Costs for erosion control measures specific to individual redevelopment areas (i.e., turbidity curtains, etc.) are included in individual redevelopment area estimates (e.g., Commercial Area 4).
- Site facility costs include electrical hookup and electricity for two office trailers (one for the contractor and one for the U.S. EPA) for 5 months. Other temporary facilities include portable sanitary services, a drinking water allowance and a small dumpster for worker general refuse. The expense of one Site truck for the duration of the services was included.
- Site facility costs include materials and construction of temporary decontamination pads and decontamination stations for workers. It was assumed that potable water could be obtained from the City of Plainwell for use during the project.
- Site facility costs include $6,000 for the installation and maintenance of a staging area for waste.
- A perimeter fence currently exists around the majority of the Site. The cost estimate assumes the fence will remain and can be utilized as a security measure to prevent access to the Site during construction activities.

## 3.0 Preparation/Pre-Excavation Work by Redevelopment Area

The following assumptions were made relative to the preparation/pre-excavation work in each of the redevelopment areas and reflected in the cost estimate.

- A Soil Erosion and Sedimentation Control Permit will be obtained from Allegan County. All other necessary permits will also be obtained prior to intrusive work at the Site.
- All areas where subsurface work is to be conducted will be cleared through a public utility locate (i.e., MISS Dig), a private utility locate, review of available drawings, and discussions with individuals knowledgeable of the Site and utilities located thereon.

**Residential Area 1**
Specific assumptions for preparation/pre-excavation work in Residential Area 1 under Remedial Alternative 3C are presented below.

- Trees and shrubs in the excavation areas will need to be cleared and grubbed.
- Turbidity curtain will be temporally installed in the Kalamazoo River during excavation and backfill activities.
- One power pole will need to be relocated for the excavation work around SB-104.

**Residential Area 2**
No specific assumptions for preparation/pre-excavation work in Residential Area 2 under Remedial Alternative 3C were utilized.

**Residential Area 3**
Specific assumptions for preparation/pre-excavation work in Residential Area 3 under Remedial Alternative 3C are presented below.

- MW-15 will be abandoned.
- Clearing will be required in the area around MW-15.

**Residential Area 4**
Specific assumptions for preparation/pre-excavation work in Residential Area 4 under Remedial Alternative 3C are presented below.

- Clearing will be required in the area around SB-301/SG-4.
- Pavement by TP-302 will be saw cut.

**Waterfront Plaza**
No specific assumptions for preparation/pre-excavation work in Waterfront Plaza under Remedial Alternative 3C were utilized.

**Mixed Residential/Commercial Area 1**
The specific assumption for preparation/pre-excavation work in Mixed Residential/Commercial Area 1 under Remedial Alternative 3C is presented below.

- Pavement in the work areas will be saw cut prior to excavation to leave a clean line for restoration activities.

**Mixed Residential/Commercial Area 2**
Specific assumptions for preparation/pre-excavation work in Mixed Residential/Commercial Area 2 under Remedial Alternative 3C are presented below.

- The loading dock at the south end of Building 1 will be evaluated by a structural engineering assessment to ensure excavation of the fuel oil line will not damage either the loading dock or Building 1.
- The pavement and concrete will be saw cut prior to excavation to create clean lines for restoration.
- A demolition notice will be submitted to the State of Michigan for the demolition of Building 5A/part of the coal tunnel. Asbestos abatement may be necessary on pipe wrap found outside of Building 5A.
- Excavation of soils under the concrete slabs of the demolished buildings (3A, 25 and 28) will require the relocation of the backfill (less than 3 feet thick) prior to excavation.
- Fuel Oil No. 6 within the former coal tunnel will be removed from the tunnel before the tunnel itself is removed.
- The piping run from the former Fuel Oil No. 6 AST and Building 5 will be exposed at one end and drained of any residual fuel oil prior to removing the line.
- Monitoring well MW-19 will be abandoned prior to excavation activities in this area.
- Monitoring well MW-22 will be abandoned prior to removal of the former fuel oil line.
- Monitoring well MW-2 will be abandoned prior to excavation activities at SB-2010 and SB-2011.

**Commercial Area 1**
No specific assumptions for preparation/pre-excavation work in Commercial Area 1 under Remedial Alternative 3C were utilized.

**Commercial Area 2**
No specific assumptions for preparation/pre-excavation work in Commercial Area 2 under Remedial Alternative 3C were utilized.

**Commercial Area 3**
No specific assumptions for preparation/pre-excavation work in Commercial Area 3 under Remedial Alternative 3C were utilized. Excavation work will not be conducted in Commercial Area 3 for Remedial Alternative 3C.

**Commercial Area 4**
Specific assumptions for preparation/pre-excavation work in Commercial Area 4 under Remedial Alternative 3C are presented below.

- Turbidity curtain will be installed in the Mill Race in the area by MW-16 (along the Mill Race) and in the area of MW-3 prior to excavation activities.
- Monitoring of the Mill Race and Kalamazoo River for turbidity will be conducted during excavation activities.
- MW-16 will be abandoned prior to excavation work in that area.
- Protection of MW-3 (barriers) will be installed.
- A structural engineering evaluation of the pedestrian bridge for stability during excavation activities will be conducted. The evaluation will determine if shoring of the bridge is necessary. An allowance of $5,000 is included in the estimate to conduct the evaluation. Shoring costs have not been included in the estimate.
- The water flow of the Mill Race will be diverted in the excavation area. The methodology for this work to be determined in the pre-design phase of the project.
- Rip rap along the Mill Race will be removed and staged for re-use.
- Pavement in the work areas will be saw cut prior to excavation to allow for restoration activities.

## 4.0 Excavation by Redevelopment Area

Conceptual excavation areas for each of the Redevelopment areas are shown of Figures 3.23 through 3.33 of the FS Report (Revision 2).

The following assumptions were made relative to excavation in each of the redevelopment areas and reflected in the cost estimate.

- Soil excavation quantities within the buildings are based on excavating horizontally by five feet in each direction and one-foot vertically beyond the sample location exceeding criteria.
- Excavation estimates assume dewatering will not be necessary and that all work can be completed in Level D PPE except Building 6A which will be conducted with supplied air (Level B) PPE.
- Standby time was not added to account for the time for laboratory analysis of verification samples. It was assumed that the project would proceed across the Site allowing for laboratory analysis to be conducted while another redevelopment area was being excavated or restored.

Specific assumptions to each redevelopment area, in addition to those presented above globally, are provided below.

**Residential Area 1**

Residential Area 1 is located at the far west end of the Site, where the majority of the former sludge dewatering lagoons were located. The former Mill wastewater treatment building, activated sludge tank and secondary clarifier were constructed over the lagoons. The wastewater treatment structures were demolished on behalf of the City of Plainwell in November and December 2013. The specific assumption for excavation in Residential Area 1 under Remedial Alternative 3C is presented below.

- Overburden present beyond the target excavation area that must be removed to achieve the full depth of excavation will be disposed of off Site.

**Residential Area 2**

Residential Area 2 is located between Residential Area 1 and Residential Area 3 and is positioned along the Kalamazoo River. This area was historically occupied by sludge dewatering lagoons (A, B, C) and a primary clarifier. The primary clarifier was demolished to the concrete slab in November 2013. No specific assumptions for excavation work in Residential Area 2 under Remedial Alternative 3C were utilized.

**Residential Area 3**

Residential Area 3 is located near the center of the Site. The former aeration basin location occupies the majority of the area. A former secondary clarifier was historically present in this area, which was demolished in November 2013 with the floor of the former clarifier remaining. Specific assumptions for excavation in Residential Area 3 under Remedial Alternative 3C are presented below.

- Material removed from the bottom of the aeration basin will require double handling due to the slopes of the former aeration basin and the depth of the excavation.

**Residential Area 4**

Residential Area 4 is positioned along the Kalamazoo River between Residential Area 3 and Mixed Residential Area 2. No aboveground structures are currently present on this area. A portion of this area was historically utilized by the Mill as a coal storage area. No specific assumptions for excavation in Residential Area 4 under Remedial Alternative 3C were made.

**Waterfront Plaza**
No excavation activities are anticipated in the Waterfront Plaza Area.

**Mixed Residential/Commercial Area 1**
Mixed Residential/Commercial Area 1 is located between Commercial Area 2 and Commercial Area 3 on the southern property line along Allegan Street. This area was once occupied by the former Specialty Minerals Building and associated above ground storage tanks. The Specialty Minerals building and ASTs were demolished to the concrete slab in December 2011.

- Underground utilities encountered (TP-303 and TP-306) between the former Specialty Minerals Building and the main Mill Buildings will be capped at either end of the excavation.

**Mixed Residential and Commercial Area 2**
Mixed Residential and Commercial Area 2 is located between Residential Area 4 and Commercial Area 4 at the northern end of the Site along the Kalamazoo River. The majority of the area is occupied by Mill Buildings and pavement. Buildings 3A, 25 and 28 along with the eastern water tower, 200,000-gallon Fuel Oil AST, and the brine USTs, were demolished on behalf of the City of Plainwell. The concrete slabs were left in place for Buildings 3A and 28. Building 25 was part of the Site's historical wastewater treatment system and had a subsurface vault and system to pump the waste water from the Mill to the on-Site WWTP at the west end of the Site. The vault under the northern portion of Building 25 was not removed. The vault floor was cracked and the sidewalls removed to 4 feet below grade, then the vault was filled with imported general fill. The concrete slab under the remaining portion of Building 25 was left in place.

Specific assumptions for excavation in Mixed Residential/Commercial Area 2 under Remedial Alternative 3C are presented below.

- A storm sewer was installed through the west side of Mixed Residential/Commercial Area 2 in 2012 by the Michigan Department of Transportation (MDOT). The approximate location of the storm sewer is shown on Figure 3.29. Before conducting excavation work to remove the former fuel oil AST line and excavate the east side of the former fuel AST, the exact location of the storm sewer line will be determined, shoring of the line may be necessary during the removal of the fuel oil AST line.
- Soils in Building 6A will be removed using a vacuum extraction system.

**Commercial Area 1**
Commercial Area 1 is located in the far southwest portion of the Site. No structures or paved areas are currently present in this area that would require unique equipment or procedures to conduct the proposed remedial activities. This area of the Site has not been developed and was not part of historic Mill operations.

- A storm sewer was installed through this area in 2012 by the Michigan Department of Transportation (MDOT). The approximate location of the storm sewer is shown on Figure 3.30. Before conducting excavation work in the area of SS-105, the exact location of the line will be determined.

**Commercial Area 2**
Commercial Area 2 is located in the southwest central portion of the Site. Structures on this portion of the Site include the City of Plainwell Public Safety Building and associated paved parking and egress/ingress areas. Excavation activities will not take place under the existing buildings or paved surfaces. No specific assumptions for Commercial Area 2 were made.

**Commercial Area 3**
Excavation work will not be conducted in Commercial Area 3 for Remedial Alternative 3C.

**Commercial Area 4**

Commercial Area 4 is located on the eastern side of the Site. The majority of this area is covered with either pavement, buildings (vacant and occupied) or former building concrete slabs. Buildings (9A, 9B, 9C, 9D, 9E, 9F, and 23) were demolished on behalf of the City of Plainwell in 2012, with the majority of the former building concrete slabs left in place and backfilled to surrounding grade. The basement areas were backfilled with a combination of crushed concrete (from the buildings on Site), soil from an adjacent retaining wall that was removed, and imported gravel material and vary in thickness from 6 feet to 9 feet. Specific assumptions for excavation in Commercial Area 4 under Remedial Alternative 3C are presented below.

- Access to both the former substation area and around MW-16 will be restricted due to the distance between existing structures and either the Kalamazoo River or the Mill Race. Excavated soils will likely need to be double handled.

## 5.0 Transportation and Disposal by Redevelopment Area

The following assumptions were made relative to the transportation and disposal of materials in each of the redevelopment areas and reflected in the cost estimate.

- Soil volumes were converted to tonnage assuming a ratio of 1.5 tons per cubic yard for soils. Tonnage for concrete was based on 1.65 tons per cubic yard of material. Waste has been categorized as non-hazardous and non-TSCA soils; TSCA soil; TSCA debris; and miscellaneous debris.
- Transportation and disposal pricing is based on the non-hazardous, non-TSCA material being accepted at Waste Management Autumn Hills Landfill in Zeeland, Michigan. A cost of $22.00 per ton for both transportation and disposal of non-hazardous, non-TSCA waste was used for the estimates.
- A disposal price of $135.00 per ton was used for TSCA soils. For estimation purposes it was assumed that the TSCA soils would be transported to the Environmental Quality Company/U.S. Ecology Company Wayne Disposal #2 Landfill, Belleville, Michigan for direct landfill disposal. Transportation of the soils was assumed to be conducted in lined 50 ton gravel trains. Transportation of each load of 50 tons was assumed to cost $500.00.
- Transportation costs assume fuel prices for diesel will not exceed $4.00 per gallon.
- Organic material generated from clearing activities was assumed to be chipped and left on Site.
- Concrete and asphalt will be disposed of off Site, not recycled.

**Residential Area 1**

The specific assumption for transportation and disposal work in Residential Area 1 under Remedial Alternative 3C is presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 935 CY.

**Residential Area 2**

The specific assumption for transportation and disposal work in Residential Area 2 under Remedial Alternative 3C is presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 620 CY.

**Residential Area 3**

The specific assumption for transportation and disposal work in Residential Area 2 under Remedial Alternative 3C is presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 1,895 CY.

**Residential Area 4**
The specific assumption for transportation and disposal work in Residential Area 3 under Remedial Alternative 3C is presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 9,390 CY.
- Allowance of $600 for asphalt.

**Waterfront Plaza**
No specific assumptions for transportation and disposal work in Waterfront Plaza under Remedial Alternative 3C were utilized. Excavation activities will not be conducted within the Waterfront Plaza area.

**Mixed Residential/Commercial Area 1**
Specific assumptions for transportation and disposal work in Mixed Residential/Commercial Area 1 under Remedial Alternative 3C are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 70 CY.
- Allowance of 50 CY for asphalt disposal.

**Mixed Residential/Commercial Area 2**
Specific assumptions for transportation and disposal work in Mixed Residential/Commercial Area 2 under Remedial Alternative 3C are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil from Building 6A with a volume of 200CY.
- Waste was assumed to be non-hazardous, non-TSCA soil from the coal tunnel area with a volume of 1,270 CY.
- Allowance of $3,500 for miscellaneous debris from the coal tunnel area (bricks, concrete).
- Waste was assumed to be non-hazardous, non-TSCA soil from the fuel oil line with a volume of 525 CY.
- Allowance of $600 for disposal of the fuel oil line piping.
- Waste was assumed to be non-hazardous, non-TSCA soil from the fuel oil No. 6 AST area with a volume of 2,500 CY.
- Allowance of $1,200 for the concrete ring the Fuel Oil AST was sitting on and buried concrete and asphalt.
- The waste from the Train Shed was assumed to be non-hazardous, non-TSCA soil from with a volume of 205 CY.
- Waste was assumed to be non-hazardous, non-TSCA soil from the north end of the Mill Buildings (Buildings 3A, 25, 28, test pits-TP-340, TP-342,TP-343 and SB-2013) plus the area around SB-2011 with a volume of 1,696 CY.
- Allowance of $6,000 for miscellaneous debris from these areas at the north end of the Mill Building.

**Commercial Area 1**
Specific assumptions for transportation and disposal work in Commercial Area 1 under Remedial Alternative 3C are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 12 CY.

**Commercial Area 2**
Specific assumptions for transportation and disposal work in Commercial Area 2 under Remedial Alternative 3C are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 12 CY.

**Commercial Area 3**
No specific assumptions for transportation and disposal work in Commercial Area 3 under Remedial Alternative 3C were utilized. Excavation activities will not be conducted within the Commercial Area 3.

**Commercial Area 4**
Specific assumptions for transportation and disposal work in Commercial Area 4 under Remedial Alternative 3C are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil from the former substation area and north of the Mill Buildings with a volume of 2,500 CY.
- Waste was assumed to be TSCA soil from the area around MW-16 with a volume of 4,660 CY.
- Waste was assumed to be non-hazardous, non-TSCA soil from the area around BK5 with a volume of 15 CY.
- Allowance of 400 CY of asphalt.

## 6.0 Restoration by Redevelopment Area

The following assumption was made relative to Site restoration in each of the redevelopment areas and reflected in the cost estimate.

- Restoration activities include backfill (material and placement), compaction, compaction testing and any other location specific restoration that may be deemed necessary at this time (e.g., replacing a floor).
- General fill from a local gravel pit at a delivered material cost of $4.58 ton was used for the estimates. Unprocessed topsoil at a delivered price of $18.98 cubic yard was also used where appropriate.
- Restoration for the excavation areas include general fill backfill compacted to 92-95 percent of the proctor.
- A 6-inch layer of unscreened topsoil will be placed over the compacted general fill in areas that were previously pervious (i.e., not paved or impervious). Topsoil will be hydroseeded, including mulch.
- Restoration for excavation areas under pavement will be backfilled with general fill and compacted to 95 percent of the proctor.
- A 6-inch layer of 21AA or equivalent will be placed on the compacted general fill and compacted to 95 percent or greater of the proctor where pavement will be installed.
- Asphalt will be replaced where removed during excavation activities.
- Permanent markers will be installed to designate areas on Site where impacted soils above Part 201 clean up criteria based on land use, remain in place.

**Residential Area 1**
Specific assumptions for Site restoration in Residential Area 1 under Remedial Alternative 3C are presented below.

- Backfill material will be imported general fill and overburden material removed to achieve excavation depth requirements but beyond the area exceeding PRGs.

**Residential Area 2**
No specific assumptions for Site restoration in Residential Area 2 under Remedial Alternative 3A were utilized.

**Residential Area 3**
Specific assumptions for Site restoration in Residential Area 3 under Remedial Alternative 3C are presented below.

- Backfill material will be imported general fill and overburden material removed to achieve excavation depth requirements but beyond the area exceeding cleanup criteria.
- MW-15 will be replaced.

**Residential Area 4**
No specific assumptions for Site restoration in Mixed Residential/Commercial Area 1 under Remedial Alternative 3C were utilized.

**Waterfront Plaza**
No specific assumptions for Site restoration in Waterfront Plaza under Remedial Alternative 3C were utilized. Restoration will not be required in the Waterfront Plaza area.

**Mixed Residential/Commercial Area 1**
No specific assumptions for Site restoration in Mixed Residential/Commercial Area 1 under Remedial Alternative 3C were utilized.

**Mixed Residential/Commercial Area 2**
Specific assumptions for Site restoration in Mixed Residential/Commercial Area 2 under Remedial Alternative 3C are presented below.

- Building 6A currently has a dirt floor; restoration would not include a concrete floor.
- Concrete (former ash silos) will not be replaced at SB-2010.
- Concrete around the former 200,000 gallon fuel oil AST will not be replaced.
- Concrete removed for excavations at SB-216, SB-220, SB-222 and SB-223 will not be replaced.
- Additional backfill will be required to fill in the void space of the coal tunnel.
- MW-2, MW-19 and MW-22 will be replaced.

**Commercial Area 1**
No specific assumptions for Site restoration in Commercial Area 1 under Remedial Alternative 3C were utilized.

**Commercial Area 2**
No specific assumptions for Site restoration in Commercial Area 2 under Remedial Alternative 3C were utilized.

**Commercial Area 3**
No specific assumptions for Site restoration in Commercial Area 3 under Remedial Alternative 3C were utilized.

**Commercial Area 4**
Specific assumptions for Site restoration in Commercial Area 4 under Remedial Alternative 3C are presented below.

- Asphalt will be 3 inches thick.
- Geotextile and Rip rap will be installed along the Mill Race.
- The Mill Race will be returned to its normal flow path.
- The turbidity curtain will be removed from the Mill Race and Kalamazoo River.
- MW-16 will be replaced.

**7.0 Demobilization**

The following assumptions were made relative to the demobilization from the Site and reflected in the cost estimate.

- Costs included in the demobilization task include time for Site tear down and final decontamination of equipment, and demobilization of equipment and personnel. Demobilization activities were assumed to take 5 working days.

**B. <u>ENGINEERING/OVERSIGHT</u>**

**1.0 Engineering/Design**

The following assumption was made relative to the installation of engineering/design and reflected in the cost estimate.

- Engineering and project design/specifications were estimated to be 15 percent of the Construction Costs.

**2.0 Construction Oversight**

The following assumption was made relative to the construction oversight and reflected in the cost estimate.

- Construction oversight was estimated to be 10 percent of the Construction Costs.

**TABLE C.3D**

**COST SUMMARY**
**REMEDIAL ALTERNATIVE 3D – EXCAVATION AND OFF-SITE DISPOSAL**
**TO MEET LAND USE FOR PART 201, $10^{-6}$ RISK LEVEL FOR ARSENIC (5.8 MG/KG), AND TSCA HIGH OCCUPANCY LEVEL**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Description* | | *Unit* | *Approx. Quantity* | *Unit Price* | *Estimated Cost* *Subtotal* | *Total* |
|---|---|---|---|---|---|---|
| **CAPITAL COSTS** | | | | | | |
| **A.** | ***PRE-DESIGN INVESTIGATION*** | | | | | **$33,200** |
| **1.0** | Sampling and Analysis Work Plan (SAP) | LS | 1 | $25,000 | $25,000 | |
| | Survey top of banks at Site | LS | 1 | $2,000 | $2,000 | |
| | Health and Safety Plan Update | LS | 1 | $1,200 | $1,200 | |
| | Multi-Area Quality Assurance Project Plan | LS | 1 | $5,000 | $5,000 | |
| **2.0** | SAP Implementation | | | | | **$151,100** |
| | Project Set up (mark locations etc.) | LS | 1 | $8,790 | $8,800 | |
| | Private Utility Locate | LS | 1 | $8,000 | $8,000 | |
| | Field Activities | DA | 23 | $2,900 | $66,700 | |
| | *Field Technicians* | | | | | |
| | *Sampling Equipment (push probe technology)* | | | | | |
| | *Expendables (PPE etc)* | | | | | |
| | Temporary Lighting and Carbon Monoxide Control | LS | 1 | $6,000 | $6,000 | |
| | Concrete Coring | LS | 1 | $6,000 | $6,000 | |
| | Laboratory Analysis | LS | 1 | $54,350 | $54,400 | |
| | Investigation Derived Waste Disposal | DA | 23 | $50 | $1,200 | |
| **3.0** | Contingency on PDI | LS | 1 | $92,150 | $92,200 | **$92,200** |
| | *Based on 50 % of SAP costs* | | | | | |
| **4.0** | Remedial Action Plan | LS | 1 | $60,000 | $60,000 | **$60,000** |
| | **TOTAL PRE-DESIGN COSTS** | | | | | **$336,500** |
| ***B.*** | ***CONSTRUCTION*** | | | | | |
| **1.0** | **Mobilization and Set up** | | | | | **$374,200** |
| | Mobilization and Set up | LS | 1 | $45,700 | $45,700 | |
| | Health and Safety | Monthly | 8 | $28,450 | $227,600 | |
| | Erosion Control | LS | 1 | $23,040 | $23,000 | |
| | Site Facilities | | | | | |
| | *Temporary Facilities* | Monthly | 8 | $6,810 | $54,500 | |
| | *Decontamination Pad and Stations* | LS | 1 | $17,375 | $17,400 | |
| | *Staging Areas* | LS | 1 | $6,000 | $6,000 | |
| **2.0** | **Additional Preparation and/or Demolition (by Redevelopment Area)** | | | | | **$158,200** |
| | Residential 1 | LS | 1 | $16,950 | $17,000 | |
| | Residential 2 | LS | 1 | - | - | |
| | Residential 3 | LS | 1 | $1,795 | $1,800 | |
| | Residential 4 | LS | 1 | $1,100 | $1,100 | |
| | Waterfront Plaza | LS | 1 | - | - | |
| | Mixed Residential/Commercial Area 1 | LS | 1 | $2,500 | $2,500 | |
| | Mixed Residential/Commercial Area 2 | LS | 1 | $67,822 | $67,800 | |
| | Commercial Area 1 | LS | 1 | $2,000 | $2,000 | |
| | Commercial Area 2 | LS | 1 | - | - | |
| | Commercial Area 3 | LS | 1 | $625 | - | |
| | Commercial Area 4 | LS | 1 | $65,987 | $66,000 | |

**TABLE C.3D**

**COST SUMMARY**
**REMEDIAL ALTERNATIVE 3D – EXCAVATION AND OFF-SITE DISPOSAL**
**TO MEET LAND USE FOR PART 201, $10^{-6}$ RISK LEVEL FOR ARSENIC (5.8 MG/KG), AND TSCA HIGH OCCUPANCY LEVEL**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Description* | | *Unit* | *Approx. Quantity* | *Unit Price* | *Estimated Cost* *Subtotal* | *Total* |
|---|---|---|---|---|---|---|
| **3.0** | **Excavation (by Redevelopment Area)** | | | | | **$468,700** |
| | Residential 1 | CY | 2,730 | $11 | $29,800 | |
| | Residential 2 | CY | 3,550 | $8 | $29,800 | |
| | Residential 3 | CY | 4,320 | $7 | $31,700 | |
| | Residential 4 | CY | 9,965 | $5 | $52,800 | |
| | Waterfront Plaza | CY | - | - | - | |
| | Mixed Residential/Commercial Area 1 | CY | 205 | $44 | $9,100 | |
| | Mixed Residential/Commercial Area 2 | CY | 6,964 | $26 | $183,900 | |
| | Commercial Area 1 | CY | 165 | $26 | $4,300 | |
| | Commercial Area 2 | CY | 2,460 | $8 | $20,600 | |
| | Commercial Area 3 | CY | 3,845 | $5 | $21,100 | |
| | Commercial Area 4 | CY | 15,375 | $6 | $85,600 | |
| **4.0** | **Transportation and Disposal (by Redevelopment Area)** | | | | | **$2,636,682** |
| | Residential 1 - Non Haz Non TSCA Soils | Ton | 4,095 | $22 | $90,100 | |
| | Residential 2 - Non Haz Non TSCA Soils | Ton | 5,325 | $22 | $117,200 | |
| | Residential 3 - Non Haz Non TSCA Soils | Ton | 6,480 | $22 | $142,600 | |
| | Residential 4 - Non Haz Non TSCA Soils | Ton | 14,948 | $22 | $328,800 | |
| | Residential 4 - Misc Debris | LS | 1 | | $600 | |
| | Waterfront Plaza - Non Haz Non TSCA Soils | Ton | - | $22 | - | |
| | Mixed Residential/Commercial Area 1 - Non Haz Non TSCA Soils | Ton | 308 | $22 | $6,800 | |
| | Mixed Residential/Commercial Area 1 - Misc. Debris | LS | - | | $1,675 | |
| | Mixed Residential/Commercial Area 2 - Non Haz Non TSCA Soils | Ton | 10,446 | $22 | $229,200 | |
| | Mixed Residential/Commercial Area 2 - Misc. Debris | LS | 1 | | $5,512 | |
| | Commercial Area 1 - Non Haz Non TSCA Soils | Ton | 248 | $22 | $5,400 | |
| | Commercial Area 2 - Non Haz Non TSCA Soils | Ton | 3,690 | $22 | $81,200 | |
| | Commercial Area 2 - Misc. Debris | LS | 1 | | $5,825 | |
| | Commercial Area 3 - Non Haz Non TSCA Soils | Ton | 5,768 | $22 | $126,900 | |
| | Commercial Area 3 - Misc. Debris | LS | 1 | | $1,750 | |
| | Commercial Area 4 - Non Haz Non TSCA Soils | Ton | 16,073 | $22 | $353,600 | |
| | Commercial Area 4 - Misc. Debris | LS | - | | $23,020 | |
| | Commercial Area 4 - TSCA | Ton | 7,000 | $160 | $1,116,500 | |
| **7.0** | **Restoration (by Redevelopment Area)** | | | | | **$989,518** |
| | Residential 1 | LS | 1 | | $56,665 | |
| | Residential 2 | LS | 1 | | $49,305 | |
| | Residential 3 | LS | 1 | | $115,685 | |
| | Residential 4 | LS | 1 | | $167,200 | |
| | Waterfront Plaza | LS | - | | - | |
| | Mixed Residential/Commercial Area 1 | LS | 1 | | $16,370 | |
| | Mixed Residential/Commercial Area 2 | LS | 1 | | $159,050 | |
| | Commercial Area 1 | LS | 1 | | $10,560 | |
| | Commercial Area 2 | LS | 1 | | $32,385 | |
| | Commercial Area 3 | LS | 1 | | $127,800 | |
| | Commercial Area 4 | LS | 1 | | $254,498 | |

**TABLE C.3D**

**COST SUMMARY**
**REMEDIAL ALTERNATIVE 3D – EXCAVATION AND OFF-SITE DISPOSAL**
**TO MEET LAND USE FOR PART 201, $10^{-6}$ RISK LEVEL FOR ARSENIC (5.8 MG/KG), AND TSCA HIGH OCCUPANCY LEVEL**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

| *Description* | | *Unit* | *Approx. Quantity* | *Unit Price* | *Estimated Cost* *Subtotal* | *Estimated Cost* *Total* |
|---|---|---|---|---|---|---|
| **8.0** | **Demobilization** | LS | 1 | $26,550 | | **$26,600** |
| | Decontamination and Demobilization | | | | | |
| | **TOTAL CONSTRUCTION COST** | | | | | **$4,653,900** |
| ***C.*** | ***ENGINEERING/OVERSIGHT*** | | | | | |
| **1.0** | **Institutional Controls** | | | | | **$50,000** |
| **2.0** | **Engineering/ Design (15 % of Construction Costs)** | | | | | **$698,100** |
| **3.0** | **Construction Oversight (10 % of Construction Costs)** | | | | | **$465,400** |
| | **TOTAL ENGINEERING/OVERSIGHT COSTS** | | | | | **$1,213,500** |
| | **CONTINGENCY ON CAPITAL COSTS (25 %)** | | | | | **$1,466,850** |
| | ***TOTAL CAPITAL COSTS*** | | | | | **$7,334,250** |

**OPERATION, MAINTENANCE, & MONITORING COSTS**

| | | | | | | |
|---|---|---|---|---|---|---|
| ***A.*** | ***ANNUAL MONITORING AND MAINTENANCE*** | | | | | **$9,600** |
| | Monthly Operation and Maintenance of Systems | Month | 12 | $800 | $9,600 | |
| | **CONTINGENCY ON OM & M COSTS (20 %)** | | | | | **$1,920** |
| | **TOTAL CAPITAL COSTS** | | | | | **$7,334,250** |
| | **NET PRESENT VALUE OF OM & M (30 YEARS @ 7 % DISCOUNT RATE)** | | | | | **$142,952** |
| | **TOTAL COST** | | | | | **$7,477,202** |

**Table C.3D**

**COST SUMMARY NOTES**
**REMEDIAL ALTERNATIVE 3D – EXCAVATION AND OFF-SITE DISPOSAL**
**TO MEET LAND USE CRITERIA FOR PART 201, $10^{-6}$ RISK LEVEL FOR ARSENIC,**
**AND TSCA HIGH OCCUPANCY LEVEL**
**FEASIBILITY STUDY REPORT**
**PLAINWELL, INC. MILL PROPERTY**
**PLAINWELL, MICHIGAN**

**GENERAL NOTES**

A. Estimate for Remedial Alternative 3D - Excavation and Off-Site Disposal to Part 201 Land Use Criteria with a Risk Based Approach of $10^{-6}$ for Arsenic (5.8 milligrams per kilogram (mg/kg), and TSCA High Occupancy Level (with restrictions) has been prepared based on available information at the time of this document. Redevelopment activities conducted, being conducted and anticipated for the Site by the City of Plainwell may affect the remediation costs. Costs presented in the Feasibility Study (FS) Report have taken into consideration anticipated redevelopment plans by the City of Plainwell. Redevelopment plans include demolition of non-historical buildings to the concrete slab as well as specific land use restrictions/designations for the Site as presented on Figure 1.4 of the FS Report. This cost estimate is expected to be within -30 % to +50 % of the actual remedial costs in accordance with United States Environmental Protection Agency (U.S. EPA) guidance.

B. Remediation activities for each of the 11 proposed redevelopment areas were estimated separately; however, the estimate assumes one mobilization and demobilization effort to conduct the work.

C. Costs assume that additional soil investigation will not be conducted under building slabs unless otherwise noted in the pre-design notes below.

D. Areas targeted for soil removal and off-Site disposal were determined based on a risk-based approach for arsenic as detailed in Appendix A of the FS Report Revision 2.

E. The cost estimate assumes that new structures have not been constructed in areas that are planned for soil excavation and existing structures remain in place.

F. The cost estimate includes abandonment and replacement costs of groundwater monitoring wells within excavation areas.

G. Costs are based on 2014 dollars.

H. All volumes are based on in-place measures unless otherwise stated.

I. Abbreviations used in the "Unit" column in the Cost Estimate Table are as follows:
   - CY = Cubic Yard
   - EA = Each
   - LS = Lump Sum
   - TN = Ton
   - LF= linear foot

**TASK NOTES:**

***CAPITAL COSTS***

**A. INVESTIGATION/CONSTRUCTION**

**1.0 Pre-Design Investigation (PDI) Activities**

The following assumptions were made relative to the PDI activities in each of the redevelopment areas and reflected in the cost estimate.

- Generation of a Sampling and Analysis Plan (SAP).
- Update the Health and Safety Plan as necessary.
- Update the Multi-Area Quality Assurance Project Plan as necessary.
- Completion of the SAP - soil boring installation and soil sample collection to delineate the vertical and horizontal extent of impact. Soil borings are assumed to be collected via direct push method. PDI samples will be collected and submitted for laboratory analysis for specific parameters determined to exceed Preliminary Remediation Goals (PRGs) during the Remedial Investigation (RI). Delineation samples will not be collected in areas that were not selected for excavation activities (i.e., under building slabs, etc.).
- Quality Assurance/Quality Control samples are included on a 1 per 10 basis.
- A survey of the "top of bank" is included in the PDI cost estimate.
- All areas where subsurface work is to be conducted will be cleared through a public utility locate (i.e., MISS Dig), a private utility locate, review of available drawings, and discussions with individuals knowledgeable of the Site and utilities located thereon.

**Residential Area 1**
PRGs exceeded in Residential Area 1 include the risked based criteria for arsenic of 5.8 mg/kg. Soil samples will be collected to delineate the extent of soil impacted with PCBs adjacent to the storm sewer line installed by the Michigan Department of Transportation (MDOT) in 2012. The PRG for PCBs was exceeded at SB-132 (former Lagoon K) and SPL-11 (former Lagoon G).

- Allowance for 150 soil samples for PCBs
- Allowance for 76 soil samples for arsenic

**Residential Area 2**
PRGs exceeded in Residential Area 2 include the risked based criteria for arsenic of 5.8 mg/kg and PCBs above 1 mg/kg.

- Allowance for 36 soil samples for arsenic
- Allowance for 76 soil samples for PCBs

**Residential Area 3**
PRGs exceeded in Residential Area 3 include the risked based criteria for arsenic of 5.8 mg/kg.

- Allowance for 60 soil samples for arsenic

**Residential Area 4**
PRGs exceeded in Residential Area 4 include the risked based criteria for arsenic of 5.8 mg/kg, Part 201 residential direct contact criteria for benzo(a)pyrene, cyanide, dibenz(a,h)anthracene and lead. Residential soil volatilization to indoor air inhalation criteria (SVIIC) was exceeded at one location for benzene. The

Part 201 non-residential direct contact criterion for lead was also exceeded in Residential Area 4. PCBs were above the PRG within Residential Area 4.

- An allowance for 60 soil samples for arsenic
- Benzene above the residential SVIIC at TP-308
    - An allowance for 4 soil samples for benzene was included in the estimate
- Cyanide was above residential direct contact criteria at SB-302 in the shallow (0-1 foot) interval
    - Four samples for cyanide were included in the estimate
- An allowance for 20 samples for lead was included in the estimate
- The PNA parameters were identified in shallow samples (0-1.5 feet) below grade at DG3, DG4 and TP-302
    - Allowance for 12 PNA samples
- PCBs were detected above the PRG of 1 mg/kg at TP-313 and SB-301
    - An allowance for 60 soil samples for PCBs was included in the estimate

**Waterfront Plaza**
PDI activities will not be specifically conducted within the Waterfront Plaza area.

**Mixed Residential/Commercial Area 1**
PRGs exceeded in Mixed Residential/Commercial Area 1 include Part 201 non-residential inhalation criteria for manganese and the risked based PRG for arsenic of 5.8 mg/kg.

- A total of 46 soil samples for arsenic will be collected.
- Soil samples will be collected from borings around TP-334 for manganese. Four samples will be collected for manganese analysis.

**Mixed Residential/Commercial Area 2**
PRGs exceeded in Mixed Residential/Commercial Area 2 include Part 201 non-residential direct contact criteria for benzo(a)pyrene, and lead. Residential direct contact criteria is exceeded at locations within Mixed Residential/Commercial Area 2 for benzo(a)pyrene, dibenz(a,h)anthracene; benzo(a)anthracene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene and lead. The risked based PRG for arsenic of 5.8 mg/kg is also exceeded at locations within Mixed Residential/Commercial Area 2. PCBs were detected above the PRG of 1 mg/kg.

Soil delineation by work area as follows:

**<u>Arsenic ONLY locations</u>**:
Building 25
- Allowance for 8 samples

Building 28
- Allowance for 8 samples

Train Shed
- Allowance for 8 samples

Coal Tunnel Area
- Allowance for 30 samples

Former Ash Silo Area (SB-2011)
- Allowance for 8 samples

Former clarifier area (TP-344)
- Allowance for 8 samples

Area north of Building 3/Former Water Tower Area (TP-340, TP-342, TP-343)
- Allowance for 16 samples

**Arsenic and Lead sample locations:**
Area around SB-2013

- Allowance for 12 samples

**Arsenic, PNAs and Lead sample locations:**
Building 3A

- Allowance for 12 samples

**Arsenic, PNAs, Lead and PCBs sample locations:**
Building 6A

- Allowance for 20 samples
- Technicians will be required to don respirators for this work
- The floor in the majority of this building is exposed soil

**Arsenic and PNAs sample locations:**
Fuel Oil AST Area

- Allowance for 24 PNA soil samples
- Allowance for 12 arsenic samples

**PCB sample locations:**
SB-217, SPI-1 and TP-8

- Allowance for 44 PCB soil samples

A total of 142 samples will be collected and analyzed for arsenic.
A total of 56 samples will be collected and analyzed for PNAs.
A total of 44 samples will be collected and analyzed for lead.
A total of 64 samples will be collected and analyzed for PCBs.

**Commercial Area 1**
PRGs exceeded in Commercial Area 1 include Part 201 non-residential inhalation criteria for manganese and the risked based PRG for arsenic of 5.8 mg/kg.

- Soil samples will be collected from the 0-2 foot below grade interval at SS-103, SS-105, SS-106 and SB-133 and analyzed for arsenic. Samples from SS-105 will also be analyzed for manganese.
- Soil samples will be collected from the 0-2 and 7-9 foot interval for SB-144 and analyzed for arsenic.

**Commercial Area2**
PRGs exceeded in Residential Area 1 include Part 201 non-residential and the risked based PRG for arsenic of 5.8 mg/kg.

- 24 additional samples would be collected for arsenic from areas outside of the building footprint (around TP-316, TP-321, TP-324 and TP-325)

**Commercial Area3**
The PRG exceeded in Commercial Area 3 is the risked based PRG for arsenic of 5.8 mg/kg.

- Allowance for 48 soil samples for arsenic

**Commercial Area 4**
The risked based PRG for arsenic of 5.8 mg/kg was exceeded in Commercial Area 4. Residential direct contact criteria is exceeded at locations within Commercial Area 4 for benzo(a)pyrene and lead. The PRG of 10 mg/kg for PCBs was exceeded within Commercial Area 4.

Soil delineation by area as follows:

**Arsenic ONLY locations**:
SB-2012
- Allowance for 4 samples

Parking lot area south of Building 17
- Allowance for 28 samples

**Arsenic and Lead sample locations:**
TP-341
- Allowance for 4 samples

**Arsenic, PNAs and Lead sample locations:**
Former Substation Area/North of Mill Buildings
- Allowance for 30 samples

**Arsenic and PCBs sample locations:**
MW-16 Area
- Allowance for 18 samples for arsenic
- Allowance for 18 samples for PCBs

A total of 84 samples will be collected and analyzed for arsenic.
A total of 30 samples will be collected and analyzed for PNAs.
A total of 18 samples will be collected and analyzed for PCBs.
A total of 34 samples will be collected and analyzed for lead.

## 2.0 Mobilization/Set-Up

The following assumptions were made relative to the mobilization/set-up in each of the redevelopment areas and reflected in the cost estimate.

- Mobilization and set-up includes: mobilization of personnel and equipment; construction survey work (e.g., excavation layout and verification sample locations); and geotechnical and chemical testing on backfill materials.
  - An allowance of $8,000 to mobilize personnel and equipment was included in the estimate.
  - $30,000 for survey work was included in the estimate.
  - Geotechnical and chemical analysis for imported materials was included in the estimate. One set of chemical analysis [Target Analyte List Metals, Target Compound List (TCL) for volatile organic compounds, TCL for semi-volatile compounds, and polychlorinated biphenyl (PCBs) per material (topsoil, general fill and 21AA/gravel]. The topsoil sample will also be analyzed for pH, phosphorous, organic content, pesticides and herbicides.
- Health and Safety includes an on-Site Health and Safety Officer (HSO) for 8 months. Also included in the costs are: air monitoring equipment and calibration gases; a decontamination trailer; and disposable personal protection equipment (PPE).
- Air monitoring assumes real-time air monitoring will be conducted during all excavation work utilizing a photoionization detector (11.7 electronVolt [eV] lamp) and fugitive dust monitor(s). Air monitoring does not include the collection of samples for laboratory analysis or laboratory analytical costs.
- Erosion control includes an allowance for silt fence (5,760 LF) and geofabric to cover catch basins on the Site. Costs for erosion control measures specific to individual redevelopment areas (i.e., turbidity curtains, etc.) are included in individual redevelopment area estimates (e.g., Commercial Area 4).

- Site facility costs include electrical hookup and electricity for two office trailers (one for the contractor and one for the U.S. EPA) for 8 months. Other temporary facilities include portable sanitary services, a drinking water allowance and a small dumpster for worker general refuse. The expense of one Site truck for the duration of the services was included.
- Site facility costs include materials and construction of temporary decontamination pads and decontamination stations for workers. It was assumed that potable water could be obtained from the City of Plainwell for use during the project.
- Site facility costs include $6,000 to for the installation and maintenance of a staging area for waste.
- A perimeter fence currently exists around the majority of the Site. The cost estimate assumes the fence will remain and can be utilized as a security measure to prevent access to the Site during construction activities.

## 3.0 Preparation/Pre-Excavation Work by Redevelopment Area

The following assumptions were made relative to the preparation/pre-excavation work in each of the redevelopment areas and reflected in the cost estimate.

- A Soil Erosion and Sedimentation Control Permit will be obtained from Allegan County. All other necessary permits will also be obtained prior to intrusive work at the Site.

- All areas where subsurface work is to be conducted will be cleared through a public utility locate (i.e., MISS Dig), a private utility locate, review of available drawings, and discussions with individuals knowledgeable of the Site and utilities located thereon.

**Residential Area 1**
Specific assumptions for preparation/pre-excavation work in Residential Area 1 under Remedial Alternative 3D are presented below.

- Trees and shrubs in the excavation areas will need to be cleared and grubbed.
- Turbidity curtain will be temporally installed in the Kalamazoo River during excavation and backfill activities.
- One power pole will need to be relocated for the excavation work around SB-104.

**Residential Area 2**
No specific assumptions for preparation/pre-excavation work in Residential Area 2 under Remedial Alternative 3D were utilized.

**Residential Area 3**
Specific assumptions for preparation/pre-excavation work in Residential Area 3 under Remedial Alternative 3D are presented below.

- MW-15 will be abandoned.
- Clearing will be required in the area around MW-15.

**Residential Area 4**
Specific assumptions for preparation/pre-excavation work in Residential Area 4 under Remedial Alternative 3D are presented below.

- Clearing will be required in the area around SB-301/SG-4.
- Pavement by TP-302 will be saw cut.

**Waterfront Plaza**
No specific assumptions for preparation/pre-excavation work in Waterfront Plaza under Remedial Alternative 3D were utilized.

**Mixed Residential/Commercial Area 1**
The specific assumption for preparation/pre-excavation work in Mixed Residential/Commercial Area 1 under Remedial Alternative 3D is presented below.

- Pavement and concrete in the work areas will be saw cut prior to excavation to leave a clean line for restoration activities.

**Mixed Residential/Commercial Area 2**
Specific assumptions for preparation/pre-excavation work in Mixed Residential/Commercial Area 2 under Remedial Alternative 3D are presented below.

- A demolition notice will be submitted to the State of Michigan for the demolition of Building 5A/part of the coal tunnel. Asbestos abatement may be necessary on pipe wrap found outside of Building 5A.
- Excavation of soils under the concrete slabs of the demolished buildings (3A, 25 and 28) will require the relocation of the backfill (less than 3 feet thick) prior to excavation.
- Fuel Oil No. 6 within the former coal tunnel will be removed from the tunnel before the tunnel itself is removed.
- The piping run from the former Fuel Oil No. 6 AST and Building 5 will be exposed at one end and drained of any residual fuel oil prior to removing the line.
- Monitoring well MW-19 will be abandoned prior to excavation activities in this area.
- Monitoring well MW-22 will be abandoned prior to removal of the former fuel oil line.
- Monitoring well MW-2 will be abandoned prior to excavation activities at SB-2010 and SB-2011.
- Large metal mixer / open topped tank in Building 1A will need to be relocated prior to excavation activities. An allowance of $2,000 to move the equipment was included in the estimate.
- Shoring may be required in Building 1A (if still in place). An allowance of $5,000 was included in the estimate for shoring.

**Commercial Area 1**
Specific assumptions for preparation/pre-excavation work in Commercial Area 1 under Remedial Alternative 3D are presented below.

- Limited clearing and grubbing will be performed in the area around SS-106 and SB-144.

**Commercial Area 2**
No specific assumptions for preparation/pre-excavation work in Commercial Area 2 under Remedial Alternative 3D were utilized.

**Commercial Area 3**
Specific assumptions for preparation/pre-excavation work in Commercial Area 3 under Remedial Alternative 3D are presented below.

- Pavement in the work areas will be saw cut prior to excavation to leave a clean line for restoration activities

**Commercial Area 4**
Specific assumptions for preparation/pre-excavation work in Commercial Area 4 under Remedial Alternative 3D are presented below.

- Turbidity curtain will be installed in the Mill Race in the area by MW-16 (along the Mill Race) and in the area of MW-3 prior to excavation activities.
- Monitoring of the Mill Race and Kalamazoo River for turbidity will be conducted during excavation activities.
- MW-16 will be abandoned prior to excavation work in that area.
- Protection of MW-3 (barriers) will be installed.
- A structural engineering evaluation of the pedestrian bridge for stability during excavation activities will be conducted. The evaluation will determine if shoring of the bridge is necessary. An allowance of $5,000 is included in the estimate to conduct the evaluation. Shoring costs have not been included in the estimate.
- The water flow of the Mill Race will be diverted in the excavation area. The methodology for this work to be determined in the pre-design phase of the project.
- Rip rap along the Mill Race will be removed and staged for re-use.
- Pavement in the work areas will be saw cut prior to excavation to allow for restoration activities.

## 4.0 Excavation by Redevelopment Area

Conceptual excavation areas for each of the Redevelopment areas are shown of Figures 3.34 through 3.44 of the FS Report (Revision 2).

The following assumptions were made relative to excavation in each of the redevelopment areas and reflected in the cost estimate.

- Excavation estimates assume dewatering will not be necessary and that all work can be completed in Level D PPE except Building 6A which will be conducted with supplied air (Level B) PPE.
- Standby time was not added to account for the time for laboratory analysis of verification samples. It was assumed that the project would proceed across the Site allowing for laboratory analysis to be conducted while another redevelopment area was being excavated or restored.

Specific assumptions to each redevelopment area, in addition to those presented above globally, are provided below.

**Residential Area 1**
Residential Area 1 is located at the far west end of the Site, where the majority of the former sludge dewatering lagoons were located. The former Mill wastewater treatment building, activated sludge tank and secondary clarifier were constructed over the lagoons. The wastewater treatment structures were demolished on behalf of the City of Plainwell in November and December 2013. The specific assumption for excavation in Residential Area 1 under Remedial Alternative 3D is presented below.

- Overburden present beyond the target excavation area that must be removed to achieve the full depth of excavation will be disposed of off Site.

**Residential Area 2**
Residential Area 2 is located between Residential Area 1 and Residential Area 3 and is positioned along the Kalamazoo River. This area was historically occupied by sludge dewatering lagoons (A, B, C) and a primary clarifier. The primary clarifier was demolished to the concrete slab in November 2013. The

specific assumption for excavation in Residential Area 2 under Remedial Alternative 3D is presented below.

- Overburden present beyond the target excavation area that must be removed to achieve the full depth of excavation can be staged and used for backfill from the area around SB-1.

**Residential Area 3**

Residential Area 3 is located near the center of the Site. The former aeration basin location occupies the majority of the area. A former secondary clarifier was historically present in this area, which was demolished in November 2013 with the floor of the former clarifier remaining. Specific assumptions for excavation in Residential Area 3 under Remedial Alternative 3D are presented below.

- Material removed from the bottom of the aeration basin will require double handling due to the slopes of the former aeration basin and the depth of the excavation.

**Residential Area 4**

Residential Area 4 is positioned along the Kalamazoo River between Residential Area 3 and Mixed Residential Area 2. No aboveground structures are currently present on this area. A portion of this area was historically utilized by the Mill as a coal storage area. No specific assumptions for excavation in Residential Area 4 under Remedial Alternative 3D were made.

**Waterfront Plaza**

No excavation activities are anticipated in the Waterfront Plaza Area.

**Mixed Residential/Commercial Area 1**

Mixed Residential/Commercial Area 1 is located between Commercial Area 2 and Commercial Area 3 on the southern property line along Allegan Street. This area was once occupied by the former Specialty Minerals Building and associated above ground storage tanks. The Specialty Minerals building and ASTs were demolished to the concrete slab in December 2011.

- Underground utilities encountered (TP-303, TP-306) between the former Specialty Minerals Building and the main Mill Buildings will be capped at either end of the excavation.

**Mixed Residential and Commercial Area 2**

Mixed Residential and Commercial Area 2 is located between Residential Area 4 and Commercial Area 4 at the northern end of the Site along the Kalamazoo River. The majority of the area is occupied by Mill Buildings and pavement. Buildings 3A, 25 and 28 along with the eastern water tower, 200,000-gallon Fuel Oil AST, and the brine USTs, were demolished on behalf of the City of Plainwell. The concrete slabs were left in place for Buildings 3A and 28. Building 25 was part of the Site's historical wastewater treatment system and had a subsurface vault and system to pump the waste water from the Mill to the on-Site WWTP at the west end of the Site. The vault under the northern portion of Building 25 was not removed. The vault floor was cracked and the sidewalls removed to 4 feet below grade, then the vault was filled with imported general fill. The concrete slab under the remaining portion of Building 25 was left in place.

Specific assumptions for excavation in Mixed Residential/Commercial Area 2 under Remedial Alternative 3D are presented below.

- A storm sewer was installed through the west side of Mixed Residential/Commercial Area 2 in 2012 by the Michigan Department of Transportation (MDOT). The approximate location of the storm sewer is shown on Figure 3.40. Before conducting excavation work to remove the former fuel oil AST line and excavate the east side of the former fuel AST, the exact location of the storm sewer line will be determined, shoring of the line may be necessary during the removal of the fuel oil AST line.
- Soils in Building 6A will be removed using a vacuum extraction system.

- It was assumed that impacted soils around SPI-1 would be excavated based on redevelopment plans call for demolition of Building 1A and would most likely include removal of the concrete slab.

**Commercial Area 1**

Commercial Area 1 is located in the far southwest portion of the Site. No structures or paved areas are currently present in this area that would require unique equipment or procedures to conduct the proposed remedial activities. This area of the Site has not been developed and was not part of historic Mill operations.

- Any excavation work conducted in the vicinity of SB-133 will require oversight by Michigan Gas Utilities due to proximity of the soil boring to the 6-inch high pressure natural gas line/working within the gas company easement.

- A storm sewer was installed through this area in 2012 by the Michigan Department of Transportation (MDOT). The approximate location of the storm sewer is shown on Figure 3.41. Before conducting excavation work in the area of SS-103 and SS-105, the exact location of the line will be determined.

**Commercial Area 2**

Commercial Area 2 is located in the southwest central portion of the Site. Structures on this portion of the Site include the City of Plainwell Public Safety Building and associated paved parking and egress/ingress areas. No specific assumptions for excavation in Commercial Area 2 under Remedial Alternative 3D were made.

**Commercial Area 3**

Commercial Area 3 is located adjacent to the former southwest corner of the Mill Buildings along Allegan Street. Structures on this area include a pump house and a former guard shack. Other historical features within this area have been demolished on behalf of the City of Plainwell. The Clay ASTs, Ammonia AST secondary containment structure, the Starch ASTs and Building 9C were demolished in 2012. The concrete slabs for all demolished features were left in place. Specific assumptions for excavation in Commercial Area 3 under Remedial Alternative 3D are presented below.

- The majority of Building 9C did not include a basement. The area where SB-248 was completed was located on the ground floor; however, this area was elevated from the surrounding ground surface by approximately 4 feet. As a result of the demolition of Building 9C the upper 4 feet of the sample interval was relocated (as part of a Soil Relocation Plan (June, 2012) generated on behalf of the City of Plainwell) and placed under imported fill in the general area of Buildings 9A, 9E.
- MDOT installed a storm sewer through this area in 2012. The approximate location of the storm sewer is shown on Figure 3.43. Before conducting excavation work in the area of TP-305 the exact location of the line will be determined.

**Commercial Area 4**

Commercial Area 4 is located on the eastern side of the Site. The majority of this area is covered with either pavement, buildings (vacant and occupied) or former building concrete slabs. Buildings (9A, 9B, 9C, 9D, 9E, 9F, and 23) were demolished on behalf of the City of Plainwell in 2012, with the majority of the former building concrete slabs left in place and backfilled to surrounding grade. The basement areas were backfilled with a combination of crushed concrete (from the buildings on Site), soil from an adjacent retaining wall that was removed, and imported gravel material and vary in thickness from 6 feet to 9 feet. Specific assumptions for excavation in Commercial Area 4 under Remedial Alternative 3D are presented below.

- Access to both the former substation area and around MW-16 will be restricted due to the distance between existing structures and either the Kalamazoo River or the Mill Race. Excavated soils will likely need to be double handled.

## 5.0 Transportation and Disposal by Redevelopment Area

The following assumptions were made relative to the transportation and disposal of materials in each of the redevelopment areas and reflected in the cost estimate.

- Soil volumes were converted to tonnage assuming a ratio of 1.5 tons per cubic yard for soils. Tonnage for concrete was based on 1.65 tons per cubic yard of material. Waste has been categorized as non-hazardous and non-TSCA soils; TSCA soil; TSCA debris; and miscellaneous debris.
- Transportation and disposal pricing is based on the non-hazardous, non-TSCA material being accepted at Waste Management Autumn Hills Landfill in Zeeland, Michigan. A cost of $22.00 per ton for both transportation and disposal of non-hazardous, non-TSCA waste was used for the estimates.
- A disposal price of $135.00 per ton was used for TSCA soils. For estimation purposes it was assumed that the TSCA soils would be transported to the Environmental Quality Company/U.S. Ecology Wayne Disposal #2 Landfill, Belleville, Michigan for direct landfill disposal. Transportation of the soils was assumed to be conducted in lined 50 ton gravel trains. Transportation of each load of 50 tons was assumed to cost $500.00.
- Transportation costs assume fuel prices for diesel will not exceed $4.00 per gallon.
- Organic material generated from clearing activities was assumed to be chipped and left on Site.
- Concrete and asphalt will be disposed of off Site, not recycled.

**Residential Area 1**

The specific assumption for transportation and disposal work in Residential Area 1 under Remedial Alternative 3D is presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 2,730 CY.

**Residential Area 2**

The specific assumption for transportation and disposal work in Residential Area 2 under Remedial Alternative 3D is presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 3,550 CY.

**Residential Area 3**

The specific assumption for transportation and disposal work in Residential Area 2 under Remedial Alternative 3D is presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 4,320 CY.

**Residential Area 4**

The specific assumption for transportation and disposal work in Residential Area 3 under Remedial Alternative 3D is presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 9,965 CY.
- Allowance of $600 for asphalt.

**Waterfront Plaza**

No specific assumptions for transportation and disposal work in Waterfront Plaza under Remedial Alternative 3D were utilized. Excavation activities will not be conducted within the Waterfront Plaza area.

**Mixed Residential/Commercial Area 1**
Specific assumptions for transportation and disposal work in Mixed Residential/Commercial Area 1 under Remedial Alternative 3D are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 205 CY.
- Allowance of 50 CY for asphalt and concrete disposal.

**Mixed Residential/Commercial Area 2**
Specific assumptions for transportation and disposal work in Mixed Residential/Commercial Area 2 under Remedial Alternative 3D are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil from Building 6A with a volume of 200CY.
- Waste was assumed to be non-hazardous, non-TSCA soil from the coal tunnel area with a volume of 1,320 CY. Additional volume from a deeper excavation at SB-308 location.
- Allowance of $3,500 for miscellaneous debris from the coal tunnel area (bricks, concrete).
- Waste was assumed to be non-hazardous, non-TSCA soil from the fuel oil line with a volume of 525 CY.
- Allowance of $600 for disposal of the fuel oil line piping
- Waste was assumed to be non-hazardous, non-TSCA soil from the fuel oil No. 6 AST area with a volume of 2,500 CY.
- Allowance of $1,200 for the concrete ring the tank was sitting on and buried concrete and asphalt.
- Waste was assumed to be non-hazardous, non-TSCA soil from the Train Shed with a volume of 485CY.
- Waste was assumed to be non-hazardous, non-TSCA soil from the north end of the Mill Buildings (Buildings-3A, 25, 28, test pits-TP-340, TP-342,TP-343, T-8 and SB-2013) with a volume of 1,916CY.
- Allowance of $6,000 for miscellaneous debris from these areas at the north end of the Mill Building.
- Waste was assumed to be non-hazardous, non-TSCA from SPl-I with a volume of 18 CY.

**Commercial Area 1**
Specific assumptions for transportation and disposal work in Commercial Area 1 under Remedial Alternative 3D are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 165 CY.

**Commercial Area 2**
Specific assumptions for transportation and disposal work in Commercial Area 2 under Remedial Alternative 3D are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 2,460 CY.

**Commercial Area 3**
Specific assumptions for transportation and disposal work in Commercial Area 3 under Remedial Alternative 3D are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil with a volume of 3,845 CY.
- Allowance of $900 for the transport and disposal of asphalt and/or concrete from the excavation areas.

**Commercial Area 4**

Specific assumptions for transportation and disposal work in Commercial Area 4 under Remedial Alternative 3D are presented below.

- Waste was assumed to be non-hazardous, non-TSCA soil from the former substation area and north of the Mill Buildings with a volume of 3,050 CY.
- Waste was assumed to be TSCA soil from the area around MW-16 with a volume of 4,660 CY.
- Waste was assumed to be non-hazardous, non-TSCA soil from the parking lot area south of Building 17 with a volume of 7,665 CY.
- Allowance of 1,575 tons of concrete from within the various buildings.
- Allowance of 400 CY of asphalt.

## 6.0 Restoration by Redevelopment Area

The following assumption was made relative to Site restoration in each of the redevelopment areas and reflected in the cost estimate.

- Restoration activities include backfill (material and placement), compaction, compaction testing and any other location specific restoration that may be deemed necessary at this time.
- General fill from a local gravel pit at a delivered material cost of $4.58 ton was used for the estimates. Unprocessed topsoil at a delivered price of $18.98 cubic yard was also used where appropriate.
- Restoration for the excavation areas outside of building footprints include general fill backfill compacted to 92-95% of the proctor.
- A 6-inch layer of unscreened topsoil will be placed over the compacted general fill in areas that were previously pervious (i.e., not paved or impervious). Topsoil will be hydroseeded, including mulch.
- Restoration for excavation areas under pavement, existing or former building slabs will be backfilled with general fill and compacted to 95% of the proctor.
- A 6-inch layer of 21AA or equivalent will be placed on the compacted general fill and compacted to 95% or greater of the proctor where pavement will be installed.
- Asphalt will be replaced where removed during excavation activities.
- Concrete removed during excavation activities under former building slabs will not be replaced.
- Permanent markers will be installed to designate areas on Site where impacted soils above Part 201 clean up criteria, based on land use, remain in place.

**Residential Area 1**

Specific assumptions for Site restoration in Residential Area 1 under Remedial Alternative 3D are presented below.

- Backfill material will be imported general fill and overburden material removed to achieve excavation depth requirements but beyond the area exceeding PRGs.

**Residential Area 2**

Specific assumptions for Site restoration in Residential Area 2 under Remedial Alternative 3D are presented below.

- Backfill material will be imported general fill and overburden material removed to achieve excavation depth requirements but beyond the area exceeding cleanup criteria.
- MW-15 will be replaced.

**Residential Area 3**
No specific assumptions for Site restoration in Residential Area 3 under Remedial Alternative 3D were utilized.

**Residential Area 4**
No specific assumptions for Site restoration in Mixed Residential/Commercial Area 1 under Remedial Alternative 3D were utilized.

**Waterfront Plaza**
No specific assumptions for Site restoration in Waterfront Plaza under Remedial Alternative 3D were utilized. Restoration will not be required in the Waterfront Plaza area.

**Mixed Residential/Commercial Area 1**
Specific assumptions for Site restoration in Mixed Residential/Commercial Area 1 under Remedial Alternative 3D are presented below.

- Concrete removed will not be replaced.

**Mixed Residential/Commercial Area 2**
Specific assumptions for Site restoration in Mixed Residential/Commercial Area 2 under Remedial Alternative 3D are presented below.

- Building 6A currently has a dirt floor; restoration would not include a concrete floor.
- Concrete (former ash silos) will not be replaced at SB-2010 and SB-2011.
- Concrete around the former 200,000 gallon fuel oil AST will not be replaced.
- Concrete removed for excavations at SPI-1, SB-216, SB-220, SB-222 and SB-223 will not be replaced.
- Additional backfill will be required to fill in the void space of the coal tunnel.
- MW-2, MW-19 and MW-22 will be replaced.

**Commercial Area 1**
No specific assumptions for Site restoration in Commercial Area 1 under Remedial Alternative 3D were utilized.

**Commercial Area 2**
No specific assumptions for Site restoration in Commercial Area 2 under Remedial Alternative 3D were utilized.

**Commercial Area 3**
No specific assumptions for Site restoration in Commercial Area 3 under Remedial Alternative 3D were utilized.

**Commercial Area 4**
Specific assumptions for Site restoration in Commercial Area 4 under Remedial Alternative 3D are presented below.

- Backfill placed in the parking lot will be 2 feet lower than current grade to achieve the desired grade requested by the current property owner.
- Asphalt will be 3 inches thick.
- Geotextile and Rip rap will be installed along the Mill Race.
- The Mill Race will be returned to its normal flow path.
- The turbidity curtain will be removed from the Mill Race and Kalamazoo River.

- MW-16 will be replaced.

**7.0 Demobilization**

The following assumptions were made relative to the demobilization from the Site and reflected in the cost estimate.

- Costs included in the demobilization task include time for Site tear down and final decontamination of equipment, and demobilization of equipment and personnel. Demobilization activities were assumed to take 5 working days.

## B. ENGINEERING/OVERSIGHT

**1.0 Engineering/Design**

The following assumption was made relative to the installation of engineering/design and reflected in the cost estimate.

- Engineering and project design/specifications were estimated to be 15 percent of the Construction Costs.

**2.0 Construction Oversight**

The following assumption was made relative to the construction oversight and reflected in the cost estimate.

- Construction oversight was estimated to be 10 percent of the Construction Costs.