

## **Appendix A**

**TABLE A-1. SURFICIAL SOIL EXPOSURE PATHWAY EQUATIONS**

Commercial/Industrial, Excavation Worker and Recreators Exposure Scenario

Non-Carcinogenic Effects

Rhodia Martinez, Peyton Slough

Surficial Soil Exposure

$$\text{SSTLs}_{\text{nc}} [\text{mg/kg}] = \text{THQ} * \text{ATnc}_{\text{ind}} * 365 / (\text{EF} * \text{ED} / \text{BW} / \text{RfDo} * 10^{-6} * (\text{IRsoil} * \text{RAFo} + \text{SA} * \text{RaFd} * \text{M}) + (\text{IRair}_{\text{outdoor}} / \text{RfDi} * (\text{VFss} + \text{VFp})))$$

Where:

THQ  
RfDo  
RfDi  
ATnc  
ED  
EF  
BW  
IRsoil  
RAFo  
RAFd  
SA  
M  
IRair\_outdoor  
VFss  
VFp

Target Hazard Quotient

Oral Reference Dose [mg/kg-day]

Inhalation Reference Dose [mg/kg-day]

Averaging Time for non-cancer effect [days]=ED\*365

Exposure Duration [years]

Exposure Frequency [day/year]

Body Weight [kg]

Soil Ingestion Rate [mg/day]

Oral Relative Absorption Factor [-]

Absorption Factor [-]

Skin Surface Area [cm<sup>2</sup>]

Soil to Skin Adherence Factor [mg/cm<sup>2</sup>]

Daily Outdoor Inhalation Rate [m<sup>3</sup>/day]

Volatilization factor surficial soils to ambient air (vapors) (mg/m<sup>3</sup>/mg/kg)

Volatilization factor surficial soils to ambient air (particulates) (mg/m<sup>3</sup>/mg/kg)

Since only the soil ingestion pathway is applicable, the equation becomes:

$$\text{SSTLs}_{\text{nc}} [\text{mg/kg}] = \text{THQ} * \text{ATnc}_{\text{ind}} * 365 / (\text{EF} * \text{ED} / \text{BW} / \text{RfDo} * 10^{-6} * \text{IRsoil} * \text{RAFo})$$

for Soil Ingestion

Not applicable to metals

Null for metals

Null for metals  
Null for metals

**TABLE A-2. SSTLs DETAILED CALCULATIONS FOR SURFICIAL SOIL PATHWAY-COPPER**

**Commercial/Industrial Exposure Scenario**

**Non-Carcinogenic Effects**

**Rhodia Martinez, Peyton Slough**

**Surficial Soil Exposure (soil ingestion)**

$$\begin{aligned}
 \text{SSTLs}_{nc\_ind} [\text{mg/kg}] &= \text{THQ} * \text{ATnc}_{ind} * 365 / [\text{EF} * \text{ED} / \text{BW} / \text{RfDo} * 10^{-6} * \text{Irsol} * \text{RAFo}] \\
 &= 1.0\text{e}+0 * 25 * 365 / (250 * (25 / 70 * (0.0371 * 10^{-(6)} * (50 * 1) ) \\
 &= 75832.4
 \end{aligned}$$

Where:

|       |                                                    |        |
|-------|----------------------------------------------------|--------|
| THQ   | Target Hazard Quotient                             | 1      |
| RfDo  | Oral Reference Dose [mg/kg-day]                    | 0.0371 |
| ATnc  | Averaging Time for non-cancer effect [days]=ED*365 | 25     |
| ED    | Exposure Duration [years]                          | 25     |
| EF    | Exposure Frequency [day/year]                      | 250    |
| BW    | Body Weight [kg]                                   | 70     |
| Irsol | Soil Ingestion Rate [mg/day]                       | 50     |
| RAFo  | Oral Relative Absorption Factor [-]                | 1      |

**TABLE A-3. SSTLs DETAILED CALCULATIONS FOR SURFICIAL SOIL PATHWAY-ZINC**

**Commercial/Industrial Exposure Scenario**

**Non-Carcinogenic Effects**

**Rhodia Martinez, Peyton Slough**

**Surficial Soil Exposure (soil ingestion)**

$$\begin{aligned}
 \text{SSTLs}_{nc\_ind} [\text{mg/kg}] &= \text{THQ} \cdot \text{ATnc}_{ind} \cdot 365 / [\text{EF} \cdot \text{ED} / \text{BW} / \text{RfDo} \cdot 10^{-6} \cdot \text{Irsoil} \cdot \text{RAFo}] \\
 &= 1.0\text{e}+0 \cdot 25 \cdot 365 / (250 \cdot (25 / 70 \cdot (0.3 \cdot 10^{(-6)} \cdot (50 \cdot 1) \\
 &= 6.13\text{E}+5 \\
 &= 1.0\text{e}+5 \cdot
 \end{aligned}$$

**Where:**

|        |                                             |     |
|--------|---------------------------------------------|-----|
| THQ    | Target Hazard Quotient                      | 1   |
| RfDo   | Oral Reference Dose [mg/kg-day]             | 0.3 |
| ATnc   | Averaging Time for non-cancer effect [days] | 25  |
| ED     | Exposure Duration [years]                   | 25  |
| EF     | Exposure Frequency [day/year]               | 250 |
| BW     | Body Weight [kg]                            | 70  |
| Irsoil | Soil Ingestion Rate [mg/day]                | 50  |
| RAFo   | Oral Relative Absorption Factor [—]         | 1   |

**Notes:**

\* H-SSTL is above 10% metal soil maximum concentration, and hence a ceiling value of 100,000 mg/kg is selected (USEPA, 2002)

**TABLE A-4. SSTLS DETAILED CALCULATIONS FOR SURFICIAL SOIL PATHWAY-COPPER**  
Excavation Workers Exposure Scenario  
Non-Carcinogenic Effects  
Rhodia Martinez, Peyton Slough

Surficial Soil Exposure (soil ingestion)

$$\begin{aligned} \text{SSTLS}_{nc\_ind} [\text{mg/kg}] &= \text{THQ} \cdot \text{ATnc}_{ind} \cdot 365 / [\text{EF} \cdot \text{ED} / \text{BW} / \text{RfDo} \cdot 10^{-6} \cdot \text{Irsol} \cdot \text{RAFo}] \\ &= 1.0\text{e}+0 \cdot 7 \cdot 365 / (20 \cdot (7 / 70 \cdot (0.0371 \cdot 10^{(-6)} \cdot (480 \cdot 1) \\ &= 9.87\text{E}+4 \end{aligned}$$

Where:

|       |                                                    |        |
|-------|----------------------------------------------------|--------|
| THQ   | Target Hazard Quotient                             | 1      |
| RfDo  | Oral Reference Dose [mg/kg-day]                    | 0.0371 |
| ATnc  | Averaging Time for non-cancer effect [days]=ED*365 | 7      |
| ED    | Exposure Duration [years]                          | 7      |
| EF    | Exposure Frequency [day/year]                      | 20     |
| BW    | Body Weight [kg]                                   | 70     |
| Irsol | Soil Ingestion Rate [mg/day]                       | 480    |
| RAFo  | Oral Relative Absorption Factor [-]                | 1      |

**TABLE A-5. SSTLs DETAILED CALCULATIONS FOR SURFICIAL SOIL PATHWAY-ZINC**

Excavation Workers Exposure Scenario

Non-Carcinogenic Effects

Rhodia Martinez, Peyton Slough

Surficial Soil Exposure (soil ingestion)

$$\begin{aligned}
 \text{SSTLs\_nc\_ind [mg/kg]} &= \text{THQ} \cdot \text{ATnc\_ind} \cdot 365 / [\text{EF} \cdot \text{ED} / \text{BW} / \text{RfDo} \cdot 10^{-6} \cdot [\text{soil} \cdot \text{RAFo}]] \\
 &= 1.0\text{e}+0 \cdot 7 \cdot 365 / (20 \cdot (7 / 70 \cdot (0.3 \cdot 10^{(-6)}) \cdot (480 \cdot 1)) \\
 &= 7.98\text{E}+5 \\
 &= 1.0\text{e}+5^*
 \end{aligned}$$

Where:

|        |                                                    |     |
|--------|----------------------------------------------------|-----|
| THQ    | Target Hazard Quotient                             | 1   |
| RfDo   | Oral Reference Dose [mg/kg-day]                    | 0.3 |
| ATnc   | Averaging Time for non-cancer effect [days]=ED*365 | 7   |
| ED     | Exposure Duration [years]                          | 7   |
| EF     | Exposure Frequency [day/year]                      | 20  |
| BW     | Body Weight [kg]                                   | 70  |
| Issoil | Soil Ingestion Rate [mg/day]                       | 480 |
| RAFo   | Oral Relative Absorption Factor [-]                | 1   |

Notes:

\* If-SSTL is above 10% metal soil maximum concentration, and hence a ceiling value of 100,000 mg/kg is selected (USEPA, 2002)

**TABLE A-6. SSTLs DETAILED CALCULATIONS FOR SURFICIAL SOIL PATHWAY-COPPER**

Recreators Exposure Scenario  
Non-Carcinogenic Effects  
Rhodia Martinez, Peyton Slough

Surficial Soil Exposure (soil ingestion)

$$\begin{aligned} \text{SSTLs}_{nc\_ind} [\text{mg/kg}] &= \text{THQ} \cdot \text{ATnc}_{ind} \cdot 365 / [\text{EF} \cdot \text{ED} / \text{BW} / \text{RfDo} \cdot 10^{-6} \cdot \text{Irsol} \cdot \text{RAFo}] \\ &= 1.0\text{e}+0 \cdot 6 \cdot 365 / (12.5 \cdot (6 / 15 \cdot (0.0371 \cdot 10^{(-6)} \cdot (100 \cdot 1) \\ &= 6.32\text{E}+4 \end{aligned}$$

Where:

|       |                                                    |        |
|-------|----------------------------------------------------|--------|
| THQ   | Target Hazard Quotient                             | 1      |
| RfDo  | Oral Reference Dose [mg/kg-day]                    | 0.0371 |
| ATnc  | Averaging Time for non-cancer effect [days]=ED*365 | 6      |
| ED    | Exposure Duration [years]                          | 6      |
| EF    | Exposure Frequency [day/year]                      | 12.5   |
| BW    | Body Weight [kg]                                   | 15     |
| Irsol | Soil Ingestion Rate [mg/day]                       | 100    |
| RAFo  | Oral Relative Absorption Factor [-]                | 1      |

Notes:

\* H-SSTL is above 10% metal soil maximum concentration, and hence a ceiling value of 100,000 mg/kg is selected (USEPA, 2002)

**TABLE A-7. SSTLs DETAILED CALCULATIONS FOR SURFICIAL SOIL PATHWAY-ZINC**

**Recreators Exposure Scenario**

**Non-Carcinogenic Effects**

**Rhodia Martinez, Peyton Slough**

**Surficial Soil Exposure (soil ingestion)**

$$\begin{aligned}
 \text{SSTLs}_{\text{nc\_ind}} [\text{mg/kg}] &= \text{THQ} \cdot \text{ATnc\_ind} \cdot 365 / [\text{EF} \cdot \text{ED} / \text{BW} / \text{RfDo} \cdot 10^{-6} \cdot \text{Irsoil} \cdot \text{RAFo}] \\
 &= 1.0\text{e}+0 \cdot 6 \cdot 365 / (12.5 \cdot (6 / 70 \cdot (0.3 \cdot 10^{-(6)} \cdot (100 \cdot 1)) \\
 &= 5.11\text{E}+5 \\
 &= 1.0\text{e}+5 \cdot
 \end{aligned}$$

Where:

|        |                                                    |        |
|--------|----------------------------------------------------|--------|
| THQ    | Target Hazard Quotient                             | 1      |
| RfDo   | Oral Reference Dose [mg/kg-day]                    | 0.0371 |
| ATnc   | Averaging Time for non-cancer effect [days]=ED*365 | 6      |
| ED     | Exposure Duration [years]                          | 6      |
| EF     | Exposure Frequency [day/year]                      | 12.5   |
| BW     | Body Weight [kg]                                   | 15     |
| Irsoil | Soil Ingestion Rate [mg/day]                       | 100    |
| RAFo   | Oral Relative Absorption Factor [-]                | 1      |

**Notes:**

\* H-SSTL is above 10% metal soil maximum concentration, and hence a ceiling value of 100,000 mg/kg is selected (USEPA, 2002)