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Final Risk Assessment Assumption Document

Franklin Steel Drum Reconditioning Facility
Franklin Steel Company, Inc.
Gahanna Industrial Park Blacklick, Ohio

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Section 1
Introduction

The purpose of this report is to present the risk assessment assumptions (RAAs), conceptual site model (CSM), property characteristics, chemicals of potential concern (COPC), potential exposure scenarios, and other assumptions associated with the development of a human health risk assessment (HHRA) for the Franklin Steel Company, Inc. facility (the site and/or Franklin Steel) located at 1385 Blatt Boulevard, Blacklick, Ohio. The facility is currently operating as the Columbus Drum Company. The information discussed in this document will be used in the development of a risk assessment and the development of cleanup criteria, i.e., Corrective Measures Study (CMS).

This document will not discuss the sampling results and/or investigation of the Franklin Steel facility. These topics are further discussed and defined in the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) report.

Section 2
Background

The Franklin Steel Company owned and operated a drum reconditioning and recycling facility in the Gahanna Industrial Park between 1971 and 1997 under the business name of Columbus Steel Drum Company. Franklin Steel operations consisted of reconditioning and recycling of open–head and closed–head 55–gallon steel drums under the Standard Industrial Classification (SIC) code 7699. Prior to 1986, approximately 38 acres of property were utilized for drum storage and processing, having a capacity of approximately 450,000 RCRA empty drums.

In June 1997, the Franklin Steel Company sold the drum reconditioning business to Evans Industries, Inc. under the name of Evans Columbus, Corp. and continued the drum reconditioning operation. Evans Industries in turn sold the drum reconditioning business to the Queen City Barrel Company in January 2001, using the original Columbus Steel Drum Company name. Property ownership throughout the various business ownership changes was retained by the Franklin Steel Company; however, as of generation of this revised RAAD, the Franklin Steel has sold the property to Queen City Barrel.

Franklin Steel entered into an Administrative Order on Consent with the Ohio Environmental Protection Agency (EPA) that requires, in part, that Franklin Steel perform an RFI to document whether or not environmental impacts have resulted from any release of hazardous wastes and hazardous constituents at the facility and to determine the nature and extent of any such releases. There were 10 Solid Waste Management Units (SWMUs) evaluated under this investigation (SAIC 2003). The 2003 SAIC RFI sub-divided the facility into three contiguous areas for investigative purposes. Contiguous Area #1 included SWMUs S101 through S108 (i.e., currently considered the active portion of the facility), Contiguous Area #2 included SWMU S109, and Contiguous Area #3 included SWMU S201.

SAIC completed the RFI field investigation and submitted the Draft RFI Report for the Franklin Steel on October 23, 1998. A Final RFI Report for the Franklin Steel was submitted on August 21, 2000. Various revisions have been made since time as reflected in the December 21, 2001, December 20, 2002, and November 21, 2003 submittals of the RFI Report. Since the November 2003 submittal, Ohio EPA has identified 12 additional areas of concern (AOCs) within the previously defined Contiguous Area #1, which need to be evaluated in the RFI. These additional AOCs are discussed in the updated RFI report.

An HHRA will be conducted in correlation with the RFI to provide additional information in determining the extent (if necessary) of corrective action.

Section 3
Chemicals of Potential Concern

All chemicals detected in environmental media of interest are considered to be COPCs unless there is a specific, justifiable rationale for their exclusion. Chemicals that meet one or more of the following criteria are excluded from the list of COPCs and will not be further evaluated in an HHRA:

- Chemicals detected are excluded from the list of COPCs if the maximum concentration is below toxicity-based thresholds associated with 100 percent (%) of the United States (U.S.) EPA Region 9 Preliminary Remediation Goals (PRGs) residential exposures for carcinogens and 10% of the U.S. EPA Region 9 PRGs for non-carcinogens, as recommended by the Ohio EPA Division of Emergency and Remedial Response. (DERR) (Ohio EPA 2004). Although the Franklin Steel study area is not within a residential land use, residential screening values are used to ensure the conservatism of the assessment. Region 9 PRG toxicity-based screening values are generally viewed as the most complete with respect to exposure pathways, toxicity criteria and chemicals considered.
- Inorganic chemicals are excluded from the list of COPCs if the maximum measured concentration is below local background concentrations and there is no evidence that its presence is related to Franklin Steel activities.
- Chemicals are excluded from the list of COPCs if they are essential nutrients (e.g., calcium).
- Chemicals are excluded from the list of COPCs if they are detected in less than 5% of samples analyzed for a given environmental medium.

Even if chemicals are present at a low frequency of detection within a given medium, they are retained as COPCs if: a) there is reasonable evidence that they are associated with plant activities; b) they are present at concentrations greater than the toxicity-based screening concentrations; c) they are degradation products of other COPCs; or d) they are persistent, bioaccumulative and toxic compounds (PBTs).

Selection of COPCs also takes into account the interconnectedness of environmental media and the potential for migration between media. If a chemical is identified as a COPC, it is also selected as a COPC in those connected media in which it was also detected. For example, chemicals identified as COPCs in sediment are also identified as COPCs in surface water, if they are detected in surface water.

Screening values for trivalent chromium rather than hexavalent chromium are used in the COPC selection process. Chromium is found in nature as the trivalent form (Barnhart 1997).

The hexavalent state is the second most stable state, but rarely occurs in nature (NPS 1997). Hexavalent chromium is manufactured by reacting chromium-containing ore with a caustic material such as sodium hydroxide at temperatures above 1000°C in an excess of oxygen. These energy intensive reaction conditions are necessary due to the inert nature of trivalent chromium and the extraordinary slow oxidation kinetics associated with the conversion of trivalent chromium to hexavalent chromium. The Franklin Steel facility did not manufacture hexavalent chromium nor has there been evidence to the use of hexavalent chromium at the facility.

However, the valance of chromium in soil could have been affected by the "ash" produced from reconditioning the used drums by burning the barrels' residues in a thermal oxidizer. Since the respirable inhaled chromium is recognized as a pulmonary and sinonasal carcinogen, the U.S. EPA Region 9 provided "carcinogenic" PRG values for "Total Chromium" in soil under the assumption of 6 to 1 ratio of hexavalent chromium to trivalent chromium [U.S. EPA Region 9 (2004) User's Guide]. Therefore, the screening toxicity value selected for total chromium in soil was Region 9 PRG's residential value of 210 milligrams per kilogram (mg/kg).

Based on the prescreening evaluation, all data retained from the frequency of detection review were then compared to background concentrations (all media), EPA Region 9 (U.S. EPA 2000) Risk-based Preliminary Remediation Goals (PRGs) (residential soil and tap water), and U.S. EPA Drinking Water Standards Maximum Contaminant Levels (MCLs). The background concentration was either the 95% upper confidence level (UCL), or the maximum detected concentration in background if this value was lower than the 95% UCL. The screening value for each constituent would be the 100% of the residential value listed on the PRG table for carcinogenic compounds and 10% the listed PRG value for non-carcinogenic compounds. Region 9 PRGs for residential soil were used for both soil and sediment comparisons, as were tap water PRGs used for comparison of surface water. This screening comparison is in accordance with the Ohio EPA Technical Decision Compendium (TDC) (April 2004), which states the use of Region 9 PRGs residential soil and tap water values for the purpose of screening sediment, soil and surface water in an HHRA. For groundwater, in cases where an MCL was available, the lesser of the MCL, 100% of the Region 9 PRG tap water exposure values for carcinogens and 10% of the listed tap water value for non-carcinogens, were used for the comparison. All background concentrations (all media) were calculated in accordance with Ohio EPA Division of Emergency and Remedial Response (DERR) TDC Methodology for Evaluating Site-specific Background Concentrations of Chemicals (March 2004).

For all media, the maximum detected value in site media was used as the comparison value. For inorganics, this value was first compared to the background value, then the PRG or MCL. For organics, the maximum detected value was compared only to the PRG or MCL (i.e., organic

background was not used to screen data). Using this methodology, it was determined whether a particular constituent met the criteria as a COPC.

Calcium, iron, magnesium, potassium, and sodium were detected in environmental samples collected from the Franklin Steel SWMUs. These chemicals are essential components of the human diet and were not detected at concentrations considered a risk to humans. Therefore, these compounds were eliminated as COPCs.

Note that retaining constituents as a result of one or several detections greater than the background criteria or for the toxicity-based reasons described above can result in COPCs with exposure concentrations less than the background criteria. For example, when less than 20 samples are available, any constituent detected above the background criteria one or more times will be retained in the risk assessment. However, in many cases, the exposure concentration (e.g., 95% UCL) for that constituent will be less than the background criteria because most of the detections were below background. The impact of this occurrence on the conclusions of the risk assessment will be addressed in the HHRA. The list of COPCs considered in the development of an HHRA, are included in Tables 3 - 1 through 3 - 4.

In order to achieve closure for the facility, it is necessary to determine if all COPCs are below associated risks and/or hazards which may cause concern to receptors of interest (i.e., human health and/or the environment). For each medium of interest, i.e., surface soil [0 – 2 feet below ground surface (bgs)], subsurface soil (greater than 2 feet bgs), sediment, surface water and groundwater data will be compiled in standard Risk Assessment Guidance for Superfund (RAGS) Part D format. This format provides information on the number of samples, the frequency of detection, and the minimum and maximum values.

Physical data collected for the Franklin Steel facility indicates the presence of a glacial deposit layer at a 5-10 feet bgs depth. This defined geological layer is persistent for naturally occurring elevated concentrations of arsenic (SAIC 2003). Thus, arsenic has been detected at elevated concentrations both within the area of the Franklin Steel facility and surrounding.

Furthermore, it is well documented that arsenic is a commonly detected background constituent in soils, particularly within glacial deposits. Elevated concentrations of arsenic, as high as 73 milligrams per kilogram (mg/kg), have been found to naturally occur in soils throughout the eastern U.S. (Shacklette, Boerngen 1984). In Ohio, arsenic has been found to occur in background soil as high as 56 mg/kg (Cox, Colvin 1996). These concentrations are well above the arsenic concentrations found within the Franklin Steel study area and that of the documented background concentration of 28.5 mg/kg. However, even though arsenic has a relatively high background concentration in the area of the Franklin Steel facility, arsenic will be evaluated through the HHRA exposure evaluation.

For a complete data set used for the purpose of developing COPCs, please refer to the revised RFI report prepared for the Franklin Steel facility (B&N 2007).

Section 4
Pathways and Receptors

This section presents exposure pathways for each media, information concerning modeling for fate and transport, identification of potentially exposed human populations, and calculations of intakes for both hypothetical current and future exposures. Future land use of the Property is assumed to be that or the same as the current operations, i.e., industrial. To further this claim, information has come available that the facility has been sold and will continue to operate as a drum reconditioning facility.

4.1 Exposure Assessment

Exposure assessment is the process of measuring or estimating the intensity, frequency and duration of human exposure to substances present in the environment. Exposure assessment includes the identification of potentially exposed populations, analysis of exposure pathways, definition of exposure units, estimation of exposure point concentrations (EPCs), and characterization of exposure scenarios. This information is used to estimate potential doses under current and reasonably foreseeable conditions. For purposes of visual interpretation, a CSM has been developed for the Franklin Steel facility. The CSM is illustrated on Figure 1.

Consistent with U.S. EPA (1992c) guidance, exposure assessment evaluates both central tendency exposure (CTE) and high end exposure (HEE) scenarios. High end scenarios describe individuals at the upper end of the population distribution (i.e., greater than the 90th percentile, but not above the distribution), while the central tendency scenarios characterize individuals in the middle of the population distribution (approximately the 50th percentile). The HEE scenario is analogous to the reasonable maximum exposure (RME) scenario described in earlier U.S. EPA guidance.

Consistent with U.S. EPA (1989a) guidance, the exposure assessment begins with the characterization of the physical setting and the human populations that may be exposed to COPCs. The characterization of potentially exposed populations includes the identification of both current and foreseeable exposures, as well as the identification of any subpopulations of concern.

4.2 Exposure Setting

As described above, the Franklin Steel facility is a large industrial facility surrounded by commercial/industrial land use. The property has long been used for industrial purposes and is located within a portion of Blacklick, Ohio that is zoned for industrial use. The Franklin Steel

facility is an active industrial facility and, as such, the company has control over any activities that occur within the facility's boundaries. Current employee manuals (Columbus Steel Drum, 2006) require workers to wear personal protective equipment (e.g., steel toe boots, long pants, and safety glasses) while on-site.

Unzinger's Ditch is a shallow drainage conveyance flowing from north to south with depths generally ranging from one to two feet. Although Unzinger's Ditch is not a desirable water body for human activity, a desk-top hypothetical preliminary human use of Unzinger's Ditch was conducted. That is, based on the setting of the drainage conveyance, surrounding development, potential future land use, and intermittent capacity and flow, Unzinger's Ditch is considered an unlikely area for trespasser activities.

Furthermore, the demographics of the area surrounding Franklin Steel are expected to influence the overall exposure setting and likelihood of various exposure scenarios. Commercial and industrial areas are located on both Research Road and Blatt Blvd, and additionally along upstream portions of Unzinger's Ditch. Commercial areas flank the downstream portion of Unzinger's Ditch. The closest residential area is located one-half mile southwest of the Franklin Steel facility. The 2000 Census data for Blacklick, Ohio, indicates a total residential population of approximately 9,500. Approximately 2,800 of these residents are under the age of 18. Census data suggest a limited portion "trespasser potential" population is accessible to the Franklin Steel facility and surrounding areas.

4.3 Identification of Exposure Scenarios and Pathways

Based on the site setting, three general exposure scenarios are plausible: Franklin Steel site workers (adults); construction/utility workers (adults), and hypothetical trespassers (children and adolescents).

4.3.1 Site Workers

As described previously, the site is currently operating as a steel drum reconditioning facility. Based on the current and projected future uses of the site, 80% of the site workers are considered to be indoor workers who may have limited exposure to environmental media. Under these conditions, it is possible that workers could contact surface soil as they walk between buildings, eat lunch outside, or engage in other work-related activities. Potentially complete pathways, therefore, include ingestion, dermal contact, and inhalation of particulates. Inhalation of volatile organic compounds (VOCs) is considered an insignificant pathway given that any volatiles will quickly disperse in ambient air.

In addition to contact with surface soil, site workers may have limited exposure to sediment and surface water while conducting routine maintenance activities within on-site settling ponds. All site workers are adults (>18 years of age) and a pathway completeness evaluation will be performed within the HHRA.

4.3.2 Construction/Utility Workers

Although the site worker evaluation is conservative in nature, that is, the site worker has a higher frequency and duration of exposure than that of any construction/utility worker. However, in the event of future development of the site, construction/utility workers may be exposed to on-site subsurface soil and groundwater. Complete pathways include ingestion and dermal contact with subsurface soil and groundwater and inhalation of soil particulates. Inhalation of VOCs from subsurface soil and groundwater is considered an insignificant pathway given that any volatiles will quickly disperse in ambient air. All construction/utilities workers are assumed to be adults (i.e., 18 years of age and older) and a pathway completeness evaluation will be performed within the HHRA.

4.3.3 Hypothetical Trespassers

Hypothetically, trespassers may access the Franklin Steel property, although this is extremely unlikely due to the vicinity and distance of the facility from residential development and the fairly undesirable nature of the surrounding land. However, in the event trespassing does occur, a trespasser may contact surface soil through incidental ingestion, dermal contact, or inhalation of particulates. Inhalation of VOCs is considered an insignificant pathway given that any volatiles will quickly disperse in ambient air. Furthermore, trespassers may come in contact with sediment and surface water in Unzinger's Ditch. Complete exposure pathways include ingestion and dermal contact with sediment and surface water. Hypothetical trespassers are assumed to be either children (6 to 12 years of age) or adolescents (12 to 18 years of age). Adults are also capable of trespassing at the facility; however, because children and adolescents have lower body weights than adults, the child and adolescent hypothetical trespasser scenarios are more conservative than (and, therefore, protective of) an adult hypothetical trespasser scenario.

4.4 Exposure Units

The typical concept of human exposure is that individuals contact impacted media on a periodic and random basis throughout the duration of the exposure period. Because of the nature of such contact, human exposure does not really occur at any one fixed point; rather, it occurs with equal likelihood at a variety of points. The collection of points where contact is equally likely

may be described as the exposure unit. Areas of the Franklin Steel study area with elevated chemical concentrations relative to surrounding areas, as well as parts of the study area with unique features that might lead to different frequencies of contact are defined as separate exposure units. For Unzinger's Ditch, the downstream and upstream segments are represented chemically by samples taken either downstream or upstream of a 15-inch diameter outfall (Outfall) just upstream of Mile 0.6. For purposes of this evaluation, exposure units and/or media that do not have any COPCs (e.g., floodplain soils) are excluded from the evaluation and are not listed below. The exposure units defined for the Franklin Steel study area include:

Exposure Unit 1a (Current Operations Area)

- Franklin Steel facility operations (S101 – S108) surface soils (0-2 feet bgs)
- Settling ponds and Unzinger's Ditch sediment (i.e., section between S108 and S109)

Exposure Unit 1b (Former Operations Area)

- Historical drum storage (S109 and S201) surface (0-2 feet bgs)/subsurface soils (> 2 feet bgs)
- Truck Trailer Parking Lot surface (0-2 feet bgs)/subsurface soils (> 2 feet bgs)

Exposure Unit 2 (Unzinger's Ditch)

- Downstream of Outfall sediment and surface water
- Upstream of the Outfall (i.e., settle ponds to outfall) sediment.

The separation of Exposure Unit 1 (i.e., a & b) is based on the distinct separation of land use. The current operations area (i.e., Exposure Unit 1 a) consist of an area that has been involved in facility operations since conception. The S109, S201 and truck trailer parking areas (i.e., Exposure Unit 1 b) were used strictly for storage and staging of drums and/or equipment, i.e., this area has never been used for facility operation activity. Therefore, these areas are relatively unaffected by facility operations. Exposure Unit 1 a & b are illustrated on Figure 2.

The physical separation of Exposure Unit 2 (Unzinger's Ditch) sediment and surface water (i.e., downstream of East Broad Street) is based on observations regarding potential human use patterns and down gradient potential of impacts from the Franklin Steel operations. The Exposure Unit 2 is illustrated in Figure 3.

4.5 Exposure Point Concentrations

U.S. EPA defines an EPC as the representative chemical concentration a receptor may contact at an exposure unit over the exposure period (U.S. EPA 1989a). EPCs for HEEs are set equal to either the maximum detected concentration or the 95% upper confidence limit on the mean

(95% UCL), whichever is lower. The EPCs for CTEs are set equal to the average (mean) concentration. The following discussions justify why it is appropriate to apply mean concentrations as central tendency EPCs and 95% UCL concentrations as high end EPCs.

First, U.S. EPA's Guidance for Risk Characterization (1995a) states that, "central tendency descriptors generally reflect central estimates of exposure or dose. The descriptor addressing central tendency may be based on either the arithmetic mean exposure or the median exposure (median estimate), either of which should be clearly labeled. The average estimate used to approximate the arithmetic mean can often be derived using average values for all the exposure factors."

Second, as noted in U.S. EPA (1989b) guidance on the assessment of health risks from fish and shellfish, "arithmetic means are needed to compare exposure estimates with reference doses (RfDs) and to calculate health risk for chronic effects because long-term consumption is an averaging process" (p. 51). U.S. EPA (1989b) continues that:

> *"Use of the upper 90 or 95% confidence limit in place of the mean would provide a conservatively high estimate of exposure. Calculation of conservative estimates for exposure is an appropriate step in uncertainty analysis. Use of upper confidence limits for chemical concentrations in combination with a plausible-upper-limit estimate for the Carcinogenic Potency Factor may lead to an unrealistic (i.e., highly unlikely) estimate of upper-bound risk, especially if a conservatively high estimate of fish consumption is also adopted. In most cases, the best estimate of exposure based on mean contaminant concentrations should be used to develop risk estimates (p. 52)."*

Third, use of the 95% UCL as the EPC for both scenarios would yield virtually identical results because the EPC is the most sensitive exposure parameter required for the calculation of risks. Using the specified EPCs for the central tendency and HEEs provides an indication of the uncertainty associated with the analytical database and exposure assumptions, as well as a measure of the influence of those exposure assumptions on the overall outcome of the risk assessment.

Fourth, calculation of population risks (in addition to individual risks) requires an estimate of average risks, which would be lacking if the 95% UCL were used as the EPC for both central tendency and HEEs, therefore, resulting in a risk assessment that is inconsistent with U.S. EPA (1992c) exposure assessment guidance.

Finally, the high end scenario, which is defined as the highest exposure that could reasonably be expected to occur for a given exposure pathway, is typically used to estimate risk for decision-making purposes (U.S. EPA 1992c). Therefore, using the 95% UCL to represent the high end EPC is a conservative and appropriate approach.

For all of these reasons, the mean concentration is a more meaningful, useful and appropriate EPC than the 95% UCL for CTEs. Derivation of mean values follows the data handling practices previously described. Occasionally, a lognormal distribution may be highly skewed, which can result in a mean value that is higher than the 95% UCL. In these cases, the minimum variance unbiased estimator of the mean (MVU) is used as the central tendency EPC, consistent with the recommendations of Gilbert (1987).

Exposure point concentrations for all media within the exposure units identified for Franklin Steel are presented in Tables 4-1 through 4-4.

4.6 Exposure Parameter Values and Dose Equations

Based on the exposure scenarios identified above, exposure parameter values and dose equations have been selected to estimate contact between people and affected environmental media. The specific parameters and equations selected for site workers, construction/utility workers and hypothetical child and adolescent trespassers are identified in Tables 4-5 through 4-16. The proposed exposure parameter values are consistent with U.S. EPA's (1997b) Exposure Factors Handbook, factoring in local considerations and updates to relevant studies that have been released since the publication of the Exposure Factors Handbook, as well as considerations from both the Ohio EPA (2006) Closure Plan Review Guidance, and Technical Background for generic cleanup numbers (GCNs). Professional judgment is also used to estimate values for a small number of factors for which these guidance documents provide no information (e.g., exposure frequency for trespassers).

For HEE scenarios, values equal to or greater than the 90th percentile are used for the most sensitive exposure parameters (U.S. EPA 1992c). All other parameters are set equal to their mean or median values. In many cases, the most sensitive exposure parameter values are expected to relate to EPCs and contact rate. However, there may be exceptions to this guideline, per U.S. EPA (1997b).

To the extent that data provided by U.S. EPA (1997b) support doing so, similar percentile values are selected for factors that are likely to be correlated. However, in the case of body weight and skin surface area, for high end scenarios, 90th percentile skin surface areas are paired with average body weights. This approach increases the conservatism of the exposure calculations, because higher (e.g., 90th percentile) body weights would effectively dilute the calculated doses, thereby lowering predicted risks. For the CTE scenarios, all parameters are set equal to their mean or median values. Additional considerations that warrant further explanation are presented in the following subsections.

4.6.1 Exposure Duration

Exposure duration describes the amount of time (in years) that an individual may spend in the area of concern (i.e., trespassing on the site or working at the site). For HEE exposures, the site and utility workers are conservatively assumed to work on the Franklin Steel facility for 21.9 years, which is U.S. EPA's (1997b) recommendation for a working lifetime. A site and utility worker CTE duration of 6.6 years is employed, based on U.S. EPA's (1997b) recommended value for the median occupational tenure for working men and women 16 years and older. Due to the short duration of potential construction activities, construction/utility workers are estimated to work at the site for one year under both HEE and CTE scenarios.

The child and adolescent trespassers are assumed to be exposed to relevant media by the number of years in the age group (i.e., 6 years for the 6 through 12 year child and 6 years for the 12 through 18 year adolescent). Therefore, both the HEE and the CTE duration are defined as 6 years for both the child and adolescent trespasser.

4.6.2 Exposure Frequency

Default values on exposure frequency of site receptors are available for site workers. Consistent with EPA (1997a), site workers were estimated to be exposed to surface soil for 250 days/year under HEE conditions and 195 days/year under CTE conditions, assuming no exposure during the 4 winter months (i.e., the ground is frozen and/or covered in snow). For the inhalation of indoor air pathway, CTE was assumed to be equal to HEE.

In contrast, data for construction/utility workers and trespassers are limited or not available. Although EPA (2002a) provides an estimated exposure frequency for the construction/utility worker, the value listed does not reflect the anticipated future uses of the site. As a result, site-specific information is used to evaluate construction/utility workers and trespassers.

The construction/utility worker is estimated to work at the site for five days per week for 26 weeks or 130 days per year under the HEE scenario. For the CTE scenario, the construction/utility worker is estimated to work at the site for 65 days or five days per week for 13 weeks. While at the site, it is assumed that construction and utility workers may occasionally be exposed to groundwater that seeps into excavation trenches. For the construction/utility worker, exposure to groundwater is assumed to occur for 52 days/year under HEE conditions and 26 days/year under CTE conditions. For the utility worker, given the short duration of exposure, it was conservatively assumed that groundwater could enter excavation trenches during the entire exposure period.

For the settling ponds and discharge channels, exposure is expected to be less frequent. These exposures correspond to 12 days per year as based on the National Pollutant Discharge Elimination System (NPDES) sampling requirements for both the HEE and CTE.

The hypothetical trespassers are assumed to access soils throughout the Franklin Steel facility either two or four days per month (corresponding to 36 and 12 days per year) for high end and central tendency exposures, respectively. Although, the site is monitored by a front kiosk and checked regularly to prevent unauthorized access, it is conservatively assumed that children and adolescents gain access to the site. Therefore, trespassers are conservatively assumed to spend approximately 10% of their time in Exposure Unit 1 (a & b) (i.e., 4 and 1 day per year) and approximately 90% of their time elsewhere in Exposure Unit 2 (i.e., 32 and 11 days per year). Similarly for Unzinger's Ditch, exposure to sediment and surface water is assumed to be limited to 36 and 18 days per year for high end and CTEs, respectively.

The above exposure frequency discussion is of the conservative nature, as the Franklin Steel facility is occupied 21 hours per day in either a full operations and/or maintenance capacity (i.e., production, equipment maintenance or facility cleaning). Therefore, an occupied structure has less intrigue to trespassers than that of an unoccupied structure.

4.6.3 Body Weight

Consistent with U.S. EPA (1997b) guidance, mean body weights of 30.8 kg, 56 kg and 71.8 kg are used for children, adolescents and adults, respectively.

4.6.4 Sediment and Soil Ingestion Rates

A soil ingestion rate of 100 mg/day is used to very conservatively estimate soil and sediment ingestion by children (ages 6 to 12) for both central tendency and HEEs. For adolescents, soil and sediment ingestion is assumed to be 50 mg/day for CTEs and 100 mg/day for HEEs. These values are more conservative than recommended by U.S. EPA (1997b) guidance, which recommends the use of 50 mg/day for all people over 6 years of age, based on data from Hawley (1985), Krablin (1989) and Calabrese, Stanek et al. (1990). However, these studies did not evaluate soil ingestion by children over the age of 6. As a result, it is conservatively assumed that children over the age of 6 ingest more soil than adults.

The soil ingestion rate of 100 mg/day is identified based on a conservative interpretation of the findings of Stanek, Calabrese et al. (2001). Stanek, Calabrese et al. (2001) estimated the long-term (annual) average soil ingestion exposure distribution for children under

6 years old, using daily soil ingestion estimates from several mass balance studies. Using bootstrapping methods, they estimated the median soil ingestion for children as 24 mg/day and the 95th percentile soil ingestion as 91 mg/day. For adults, soil and sediment ingestion is assumed to be 50 mg/day for both the high end and CTEs, consistent with U.S. EPA (1997b) guidance.

4.6.5 Fraction Sediment or Soil Ingested from Source

The soil and sediment ingestion rates described above reflect the total amount of soil or sediment incidentally ingested throughout the day from all sources. EPA's (1997a) recommended soil ingestion rates for children are based on trace element mass balance studies that measured the total trace element input (from food and water) and output (from urine and feces) over comparable time periods on subjects, and converted the difference to the amount of soil ingested using element concentrations in soil. Thus, these studies looked at soil ingestion over the exposure period from all sources and converted it to a daily intake rate. These rates should not be interpreted to represent the soil or sediment intake during only a portion of a day at a specific location.

It is reasonable to conclude that children and adolescents ingest soil from other play areas, and in and around the home, in addition to the hypothetical ingestion of soil and sediment from the site. Therefore, a factor for the fraction of soil or sediment ingested from the source is incorporated into the equation used to calculate exposures to trespassers. Although it is highly unlikely that anyone would spend half of their waking hours trespassing on the site or in Unzinger's Ditch, a value of 0.5 is conservatively assumed for purposes of evaluation in the fraction of soil and the fraction of sediment ingested from the site and other off-site areas for the hypothetical trespasser. In other words, it is assumed that half of the total soil or sediment ingested per day is derived from the site and half of the total soil or sediment ingested per day is derived from off-site areas.

One hundred percent of the site worker and construction/utility worker soil ingestion is conservatively assumed to be derived from the site.

4.6.6 Surface and Ground Water Ingestion Rate

A water ingestion rate of 0.05 L/day is used to estimate incidental surface water or ground water ingestion by construction/utility workers and trespassers for both HEE and CTE scenarios, consistent with EPA (1989) guidance.

4.6.7 Skin Surface Area

Within an HHRA, the 90th percentile and 50th percentile of skin surface areas for the relevant body parts will be used for the HEE and CTE scenarios, respectively (U.S. EPA 1997b).

Site workers are assumed to have exposed skin surface areas corresponding to hands and one-half the head. As previously discussed, this assumption is consistent with the requirements of the employee manual (Franklin Steel 2006).

The assumed exposed skin surface areas that are applied in an HHRA hypothetical trespasser are assumed to wear sleeveless shirts, shorts and sandals in the summer. In the spring and fall, hypothetical trespassers are assumed to wear short-sleeved shirts, pants and shoes or sneakers. In the winter, hypothetical trespassers are assumed to wear coats, pants and shoes or boots.

4.6.8 Skin Adherence Factor

Adherence of soil and sediment to exposed skin is an integral part of the assessment of dermal exposures. Kissel, Richter et al. (1996) and Kissel, Shirai et al. (1998) evaluated skin adherence to various body parts for different indoor and outdoor activities. Although Kissel, Richter et al. (1996) and Kissel, Shirai et al. (1998) did not specifically consider scenarios identical to those that shall be included in an HHRA, several scenarios that they did consider approximate dermal adherence associated with scenarios relevant to all risk assessments.

A dermal adherence factor of 0.2 mg/cm^2 is applied for site workers contacting soil and sediment under both HEE and CTE scenarios, based on the weighted 50th percentile for equipment operators and utility workers (U.S. EPA 2001b).

For children and adolescents who trespass at the Operations Area and/or the Unzinger's Ditch, Kissel, Richter et al.'s (1996) and Kissel, Shirai et al.'s (1998) children playing in wet soil scenario yields an adherence factor for contact with sediment of 0.2 mg/cm^2-day. For adolescents' exposures to soil, the adolescent soccer player scenario yields a skin adherence factor of 0.04 mg/cm^2-day for both HEE and CTE scenarios. For children's exposures to soil, the child playing with dry soil scenario also yields a skin adherence factor of 0.04 mg/cm2-day for both HEE and CTE scenarios. These values are applied to the relevant exposure scenarios and are consistent with recommendations of U.S. EPA (2001b).

All of these adherence factors are based on CTE estimates of skin surface area and adherence for HEE activities (i.e., reed gathering, gardening, playing in wet or dry soil, or playing soccer). U.S. EPA (2001b) considers these adherence factors conservative because actual activities (e.g., wading, walking) are likely to result in considerably lower levels of adherence.

4.6.9 Dermal Absorption Factor

Dermal absorption factors, consistent with U.S. EPA (2001b) guidance, will be used in the HHRA to derive intake via dermal contact. A dermal absorption factor of 0.13 for PAHs is based on Wester, Maibach et al. (1990). U.S. EPA (2001b) does not provide dermal absorption factors for lead. Instead, U.S. EPA Region 3 (1995c) for assessing dermal exposure to soils will be used to determine a dermal absorption factor for inorganic COPCs. U.S. EPA Region 3 recommends using a value of 0.01 based on Ryan, Hawkins et al. (1987).

Dermal absorption factors for COPCs employed within an HHRA are listed in Table 4-17.

4.6.10 Dermal Permeability Coefficients

Dermal permeability constants expressed in centimeters per hour (cm/hr) are used to estimate uptake of chemicals in surface water through the skin. U.S. EPA (2001b) presents permeability constants for most COPCs in surface water. For those surface water COPCs that lack published permeability coefficients (e.g., benzo(k)fluoranthene), the following equation is used to calculate permeability coefficients, as presented in U.S. EPA (2001b):

$$\text{Log Kp} = -2.8 + 0.67\text{LogKow} - 0.0056\text{MW}$$

where:

Log Kp	=	Logarithm of the permeability coefficient;
LogKow	=	Logarithm of the octanol-water partition coefficient; and
MW	=	Molecular weight.

4.6.11 Volitization Factor

For the site worker and hypothetical trespasser scenarios, estimation of doses via inhalation of vapors requires the derivation of a volatilization factor for each COPC. Table 4-18 presents the methodology and assumptions that are employed in the derivation of volatilization factors for COPCs.

The Jury Model was used to estimate the concentration of chemicals in air volatilized from soil. The model is applicable where saturation has not occurred. The affected soil is above the elevation of groundwater and there was no free product detected in the monitoring wells at the site, so this model is appropriate. A volatilization factor (VF) is calculated for on-site workers and trespassers based on different exposure times.

Equations:

$$D_a = \frac{\left[\left(\theta_a^{10/3} \text{ x Di x H}\right) + \left(\theta_w^{10/3} \text{x } D_2\right)\right] / n^2}{\left(P_b \text{ x } K_d\right) + \theta_w + \left(\theta_a \text{ x H}\right)}$$

$$VF = \frac{Q}{C} \text{ x } \frac{\left(3.14 \text{ x } D_a \text{ x T}\right)}{2 \text{ x } P_b \text{ x } D_a} \text{ x } 0.001$$

where:

Da	=	Apparent Diffusivity	Calculated
θa	=	Air-filled Soil Porosity	031
Di	=	Diffusivity in Air	Chemical-specific
H	=	Henry's Constant	Chemical-specific
θw	=	Water-filled Soil Porosity	0.15
Dw	=	Diffusivity in Water	Chemical-specific
n	=	Total Soil Porosity	0.46
Pb	=	Dry Soil Bulk Density	1.43 (g/cm3)
Kd	=	Soil/Water Partition Coefficient	Chemical-specific
VF	=	Volatilization Factor	Calculated
Q/C	=	Constant	85.63 g/m2-S/kg/m3
T	=	Exposure Interva	9.5x108 sec.

A summary of the site-specific parameters used in the Jury inhalation of volatiles model will be included in the HHRA.

A Jury Model will be used to estimate the inhaled concentration of chemicals in respirable particles from soil at the Franklin Steel facility. The model is applicable where saturation has not occurred. Evaluations of the Franklin Steel facility indicate affected surface soils are above the elevation of the groundwater so this model is appropriate. A particulate emission factor (PEF) is calculated for a site worker and trespasser exposure, which is used in the intake equation for dusts.

Equation:

$$PEF = \frac{Q}{C} \times \frac{3600}{0.036 \times (1 - V) \times (\frac{U_m}{U_t})^3 \times F_x}$$

where:

PEF	=	Particulate Emission Factor	Calculated
Q/C	=	Inverse of the Mean Concentration at Center of Square Source	85.63
V	=	Fraction of Vegetative Cover	0.5
Um	=	Mean Annual Wind Speed	4.2 m/s
Ut	=	Equivalent Threshold Value of Wind Speed at 7 m	11.32 m/s
Fx	=	Function Dependent on Ut/Um	0.371

A summary of the site-specific parameters used will be discussed in the HHRA.

4.6.12 Calculation of Doses

"Doses" for the site worker, construction/utility worker and hypothetical trespasser scenarios are conservatively estimated using the equations shown in Tables 4-5 through 4-16. For computational efficiency, "doses" are calculated using all exposure factors <u>except</u> those that are chemical-specific. Therefore, because the values presented are not true intake rates or doses, they are presented as "doses" in an HHRA.

4.7 Toxicity Assessment

Part of an HHRA is the toxicity assessment. In this step, the relationship between the administered and/or the absorbed dose of a chemical and the magnitude or likelihood of the adverse health effects are characterized (U.S. EPA 1989a). For systemic toxicants, or chemicals that give rise to toxic endpoints other than cancer and gene mutations (called noncarcinogenic effects), the toxicity assessment process determines a threshold value below which adverse noncarcinogenic effects are not expected in the general population, including sensitive subgroups. For chemicals that are known or suspected to cause cancer, the toxicity assessment defines the relationship between the dose of the risk agent and the probability of induction of carcinogenic effects in humans or animal species of interest.

Quantitative toxicity values are used in risk assessment to evaluate health risks based on the relationship between the dose of chemical received and the incidence or magnitude of the toxic response observed (i.e., the dose-response relationship). Laboratory animal studies are generally used to characterize the dose-response relationship for a chemical, unless adequate human epidemiological data are available.

A toxicity assessment is presented below for all COPCs. The Ohio EPA – DERR (TDC 2004) recommends use of toxicity values identified using a hierarchy of approved sources. The three primary sources are (in descending order of preference): EPA's Integrated Risk Information System (IRIS); EPA's Office of Research and Development (ORD) provisional peer-reviewed toxicity values (PPRTVs); and U.S. EPA's Health Effects Assessment Summary Tables (HEAST) (U.S. EPA 1997c). However, where alternative, more scientifically defensible toxicity values are available; the effect of those alternative values on the risk conclusions may be considered as part of the uncertainty analysis.

4.7.1 Noncarcinogenic Effects

In the risk assessment process, a distinction is made between cancer and noncancer health effects. For noncancer effects, the toxicity assessment yields a reference dose (RfD) or reference concentration (RfC), which corresponds to an estimate of the daily dose or concentration likely to be without appreciable risk of adverse noncarcinogenic effects during a lifetime, with uncertainty spanning perhaps an order of magnitude (Dourson and Stara 1983).

RfD values are generally calculated by determining the highest dose at which there are no observable adverse health effects (NOAEL) and by adjusting this dose using a series of uncertainty factors (UFs) and modifying factors (MFs). These practices are intended to conservatively account for the variation in sensitivity within the human population, uncertainty in extrapolating from animals to humans, uncertainty in extrapolating from short-term animal studies to chronic exposures in humans, and/or the inability of the toxicological database to address all possible adverse outcomes in humans. Modifying factors may be applied to address specific scientific uncertainties or overall database quality. For studies in which a NOAEL cannot be identified, the lowest dose associated with an observable adverse effect (LOAEL) is used and an additional UF is applied to account for the uncertainty of using LOAEL data rather than NOAEL data.

Table 4-19 summarizes the noncancer toxicity data for COPCs for the oral and dermal pathways. For each COPC, the target organ for the critical effect is noted and the magnitude of the total UF is indicated.

It is not necessary to adjust noncancer toxicity values to account for body weights other than 70 kg or lifetimes other than 70 years. U.S. EPA's (1997b) Exposure Factors Handbook states that standard exposure assumptions (e.g., 70 kg body weight, 70 year lifetime, 20 m^3 per day inhalation rate) are inaccurate for the national population. Appendix 1A of the Exposure Factors Handbook presents procedures for ensuring that population parameters used in exposure assessments are consistent with the population parameters used to derive the dose-response values in IRIS. Noncancer toxicity values (i.e., RfDs and RfCs) are based on animal or human dose-response data and application of uncertainty factors. As such, these values do not contain any human exposure factors. Therefore, no adjustment for body weight or lifetime duration is necessary (U.S. EPA 1997b).

Unadjusted oral RfDs are used to evaluate dermal exposure scenarios. The simplistic oral-to-dermal route extrapolation outlined by U.S. EPA (1989a) is subject to a number of uncertainties related to differences in pre-systemic metabolism and absorption rate. In addition, there is a large degree of variability in the analysis of oral absorption studies for many chemicals. U.S. EPA (2001b) states that adjustment of an oral toxicity factor is only recommended when a scientifically defensible database demonstrates that gastrointestinal absorption is less than 50%. U.S. EPA (2001b) does not recommend adjusting the oral toxicity values of any of the COPC evaluated in a human heath risk assessment.

Table 4-20 summarizes the noncancer toxicity data for COPCs for the inhalation pathway. For those COPCs lacking published toxicity values (e.g., RfDs or RfCs), Ohio EPA DERR was contacted for recommendations. Based on U.S. EPA, the preferred method for route-to-route extrapolation involves the physiologically based pharmacokinetic (PBPK) models, capable of describing disposition of the chemical for the oral, inhalation and other routes of exposure (U.S. EPA 1994).

4.7.2 Carcinogenic Effects

The assessment of cancer health effects generally follows a two-step process consisting of assignment of a qualitative weight of evidence classification and derivation of a quantitative toxicity value when appropriate.

The weight of evidence classification scheme contains five classes, as follows:

Group A	Known human carcinogens;
Group B	Probable human carcinogens;
	B1: Probable human carcinogen; limited evidence in humans;
	B2: Probable human carcinogen; sufficient evidence in animals and inadequate data in humans;
Group C	Possible human carcinogens;
Group D	Inadequate evidence to classify; and
Group E	No evidence of carcinogenicity.

The weight of evidence classification is based on the strength of the data demonstrating carcinogenesis in both laboratory animal studies and human epidemiology studies. Quantitative toxicity values, including cancer slope factors (CSFs) and/or inhalation unit risk (UR) values are generally derived for Group A and B1/B2 carcinogens. Because U.S. EPA generally favors use of a linear dose-response model, many available CSFs and UR values were derived using the linearized multistage model (LMS). These CSFs and UR values usually represent the 95% UCL on the probability of a response per unit dose of a chemical, and are expressed as either (mg/kg-day)-1 or (ug/m3)-1, respectively.

A more recent approach to cancer risk assessment is presented in U.S. EPA's (1996c) Proposed Guidelines for Carcinogen Risk Assessment. Under this approach, standard cancer risk descriptors are used instead of the traditional classification scheme and several alternative methods are available for dose-response modeling and low dose extrapolation. U.S. EPA is in the process of re-evaluating dose-response assessments that pre-date the 1996 guidance, with the goal of making them consistent with the new guidance and more reflective of actual toxicological potential. HHRAs based on the older methodology may overestimate the potential for toxic effects. Table 4-21 summarizes the oral and dermal toxicity data for carcinogens identified as COPCs. For each COPC, the weight of evidence classification and the target organ for cancer are presented.

Unadjusted oral CSFs are used to evaluate dermal exposure scenarios. As discussed above, current guidance from U.S. EPA (2001b) states that adjustment of an oral toxicity factor is only recommended when a scientifically defensible database demonstrates that gastrointestinal absorption is less than 50%. U.S. EPA (2001b) does not recommend adjusting the oral toxicity values of any of the COPCs.

CSFs based on animal studies (e.g., CSFs for PAHs) contain an animal-to-human scaling factor that is based on a human body weight of 70 kg. Therefore, CSFs will be adjusted to reflect the 71.8 kg body weight used in the exposure assessment. A body weight correction factor of 1.01 [=(71.8/70)1/3] was calculated using the equation presented in

Table 1A-1 of the Exposure Factors Handbook (U.S. EPA 1997b). Therefore, CSFs for PAHs are multiplied by 1.01 to yield adjusted CSFs. A lifetime duration adjustment is not necessary for CSFs derived from animal data, because the assumption is made that events occurring in the lifetime animal bioassay will occur with equal probability in a human lifetime, regardless of duration (U.S. EPA 1997b).

Table 4-22 summarizes the cancer toxicity data for COPCs for the inhalation pathway.

4.7.3 Chemical-Specific Toxicity Values

While the majority of toxicity values that will be applied in an HHRA and presented in Tables 4-19 through 4-22 are default values recommended by U.S. EPA, those proposed for PAHs and inorganic compounds warrant further discussion, as follows.

4.7.3.1 PAHs

Oral RfDs are available from IRIS for several individual PAH compounds. There are many additional PAHs for which no RfD value has been assigned by U.S. EPA, due to a lack of specific toxicological studies. Many PAH compounds produce similar types of noncancer health effects (i.e., liver and kidney toxicity). Therefore, the oral RfD for naphthalene is used for structurally similar PAHs lacking verified RfDs. For all other PAHs that lack verified RfDs, the RfD for pyrene is used as a surrogate. The RfD for pyrene is the lowest for the PAH derivatives; therefore, this is a very conservative approach that is expected to significantly overestimate noncancer hazards from PAHs.

Cancer risks are evaluated for the seven PAH derivatives considered by U.S. EPA to be probable human carcinogens: benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. The evaluation of PAH cancer risks is performed using U.S. EPA's provisional guidance for risk assessment of PAHs (U.S. EPA 1993). U.S. EPA (1993) describes this approach as estimation of the order of potential potency for various PAH compounds. This approach utilizes data from skin painting, interperitoneal or subcutaneous injection, and lung implantation studies and dose-response modeling techniques to estimate the potency of each PAH relative to benzo(a)pyrene. The estimated relative potency is then applied to the CSF for benzo(a)pyrene that is presented in IRIS.

4.7.3.2 Inorganic Compounds

Various inorganic compounds have been identified as COPCs for the Franklin Steel facility. Oral RfD values for all, excluding lead, are available from IRIS and or NCEA. U.S. EPA has not issued either cancer or noncancer toxicity criteria for lead. Rather, exposure to lead is typically evaluated using biokinetic uptake models that provide estimates of blood lead levels in either children or adults. U.S. EPA has used their Integrated Exposure Uptake Biokinetic (IEUBK) Model to derive a screening level for lead in residential soil of 400 mg/kg (U.S. EPA 1994b). The IEUBK model was developed specifically for evaluating lead exposures in children and therefore cannot be used to evaluate adult exposures to lead. Therefore, in the assessment of adult exposure to lead, recommendations of the Technical Review Workgroup (TRW) will be utilized in the development of the HHRA.

U.S. EPA uses a default calculated non-residential lead exposure concentration of 710 mg/kg (U.S. EPA 2003), based on an approach recommended by a TRW for Lead (TRW 1996). This approach uses a method that relates soil lead intake to blood lead concentrations in women of childbearing age. Hence, risks posed by lead to children are evaluated by comparing the EPCs for lead to the 400 mg/kg screening level (U.S. EPA 1994b), while risks posed by lead to adults are evaluated by comparing EPCs for lead to the 710 mg/kg screening concentration (TRW 1996). Surface water EPCs for lead are compared to U.S. EPA's action level for lead in drinking water (15 μg/L) (cited in U.S. EPA Region 5's Multimedia Strategy for the Management and Reduction of Lead Hazards www.epa.gov/reg5foia/pb/strategy).

Section 5
Risk Characterization

Risks will be characterized by integrating the toxicity and exposure assessments into quantitative expressions of risk based on the guidance provided in U.S. EPA, 1989b. To characterize carcinogenic risks, probabilities that an individual will develop cancer over a lifetime of exposure will be estimated from projected intakes and chemical-specific dose-response information. This probability is expressed as an excess lifetime cancer risk (ELCR). To characterize potential noncarcinogenic effects, comparisons were made between the projected intakes of substances and approved toxicity values. This comparison is expressed as a hazard quotient (HQ). Risks are quantified for each exposure pathway for those COPCs for which Ohio EPA approves toxicological criteria.

For carcinogens, risks are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen (i.e., incremental or excess individual lifetime cancer risk). Carcinogenic risks are calculated using the chronic daily intake determined through the exposure assessment and chemical specific toxicity criteria. The cancer risk equation is defined below:

Cancer Risk = CDI x SF

Where:

CDI = Chronic Daily Intake averaged over 70 years (mg/kg-day); and,
SF = Chemical specific slope factor (mg/kg-day)-1

U.S. EPA guidance requires that risks associated with simultaneous exposures to several substances be estimated. In order to assess the risks posed by multiple chemicals, individual cancer risks are summed for each exposure pathway using the following equation:

Riskt = Risk1 + Risk2 +....Riski

Where:

Riskt = the total cancer risk, expressed as a unitless probability; and
Riski = the risk estimate for the ith substance,

The risk summation methodology assumes that there are no synergistic or antagonistic chemical interactions and that all substances result in the same carcinogenic effect.

For noncarcinogens the potential for toxic effects is measured by comparing an exposure level over a specific time period with a chemical-specific reference dose derived for a similar exposure period. The noncancer HQ ratio assumes that there is a level of exposure below which it is unlikely that adverse health effects will occur, even to sensitive sub-populations. The threshold level is determined through animal and human epidemiological studies and is called the reference dose or RFD. The equation for determining the noncancer HQ is described below:

Noncancer Hazard Quotient = E/RFD

Where:

E = exposure level (or intake);
RFD = chemical-specific reference dose

If the hazard quotient exceeds unity (1), there may be a potential noncancer effect. To assess the overall potential for noncarcinogenic effects posed by more than one chemical, a hazard index (HI) approach is used. This approach assumes that simultaneous sub-threshold exposures to several chemicals could result in an adverse health effect.

The HI is equal to the sum of the HQs, as shown below:

Noncancer Hazard Index = E1/RfD1 + E2/RfD2 +...Ei/RFi

Where:

Ei = exposure level (or intake) for the ith toxicant;
RFi = chemical-specific reference dose for the ith toxicant

The HI assumes that the magnitude of the effect will be proportional to the sum of the hazard quotients.

Section 6
Risk Evaluation

Potential risks and hazards will be evaluated against the EPA risk-based goals established by Ohio EPA RCRA guidance for RFI and RCRA Closure units (Ohio EPA 1999). The risk-based goal for carcinogenic compounds has been established at a 1 x 10-5 (1E-05) ELCR. For noncarcinogens, acceptable exposure levels are concentrations that do not exceed a HI of 1. Compounds present in media at the Franklin Steel site above these risk-based goals will be discussed (and/or evaluated) further within the HHRA to determine if remedial action is warranted.

Section 7
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Tables

TABLE 3-1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SOILS

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Medium: Soils
Exposure Medium: Soil
Exposure Point: Operations Area

Chemical	Minimum Concentration (detections)	Maximum Concentration (detections)	Units	Detection Frequency	Concentration Used for Screening	Background Value	Screening Toxicity Value [a]	COPC Flag	Rationale for Deletion or Selection [b]
Metals									
Aluminum	369	29,900	mg/kg	342/334	29,900	15,430	7,600	Y	ASL
Antimony	0.05	117	mg/kg	343/108	117	--	3.1	Y	ASL
Arsenic	0.22	288	mg/kg	365/343	288	34	1.6	Y	ASL
Barium	26	5,400	mg/kg	359/359	5,400	239	540	Y	ASL
Beryllium	0.10	1.8	mg/kg	341/279	1.8	1.0	15	N	BSL
Cadmium	0.17	79	mg/kg	358/250	79	1.7	3.7	Y	ASL
Calcium	123	321,000	mg/kg	342/329	321,000	22,134	--	N	BSL
Chromium	5.6	1,120	mg/kg	361/349	1,120	21	210	Y	ASL
Cobalt	0.81	51	mg/kg	342/331	51	21	900	N	BSL
Copper	0.74	8,210	mg/kg	343/342	8,210	52	310	Y	ASL
Cyanide	0.14	13	mg/kg	344/46	13	--	120	N	BSL
Iron	3,320	166,000	mg/kg	344/331	166,000	39,650	2,300	Y	ASL
Lead	6.4	5,060	mg/kg	360/358	5,060	35	710	Y	ASL
Magnesium	753	74,700	mg/kg	341/327	74,700	11,057	--	N	NTX
Manganese	52	2,720	mg/kg	341/341	2,720	1,313	180	Y	ASL
Mercury	0.0082	41	mg/kg	358/235	41	0.046	2.3	Y	ASL
Nickel	5.3	468	mg/kg	342/331	468	65	160	Y	ASL
Potassium	90	3,610	mg/kg	342/327	3,610	1,490	--	N	NTX
Selenium	0.19	15	mg/kg	357/209	15.3	9.9	39	N	BSL
Silver	0.0096	20	mg/kg	358/62	20	--	39	N	BSL
Sodium	38	4,970	mg/kg	357/264	4,970	--	--	N	NTX
Thallium	0.057	2.4	mg/kg	342/174	2.4	1.7	0.52	Y	ASL
Vanadium	4.9	137	mg/kg	343/329	137	40	7.8	Y	ASL
Zinc	23	6,740	mg/kg	343/339	6,740	171	2,300	Y	ASL
PCBs									
Aroclor 1248	20	20	µg/kg	311/1	20	--	22	N	BSL
Aroclor 1254	44	1,000	µg/kg	311/5	1,000	--	220	Y	ASL
delta-BHC[c]	3.5	3.5	µg/kg	311/1	3.5	--	32	N	BSL
Methoxychlor	44	44	µg/kg	311/1	44	--	31,000	N	BSL

TABLE 3-1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SOILS

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Medium: Soils
Exposure Medium: Soil
Exposure Point: Operations Area

Chemical	Minimum Concentration (detections)	Maximum Concentration (detections)	Units	Detection Frequency	Concentration Used for Screening	Background Value	Screening Toxicity Value [a]	COPC Flag	Rationale for Deletion or Selection [b]
SVOCs									
2,4-Dimethylphenol	72	7,380	µg/kg	327/7	7,380	--	120,000	N	BSL
2-Methylnaphthalene[d]	40	8,000	µg/kg	327/35	8,000	--	560	Y	ASL
2-Methylphenol	71	9,370	µg/kg	327/12	9,370	--	310,000	N	BSL
4-Methylphenol	58	9,490	µg/kg	327/8	9,490	--	31,000	N	BSL
Acenaphthene	110	490	µg/kg	327/3	490	--	370,000	N	BSL
Acenaphthylene[e]	640	640	µg/kg	327/1	640	--	37,000	N	BSL
Anthracene	16	1,700	µg/kg	327/10	1,700	--	2,200,000	N	BSL
Benzo(a)anthracene	8.4	6,200	µg/kg	327/19	6,200	--	620	Y	ASL
Benzo(a)pyrene	8.3	5,100	µg/kg	326/17	5,100	--	62	Y	ASL
Benzo(b)fluoranthene	11	5,900	µg/kg	326/36	5,900	--	620	Y	ASL
Benzo(g,h,i)perylene[f]	54	1,400	µg/kg	326/15	1,400	--	23,000	N	BSL
Benzo(k)fluoranthene	39	2,800	µg/kg	326/16	2,800	--	6,200	N	BSL
Butylbenzylphthalate	41	36,000	µg/kg	326/82	36,000	--	1,200,000	N	BSL
Carbazole	50	330	µg/kg	325/3	330	--	24,000	N	BSL
Chrysene	26	5,300	µg/kg	325/32	5,300	--	62,000	N	BSL
Di-n-butylphthalate	41	8,600	µg/kg	326/67	8,600	70	6,200,000	N	BSL
Di-n-octylphthalate	41	83,000	µg/kg	326/20	83,000	--	240,000	N	BSL
Dibenzo(a,h)anthracene	76	960	µg/kg	326/2	960	--	62	Y	ASL
Dibenzofuran	46	270	µg/kg	326/7	270	--	15,000	N	BSL
Diethyl phthalate	71	1,500	µg/kg	326/3	1,500	--	4,900,000	N	BSL
Dimethyl phthalate	62	930	µg/kg	326/6	930	--	10,000,000	N	BSL
Fluoranthene	26	11,000	µg/kg	326/51	11,000	--	230,000	N	BSL
Fluorene	38	1,100	µg/kg	326/5	1,100	--	270,000	N	BSL
Indeno(1,2,3-cd)pyrene	45	442	µg/kg	326/13	442	--	620	N	BSL
Isophorone	42	3,400	µg/kg	326/19	3,400	--	510,000	N	BSL

TABLE 3-1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SOILS

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Medium: Soils
Exposure Medium: Soil
Exposure Point: Operations Area

Chemical	Minimum Concentration (detections)	Maximum Concentration (detections)	Units	Detection Frequency	Concentration Used for Screening	Background Value	Screening Toxicity Value [a]	COPC Flag	Rationale for Deletion or Selection [b]
N-Nitrosodiphenylamine	73	370	µg/kg	326/3	370	--	9.5	Y	ASL
Naphthalene	34	17,000	µg/kg	326/41	17,000	--	5,600	Y	ASL
Phenanthrene[g]	27	6,300	µg/kg	326/54	6,300	--	220,000	N	BSL
Phenol	34	6,000	µg/kg	327/19	6,000	--	1,800,000	N	BSL
Pyrene	22	10,000	µg/kg	327/56	10,000	--	230,000	N	BSL
bis(2-Ethylhexyl) phthalate	38	1,300,000	µg/kg	335/327	1,300,000	--	35,000	Y	ASL
4,6-Dinitro-2-methylphenol	204	1,180	µg/kg	327/10	1,180	--	610	Y	ASL
2,4-Dinitrophenol	398	508	µg/kg	327/2	508	--	12,000	N	BSL
Hexachloroethane	63	70	µg/kg	327/2	70	--	35,000	N	BSL
4-Nitroaniline	59	59	µg/kg	327/1	59	--	23,000	N	BSL
Nitrobenzene	54	54	µg/kg	327/1	54	--	100,000	N	BSL
4-Nitrophenol[h]	118	2,290	µg/kg	327/5	2,290	--	200	Y	ASL
Pentachlorophenol	133	162	µg/kg	327/3	162	--	3,000	N	BSL
4-Chloro-3-methylphenol	97	97	µg/kg	327/1	97	--	--	N	NTX
VOCs									
1,1,1-Trichloroethane	1.6	48	µg/kg	290/7	48	--	120,000	N	BSL
1,1,2-Trichloroethane	10	10	µg/kg	290/1	10	--	730	N	BSL
1,1-Dichloroethane	1.5	580	µg/kg	290/16	580	--	51,000	N	BSL
1,1-Dichloroethene	2.9	2.9	µg/kg	290/1	2.9	--	12,000	N	BSL
1,2-Dichloroethane	2.7	2.7	µg/kg	290/1	2.7	--	280	N	BSL
1,2-Dichloroethene, Total	1.6	1,200	µg/kg	290/13	1,200	--	6,900	N	BSL
1-Propanol	6.0	6.0	µg/kg	270/1	6.0	--	--	N	NTX
2-Butanone	3.0	140	µg/kg	290/33	140	--	2,200,000	N	BSL
4-Methyl-2-pentanone	3.0	87	µg/kg	290/7	87	--	530,000	N	BSL
Acetone	3.0	1,100	µg/kg	290/56	1,100	--	1,400,000	N	BSL
Benzene	0.56	17	µg/kg	590/7	17	--	1,400	N	BSL
Carbon disulfide	0.50	7.6	µg/kg	290/17	7.6	--	36,000	N	BSL
Chlorobenzene	0.43	3,900	µg/kg	290/7	3,900	--	15,000	N	BSL

TABLE 3-1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SOILS

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Medium: Soils
Exposure Medium: Soil
Exposure Point: Operations Area

Chemical	Minimum Concentration (detections)	Maximum Concentration (detections)	Units	Detection Frequency	Concentration Used for Screening	Background Value	Screening Toxicity Value [a]	COPC Flag	Rationale for Deletion or Selection [b]
Chloroethane	3.0	12	µg/kg	290/3	12	--	3,000	N	BSL
Chloroform	1.6	1.9	µg/kg	290/2	1.9	--	220	N	BSL
Chloromethane	12	860	µg/kg	290/2	860	--	4,700	N	BSL
Ethylbenzene	1.2	210,000	µg/kg	290/31	210,000	--	40,000	Y	ASL
Methylene chloride	1.9	1,300	µg/kg	290/52	1,300	--	9,100	N	BSL
Styrene	5.3	5.3	µg/kg	290/1	5.3	--	170,000	N	BSL
Tetrachloroethene	1.2	1,200	µg/kg	290/16	1,200	--	480	Y	ASL
Toluene	0.41	310,000	µg/kg	290/44	310,000	--	52,000	Y	ASL
Trichloroethene	0.57	690	µg/kg	290/12	690	--	53	Y	ASL
Vinyl chloride	0.63	33	µg/kg	290/3	33	--	79	N	BSL
Xylenes, Total	0.95	720,000	µg/kg	290/47	720,000	--	27,000	Y	ASL
Dibromochloromethane	1.1	1.1	µg/kg	290/1	1.1	--	110	N	BSL
2-Hexanone	11	13	µg/kg	290/2	13	--	--	N	NTX

Notes:
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
COPC = chemical of potential concern
N = not a COPC; Y = COPC
-- = no data available
[a] Ohio EPA (2004) Use of U.S. EPA Region 9 PRGs as Screening Values in Human Health Risk Assessments (i.e., 10% of non-carcinogenic and 100% of the carcinogenic residential soil values)
[b] Selection Reason: Above Screening Levels (ASL)

Deletion Reason: No Toxicity Information (NTX)
Below Screening Level (BSL)

[c] Based on the value for HCH-technical
[d] Based on the value for naphthalene
[e] Based on the value for benzo(b)fluoranthene
[f] Based on the value for pyrene
[g] Based on the value for anthracene
[h] based on the value for nitrobenzene

TABLE 3-2

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SEDIMENTS

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Medium: Sediments
Exposure Medium: Sediment
Exposure Point: Unzinger's Ditch

Chemical	Minimum Concentration (detections)	Maximum Concentration (detections)	Units	Detection Frequency	Concentration Used for Screening	Background Value	Screening Toxicity Value [a]	COPC Flag	Rationale for Deletion or Selection [b]
Metals									
Aluminum	1,490	20,300	mg/kg	40/40	20,300	--	7,600	Y	ASL
Antimony	0.10	19	mg/kg	40/20	19	--	3.1	Y	ASL
Arsenic	0.22	38	mg/kg	40/40	38	28.5	0.39	Y	ASL
Barium	23	1,250	mg/kg	40/40	1,250	--	540	Y	ASL
Beryllium	0.13	1.0	mg/kg	40/36	1.0	--	15	N	BSL
Cadmium	0.38	10	mg/kg	40/33	10	--	3.7	Y	ASL
Calcium	3,750	170,000	mg/kg	40/40	170,000	--	--	N	NTX
Chromium	4.0	164	mg/kg	40/40	164	21	210	N	BSL
Cobalt	2.1	29	mg/kg	40/39	29	--	900	N	BSL
Copper	11	164	mg/kg	40/40	164	--	310	N	BSL
Cyanide	0.63	0.84	mg/kg	40/5	0.84	--	120	N	BSL
Iron	7,890	41,900	mg/kg	40/40	41,900	--	2,300	Y	ASL
Lead	9.3	775	mg/kg	40/40	775	31	710	Y	ASL
Magnesium	1,360	32,600	mg/kg	40/40	32,600	--	--	N	NTX
Manganese	89	1,520	mg/kg	40/40	1,520	--	180	Y	ASL
Mercury	0.012	0.57	mg/kg	40/31	0.57	--	2.3	N	BSL
Nickel	5.0	152	mg/kg	40/40	152	--	160	N	BSL
Potassium	184	2,290	mg/kg	40/40	2,290	--	--	N	NTX
Selenium	0.35	16	mg/kg	40/26	16	--	39	N	BSL
Silver	0.18	167	mg/kg	40/12	167	--	39	Y	ASL
Sodium	1.0	1,200	mg/kg	40/29	1,200	--	--	N	NTX
Thallium	0.47	10	mg/kg	40/15	10	--	0.5	Y	ASL
Vanadium	8.8	48	mg/kg	40/40	48	--	8	Y	ASL
Zinc	58	954	mg/kg	40/40	954	--	2,300	N	BSL

TABLE 3-2

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SEDIMENTS

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Medium: Sediments
Exposure Medium: Sediment
Exposure Point: Unzinger's Ditch

Chemical	Minimum Concentration (detections)	Maximum Concentration (detections)	Units	Detection Frequency	Concentration Used for Screening	Background Value	Screening Toxicity Value [a]	COPC Flag	Rationale for Deletion or Selection [b]
SVOCs									
2-Methylnaphthalene[c]	97	940	µg/kg	40/6	940	--	560	Y	ASL
4-Methylphenol	120	500	µg/kg	40/3	500	--	310,000	N	BSL
Acenaphthene	43	540	µg/kg	40/5	540	--	370,000	N	BSL
Acenaphthylene[d]	180	3,600	µg/kg	40/3	3,600	--	37,000	N	NTX
Anthracene	43	3,400	µg/kg	40/17	3,400	--	2,200,000	N	BSL
Benzo(a)anthracene	87	9,900	µg/kg	40/25	9,900	--	620	Y	ASL
Benzo(a)pyrene	110	16,000	µg/kg	40/25	16,000	--	62	Y	ASL
Benzo(b)fluoranthene	70	28,000	µg/kg	40/27	28,000	--	620	Y	ASL
Benzo(g,h,i)perylene[e]	110	5,100	µg/kg	40/24	5,100	--	23,000	N	BSL
Benzo(k)fluoranthene	74	12,000	µg/kg	40/24	12,000	--	6,200	Y	ASL
Butylbenzylphthalate	52	2,100	µg/kg	40/13	2,100	--	1,200,000	N	BSL
Carbazole	37	860	µg/kg	40/15	860	--	24,000	N	BSL
Chrysene	52	19,000	µg/kg	40/27	19,000	--	62,000	N	BSL
Di-n-butylphthalate	56	2,400	µg/kg	40/6	2,400	--	6,200,000	N	BSL
Dibenzo(a,h)anthracene	68	1,900	µg/kg	40/15	1,900	--	62	Y	ASL
Dibenzofuran	36	310	µg/kg	40/6	310	--	15,000	N	BSL

TABLE 3-2

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SEDIMENTS

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Medium: Sediments
Exposure Medium: Sediment
Exposure Point: Unzinger's Ditch

Chemical	Minimum Concentration (detections)	Maximum Concentration (detections)	Units	Detection Frequency	Concentration Used for Screening	Background Value	Screening Toxicity Value [a]	COPC Flag	Rationale for Deletion or Selection [b]
Di-n-octyl phthlate	3,100	3,100	µg/kg	40/1	3,100	--	240,000	N	BSL
Fluoranthene	63	13,000	µg/kg	40/31	13,000	--	230,000	N	BSL
Fluorene	69	540	µg/kg	40/8	540	--	270,000	N	BSL
Indeno(1,2,3-cd)pyrene	93	6,000	µg/kg	40/24	6,000	--	620	Y	ASL
Naphthalene	250	1,600	µg/kg	40/4	1,600	--	5,600	N	BSL
Phenanthrene[f]	76	7,100	µg/kg	40/27	7,100	--	220,000	N	BSL
Phenol	51	94	µg/kg	40/2	94	--	1,800,000	N	BSL
Pyrene	53	9,700	µg/kg	40/30	9,700	--	230,000	N	BSL
bis(2-Ethylhexyl) phthalate	61	620,000	µg/kg	40/28	620,000	--	35,000	Y	ASL
VOCs									
1,2-Dichloroethene, Total	8.0	8.0	µg/kg	40/1	8.0	--	6,900	N	BSL
2-Butanone	4.3	31	µg/kg	40/6	31	--	2,200,000	N	BSL
Acetone	7.2	54	µg/kg	40/8	54	--	1,400,000	N	BSL
Carbon disulfide	3.1	3.1	µg/kg	40/1	3.1	--	36,000	N	BSL
Chlorobenzene	1.6	1.6	µg/kg	40/1	1.6	--	15,000	N	BSL
Ethylbenzene	450	2,000	µg/kg	40/3	2,000	--	40,000	N	BSL
Tetrachloroethene	4.0	4.0	µg/kg	40/1	4.0	--	480	N	BSL
Toluene	6.8	860	µg/kg	40/7	860	--	52,000	N	BSL
Trichloroethene	8.0	8.0	µg/kg	40/1	8.0	--	53	N	BSL
Xylenes, Total	200	19,000	µg/kg	40/4	19,000	--	27,000	N	BSL

Notes:
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
COPC = chemical of potential concern
N = not a COPC; Y = COPC
-- = no data available
[a] Ohio EPA (2004) Use of U.S. EPA Region 9 PRGs as Screening Values in Human Health Risk Assessments (i.e., 10% of non-carcinogenic and 100% of the carcinogenic residential soil values)
[b] Selection Reason: Above Screening Levels (ASL)

Deletion Reason: No Toxicity Information (NTX)
Below Screening Level (BSL)
[c] Based on the value for naphthalene
[d] Based on the value for benzo(b)fluoranthene
[e] Based on the value for pyrene
[f] Based on the value for anthracene

TABLE 3-3

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE WATER

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Medium: Surface Water
Exposure Medium: Surface Water
Exposure Point: Unzinger's Ditch

Chemical	Minimum Concentration (detections)	Maximum Concentration (detections)	Units	Detection Frequency	Concentration Used for Screening	Background Value	Screening Toxicity Value [a]	COPC Flag	Rationale for Deletion or Selection [b]
Metals									
Aluminum	0.25	30	mg/l	20/19	30	1.5	3.6	Y	ASL
Antimony	0.00022	0.024	mg/l	20/4	0.024	--	0.002	Y	ASL
Arsenic	0.00180	0.017	mg/l	20/9	0.017	--	0.000045	Y	ASL
Barium	0.055	0.45	mg/l	20/20	0.45	0.12	0.26	Y	ASL
Calcium	41	134	mg/l	20/20	134	91	-	N	NTX
Chromium (VI)	0.0010	0.032	mg/l	20/5	0.032	--	0.11	N	BSL
Cobalt	0.00042	0.0085	mg/l	20/5	0.0085	--	0.73	N	BSL
Copper	0.0037	0.19	mg/l	20/13	0.19	0.010	0.15	Y	ASL
Cyanide	0.0050	0.060	mg/l	20/4	0.060	--	0.07	N	BSL
Iron	0.22	27	mg/l	20/20	27	2.2	1.1	Y	ASL
Lead	0.00078	0.061	mg/l	20/11	0.061	0.0010	0.015	Y	ASL
Magnesium	7.5	40	mg/l	20/20	40	27	-	N	NTX
Manganese	0.010	2.6	mg/l	20/20	2.6	0.34	0.09	Y	ASL
Mercury	0.000019	0.00020	mg/l	20/4	0.00020	--	0.0004	N	BSL
Nickel	0.0025	0.048	mg/l	20/6	0.048	--	0.07	N	BSL
Potassium	2.4	85	mg/l	20/15	85	6.9	-	N	NTX
Silver	0.0045	0.0045	mg/l	20/1	0.0045	--	0.02	N	BSL
Sodium	7.8	0.0020	mg/l	20/20	0.0020	48	-	N	NTX
Thallium	0.000048	0.0016	mg/l	20/2	0.0016	--	0.0002	Y	ASL
Vanadium	0.0034	0.090	mg/l	20/5	0.090	--	0.004	Y	ASL
Zinc	0.015	0.49	mg/l	20/16	0.49	--	1.1	N	BSL

TABLE 3-3

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE WATER

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Medium: Surface Water
Exposure Medium: Surface Water
Exposure Point: Unzinger's Ditch

Chemical	Minimum Concentration (detections)	Maximum Concentration (detections)	Units	Detection Frequency	Concentration Used for Screening	Background Value	Screening Toxicity Value [a]	COPC Flag	Rationale for Deletion or Selection [b]
SVOCs									
2-Methylnaphthalene[c]	3.0	3.0	µg/l	20/1	3.0	--	0.062	Y	ASL
2-Methylphenol	4.6	15	µg/l	20/2	15	--	180	N	BSL
4-Methylphenol	2.0	39	µg/l	20/4	39	--	18	Y	ASL
Benzo(a)pyrene	1.1	4.0	µg/l	20/2	4.0	--	0.0092	Y	ASL
Benzo(b)fluoranthene	2.2	2.2	µg/l	20/1	2.2	--	0.092	Y	ASL
Benzo(k)fluoranthene	1.2	1.2	µg/l	20/1	1.2	--	0.92	Y	ASL
Chrysene	2.7	2.7	µg/l	20/1	2.7	--	9.2	N	BSL
Di-n-Butyl phthalate	3.7	3.7	µg/l	20/1	3.7	--	360	N	BSL
Fluoranthene	1.4	7.5	µg/l	20/3	7.5	--	150	N	BSL
Isophorone	7.1	120	µg/l	20/2	120	--	71	Y	ASL
Phenanthrene	4.4	6.6	µg/l	20/2	6.6	--	-	N	NTX
Phenol	3.0	61	µg/l	20/3	61	--	1,100	N	BSL
Pyrene	5.9	5.9	µg/l	20/1	5.9	--	18	N	BSL
bis(2-Ethylhexyl) phthalate	2.0	8.0	µg/l	20/2	8.0	--	4.8	Y	ASL
VOCs									
2-Butanone	1.6	350	µg/l	20/3	350	--	700	N	BSL
4-Methyl-2-pentanone	2.1	50	µg/l	20/2	50	--	200	N	BSL
Acetone	5.8	810	µg/l	20/4	810	--	550	Y	ASL
Chloroform	2.0	2.0	µg/l	20/1	2.0	--	0.17	Y	ASL

Notes:
mg/l = milligrams per kilogram
µg/l = micrograms per kilogram
COPC = chemical of potential concern
N = not a COPC; Y = COPC
-- = no data available
[a] Ohio EPA (2004) Use of U.S. EPA Region 9 PRGs as Screening Values in Human Health Risk Assessments (i.e., 10% of non-carcinogenic and 100% of the carcinogenic tap water values)
[b] Selection Reason: Above Screening Levels (ASL)

Deletion Reason: No Toxicity Information (NTX)
Below Screening Level (BSL)
[c] Based on the value for naphthalene

TABLE 3-4

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Operations Area

Chemical	Minimum Concentration	Maximum Concentration	Units	Detection Frequency	Concentration Used for Screening	Background Value[1]	Screening Toxicity Value [a]	COPC Flag	Rationale for Deletion or Selection [b]
Metals[2]									
Aluminum	0.030	2.4	mg/l	223/55	2.4	29	0.20	Y	ASL
Antimony	0.0024	0.0072	mg/l	223/15	0.0072	--	0.0060	Y	ASL
Arsenic	0.0014	0.029	mg/l	223/100	0.029	0.064	0.010	N	BBL
Barium	0.023	0.78	mg/l	223/201	0.78	0.60	2.0	N	BSL
Beryllium	0.0078	0.40	mg/l	223/17	0.40	0.0040	0.0040	Y	ASL
Cadmium	0.00027	0.0034	mg/l	223/7	0.0034	0.011	0.0050	N	BSL
Calcium	56	658	mg/l	223/216	658	585	--	N	NTX
Chromium	0.0063	0.0090	mg/l	223/2	0.0090	0.087	0.10	N	BSL
Cobalt	0.0011	0.028	mg/l	223/23	0.028	0.058	0.0073	N	BBL
Copper	0.0033	0.083	mg/l	223/11	0.083	0.092	1.0	N	BSL
Iron	0.062	13	mg/l	223/209	13	73	0.30	N	BBL
Lead	0.0010	0.0020	mg/l	223/2	0.0020	0.053	0.015	N	BSL
Magnesium	17	121	mg/l	223/216	121	97	--	N	NTX
Manganese	0.031	3.9	mg/l	223/216	3.9	2.2	0.050	Y	ASL
Mercury	0.000021	0.00014	mg/l	223/25	0.00014	0.00030	0.0020	N	BSL
Nickel	0.0022	0.25	mg/l	223/60	0.25	0.12	0.0073	Y	ASL
Potassium	0.76	7.4	mg/l	223/215	7.4	11	--	N	NTX
Selenium	0.0041	0.0060	mg/l	223/10	0.0060	0.012	0.050	N	BSL
Sodium	3.4	241	mg/l	223/211	241	116	--	N	NTX
Thallium	0.000014	0.012	mg/l	223/12	0.012	0.0070	0.0020	Y	ASL
Vanadium	0.00029	0.0081	mg/l	223/3	0.0081	0.18	0.00036	N	BBL
Zinc	0.0050	0.20	mg/l	223/76	0.20	0.39	5.0	N	BSL

TABLE 3-4

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Operations Area

Chemical	Minimum Concentration	Maximum Concentration	Units	Detection Frequency	Concentration Used for Screening	Background Value[1]	Screening Toxicity Value [a]	COPC Flag	Rationale for Deletion or Selection [b]
SVOCs									
Benzo(g,h,i)perylene	0.61	0.61	µg/l	223/1	0.61	--	18	N	NTX
Diethyl phthalate	1.4	1.4	µg/l	223/1	1.4	--	2,900	N	NTX
Fluorene	0.23	0.23	µg/l	223/1	0.23	--	24	N	NTX
Indeno(1,2,3-cd)pyrene	0.39	0.39	µg/l	223/1	0.39	--	0.092	Y	ASL
Phenol	4.6	4.6	µg/l	223/1	4.6	--	1,100	N	NTX
Pyrene	0.24	0.28	µg/l	223/2	0.28	--	18	N	NTX
bis(2-Ethylhexyl) phthalate	1.2	250	µg/l	223/15	250	--	6.0	Y	ASL
VOCs									
1,1-Dichloroethane	0.29	6.3	µg/l	223/14	6.3	--	81	N	NTX
1,1-Dichloroethene	0.28	0.28	µg/l	223/1	0.28	--	7.0	N	BSL
2-Butanone	0.63	0.97	µg/l	223/2	0.97	--	700	N	NTX
4-Methyl-2-pentanone	2.2	2.2	µg/l	223/1	2.2	--	2,000	N	BSL
Acetone	2.0	8.5	µg/l	223/3	8.5	--	550	N	NTX
Carbon disulfide	0.12	0.92	µg/l	223/15	0.92	--	100	N	NTX
Chloroethane	0.34	460	µg/l	223/22	460	--	4.6	Y	ASL
Chloroform	0.97	0.97	µg/l	223/1	0.97	--	80	N	BSL
Chloromethane	0.26	0.26	µg/l	223/1	0.26	--	16	N	NTX
Methylene chloride	0.17	6.7	µg/l	223/9	6.7	--	4.3	Y	ASL
Styrene	0.60	0.68	µg/l	223/3	0.68	--	100	N	BSL
Toluene	0.20	0.28	µg/l	223/4	0.28	--	1,000	N	BSL
Vinyl chloride	2.1	8.3	µg/l	223/5	8.3	--	2.0	N	BSC
Xylenes, Total	0.48	0.49	µg/l	223/2	0.49	--	10,000	N	BSL

Notes:
1 = Background concentration calculated per Ohio EPA DERR-00-RR-039P protocol
2 - representative field filtered samples
mg/l = milligrams per kilogram
µg/l = micrograms per kilogram
COPC = chemical of potential concern
N = not a COPC; Y = COPC
-- = no data available
[a] The lesser of U.S. EPA Region 9 PRGs as Screening Values in Human Health Risk Assessments (i.e., 10% of non-carcinogenic and 100% of the carcinogenic tap water values) or Drinking Water Standards Maximum Contaminant Levels.
[b] Selection Reason: Above Screening Levels (ASL)

Deletion Reason: No Toxicity Information (NTX)
Below Screening Level (BSL)
Below Background Level (BBL)
Below Screening Criteria (<5%) (BSC)

TABLE 4-1

EXPOSURE POINT CONCENTRATION SUMMARY - SOILS

Franklin Steel, Blacklick, Ohio

Chemical	Units	Arithmetic Mean	95 % UCL (lognormal)	Maximum Concentration	High End Exposure			Central Tendency Exposure		
					EPC Value	EPC Statistic	EPC Rationale	EPC Value	EPC Statistic	EPC Rationale
Metals										
Aluminum	mg/kg	8,412	459	29,900	459	95% UCL	lower of 95% UCL and Max.	8,412	mean	Estimate of central tendency
Antimony	mg/kg	10	3.5	117	3.5	95% UCL	lower of 95% UCL and Max.	10	mean	Estimate of central tendency
Arsenic	mg/kg	17	2.0	288	2.0	95% UCL	lower of 95% UCL and Max.	17	mean	Estimate of central tendency
Barium	mg/kg	272	57	5,400	57	95% UCL	lower of 95% UCL and Max.	272	mean	Estimate of central tendency
Cadmium	mg/kg	3.8	1.2	79	1.2	95% UCL	lower of 95% UCL and Max.	3.8	mean	Estimate of central tendency
Chromium	mg/kg	40	9.5	1,120	9.5	95% UCL	lower of 95% UCL and Max.	40	mean	Estimate of central tendency
Copper	mg/kg	74	48.8	8,210	49	95% UCL	lower of 95% UCL and Max.	74	mean	Estimate of central tendency
Iron	mg/kg	27,943	1,946	166,000	1,946	95% UCL	lower of 95% UCL and Max.	27,943	mean	Estimate of central tendency
Lead	mg/kg	176	58	5,060	58	95% UCL	lower of 95% UCL and Max.	176	mean	Estimate of central tendency
Manganese	mg/kg	419	34	2,720	34	95% UCL	lower of 95% UCL and Max.	419	mean	Estimate of central tendency
Mercury	mg/kg	0.26	0.35	41	0.35	95% UCL	lower of 95% UCL and Max.	0.26	mean	Estimate of central tendency
Nickel	mg/kg	35	3.4	468	3.4	95% UCL	lower of 95% UCL and Max.	35	mean	Estimate of central tendency
Thallium	mg/kg	0.77	0.071	2.4	0.071	95% UCL	lower of 95% UCL and Max.	0.77	mean	Estimate of central tendency
Vanadium	mg/kg	31	1.56	137	1.6	95% UCL	lower of 95% UCL and Max.	31	mean	Estimate of central tendency
Zinc	mg/kg	330	90	6,740	90	95% UCL	lower of 95% UCL and Max.	330	mean	Estimate of central tendency
PCBs										
Aroclor 1254	µg/kg	503	361	1,000	361	95% UCL	lower of 95% UCL and Max.	503	mean	Estimate of central tendency
SVOCs										
2-Methylnaphthalene	µg/kg	460	554	8,000	554	95% UCL	lower of 95% UCL and Max.	460	mean	Estimate of central tendency
Benzo(a)anthracene	µg/kg	455	664	6,200	664	95% UCL	lower of 95% UCL and Max.	455	mean	Estimate of central tendency
Benzo(a)pyrene	µg/kg	500	697	5,100	697	95% UCL	lower of 95% UCL and Max.	500	mean	Estimate of central tendency
Benzo(b)fluoranthene	µg/kg	133	382	5,900	382	95% UCL	lower of 95% UCL and Max.	133	mean	Estimate of central tendency
Dibenzo(a,h)anthracene	µg/kg	263	366	450	366	95% UCL	lower of 95% UCL and Max.	263	mean	Estimate of central tendency
N-Nitrosodiphenylamine	µg/kg	191	178	370	178	95% UCL	lower of 95% UCL and Max.	191	mean	Estimate of central tendency
Naphthalene	µg/kg	860	1,000	17,000	1,000	95% UCL	lower of 95% UCL and Max.	860	mean	Estimate of central tendency
bis(2-Ethylhexyl) phthalate	µg/kg	28,805	24,549	1,300,000	24,549	95% UCL	lower of 95% UCL and Max.	28,805	mean	Estimate of central tendency
4,6-Dinitro-2-methylphenol	µg/kg	383	175	1,180	175	95% UCL	lower of 95% UCL and Max.	383	mean	Estimate of central tendency
4-Nitrophalene	µg/kg	988	1,030	2,290	1,030	95% UCL	lower of 95% UCL and Max.	988	mean	Estimate of central tendency
VOCs										
Ethylbenzene	µg/kg	9,262	13,416	210,000	13,416	95% UCL	lower of 95% UCL and Max.	9,262	mean	Estimate of central tendency
Tetrachloroethene	µg/kg	113	157	1,200	157	95% UCL	lower of 95% UCL and Max.	113	mean	Estimate of central tendency
Toluene	µg/kg	8,960	13,888	310,000	13,888	95% UCL	lower of 95% UCL and Max.	8,960	mean	Estimate of central tendency
Trichloroethene	µg/kg	73	110	690	110	95% UCL	lower of 95% UCL and Max.	73	mean	Estimate of central tendency
Xylenes, Total	µg/kg	27,970	32,998	720,000	32,998	95% UCL	lower of 95% UCL and Max.	27,970	mean	Estimate of central tendency

Notes:

mg/kg = milligrams per kilogram

µg/kg = micrograms per kilogram

EPC = Exposure Point Concentration

UCL = Upper Confidence Level

max. = maximum

TABLE 4-3

EXPOSURE POINT CONCENTRATION SUMMARY - SURFACE WATER

Franklin Steel, Blacklick, Ohio

Chemical	Units	Arithmetic Mean	95 % UCL (lognormal)	Maximum Concentration	High End Exposure			Central Tendency Exposure		
					EPC Value	EPC Statistic	EPC Rationale	EPC Value	EPC Statistic	EPC Rationale
Metals										
Aluminum	mg/kg	3.4	4.0	30	4.0	95% UCL	lower of 95% UCL and Max.	3.4	mean	Estimate of central tendency
Antimony	mg/kg	0.0084	0.010	0.024	0.010	95% UCL	lower of 95% UCL and Max.	0.0084	mean	Estimate of central tendency
Arsenic	mg/kg	0.0081	0.0042	0.017	0.0042	95% UCL	lower of 95% UCL and Max.	0.0081	mean	Estimate of central tendency
Barium	mg/kg	0.12	0.048	0.45	0.048	95% UCL	lower of 95% UCL and Max.	0.12	mean	Estimate of central tendency
Copper	mg/kg	0.019	0.011	0.056	0.011	95% UCL	lower of 95% UCL and Max.	0.019	mean	Estimate of central tendency
Iron	mg/kg	3.8	3.3	27	3.3	95% UCL	lower of 95% UCL and Max.	3.8	mean	Estimate of central tendency
Lead	mg/kg	0.018	0.014	0.061	0.014	95% UCL	lower of 95% UCL and Max.	0.018	mean	Estimate of central tendency
Manganese	mg/kg	0.39	0.41	2.6	0.41	95% UCL	lower of 95% UCL and Max.	0.39	mean	Estimate of central tendency
Thallium	mg/kg	0.000057	0.000018	0.000066	0.000018	95% UCL	lower of 95% UCL and Max.	0.000057	mean	Estimate of central tendency
Vanadium	mg/kg	0.025	0.032	0.090	0.032	95% UCL	lower of 95% UCL and Max.	0.025	mean	Estimate of central tendency
SVOCs										
2-Methylnaphthalene	µg/kg	15	-	15	15	max.	maximum concentration	15	max.	max. [a]
4-Methylphenol	µg/kg	15	24	39	24	95% UCL	lower of 95% UCL and Max.	15	mean	Estimate of central tendency
Benzo(a)pyrene	µg/kg	1.1	-	1.1	1.1	max.	maximum concentration	1.1	max.	max. [a]
Benzo(b)fluoranthene	µg/kg	2.2	-	2.2	2.2	max.	maximum concentration	2.2	max.	max. [a]
Benzo(k)fluoranthene	µg/kg	1.2	-	1.2	1.2	max.	maximum concentration	1.2	max.	max. [a]
Isophorone	µg/kg	120	-	120	120	max.	maximum concentration	120	max.	max. [a]
bis(2-Ethylhexyl) phthalate	µg/kg	5	6	8	6	95% UCL	lower of 95% UCL and Max.	5	mean	Estimate of central tendency
VOCs										
Acetone	µg/kg	171	313	810	313	95% UCL	lower of 95% UCL and Max.	171	mean	Estimate of central tendency
Chloroform	µg/kg	2.0	-	2.0	2.0	max.	maximum concentration	2.0	max.	max. < mean [a]

Notes:

mg/kg = milligrams per kilogram

µg/kg = micrograms per kilogram

EPC = Exposure Point Concentration

UCL = Upper Confidence Level

max. = maximum

[a] Limited sample quantity, therefore, the maximum detected concentrations was used

TABLE 4-4

EXPOSURE POINT CONCENTRATION SUMMARY - GROUNDWATER

Franklin Steel, Blacklick, Ohio

Chemical	Units	Arithmetic Mean	95 % UCL (lognormal)	Maximum Concentration	High End Exposure			Central Tendency Exposure		
					EPC Value	EPC Statistic	EPC Rationale	EPC Value	EPC Statistic	EPC Rationale
Metals										
Aluminum	mg/kg	14	3.0	120	3.0	95% UCL	lower of 95% UCL and Max.	14	mean	Estimate of central tendency
Antimony	mg/kg	0.0036	0.00060	0.0072	0.00060	95% UCL	lower of 95% UCL and Max.	0.0036	mean	Estimate of central tendency
Beryllium	mg/kg	0.19	0.061	0.40	0.061	95% UCL	lower of 95% UCL and Max.	0.19	mean	Estimate of central tendency
Manganese	mg/kg	0.30	0.045	3.9	0.045	95% UCL	lower of 95% UCL and Max.	0.30	mean	Estimate of central tendency
Nickel	mg/kg	0.090	0.018	0.65	0.018	95% UCL	lower of 95% UCL and Max.	0.090	mean	Estimate of central tendency
Thallium	mg/kg	0.0014	0.0019	0.012	0.0019	95% UCL	lower of 95% UCL and Max.	0.0014	mean	Estimate of central tendency
SVOCs										
Indeno(1,2,3-cd)pyrene	µg/kg	0.39	0.39	0.39	0.39	max.	lower of 95% UCL and Max.	0.39	max.	max. < mean [a]
bis(2-Ethylhexyl) phthalate	µg/kg	27	32	250	32	95% UCL	lower of 95% UCL and Max.	27	mean	Estimate of central tendency
VOCs										
Chloroethane	µg/kg	163	58	460	58	95% UCL	lower of 95% UCL and Max.	163	mean	Estimate of central tendency
Methylene chloride	µg/kg	1.2	1.5	6.7	1.5	95% UCL	lower of 95% UCL and Max.	1.2	mean	Estimate of central tendency

Notes:

mg/kg = milligrams per kilogram

µg/kg = micrograms per kilogram

EPC = Exposure Point Concentration

UCL = Upper Confidence Level

max. = maximum

TABLE 4-5

VALUES AND EQUATIONS USED FOR DOSE CALCULATIONS - SITE WORKER - SOIL

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Exposure Medium: Surface Soil
Exposure Point: Operations Area
Receptor Population: Site Worker
Receptor Age: Adult

Exposure Route	Exposure Medium	Parameter Code	Parameter Definition	Units	High End Value	High End Rationale/ Reference	Central Tendency Value	Central Tendency Rationale/ Reference	Equation
Ingestion	Surface Soil	IR	Ingestion Rate	mg/day	50	USEPA, 1997b	50	USEPA, 1997b	"Dose" = IR x Ao x EF x ED x CF x FI x
		Ao	Oral Absorption	unitless	1.0	assumption	1.0	assumption	1/BW x 1/AT
		EF	Exposure Frequency	days/year	250	assumption	195	assumption	
		ED	Exposure Duration	years	21.9	USEPA, 1997b	6.6	USEPA, 1997b	
		CF	Conversion Factor	kg/mg	1E-06	by definition	1E-06	by definition	
		FI	Fraction Ingested from Source	unitless	1.0	OEPA, 2006	1.0	OEPA, 2006	
		BW	Body Weight	kg	71.8	USEPA, 1997b	71.8	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	7,994	USEPA, 1997b	2,409	USEPA, 1997b	
Dermal	Surface Soil	SA	Surface Area	cm^2	1,661	USEPA, 1997b	1,506	USEPA, 1997b	"Dose" = SA x AF x EF x ED x CF x
		AF	Adherence Factor	mg/cm^2-day	0.2	USEPA, 2001b	0.2	USEPA, 2001b	1/BW x 1/AT
		EF	Exposure Frequency	days/year	250	assumption	195	assumption	
		ED	Exposure Duration	years	22	USEPA, 1997b	6.6	USEPA, 1997b	
		CF	Conversion Factor	kg/mg	1E-06	by definition	1E-06	by definition	
		BW	Body Weight	kg	71.8	USEPA, 1997b	71.8	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	7,994	USEPA, 1997b	2,409	USEPA, 1997b	
Inhalation	Surface Soil	EF	Exposure Frequency	days/year	250	assumption	195	assumption	"Dose-c" =
		ED	Exposure Duration	years	21.9	USEPA, 1997b	6.6	USEPA, 1997b	EF x ED x CF x 1/ATc
		CF	Conversion Factor	µg/mg	1,000	by definition	1,000	by definition	"Dose-nc" =
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	EF x ED x 1/ATnc
		ATnc	Averaging Time (noncancer)	days	7,994	USEPA, 1997b	2,409	USEPA, 1997b	

Notes:

HEE = high end exposure

CTE = central tendency exposure

		Cancer		Noncancer	
	Units	HEE	CTE	HEE	CTE
"Dose" Ing	kg/kg-day	1.4E-07	3.3E-08	4.8E-07	3.7E-07
"Dose" Dermal	kg/kg-day	9.3E-07	2.0E-07	3.2E-06	2.2E-06
"Dose" Inhalation	µg/mg (cancer); unitless (noncancer)	2.0E+02	4.7E+01	6.8E-01	5.3E-01

TABLE 4-6

VALUES AND EQUATIONS USED FOR DOSE CALCULATIONS - SITE WORKER - SEDIMENT

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Exposure Medium: Sediment
Exposure Point: Settling Ponds and Discharge Channels
Receptor Population: Site Worker
Receptor Age: Adult

Exposure Route	Exposure Medium	Parameter Code	Parameter Definition	Units	High End Value	High End Rationale/ Reference	Central Tendency Value	Central Tendency Rationale/ Reference	Equation
Ingestion	Sediment	IR	Ingestion Rate	mg/day	50	USEPA, 1997b	50	USEPA, 1997b	"Dose" = IR x Ao x EF x ED x CF x FI x
		Ao	Oral Absorption	unitless	1.0	assumption	1.0	assumption	1/BW x 1/AT
		EF	Exposure Frequency	days/year	12	assumption	12	assumption	
		ED	Exposure Duration	years	21.9	USEPA, 1997b	6.6	USEPA, 1997b	
		CF	Conversion Factor	kg/mg	1E-06	by definition	1E-06	by definition	
		FI	Fraction Ing. from Source	unitless	1.0	OEPA, 2006	1.0	OEPA, 2006	
		BW	Body Weight	kg	71.8	USEPA, 1997b	71.8	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	7,994	USEPA, 1997b	2,409	USEPA, 1997b	
Dermal	Sediment	SA	Surface Area	cm^2	1,661	USEPA, 1997b	1,506	USEPA, 1997b	"Dose" = SA x AF x EF x ED x CF x
		AF	Adherence Factor	mg/cm^2-day	0.2	USEPA, 2001b	0.2	USEPA, 2001b	1/BW x 1/AT
		EF	Exposure Frequency	days/year	12	assumption	12	assumption	
		ED	Exposure Duration	years	21.9	USEPA, 1997b	6.6	USEPA, 1997b	
		CF	Conversion Factor	kg/mg	1E-06	by definition	1E-06	by definition	
		BW	Body Weight	kg	71.8	USEPA, 1997b	71.8	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	7,994	USEPA, 1997b	2,409	USEPA, 1997b	

Notes:

HEE = high end exposure

CTE = central tendency exposure

		Cancer		Noncancer	
	Units	HEE	CTE	HEE	CTE
"Dose" Ing	kg/kg-day	6.7E-09	2.0E-09	2.3E-08	2.3E-08
"Dose" Dermal	kg/kg-day	4.4E-08	1.2E-08	1.5E-07	1.4E-07

TABLE 4-7

VALUES AND EQUATIONS USED FOR DOSE CALCULATIONS - SITE WORKER - SURFACE WATER

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Exposure Medium: Surface Water
Exposure Point: Settling Ponds and Discharge Channels
Receptor Population: Site Worker
Receptor Age: Adult

Exposure Route	Exposure Medium	Parameter Code	Parameter Definition	Units	High End Value	High End Rationale/ Reference	Central Tendency Value	Central Tendency Rationale/ Reference	Equation
Ingestion	Surface Water	IR	Ingestion Rate	L/day	0.05	USEPA, 1989a	0.05	USEPA, 1989a	"Dose" = IR x Ao x EF x ED x 1/BW x 1/AT
		Ao	Oral Absorption	unitless	1.0	assumption	1.0	assumption	
		EF	Exposure Frequency	days/year	12	assumption	12	assumption	
		ED	Exposure Duration	years	21.9	USEPA, 1997b	6.6	USEPA, 1997b	
		BW	Body Weight	kg	71.8	USEPA, 1997b	71.8	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	7,994	USEPA, 1997b	2,409	USEPA, 1997b	
Dermal	Surface Water	SA	Surface Area	cm^2	1,661	USEPA, 1997b	1,506	USEPA, 1997b	"Dose" = SA x EF x ED x ET x CF x 1/BW x 1/AT
		EF	Exposure Frequency	days/year	12	assumption	12	assumption	
		ED	Exposure Duration	years	21.9	USEPA, 1997b	6.6	USEPA, 1997b	
		ET	Exposure Time	hr/day	1.00	assumption	1.00	assumption	
		CF	Conversion Factor	L/cm^3	0.001	by definition	0.001	by definition	
		BW	Body Weight	kg	71.8	USEPA, 1997b	71.8	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	7,994	USEPA, 1997b	2,409	USEPA, 1997b	

Notes:

HEE = high end exposure

CTE = central tendency exposure

		Cancer		Noncancer	
	Units	HEE	CTE	HEE	CTE
"Dose" Ing	L/kg-day	6.7E-06	2.0E-06	2.3E-05	2.3E-05
"Dose" Dermal	L-hr/kg-cm-day	2.2E-04	6.1E-05	7.6E-04	6.9E-04

TABLE 4-8

VALUES AND EQUATIONS USED FOR DOSE CALCULATIONS - CONSTRUCTION/UTILITY WORKER - SOIL

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Exposure Medium: Surface Soil
Exposure Point: Operations Area
Receptor Population: Construction/Utility Worker
Receptor Age: Adult

Exposure Route	Exposure Medium	Parameter Code	Parameter Definition	Units	High End Value	High End Rationale/ Reference	Central Tendency Value	Central Tendency Rationale/ Reference	Equation
Ingestion	Surface Soil	IR	Ingestion Rate	mg/day	50	USEPA, 1997b	50	USEPA, 1997b	"Dose" = IR x Ao x EF x ED x CF x FI x
		Ao	Oral Absorption	unitless	1.0	assumption	1.0	assumption	1/BW x 1/AT
		EF	Exposure Frequency	days/year	130	assumption	65	assumption	
		ED	Exposure Duration	years	21.9	USEPA, 1997b	6.6	USEPA, 1997b	
		CF	Conversion Factor	kg/mg	1E-06	by definition	1E-06	by definition	
		FI	Fraction Ingested from Source	unitless	1.0	OEPA, 2006	1.0	OEPA, 2006	
		BW	Body Weight	kg	71.8	USEPA, 1997b	71.8	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	7,994	USEPA, 1997b	2,409	USEPA, 1997b	
Dermal	Surface Soil	SA	Surface Area	cm^2	1,661	USEPA, 1997b	1,506	USEPA, 1997b	"Dose" = SA x AF x EF x ED x CF x
		AF	Adherence Factor	mg/cm^2-day	0.2	USEPA, 2001b	0.2	USEPA, 2001b	1/BW x 1/AT
		EF	Exposure Frequency	days/year	130	assumption	65	assumption	
		ED	Exposure Duration	years	22	USEPA, 1997b	6.6	USEPA, 1997b	
		CF	Conversion Factor	kg/mg	1E-06	by definition	1E-06	by definition	
		BW	Body Weight	kg	71.8	USEPA, 1997b	71.8	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	7,994	USEPA, 1997b	2,409	USEPA, 1997b	
Inhalation	Surface Soil	EF	Exposure Frequency	days/year	130	assumption	65	assumption	"Dose-c" =
		ED	Exposure Duration	years	21.9	USEPA, 1997b	6.6	USEPA, 1997b	EF x ED x CF x 1/ATc
		CF	Conversion Factor	µg/mg	1,000	by definition	1,000	by definition	"Dose-nc" =
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	EF x ED x 1/ATnc
		ATnc	Averaging Time (noncancer)	days	7,994	USEPA, 1997b	2,409	USEPA, 1997b	

Notes:

HEE = high end exposure

CTE = central tendency exposure

		Cancer		Noncancer	
	Units	HEE	CTE	HEE	CTE
"Dose" Ing	kg/kg-day	7.2E-08	1.1E-08	2.5E-07	1.2E-07
"Dose" Dermal	kg/kg-day	4.8E-07	6.6E-08	1.6E-06	7.5E-07
"Dose" Inhalation	µg/mg (cancer); unitless (noncancer)	1.0E+02	1.6E+01	3.6E-01	1.8E-01

TABLE 4-9

VALUES AND EQUATIONS USED FOR DOSE CALCULATIONS - CONSTRUCTION/UTILITY WORKER - SEDIMENT

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Exposure Medium: Sediment
Exposure Point: Settling Ponds and Discharge Channels
Receptor Population: Construction/Utility Worker
Receptor Age: Adult

Exposure Route	Exposure Medium	Parameter Code	Parameter Definition	Units	High End Value	High End Rationale/ Reference	Central Tendency Value	Central Tendency Rationale/ Reference	Equation
Ingestion	Sediment	IR	Ingestion Rate	mg/day	50	USEPA, 1997b	50	USEPA, 1997b	"Dose" = IR x Ao x EF x ED x CF x FI x 1/BW x 1/AT
		Ao	Oral Absorption	unitless	1.0	assumption	1.0	assumption	
		EF	Exposure Frequency	days/year	52	assumption	26	assumption	
		ED	Exposure Duration	years	21.9	USEPA, 1997b	6.6	USEPA, 1997b	
		CF	Conversion Factor	kg/mg	1E-06	by definition	1E-06	by definition	
		FI	Fraction Ing. from Source	unitless	1.0	OEPA, 2006	1.0	OEPA, 2006	
		BW	Body Weight	kg	71.8	USEPA, 1997b	71.8	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	7,994	USEPA, 1997b	2,409	USEPA, 1997b	
Dermal	Sediment	SA	Surface Area	cm^2	1,661	USEPA, 1997b	1,506	USEPA, 1997b	"Dose" = SA x AF x EF x ED x CF x 1/BW x 1/AT
		AF	Adherence Factor	mg/cm^2-day	0.2	USEPA, 2001b	0.2	USEPA, 2001b	
		EF	Exposure Frequency	days/year	52	assumption	26	assumption	
		ED	Exposure Duration	years	21.9	USEPA, 1997b	6.6	USEPA, 1997b	
		CF	Conversion Factor	kg/mg	1E-06	by definition	1E-06	by definition	
		BW	Body Weight	kg	71.8	USEPA, 1997b	71.8	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	7,994	USEPA, 1997b	2,409	USEPA, 1997b	

Notes:

HEE = high end exposure

CTE = central tendency exposure

		Cancer		Noncancer	
	Units	HEE	CTE	HEE	CTE
"Dose" Ing	kg/kg-day	2.9E-08	4.4E-09	9.9E-08	5.0E-08
"Dose" Dermal	kg/kg-day	1.9E-07	2.6E-08	6.6E-07	3.0E-07

TABLE 4-10

VALUES AND EQUATIONS USED FOR DOSE CALCULATIONS - CONSTRUCTION/UTILITY WORKER - SURFACE WATER

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Exposure Medium: Surface Water
Exposure Point: Settling Ponds and Discharge Channels
Receptor Population: Construction/Utility Worker
Receptor Age: Adult

Exposure Route	Exposure Medium	Parameter Code	Parameter Definition	Units	High End Value	High End Rationale/ Reference	Central Tendency Value	Central Tendency Rationale/ Reference	Equation
Ingestion	Surface Water	IR	Ingestion Rate	L/day	0.05	USEPA, 1989a	0.05	USEPA, 1989a	"Dose" = IR x Ao x EF x ED x 1/BW x 1/AT
		Ao	Oral Absorption	unitless	1.0	assumption	1.0	assumption	
		EF	Exposure Frequency	days/year	52	assumption	26	assumption	
		ED	Exposure Duration	years	21.9	USEPA, 1997b	6.6	USEPA, 1997b	
		BW	Body Weight	kg	71.8	USEPA, 1997b	71.8	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	7,994	USEPA, 1997b	2,409	USEPA, 1997b	
Dermal	Surface Water	SA	Surface Area	cm^2	1,661	USEPA, 1997b	1,506	USEPA, 1997b	"Dose" = SA x EF x ED x ET x CF x 1/BW x 1/AT
		EF	Exposure Frequency	days/year	52	assumption	26	assumption	
		ED	Exposure Duration	years	21.9	USEPA, 1997b	6.6	USEPA, 1997b	
		ET	Exposure Time	hr/day	1.00	assumption	1.00	assumption	
		CF	Conversion Factor	L/cm^3	0.001	by definition	0.001	by definition	
		BW	Body Weight	kg	71.8	USEPA, 1997b	71.8	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	7,994	USEPA, 1997b	2,409	USEPA, 1997b	

Notes:

HEE = high end exposure

CTE = central tendency exposure

		Cancer		Noncancer	
	Units	HEE	CTE	HEE	CTE
"Dose" Ing	L/kg-day	2.9E-05	4.4E-06	9.9E-05	5.0E-05
"Dose" Dermal	L-hr/kg-cm-day	9.6E-04	1.3E-04	3.3E-03	1.5E-03

TABLE 4-11

VALUES AND EQUATIONS USED FOR DOSE CALCULATIONS - HYPOTHETICAL CHILD TRESPASSER - SOIL

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Exposure Medium: Surface Soil
Exposure Point: Operations Area
Receptor Population: Hypothetical Trespasser
Receptor Age: Child (6 to 12 years old)

Exposure Route	Exposure Medium	Parameter Code	Parameter Definition	Units	High End Value	High End Rationale/ Reference	Central Tendency Value	Central Tendency Rationale/ Reference	Equation
Ingestion	Surface Soil	IR	Ingestion Rate	mg/day	100	USEPA, 2001a	100	USEPA, 2001a	"Dose" = IR x Ao x EF x ED x CF x FI x
		Ao	Oral Absorption	unitless	1.0	assumption	1.0	assumption	1/BW x 1/AT
		EF	Exposure Frequency	days/year	36	assumption	12	assumption	
		ED	Exposure Duration	years	6	USEPA, 1997b	6	USEPA, 1997b	
		CF	Conversion Factor	kg/mg	1E-06	by definition	1E-06	by definition	
		FI	Fraction Ingested from Source	unitless	0.5	assumption	0.5	assumption	
		BW	Body Weight	kg	30.8	USEPA, 1997b	30.8	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	2,190	USEPA, 1997b	2,190	USEPA, 1997b	
Dermal	Surface Soil	SA	Surface Area	cm^2	3,249	USEPA, 1997b	2,756	USEPA, 1997b	"Dose" = SA x AF x EF x ED x CF x
		AF	Adherence Factor	mg/cm^2-day	0.04	USEPA, 2001b	0.04	USEPA, 2001b	1/BW x 1/AT
		EF	Exposure Frequency	days/year	36	assumption	12	assumption	
		ED	Exposure Duration	years	6	USEPA, 1997b	6	USEPA, 1997b	
		CF	Conversion Factor	kg/mg	1E-06	by definition	1E-06	by definition	
		BW	Body Weight	kg	30.8	USEPA, 1997b	30.8	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	2,190	USEPA, 1997b	2,190	USEPA, 1997b	
Inhalation	Surface Soil	EF	Exposure Frequency	days/year	36	assumption	12	assumption	"Dose-c" =
		ED	Exposure Duration	years	6	USEPA, 1997b	6	USEPA, 1997b	EF x ED x CF x 1/ATc
		CF	Conversion Factor	µg/mg	1,000	by definition	1,000	by definition	"Dose-nc" =
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	EF x ED x 1/ATnc
		ATnc	Averaging Time (noncancer)	days	2,190	USEPA, 1997b	2,190	USEPA, 1997b	

Notes:

HEE = high end exposure

CTE = central tendency exposure

	Units	Cancer		Noncancer	
		HEE	CTE	HEE	CTE
"Dose" Ing	kg/kg-day	1.3E-08	4.3E-09	1.6E-07	5.3E-08
"Dose" Dermal	kg/kg-day	3.3E-08	9.4E-09	4.2E-07	1.2E-07
"Dose" Inhalation	µg/mg (cancer); unitless (noncancer)	7.9E+00	2.6E+00	9.9E-02	3.3E-02

TABLE 4-12

VALUES AND EQUATIONS USED FOR DOSE CALCULATIONS - HYPOTHETICAL CHILD TRESPASSER - SEDIMENT

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Exposure Medium: Sediment
Exposure Point: Unzinger's Ditch
Receptor Population: Hypothetical Trespasser
Receptor Age: Child (6 to 12 years old)

Exposure Route	Exposure Medium	Parameter Code	Parameter Definition	Units	High End Value	High End Rationale/ Reference	Central Tendency Value	Central Tendency Rationale/ Reference	Equation
Ingestion	Sediment	IR	Ingestion Rate	mg/day	100	USEPA, 2001a	100	USEPA, 2001a	"Dose" = IR x Ao x EF x ED x CF x FI x
		Ao	Oral Absorption	unitless	1.0	assumption	1.0	assumption	1/BW x 1/AT
		EF	Exposure Frequency	days/year	36	assumption	12	assumption	
		ED	Exposure Duration	years	6	USEPA, 1997b	6	USEPA, 1997b	
		CF	Conversion Factor	kg/mg	1E-06	by definition	1E-06	by definition	
		FI	Fraction Ingested from Source	unitless	0.5	assumption	0.5	assumption	
		BW	Body Weight	kg	30.8	USEPA, 1997b	30.8	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	2,190	USEPA, 1997b	2,190	USEPA, 1997b	
Dermal	Sediment	SA	Surface Area	cm^2	3,249	USEPA, 1997b	2,756	USEPA, 1997b	"Dose" = SA x AF x EF x ED x CF x
		AF	Adherence Factor	mg/cm^2-day	0.2	USEPA, 2001b	0.2	USEPA, 2001b	1/BW x 1/AT
		EF	Exposure Frequency	days/year	36	assumption	12	assumption	
		ED	Exposure Duration	years	6	USEPA, 1997b	6	USEPA, 1997b	
		CF	Conversion Factor	kg/mg	1E-06	by definition	1E-06	by definition	
		BW	Body Weight	kg	30.8	USEPA, 1997b	30.8	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	2,190	USEPA, 1997b	2,190	USEPA, 1997b	

Notes:

HEE = high end exposure

CTE = central tendency exposure

		Cancer		Noncancer	
	Units	HEE	CTE	HEE	CTE
"Dose" Ing	kg/kg-day	1.3E-08	4.3E-09	1.6E-07	5.3E-08
"Dose" Dermal	kg/kg-day	1.7E-07	4.7E-08	2.1E-06	5.9E-07

TABLE 4-13

VALUES AND EQUATIONS USED FOR DOSE CALCULATIONS - HYPOTHETICAL CHILD TRESPASSER - SURFACE WATER

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Exposure Medium: Surface Water
Exposure Point: Unzinger's Ditch
Receptor Population: Hypothetical Trespasser
Receptor Age: Child (6 to 12 years old)

Exposure Route	Exposure Medium	Parameter Code	Parameter Definition	Units	High End Value	High End Rationale/ Reference	Central Tendency Value	Central Tendency Rationale/ Reference	Equation
Ingestion	Surface Water	IR	Ingestion Rate	L/day	0.05	USEPA, 1989a	0.05	USEPA, 1989a	"Dose" = IR x Ao x EF x ED x 1/BW x 1/AT
		Ao	Oral Absorption	unitless	1.0	assumption	1.0	assumption	
		EF	Exposure Frequency	days/year	36	assumption	12	assumption	
		ED	Exposure Duration	years	6	USEPA, 1997b	6	USEPA, 1997b	
		BW	Body Weight	kg	30.8	USEPA, 1997b	30.8	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	2,190	USEPA, 1997b	2,190	USEPA, 1997b	
Dermal	Surface Water	SA	Surface Area	cm^2	3,249	USEPA, 1997b	2,756	USEPA, 1997b	"Dose" = SA x EF x ED x ET x CF x 1/BW x 1/AT
		EF	Exposure Frequency	days/year	36	assumption	12	assumption	
		ED	Exposure Duration	years	6	USEPA, 1997b	6	USEPA, 1997b	
		ET	Exposure Time	hrs/day	1	USEPA, 1997b	1	USEPA, 1997b	
		CF	Conversion Factor	L/cm^3	0.001	by definition	0.001	by definition	
		BW	Body Weight	kg	30.8	USEPA, 1997b	30.8	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	2,190	USEPA, 1997b	2,190	USEPA, 1997b	

Notes:

HEE = high end exposure

CTE = central tendency exposure

		Cancer		Noncancer	
	Units	HEE	CTE	HEE	CTE
"Dose" Ing	L/kg-day	1.3E-05	4.3E-06	1.6E-04	5.3E-05
"Dose" Dermal	L-hr/kg-cm-day	8.3E-04	2.4E-04	1.0E-02	2.9E-03

TABLE 4-14

VALUES AND EQUATIONS USED FOR DOSE CALCULATIONS - HYPOTHETICAL ADOLESCENT TRESPASSER - SOIL

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Exposure Medium: Surface Soil
Exposure Point: Operations Area
Receptor Population: Hypothetical Trespasser
Receptor Age: Adolescent (12 to 18 years old)

Exposure Route	Exposure Medium	Parameter Code	Parameter Definition	Units	High End Value	High End Rationale/ Reference	Central Tendency Value	Central Tendency Rationale/ Reference	Equation
Ingestion	Surface Soil	IR	Ingestion Rate	mg/day	100	USEPA, 2001a	50	USEPA, 1997b	"Dose" = IR x Ao x EF x ED x CF x FI x
		Ao	Oral Absorption	unitless	1.0	assumption	1.0	assumption	1/BW x 1/AT
		EF	Exposure Frequency	days/year	36	assumption	12	assumption	
		ED	Exposure Duration	years	6	USEPA, 1997b	6	USEPA, 1997b	
		CF	Conversion Factor	kg/mg	1E-06	by definition	1E-06	by definition	
		FI	Fraction Ingested from Source	unitless	0.5	assumption	0.5	assumption	
		BW	Body Weight	kg	56	USEPA, 1997b	56	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	2,190	USEPA, 1997b	2,190	USEPA, 1997b	
Dermal	Surface Soil	SA	Surface Area	cm^2	4,786	USEPA, 1997b	4,159	USEPA, 1997b	"Dose" = SA x AF x EF x ED x CF x
		AF	Adherence Factor	mg/cm^2-day	0.04	USEPA, 2001b	0.04	USEPA, 2001b	1/BW x 1/AT
		EF	Exposure Frequency	days/year	36	assumption	12	assumption	
		ED	Exposure Duration	years	6	USEPA, 1997b	6	USEPA, 1997b	
		CF	Conversion Factor	kg/mg	1E-06	by definition	1E-06	by definition	
		BW	Body Weight	kg	56	USEPA, 1997b	56	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	2,190	USEPA, 1997b	2,190	USEPA, 1997b	
Inhalation	Surface Soil	EF	Exposure Frequency	days/year	36	assumption	12	assumption	"Dose-c" =
		ED	Exposure Duration	years	6	USEPA, 1997b	6	USEPA, 1997b	EF x ED x CF x 1/ATc
		CF	Conversion Factor	µg/mg	1,000	by definition	1,000	by definition	"Dose-nc" =
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	EF x ED x 1/ATnc
		ATnc	Averaging Time (noncancer)	days	2,190	USEPA, 1997b	2,190	USEPA, 1997b	

Notes:

HEE = high end exposure

CTE = central tendency exposure

	Units	Cancer		Noncancer	
		HEE	CTE	HEE	CTE
"Dose" Ing	kg/kg-day	7.0E-09	1.2E-09	8.8E-08	1.5E-08
"Dose" Dermal	kg/kg-day	2.7E-08	7.8E-09	3.4E-07	9.8E-08
"Dose" Inhalation	µg/mg (cancer); unitless (noncancer)	7.9E+00	2.6E+00	9.9E-02	3.3E-02

TABLE 4-15

VALUES AND EQUATIONS USED FOR DOSE CALCULATIONS - HYPOTHETICAL ADOLESCENT TRESPASSER - SEDIMENT

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Exposure Medium: Sediment
Exposure Point: Unzinger's Ditch
Receptor Population: Hypothetical Trespasser
Receptor Age: Adolescent (12 to 18 years old)

Exposure Route	Exposure Medium	Parameter Code	Parameter Definition	Units	High End Value	High End Rationale/ Reference	Central Tendency Value	Central Tendency Rationale/ Reference	Equation
Ingestion	Sediment	IR	Ingestion Rate	mg/day	100	USEPA, 2001a	50	USEPA, 1997b	"Dose" = IR x Ao x EF x ED x CF x FI x 1/BW x 1/AT
		Ao	Oral Absorption	unitless	1.0	assumption	1.0	assumption	
		EF	Exposure Frequency	days/year	36	assumption	12	assumption	
		ED	Exposure Duration	years	6	USEPA, 1997b	6	USEPA, 1997b	
		CF	Conversion Factor	kg/mg	1E-06	by definition	1E-06	by definition	
		FI	Fraction Ingested from Source	unitless	0.5	assumption	0.5	assumption	
		BW	Body Weight	kg	56	USEPA, 1997b	56	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	2,190	USEPA, 1997b	2,190	USEPA, 1997b	
Dermal	Sediment	SA	Surface Area	cm^2	4,786	USEPA, 1997b	4,159	USEPA, 1997b	"Dose" = SA x AF x EF x ED x CF x 1/BW x 1/AT
		AF	Adherence Factor	mg/cm^2-day	0.2	USEPA, 2001b	0.2	USEPA, 2001b	
		EF	Exposure Frequency	days/year	36	assumption	12	assumption	
		ED	Exposure Duration	years	6	USEPA, 1997b	6	USEPA, 1997b	
		CF	Conversion Factor	kg/mg	1E-06	by definition	1E-06	by definition	
		BW	Body Weight	kg	56	USEPA, 1997b	56	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	2,190	USEPA, 1997b	2,190	USEPA, 1997b	

Notes:

HEE = high end exposure

CTE = central tendency exposure

		Cancer		Noncancer	
	Units	HEE	CTE	HEE	CTE
"Dose" Ing	kg/kg-day	7.0E-09	1.2E-09	8.8E-08	1.5E-08
"Dose" Dermal	kg/kg-day	1.3E-07	3.9E-08	1.7E-06	4.9E-07

TABLE 4-16

VALUES AND EQUATIONS USED FOR DOSE CALCULATIONS - HYPOTHETICAL ADOLESCENT TRESPASSER - SURFACE WATER

Franklin Steel, Blacklick, Ohio

Scenario Timeframe: Current and Future
Exposure Medium: Surface Water
Exposure Point: Unzinger's Ditch
Receptor Population: Hypothetical Trespasser
Receptor Age: Adolescent (12 to 18 years old)

Exposure Route	Exposure Medium	Parameter Code	Parameter Definition	Units	High End Value	High End Rationale/ Reference	Central Tendency Value	Central Tendency Rationale/ Reference	Equation
Ingestion	Surface Water	IR	Ingestion Rate	L/day	0.05	USEPA, 1989a	0.05	USEPA, 1989a	"Dose" = IR x Ao x EF x ED x 1/BW x 1/AT
		Ao	Oral Absorption	unitless	1.0	assumption	1.0	assumption	
		EF	Exposure Frequency	days/year	36	assumption	12	assumption	
		ED	Exposure Duration	years	6	USEPA, 1997b	6	USEPA, 1997b	
		BW	Body Weight	kg	56	USEPA, 1997b	56	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	2,190	USEPA, 1997b	2,190	USEPA, 1997b	
Dermal	Surface Water	SA	Surface Area	cm^2	4,786	USEPA, 1997b	4,159	USEPA, 1997b	"Dose" = SA x EF x ED x ET x CF x 1/BW x 1/AT
		EF	Exposure Frequency	days/year	36	assumption	12	assumption	
		ED	Exposure Duration	years	6	USEPA, 1997b	6	USEPA, 1997b	
		ET	Exposure Time	hrs/day	1	assumption	1	assumption	
		CF	Conversion Factor	L/cm^3	0.001	by definition	0.001	by definition	
		BW	Body Weight	kg	56	USEPA, 1997b	56	USEPA, 1997b	
		ATc	Averaging Time (cancer)	days	27,375	USEPA, 1997b	27,375	USEPA, 1997b	
		ATnc	Averaging Time (noncancer)	days	2,190	USEPA, 1997b	2,190	USEPA, 1997b	

Notes:

HEE = high end exposure

CTE = central tendency exposure

		Cancer		Noncancer	
	Units	HEE	CTE	HEE	CTE
"Dose" Ing	L/kg-day	7.0E-06	2.3E-06	8.8E-05	2.9E-05
"Dose" Dermal	L-hr/kg-cm-day	6.7E-04	2.0E-04	8.4E-03	2.4E-03

TABLE 4-17
DERMAL FACTORS
Franklin Steel, Blacklick, Ohio

Chemical of Potential Concern	Dermal Permeability Coefficient (cm/hr)	Reference	Dermal Absorption Factor (unitless)	Reference
Metals				
Aluminum	0.0010	USEPA 2004 (RAGS Part E)	0.0010	USEPA 2001b (RAGS Part E)
Antimony	0.0010	USEPA 2001 (RAGS Part E)	0.0010	USEPA Region 4
Arsenic	0.0010	USEPA 2004 (RAGS Part E)	0.030	USEPA 2004 (RAGS Part E)
Barium	0.0010	USEPA 2004 (RAGS Part E)	0.0010	USEPA 2004 (RAGS Part E)
Beryllium	0.0010	USEPA 2001 (RAGS Part E)	0.0010	USEPA Region 4
Cadmium	0.0010	USEPA 2004 (RAGS Part E)	0.0010	USEPA 2004 (RAGS Part E)
Chromium	0.0010	USEPA 2001 (RAGS Part E)	0.0010	USEPA Region 4
Copper	0.0010	USEPA 2004 (RAGS Part E)	0.0010	USEPA 2004 (RAGS Part E)
Iron	0.0010	USEPA 2001 (RAGS Part E)	0.0010	USEPA Region 4
Lead	0.00010	USEPA 2001 (RAGS Part E)	0.010	USEPA 1995c
Manganese	0.0010	USEPA 2001 (RAGS Part E)	0.0010	USEPA Region 4
Mercury	0.24	USEPA 2004 (RAGS Part E)	0.0010	USEPA 2004 (RAGS Part E)
Nickel	0.00020	USEPA 2004 (RAGS Part E)	0.0010	USEPA 2004 (RAGS Part E)
Silver	0.00060	USEPA 2004 (RAGS Part E)	0.0010	USEPA 2004 (RAGS Part E)
Thallium	0.0010	USEPA 2001 (RAGS Part E)	0.0010	USEPA Region 4
Vanadium	0.0010	USEPA 2001 (RAGS Part E)	0.0010	USEPA Region 4
Zinc	0.00060	USEPA 2004 (RAGS Part E)	0.0010	USEPA 2004 (RAGS Part E)
PCBs				
Aroclor 1254	N/A	—	0.017	Calculated from Total Organic Carbon (4.6%) [a]
SVOCs				
4,6-Dinitro-2-methylphenol	0.0037	USEPA 2004 (RAGS Part E)	0.010	USEPA 2004 (RAGS Part E)
4-Nitrophalene	0.0061	USEPA 2004 (RAGS Part E)	0.010	USEPA 2004 (RAGS Part E)
2-Methylnaphthalene	0.142	USEPA 2004 (RAGS Part E)	0.010	USEPA 2004 (RAGS Part E)
4-Methylphenol	0.0099	USEPA 2004 (RAGS Part E)	0.010	USEPA 2004 (RAGS Part E)
Benzo(a)anthracene	0.48	USEPA 2001b (RAGS Part E)	0.13	USEPA 2001b (RAGS Part E)
Benzo(a)pyrene	0.66	USEPA 2001b (RAGS Part E)	0.13	USEPA 2001b (RAGS Part E)
Benzo(b)fluoranthene	0.76	USEPA 2001b (RAGS Part E)	0.13	USEPA 2001b (RAGS Part E)
Benzo(k)fluoranthene	0.76	USEPA 2001b (RAGS Part E)	0.13	USEPA 2001b (RAGS Part E)
Dibenzo(a,h)anthracene	1.1	USEPA 2001b (RAGS Part E)	0.13	USEPA 2001b (RAGS Part E)
Indeno(1,2,3-cd)pyrene	1.1	USEPA 2001b (RAGS Part E)	0.13	USEPA 2001b (RAGS Part E)
Isophorone	0.0035	USEPA 2001b (RAGS Part E)	0.10	USEPA 2001b (RAGS Part E)
bis(2-Ethylhexyl)phthalate	0.68	USEPA 2001b (RAGS Part E)	0.10	USEPA 2001b (RAGS Part E)
N-Nitrosodiphenylamine	0.020	USEPA 2004 (RAGS Part E)	0.010	USEPA 2004 (RAGS Part E)
Naphthalene	0.069	USEPA 2004 (RAGS Part E)	0.13	USEPA 2004 (RAGS Part E)
VOCs				
Acetone	0.00057	USEPA 2004 (RAGS Part E)	0.010	USEPA 2004 (RAGS Part E)
Chloroethane	0.0080	USEPA 2004 (RAGS Part E)	0.010	USEPA 2004 (RAGS Part E)
Chloroform	0.0089	USEPA 2004 (RAGS Part E)	0.010	USEPA 2004 (RAGS Part E)
Ethylbenzene	0.073	USEPA 2004 (RAGS Part E)	0.010	USEPA 2004 (RAGS Part E)
Methylene chloride	0.0044	USEPA 2004 (RAGS Part E)	0.010	USEPA 2004 (RAGS Part E)
Tetrachloroethene	0.048	USEPA 2004 (RAGS Part E)	0.010	USEPA 2004 (RAGS Part E)
Toluene	0.045	USEPA 2004 (RAGS Part E)	0.010	USEPA 2004 (RAGS Part E)
Trichloroethene	0.015	USEPA 2004 (RAGS Part E)	0.010	USEPA 2004 (RAGS Part E)
Xylenes, Total	0.047	USEPA 2001b (RAGS Part E)	0.010	USEPA 2004 (RAGS Part E)

Notes:
N/A = not applicable; total PCBs are not a chemical of potential concern in surface water
PCBs = polychlorinated biphenyls
SVOCs = semi-volatile organic compounds
VOCs = volatile organic compounds

[a] dermal absorption factor (unitless) = (-0.1395 x % total organic carbon + 2.1628) / 100

TABLE 4-18
SOIL TO AIR VOLATILIZATION FACTORS
Franklin Steel, Blacklick, Ohio

Chemical of Potential Concern	Inverse of the mean concentration at the center of a 0.5 square-acre source [a]	Exposure interval [a]	Dry soil bulk density [a]	Air-filled soil porosity [b]	Total soil porosity [c]	Water-filled soil porosity [a]	Soil particle density [a]	Diffusivity in air [d]	Henry's Law Constant [d]	Diffusivity in water [d]	Soil-water partition coefficient [e]	Soil-organic carbon partition coefficient [d]	Fraction organic carbon in soil [f]	Apparent diffusivity [g]	Soil to Air Volatilization Factor [h]
	Q/C	T	ρ_b	SP_a	n	SP_w	ρ_s	D_i	H	D_w	Kd	Koc	foc	D_A	VF
	g/m^2-s per kg/m^3	s	g/cm^3	unitless	unitless	unitless	g/cm^3	cm^2/s	unitless	cm^2/s	cm^3/g	cm^3/g	g/g	cm^2/s	m^3/kg
Metals															
Aluminum	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	NA	NA	9.57E-06	1.50E+01 [d]	NA	0.046	NA	NA
Antimony	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	NA	2.45E-02	9.57E-06	4.50E+01 [d]	NA	0.046	NA	NA
Arsenic	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	NA	NA	NA	2.90E+01 [d]	NA	0.046	NA	NA
Barium	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	NA	NA	NA	4.10E+01 [d]	NA	0.046	NA	NA
Beryllium	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	NA	NA	NA	7.90E+02 [d]	NA	0.046	NA	NA
Cadmium	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	NA	NA	NA	7.50E+01 [d]	NA	0.046	NA	NA
Chromium	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	NA	NA	NA	1.80E+06 [d]	NA	0.046	NA	NA
Copper	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	NA	NA	NA	3.50E+01 [d]	NA	0.046	NA	NA
Iron, Total	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	NA	NA	NA	2.50E+01 [d]	NA	0.046	NA	NA
Lead, total	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	NA	NA	NA	9.00E+02 [d]	NA	0.046	NA	NA
Manganese	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	NA	NA	NA	6.50E+01 [d]	NA	0.046	NA	NA
Mercury	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.0307	NA	6.30E-06	5.20E+01 [d]	NA	0.046	NA	NA
Nickel	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	NA	NA	NA	6.50E+01 [d]	NA	0.046	NA	NA
Silver	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	NA	NA	NA	8.30E+00 [d]	NA	0.046	NA	NA
Thallium	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	NA	NA	NA	7.10E+01 [d]	NA	0.046	NA	NA
Vanadium	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	NA	NA	NA	6.20E+01 [d]	NA	0.046	NA	NA
Zinc	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	NA	NA	NA	6.20E+01 [d]	NA	0.046	NA	NA
PCBs															
Aroclor 1254	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.0175	1.96E-02	8.00E-06	7.27E+04	1.58E+06	0.046	3.16E-10	9.2E+06
SVOCs															
4,6-Dinitro-2-methylphenol	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.0293	5.72E-05	6.91E-06	2.77E+01	6.02E+02	0.046	5.50E-09	2.2E+06
4-Nitrophalene	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.0430	1.70E-08	9.61E-06	1.42E+01	3.09E+02	0.046	3.97E-09	2.6E+06
2-Methylnaphthalene	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.0480	2.12E-02	7.84E-06	1.37E+02	2.98E+03	0.046	4.96E-07	2.3E+05
4-Methylphenol	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.0740	4.09E-05	1.00E-05	2.00E+01	4.34E+02	0.046	1.30E-08	1.4E+06
Benzo(a)anthracene	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.0510	1.37E-04	9.00E-06	1.83E+04	3.98E+05	0.046	2.84E-11	3.1E+07
Benzo(a)pyrene	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.0430	4.63E-05	9.00E-06	4.69E+04	1.02E+06	0.046	3.97E-12	8.2E+07
Benzo(b)fluoranthene	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.0226	4.55E-03	5.56E-06	5.66E+04	1.23E+06	0.046	1.22E-10	1.5E+07
Benzo(k)fluoranthene	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.0226	3.40E-05	5.56E-06	5.66E+04	1.23E+06	0.046	1.49E-12	1.3E+08
Dibenzo(a,h)anthracene	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.0202	6.00E-07	5.18E-06	1.75E+05	3.80E+06	0.046	1.80E-13	3.9E+08
Indeno(1,2,3-cd)pyrene	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.0190	6.56E-05	5.66E-06	1.60E+05	3.47E+06	0.046	7.31E-13	1.9E+08
Isophorone	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.0623	6.60E-06	6.76E-06	2.15E+00	4.68E+01	0.046	2.99E-08	9.5E+05
bis(2-Ethylhexyl)phthalate	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.0351	1.30E-07	3.66E-06	5.11E+03	1.11E+05	0.046	4.30E-12	7.9E+07
N-Nitrosodiphenylamine	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.0312	4.95E-05	6.35E-06	2.83E+02	6.15E+03	0.046	4.97E-10	7.3E+06
Naphthalene	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.0590	1.80E-02	7.50E-06	8.45E+01	1.84E+03	0.046	8.39E-07	1.8E+05
VOCs															
Acetone	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.124	1.62E-03	1.14E-05	9.11E-02	1.98E+00	0.046	6.87E-05	2.0E+04
Chloroethane	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.271	4.54E-01	1.15E-05	1.09E+00	2.37E+01	0.046	6.34E-03	2.1E+03
Chloroform	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.104	1.50E-01	1.00E-05	1.61E+00	3.50E+01	0.046	5.96E-04	6.7E+03
Ethylbenzene	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.0750	3.22E-01	7.80E-06	2.38E+01	5.18E+02	0.046	6.72E-05	2.0E+04
Methylene chloride	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.101	1.33E-01	1.17E-05	1.09E+00	2.37E+01	0.046	7.32E-04	6.0E+03
Tetrachloroethene	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.0720	7.24E-01	8.20E-06	4.91E+00	1.07E+02	0.046	6.73E-04	6.3E+03
Toluene	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.0870	2.71E-01	8.60E-06	1.23E+01	2.68E+02	0.046	1.26E-04	1.5E+04
Trichloroethene	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.0790	4.03E-01	9.10E-06	3.11E+00	6.77E+01	0.046	6.43E-04	6.4E+03
Xylenes, Total	85.63	9.5E+08	1.43	0.31	0.46	0.15	2.65	0.0737	7.00E-03	9.34E-06	2.56E+01	5.56E+02	0.046	1.34E-06	1.4E+05

Notes:

PCBs = polychlorinated biphenyls

SVOCs = semi-volatile organic compounds

VOCs = volatile organic compounds

[a] USEPA 2001d

[b] Air-filled soil porosity = n-SP_w

[c] Total soil porosity = 1-(ρ_b/ρ_s)

[d] RAIS (Risk Assessment Information Systems chemical factors database), 2002 for all chemicals except benzo(g,h,i)perylene. For benzo(g,h,i)perylene, www.epa.gov/ttn/chief/softwar/water was used.

[e] Kd = Koc x foc

[f] site specific

[g] $D_A = [(SP_a^{10/3} \times D_i \times H + SP_w^{10/3} \times D_w) / n^2] / (\rho_b \times K_d + SP_w + SP_a \times H)$

[h] $VF = (QC \times (3.14 \times D_A \times T)^{1/2} \times 10^{-4}) / (2 \times \rho_b \times D_A)$

TABLE 4-19
NONCANCER TOXICITY DATA - ORAL/DERMAL
Franklin Steel, Blacklick, Ohio

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value Applied	Oral to Dermal Adjustment Factor	Adjusted Dermal RfD	Units	Critical Effect/ Target Organ Organ	Combined Uncertainty/Modifying Factors	Sources of RfD
Metals								
Aluminum	chronic	1.0	1.0	1.0	mg/kg-day	psychomotor/cognitive impairment	100	RAIS
Antimony	chronic	0.00040	0.15	0.000060	mg/kg-day	blood glucose and cholesterol	1000	IRIS
Arsenic	chronic	0.00030	1.0	0.00030	mg/kg-day	hyperpigmentation, keratosis, vascular complications	3	IRIS
Barium	subchronic	0.20	0.070	0.014	mg/kg-day	nephropathy	300	IRIS
Beryllium	chronic	0.0020	0.0070	0.000014	mg/kg-day	small intestinal lesions	300	IRIS
Cadmium	chronic	0.00050	0.050	0.000025	mg/kg-day	proteninura	10	IRIS
Chromium	chronic	1.5	0.013	0.019	mg/kg-day	NA	1000	IRIS
Copper	chronic	0.040	1.0	0.040	mg/kg-day	NA	N/A	RAIS
Iron	chronic	0.30	0.010	0.30	mg/kg-day	not specified [b]	not specified [c]	NCEA
Lead	chronic	N/A	0.010	N/A	N/A	N/A	N/A	N/A
Manganese	chronic	0.14	0.040	0.0056	mg/kg-day	CNS effects	1	IRIS
Mercury	chronic	0.00030	1.0	0.00030	mg/kg-day	N/A	30	RAIS
Nickel	chronic	0.020	0.040	0.00080	mg/kg-day	decreased body and organ weight	300	RAIS
Silver	chronic	0.0050	1.0	0.0050	mg/kg-day	skin/argyria	3	IRIS
Thallium	chronic	0.000080	0.010	0.000080	mg/kg-day	increased levels of SGOT and LHD	3000	IRIS
Vanadium	chronic	0.0090	0.010	0.0090	mg/kg-day	decreased hair cystine	100	IRIS
Zinc	chronic	0.3000	1.0	0.30	mg/kg-day	decrease in ESOD concentrations	3	IRIS
PCBs								
Aroclor 1254	chronic	0.000020	1.0	0.000020	mg/kg-day	skin/eye/immune sys.	300	IRIS
SVOCs								
4,6-Dinitro-2-methylphenol	chronic	NA	N/A	NA	N/A	NA	N/A	NA
4-Nitrophalene	chronic	NA	N/A	NA	N/A	NA	N/A	NA
2-Methylnaphthalene	chronic	0.0040	1.0	0.0040	mg/kg-day	pulmonary alveolar	1000	IRIS
4-Methylphenol	chronic	NA	N/A	NA	N/A	NA	NA	IRIS
Benz(a)anthracene	chronic	0.030 [a]	1.0	0.030	mg/kg-day	NA	N/A	N/A
Benzo(a)pyrene	chronic	0.030 [a]	1.0	0.030	mg/kg-day	NA	N/A	N/A
Benzo(b)fluoranthene	chronic	0.030 [a]	1.0	0.030	mg/kg-day	NA	N/A	N/A
Benzo(k)fluoranthene	chronic	0.030 [a]	1.0	0.030	mg/kg-day	NA	N/A	N/A
Dibenz(a,h)anthracene	chronic	0.030 [a]	1.0	0.030	mg/kg-day	NA	N/A	N/A
Indeno(1,2,3-cd)pyrene	chronic	0.030 [a]	1.0	0.030	mg/kg-day	NA	N/A	N/A
Isophorone	chronic	0.20	1.0	0.20	mg/kg-day	liver/kidney pathology	1000	IRIS
bis(2-Ethylhexyl)phthalate	chronic	0.020	1.0	0.020	mg/kg-day	increased relative liver weight	1000	IRIS
N-Nitrosodiphenylamine	chronic	NA	N/A	NA	N/A	bladder tumors	NA	IRIS
Naphthalene	chronic	0.020	1.0	0.020	mg/kg-day	terminal body weights	3000	IRIS
VOCs								
Acetone	chronic	0.90	1.0	0.90	mg/kg-day	liver	1000	RAIS
Chloroethane	chronic	NA	N/A	NA	N/A	NA	N/A	RAIS
Chloroform	chronic	0.010	1.0	0.010	mg/kg-day	fatty cyst formation	1000	IRIS
Elthylbenzene	chronic	0.10	1.0	0.10	mg/kg-day	liver and kidney	1000	RAIS
Methylene chloride	chronic	0.060	1.0	0.060	mg/kg-day	toxicity	100	RAIS
Tetrachloroethene	chronic	0.010	1.0	0.01	mg/kg-day	hepatotoxicity and weight gain	1000	IRIS
Toluene	chronic	0.080	1.0	0.080	mg/kg-day	increased kidney weight	3000	RAIS
Trichloroethene	chronic	0.00030	1.0	0.00030	mg/kg-day	liver, kidney developmental effects	N/A	RAIS
Xylenes, total	chronic	0.20.	1.0	0.20	mg/kg-day	decreased body weight, increased mortality	1000	IRIS

Notes:
IRIS = Integrated Risk Information Service (www.epa.gov/iris)
NCEA = National Center for Environmental Assessment
RAIS = Risk Assessment Information System
N/A = not applicable
NA = no data available
RfD = Reference Dose
mg/kg-day = milligrams per kilogram bodyweight per day

[a] The RfD for pyrene was used for all PAHs without verified RfDs.
[b] EPA Region 9 Preliminary Remedial Goal tables cite NCEA as the source of the iron RfD (primary studies were not discussed).
[c] USEPA Region 9 Preliminary Remedial Goal tables cite NCEA as the source of the iron RfD (primary studies were not discussed).

TABLE 4-20
NONCANCER TOXICITY DATA - INHALATION
Franklin Steel, Blacklick, Ohio

Chemical of Potential Concern	Inhalation RfC Value Applied	Units	Critical Effect/ Target Organ	Combined Uncertainty/Modifying Factors	Source of RfC
Metals					
Aluminum	0.0050	mg/m^3	psychomotor/cognitive impairment	300	RAIS
Antimony	0.00190	mg/m^3	NA	N/A	calculated from RfD [a]
Arsenic	NA	N/A	NA	N/A	N/A
Barium	0.00050	mg/m^3	fetotoxicity	1000	RAIS
Beryllium	0.000020	mg/m^3	Nasal Cavity	1	IRIS
Cadmium	NA	N/A	NA	N/A	N/A
Chromium	NA	N/A	NA	N/A	IRIS
Copper	NA	N/A	NA	N/A	RAIS
Iron	1.0	mg/m^3	NA	1	calculated from RfD [a]
Lead	NA	N/A	NA	N/A	N/A
Manganese	0.000050	mg/m^3	CNS	1	IRIS
Mercury	0.00030	mg/m^3	hand temor, memory disturbance, autonomic dysfunction	30	IRIS
Nickel	NA	N/A	NA	N/A	RAIS
Silver	NA	N/A	NA	N/A	RAIS
Thallium	0.00040	mg/m^3	NA	N/A	calculated from RfD [a]
Vanadium	0.04310	mg/m^3	NA	N/A	calculated from RfD [a]
Zinc	NA	N/A	NA	N/A	RAIS
PCBs					
Aroclor 1254	0.00010	mg/m^3	NA	N/A	calculated from RfD [a]
SVOCs					
4,6-Dinitro-2-methylphenol	NA	N/A	NA	N/A	NA
4-Nitrophalene	NA	N/A	NA	N/A	NA
2-Methylnaphthalene	NA	N/A	NA	N/A	IRIS
4-Methylphenol	NA	N/A	NA	N/A	IRIS
Benz(a)anthracene	0.10	mg/m^3	NA	N/A	calculated from RfD [a]
Benzo(a)pyrene	0.10	mg/m^3	NA	N/A	calculated from RfD [a]
Benzo(b)fluoranthene	0.10	mg/m^3	NA	N/A	calculated from RfD [a]
Benzo(k)fluoranthene	0.10	mg/m^3	NA	N/A	calculated from RfD [a]
Dibenz(a,h)anthracene	0.10	mg/m^3	NA	N/A	calculated from RfD [a]
Indeno(1,2,3-cd)pyrene	0.10	mg/m^3	NA	N/A	calculated from RfD [a]
Isophorone	1.0	mg/m^3	Liver	N/A	calculated from RfD [a]
bis(2-Ethylhexyl)phthalate	0.10	mg/m^3	NA	N/A	calculated from RfD [a]
N-Nitrosodiphenylamine	NA	N/A	NA	N/A	IRIS
Naphthalene	0.0030	mg/m^3	nasel cavity	3000	IRIS
VOCs					
Acetone					
Chloroethane	1.0E+01	mg/m^3		300	IRIS
Chloroform					
Elthylbenzene	1.0	mg/m^3	developmental toxicity	300	RAIS
Methylene chloride	3.0	mg/m^3	toxicity	100	RAIS
Tetrachloroethene	0.60	mg/m^3	tubular cell karyomegaly	30	RAIS
Toluene	5.0	mg/m^3	neurological effects	10	RAIS
Trichloroethene	0.040	mg/m^3	CNS, liver and endocrine system	NA	RAIS
Xylenes, total	0.96	mg/m^3	CNS	1	IRIS

Notes:
IRIS = USEPA Integrated Risk Information Service (www.epa.gov/iris)
CNS = central nervous system
N/A = not applicable
NA = no data available
RfC = Reference Concentration
RfD = Reference Dose
mg/m^3 = milligrams per cubic meter

[a] RfC = (RfD* 71.8 kg) / (15 m^3/day)

TABLE 4-21
CANCER TOXICITY DATA - ORAL/DERMAL
Franklin Steel, Blacklick, Ohio

Chemical of Potential Concern	Oral Cancer Slope Factor	Body Weight Correction Factor [a]	Adjusted Dermal Cancer Slope Factor	Units	Weight of Evidence/ Cancer Guideline Description	Source
Metals						
Aluminum	NA	N/A	NA	N/A	D	RAIS
Antimony	NA	N/A	NA	N/A	NA	IRIS
Arsenic	1.5	N/A	1.5	$(mg/kg\text{-}day)^{-1}$	A	IRIS
Barium	NA	N/A	NA	N/A	D	RAIS
Beryllium	8.4	N/A	NA	$(mg/kg\text{-}day)^{-1}$	B2	IRIS
Cadmium	NA	N/A	NA	N/A	B1	IRIS
Chromium	NA	N/A	NA	N/A	D	IRIS
Copper	NA	N/A	NA	N/A	D	RAIS
Iron	NA	N/A	NA	N/A	B2	IRIS
Lead	NA	N/A	NA	N/A	B2	IRIS
Manganese	NA	N/A	NA	N/A	D	IRIS
Mercury	NA	N/A	NA	N/A	D	RAIS
Nickel	NA	N/A	NA	N/A	D	RAIS
Silver	NA	N/A	NA	N/A	D	RAIS
Thallium	NA	N/A	NA	N/A	D	IRIS
Vanadium	NA	N/A	NA	N/A	D	IRIS
Zinc	NA	N/A	NA	N/A	D	RAIS
PCBs						
Aroclor 1254 (HEE)	2.0	1.0	2.0	$(mg/kg\text{-}day)^{-1}$	B2	IRIS
Aroclor 1254 (CTE)	1.0	1.0	1.0	$(mg/kg\text{-}day)^{-1}$	B2	IRIS
SVOCs						
4,6-Dinitro-2-methylphenol	NA	N/A	NA	N/A	NA	NA
4-Nitrophalene	NA	N/A	NA	N/A	NA	NA
2-Methylnaphthalene	NA	N/A	NA	N/A	NA	IRIS
4-Methylphenol	NA	N/A	NA	N/A	C	IRIS
Benz(a)anthracene	0.73	1.0	0.74	$(mg/kg\text{-}day)^{-1}$	B2	NCEA
Benzo(a)pyrene	7.3	1.0	7.4	$(mg/kg\text{-}day)^{-1}$	B2	IRIS
Benzo(b)fluoranthene	0.73	1.0	0.74	$(mg/kg\text{-}day)^{-1}$	B2	NCEA
Benzo(k)fluoranthene	0.073	1.0		$(mg/kg\text{-}day)^{-1}$	B2	NCEA
Dibenz(a,h)anthracene	7.3	1.0	7.4	$(mg/kg\text{-}day)^{-1}$	B2	IRIS
Indeno(1,2,3-cd)pyrene	0.73	1.0	0.74	$(mg/kg\text{-}day)^{-1}$	B2	NCEA
Isophorone	0.00095	1.0	0.0010	$(mg/kg\text{-}day)^{-1}$	C	IRIS
bis(2-Ethylhexyl)phthalate	0.014	1.0	0.014	$(mg/kg\text{-}day)^{-1}$	B2	IRIS
N-Nitrosodiphenylamine	0.0049	1.0	0.0049	$(mg/kg\text{-}day)^{-1}$	B2	RAIS
Naphthalene	NA	N/A	NA	N/A	C	IRIS
VOCs						
Acetone	NA	N/A	NA	N/A	D	RAIS
Chloroethane	NA	N/A	NA	N/A	NA	RAIS
Chloroform	0.01	N/A	0.0061	$(mg/kg\text{-}day)^{-1}$	B2	IRIS
Elthylbenzene	NA	N/A	NA	N/A	D	RAIS
Methylene chloride	0.0075	N/A	NA	$(mg/kg\text{-}day)^{-1}$	B2	RAIS
Tetrachloroethene	0.54	N/A	0.052	$(mg/kg\text{-}day)^{-1}$	C-B2	RAIS
Toluene	NA	N/A	NA	N/A	D	RAIS
Trichloroethene	0.40	N/A	NA	$(mg/kg\text{-}day)^{-1}$	B2	RAIS
Xylenes, total	NA	N/A	NA	N/A	NA	IRIS

Notes:
IRIS = Integrated Risk Information System
NCEA = National Cener for Environmental Assessment
RAIS = Risk Assessment Information System
N/A = not applicable
NA = no data available
$(mg/kg\text{-}day)^{-1}$ = per milligram per kilogram bodyweight per day

[a] Body Weight Correction Factor = $(71.8\ kg/70\ kg)^{1/3}$ (USEPA, 1997b)

USEPA Weight of Evidence Group:
A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity

TABLE 4-22
CANCER TOXICITY DATA - INHALATION
Franklin Steel, Blacklick, Ohio

Chemical of Potential Concern	Inhalation UR Value Applied	Units	Weight of Evidence/ Cancer Guideline Description	Source of UR
Metals				
Aluminum				
Antimony	NA	N/A	NA	RAIS
Arsenic	0.0043	$(\mu g/m^3)^{-1}$	A	IRIS
Barium	NA	N/A	NA	RAIS
Beryllium	0.00024	$(\mu g/m^3)^{-1}$	B2	IRIS
Cadmium	0.0018	$(\mu g/m^3)^{-1}$	B1	IRIS
Chromium	NA	N/A	D	IRIS
Copper	NA	N/A	NA	RAIS
Iron	NA	N/A	NA	IRIS
Lead	NA	N/A	B2	IRIS
Manganese	NA	N/A	D	IRIS
Mercury	NA	N/A	D	IRIS
Nickel	0.00024	$(\mu g/m^3)^{-1}$	A	IRIS
Silver	NA	N/A	D	RAIS
Thallium	NA	N/A	D	IRIS
Vanadium	NA	N/A	D	IRIS
Zinc	NA	N/A	D	RAIS
PCBs				
Aroclor 1254	0.00042	$(\mu g/m^3)^{-1}$	B2	0.57
SVOCs				
4,6-Dinitro-2-methylphenol	NA	N/A	NA	NA
4-Nitrophalene	NA	N/A	NA	NA
2-Methylnaphthalene	NA	N/A	NA	IRIS
4-Methylphenol	NA	N/A	C	IRIS
Benz(a)anthracene	0.088	$(\mu g/m^3)^{-1}$	B2	RAIS
Benzo(a)pyrene	0.88	$(\mu g/m^3)^{-1}$	B2	RAIS
Benzo(b)fluoranthene	0.088	$(\mu g/m^3)^{-1}$	B2	RAIS
Benzo(k)fluoranthene	0.0088	$(\mu g/m^3)^{-1}$	B2	RAIS
Dibenz(a,h)anthracene	0.88	$(\mu g/m^3)^{-1}$	B2	RAIS
Indeno(1,2,3-cd)pyrene	0.088	$(\mu g/m^3)^{-1}$	B2	RAIS
Isophorone	NA	N/A	C	IRIS
bis(2-Ethylhexyl)phthalate	0.014	$(\mu g/m^3)^{-1}$	B2	IRIS
N-Nitrosodiphenylamine	NA	N/A	B2	IRIS
Naphthalene	NA	N/A	C	IRIS
VOCs				
Acetone	NA	N/A	D	RAIS
Chloroethane	NA	N/A	NA	RAIS
Chloroform	0.000023	$(\mu g/m^3)^{-1}$	B2	IRIS
Elthylbenzene	0.0011	$(\mu g/m^3)^{-1}$	D	RAIS
Methylene chloride	0.00047	$(\mu g/m^3)^{-1}$	B2	RAIS
Tetrachloroethene	0.058	$(\mu g/m^3)^{-1}$	C-B2	RAIS
Toluene	NA	N/A	D	RAIS
Trichloroethene	NA	N/A	B2	RAIS
Xylenes, total	NA	N/A	NA	IRIS

Notes:
IRIS = Integrated Risk Information System
RAIS = Risk Assessment Information System
N/A = not applicable
NA = not available
UR = Unit Risk
$(\mu g/m^3)^{-1}$ = per microgram per cubic meter

USEPA Weight of Evidence Group:
A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity

Figures

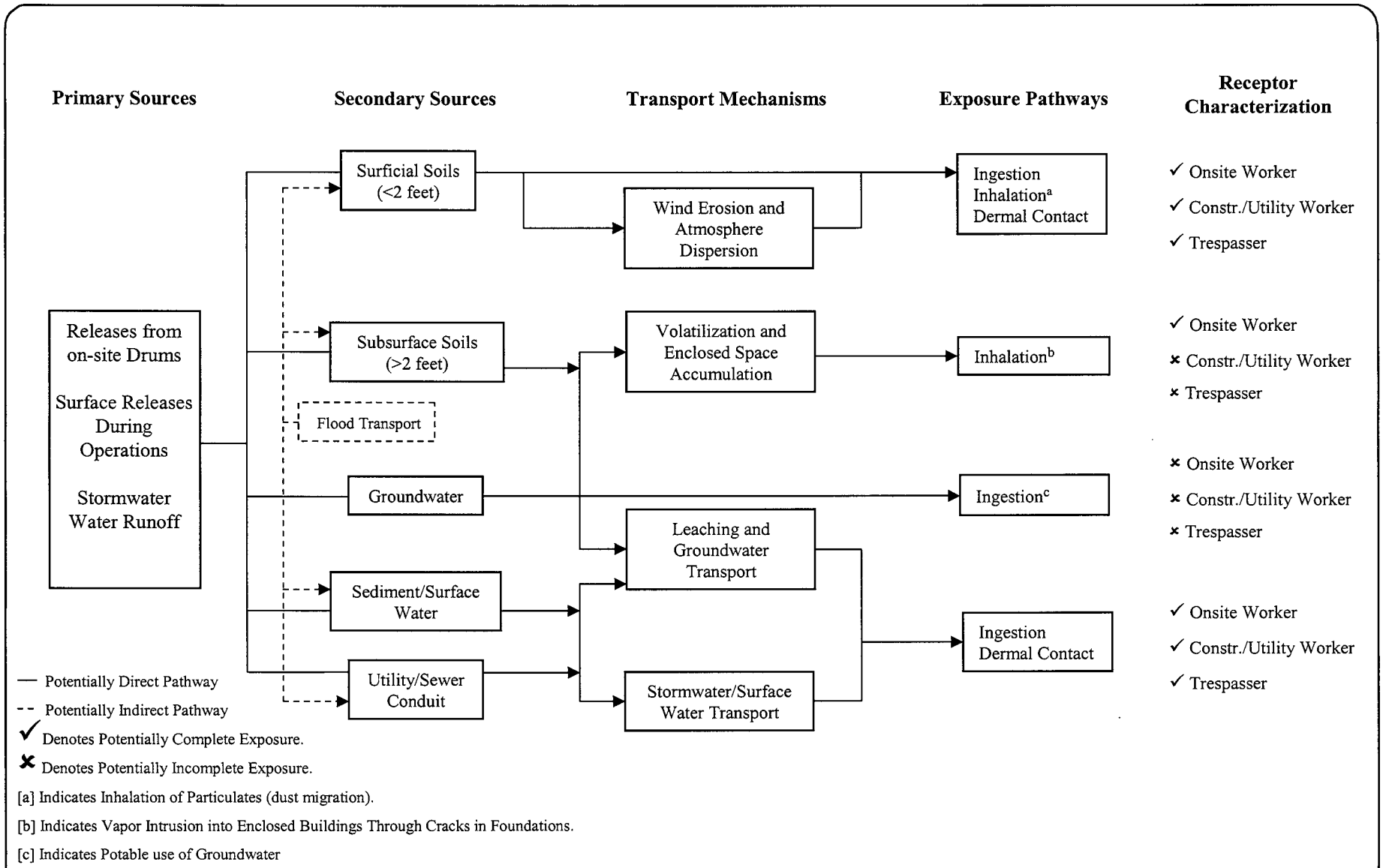

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Figure 1 Conceptual Site Model For Franklin Steel Exposures