6.0 EXPOSURE PATHWAY ANALYSIS

This section presents the equations and factors used to calculate individual chemical intakes from exposure to the media-specific chemical concentrations modeled in Section 5.0. As described previously, exposures were modeled for the following populations:

Farmer (adult and child);
Fisherman (adult and child);
Typical resident (adult and child);

Exposures were evaluated for both typical and high end exposure scenarios. In combination, the typical and high end exposure scenarios serve to bound the potential exposures estimated for the population surrounding the facility. The typical exposure scenario evaluates risk using exposure assumptions set at their central tendencies for the populations being evaluated.

The high end exposures are calculated to provide a reasonable upper bound to the potential risks associated with exposure to emissions from the kiln stacks. The high end exposure scenario was defined by setting one or more of the exposure assumptions to upper bound or maximum values while keeping other exposure assumptions at their typical values. Site-specific and population-specific information as well as technical judgment were employed in arriving at an appropriate mix of high end and typical exposure values. This mix of high end and typical exposure assumptions yields a reasonable maximum exposure.

For both the typical and high end exposure scenarios, both child and adult exposures were estimated. Child exposures are presented, in addition to adult exposures, because for some scenarios evaluated a child's activity patterns are such that their exposure, when corrected for body weight, may exceed that of an adult. The child was generally assumed to be from 1 to 7 years of age for most of the scenarios evaluated.

In general, U.S. EPA recommended exposure factors were used where site-specific data was unavailable. Sources for these exposure factors include: the indirect exposure

guidance document (U.S. EPA 1990), *U.S. EPA's Risk Assessment Guidance for Superfund* (RAGS) (U.S. EPA 1989a), *Estimating Exposures to Dioxin-Like Compounds* (U.S. EPA 1992a), and the U.S. EPA 1998 HHRAP guidance document. When appropriate, exposure parameters known or thought to be more representative of the population of Cass and Carroll Counties were used in lieu of guidance recommended values.

Lastly, it is noted that several of the exposure parameters used in the equations described in this section are standard to all scenarios. These include the child and adult body weights (assumed to be 15 kg and 70 kg, respectively) and an exposure duration of 30 years for the typical adult population and 6 years for the child population for all scenarios. It should be noted that the exposure duration of 30 years represents U.S. EPA's estimate of an upperbound residency period for all populations. A shorter exposure duration (e.g., nine years) has been determined to be the average for residency at any location on a nationwide basis. Use of the 30-year exposure period for the adult exposure durations, therefore, may overestimate the average exposure duration for local populations. However, the nine year value was not selected for use in the typical exposure scenarios because of the site's rural site setting and the relatively large study area considered which suggest that a typical residency period within the study area may exceed nine years.

6.1 EXPOSURE TO AIR

The following equation was used to estimate inhalation exposures to all chemicals present in emissions from the ESSROC facility.

Intake (mg-kg/day) = CA*FR*IR*ET*ED*EF*0.001/BW*AT [Equation 6-1]

where:

CA = concentration in air (ug/m^3)
FR = fraction respirable (unitless)
IR = inhalation rate (m^3/hour)
ET = exposure time (hours/day)
EF = exposure frequency (days/year)
ED = exposure duration (years)
BW = body weight (kg)

AT = averaging time (days)
0.001 = conversion factor ug/m^3 to mg/m^3

The primary factors affecting daily intake are the assumed inhalation rates, the daily exposure duration and the modeled air concentrations. Inhalation rates of 0.6 m^3/hour and 0.83 m^3 hour were used for the child and adult populations, respectively (U.S. EPA, 1997a) for both the typical and the high end exposure scenarios. These inhalation rates are based on an individual involved in light activity. Exposure times of 24 hours/day was assumed for the child and adult populations for both the typical and high end exposure scenarios.

The exposure frequency for the child and adult populations was assumed to be 350 days/year based on U.S. EPA guidance (U.S. EPA, 1991a) for both scenarios. As discussed above, exposure durations of 30 years for adults and 6 years for children were chosen for both exposure scenarios. Averaging times of 2,190 and 10,950 days were used to evaluate exposures to noncarcinogenic compounds by the child and adult populations, respectively. An averaging time of 25,550 days was used for both the child and adult populations for exposure to carcinogenic compounds.

All of the parameter values used to estimate inhalation intakes are summarized in Table 6-1.

6.2 EXPOSURE TO SOIL

Intake of chemicals of concern in soil may occur through the ingestion and dermal absorption exposure routes. The concentrations of the chemicals of concern in untilled soils, using the maximum exposure area air parameter values previously determined in Section 5.2 and shown on Table 4-4, were used in this evaluation. These concentrations are used to evaluate the high end and typical exposure scenarios, respectively. Untilled soil concentrations were selected because they represent soil concentrations in areas where the majority of an individual exposure is expected to occur.

The following sections summarize the methods used to estimate the intakes for the chemicals of concern in soil through the incidental ingestion and dermal absorption pathways.

6.2.1 INCIDENTAL INGESTION

The following equation was used to estimate the magnitude of incidental ingestion of chemicals of concern in soil attributable to emissions from the ESSROC facility.

Intake (mg-kg/day) = CS*IR*CF*FI*EF*ED/BW*AT [Equation 6-2]

where:

CS = chemical concentration in soil (mg/kg)
IR = soil ingestion rate (mg/day)
CF = conversion factor (10^{-6} kg/mg)
FI = fraction ingested from contaminated source
EF = exposure frequency (days/year)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time (days)

The soil ingestion rates used to estimate intake are the soil ingestion rates for children and adults as recommended by the U.S. EPA (U.S. EPA, 1991a). For children, a soil ingestion rate of 200 mg/day was used, and for adults a soil ingestion rate of 100 mg/day was used. These daily soil ingestion rates account for incidental soil ingestion as a result of normal day-to-day activities.

The exposure frequency for the child and adult populations was assumed to be 350 days/year based on U.S. EPA guidance (U.S. EPA, 1991a). The fraction of soil ingested from contaminated sources was assumed to be 1.0 for all scenarios. As previously stated, exposure durations of 30 years for an adult and 6 years for a child were used for both the typical and high end exposure scenarios. Averaging times of 2,190 and 10,950 days were used to evaluate exposures to noncarcinogenic compounds by the child and adult populations, respectively. An averaging time of 25,550 days was used for both the child and adult populations for exposure to carcinogenic compounds.

The parameter values used to estimate soil intakes via ingestion are summarized in Table 6-1.

6.2.2 DERMAL ABSORPTION

The following equation was used to estimate the magnitude of dermal absorption of chemicals of concern in soil attributable to emissions from the ESSROC facility.

Intake (mg-kg/day) = CS*CF*SA*AF*ABS*EF*ED/BW*AT [Equation 6-3]

where:

CS = chemical concentration in soil (mg/kg)
CF = conversion factor (10^{-6} kg/mg)
SA = skin surface area (cm^2/event)
AF = soil to skin adherence factor (mg/cm^2)
ABS = absorption factor (unitless)
EF = exposure frequency (days/year)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time (days)

The total skin surface area exposed was estimated to be 970 cm^2 and 1,890 cm^2 for the child and adult typical exposure populations, respectively, and 2,440 cm^2 and 4,950 cm^2 for the child and adult high end exposure scenarios, respectively. These values represent a conservative reasonable estimate of skin surface area exposed year round. It is noted that more skin surface would be exposed during the summer months and less during the winter months.

A soil to skin adherence factor of 0.2 mg/cm^2 was used for all populations and scenarios modeled and is based on U.S. EPA guidance.

Absorption factors of 1% and 10% were used for inorganic and semi-volatile organic compounds (Ryan et al. 1987), respectively, with one exception. An absorption factor of 3% was used for dioxins based on U.S. EPA guidance (U.S. EPA, 1992a). In using these default dermal absorption factors, it is noted that these default values represent the dermal absorption efficiency (i.e., 1 or 10%) of the particular compound relative to its oral

absorption efficiency. These default values are considered relative absorption factors and not absolute absorption factors.

The body weight, exposure frequency, exposure duration, and averaging time values were the same as those used in the soil ingestion equation for both the typical and high end exposure scenarios.

The parameter values used to estimate soil intakes via dermal absorption Table 6-1 summarizes.

6.3 EXPOSURE TO SURFACE WATER

Intake of chemicals in surface water may occur through several exposure routes, including:

- Ingestion of surface water used for drinking water;
- Incidental ingestion of surface water while swimming;
- Dermal contact with surface water while swimming; and
- Consumption of fish from surface water.

Three surface water bodies were evaluated in this assessment: the Eel River which is Logansport's water supply, the Wabash River assumed to be used for recreational purposes including recreational fishing and swimming; and France Park, a local recreation spot. The concentrations of chemicals of concern in these water bodies are presented in Table 5-6.

6.3.1 INGESTION OF DRINKING WATER

The following equation was used to estimate the intakes of chemicals from ingestion of drinking water obtained from the Eel River and used as a municipal water supply.

Intake (mg-kg/day) = CW*IR*EF*ED/BW*AT [Equation 6-4]

where:

CW = chemical concentration in water (mg/liter)
IR = ingestion rate (liters/day)
EF = exposure frequency (days/year)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time (days)

For this scenario, the dissolved phase (Cdw) chemical concentration was used. The dissolved phase fraction was used because the municipal water supply for Logansport is treated with clarifiers and filters, which will remove chemicals adsorbed to suspended solids.

Adults were assumed to ingest water a rate of 2 L/day for both the typical and high end scenario. Children were assumed to ingest 1 L/day for both scenarios (U.S. EPA, 1997a).

The body weight, exposure frequency, exposure duration, and averaging time values were the same as those used in the soil ingestion equation for both the typical and high end exposure scenarios.

6.3.2 INCIDENTAL INGESTION OF WATER

Individuals involved in recreational activities involving water could incidentally ingest water. The following equation was used to estimate the intakes of chemicals from incidental ingestion of water during recreational activities.

Intake (mg-kg/day) = CW*IR*ET*EF*ED/BW*AT [Equation 6-5]

where:

CW = chemical concentration in water (mg/L)
IR = ingestion rate (liters/hour)
ET = exposure time (hours/event)
EF = exposure frequency (days/year)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time (years)

The chemical concentrations in the dissolved phase for the Wabash River and the swimming lake at France Park were used to estimate the chemical intakes associated with

incidental ingestion of water while swimming (Equation 6-5) for the typical and high end exposure scenarios, respectively. An ingestion rate of 50 ml/hour, an exposure time of 2.6 hours/event were assumed for both the typical and high end exposure scenarios. Exposure frequencies of 7 and 20 days/year (U.S. EPA, 1997a) were used for the typical and high end exposure scenarios, respectively.

The body weight, exposure duration, and averaging time values were the same as those used in the soil ingestion equation for both the typical and high end exposure scenarios.

6.3.3 DERMAL ABSORPTION

The following equation was used to estimate the intakes of chemicals that could occur by dermal absorption while swimming.

Intake (mg-kg/day) = CW*SA*PC*ET*EF*ED*CF/BW*AT [Equation 6-6]

where:

CW = chemical concentration in water (mg/L)
SA = skin surface area available for contact (cm^2)
PC = dermal permeability constant (cm/hour)
ET = exposure time (hours/event)
EF = exposure frequency (days/year)
ED = exposure duration (years)
CF = volumetric conversion factor for water (liter/cm^3)
BW = body weight (kg)
AT = averaging time (days)

The dissolved fraction chemical concentrations in the Wabash River and the swimming lake at France Park were used to estimate intakes associated with dermal absorption for the typical and high end exposures, respectively.

Equation 6-6 uses a dermal permeability constant (PC) to estimate the flux of chemicals through skin during water exposures. Dermal permeability constants are chemical-specific and the methods used to determine the dermal permeability constants are presented in Appendix C. An exposure time of 2.6 hours/event was used for both scenarios. As with incidental ingestion, adult and child exposure frequencies of 7 days/year for the typical scenario and 20 days per year for the high end scenario were

used to estimate dermal exposure by swimming. Estimates of exposed skin surface area were obtained from U.S. EPA guidance (U.S. EPA, 1997a). The 50th percentile total body surface area of adult males (19,400 cm^2) was used in the equation for adults. The 50th percentile total body surface areas of males ages 1 to 7 years (7,280 cm^2) was used in the equation for children. These surface areas were used for both the typical and high end exposure scenarios.

Body weights, averaging times, exposure durations, and exposure frequencies were the same as used for the incidental ingestion of surface water while swimming.

6.3.4 INGESTION OF FISH

The following equation was used to estimate the intakes of chemicals due to ingestion of locally caught fish.

Intake (mg-kg/day) = Cf*IRf*FI*EF*ED/AT [Equation 6-7]

where:

Cf = chemical concentration in fish (mg/kg)
IRf = fish ingestion rate (kg/kg BW/day)
FI = fraction ingested from contaminated source (unitless)
EF = exposure frequency (days/year)
ED = exposure duration (years)
AT = averaging time (days)

The concentrations of chemicals of potential concern in fish were estimated using the equation and available bioaccumulation and bioconcentration factors, as described in Section 5.4.2. For the high end adult exposure scenario, a fish consumption rate of 32 g/day representing the average of the 95th percentile consumption rates from published freshwater recreational fishing surveys conducted in Michigan and Wisconsin (U.S. EPA Exposure Factors Handbook; Volume II, Chapter 10, 1997) was used. This value was divided by the standard adult body weight of 70 kg to give a consumption rate of 0.00045 kg/kgBW/day. For the high end child exposure scenario, the U.S. population 95th percentile consumption rate for children 0 to 9 years of age of 0.00035 kg/kgBw/day was used.

For the typical exposure scenario, a fish consumption rate representing the U.S. population average of 14.3 g/day for adults was divided by the adult body weight and adjusted by 50% to account for the fraction of total consumption attributed to freshwater sources. This results in a consumption rate of 0.000102 kg/kg BW/day for an adult. For child typical exposures, the U.S. population average consumption rate of 0.000188 kg/kgBW/day for children 0 to 9 years of age was used.

For the high end exposure scenario, it was assumed that a fisherman would obtain 25% of his fish diet from the Wabash River. Therefore, the fraction fish ingested from the Wabash River for the fisherman under the high end scenario was assumed to be 0.25. The fraction ingested from the impacted source was assumed to be 0.1 for the typical exposure scenario.

Averaging times, exposure durations, and exposure frequencies were the same as those used in the soil ingestion equation and are presented on Table 6-1.

6.4 EXPOSURE TO PLANTS

The following equation was used to estimate the intake of chemicals of concern from the consumption of plants.

Intake (mg-kg/day) = Cp*IRp*FI*EF*ED/AT [Equation 6-8]

where:

Cp = chemical concentration in plant (mg/kg)
IRp = plant ingestion rate (kg/kg BW/day)
FI = fraction ingested from contaminated source (unitless)
EF = exposure frequency (days/year)
ED = exposure duration (years)
AT = averaging time (days)

The predicted vegetable concentrations used as intakes for these equations were those determined in Section 5.5 and presented on Table 5-9.

Intakes rates for all three home produced vegetable categories evaluated in this risk assessment for both the typical and high end exposure scenarios were derived from data presented in U.S. EPA 1997a and described in the U.S. EPA 1998 HHRAP guidance document. The ingestion rates described in the U.S. EPA 1998 HHRAP guidance document were derived from a 1987-1988 USDA National Food Consumption Survey. For the vegetable categories modeled in this risk assessment, the consumption rates are as follows:

Plant (Plant Group)	**Consumption Rate (kg DW/kg BW/day)**	
	Adults	**Children**
Sweet Corn (Protected)	0.00057	0.00077
Potatoes (Belowground)	0.00014	0.00022
Spinach (Exposed Aboveground)	0.0003	0.00042

The fraction of vegetables consumed by local residents/farmers under the typical and high end exposure scenario that are grown on contaminated soil were determined from data presented in Table 5-7 of U.S. EPA 1990. This data presents the percentage of plant foods produced at home. There is significant uncertainty in this data in that it is based on a one time limited three day study. However, in the absence of more specific data on this subject, these data are used as a reasonable estimate of the likely fraction of these crops that are home grown. Table 5-7 of U.S. EPA 1990 presents data for four populations: all urbanization, central city, suburban and non-metropolitan. Data for the nonmetropolitan population is thought to best represent an upper bound for the majority of home gardening residents of Cass and Carroll Counties and is used for the typical exposures modeled in this risk assessment. For the vegetables included in the generic home garden under the typical and high exposure scenarios these fractions were determined to be:

	Typical	**High End**
Sweet Corn	0.34	0.67
Potatoes	0.065	0.22
Spinach	0.17	0.33

It should be noted that in addition to the uncertainty in this data due to its being based on a single three day study, there is also uncertainty presented by the fact that the above

fractions represent home grown vegetables only and that some residents may consume other locally grown vegetables (i.e., traded with neighbors or purchased at local garden stands). This uncertainty is lessened somewhat by the fact that Cass and Carroll counties are not significant producers of garden type vegetables for export. As stated previously, over 85% of the cropland in the area is used for production of just two crops (corn and soybeans).

Averaging times, exposure durations, and exposure frequencies used to estimate exposures to home grown vegetables were the same as those used in the soil ingestion equation.

6.5 EXPOSURE TO MEAT, POULTRY, AND DAIRY PRODUCTS

Chemical intake from the consumption of meat, poultry and dairy products was calculated by multiplying the concentration of pollutant in the food product by the consumption rate of that product and by the fraction of that product produced in an area impacted by kiln emissions. The equation expressing this relationship is presented as follows.

Intake (mg-kg/day) = Ct*IRt*FI*EF*ED/AT [Equation 6-9]

where:

Ct = chemical concentration in animal product (mg/kg)
IRt = product ingestion rate (kg/kg BW/day)
FI = fraction ingested from contaminated source (unitless)
EF = exposure frequency (days/year)
ED = exposure duration (years)
AT = averaging time (days)

The consumption rates for animal products used in this equation are those presented in Table 5-8 of U.S. EPA 1990. The 50th percentile consumption rates for adults and children are presented below (all are presented in units of kg DW/kg BW/day):

	Adult	Child
Beef	0.00054	0.0012
Dairy	0.00072	0.00380
Pork	0.00033	0.00096
Poultry	0.00011	0.00035
Eggs	0.00012	0.00053

For the typical and high end exposure scenarios, the fractions of animal products consumed by local residents that is raised on feed from areas impacted by the kiln emissions was determined from data presented in Table 5-9 of U.S. EPA 1990. The data used to evaluate the intake rates for the populations modeled in this assessment were the percentages for non-metropolitan populations presented in this table. No specific recommendations for these fractions are presented in U.S. EPA 1990. U.S. EPA (1992a) cites a survey of 900 rural farm households in developing high end fractions of 0.44 and 0.4 for beef and dairy products, respectively. These data are used for determining the fraction of animal products for the typical and high end exposure scenario as listed below:

	Typical	High End
Beef	0.15	0.44
Dairy	0.031	0.40
Pork	0.09	0.44
Poultry	0.08	0.44
Eggs	0.079	0.44

Body weights, averaging times, exposure durations and exposure frequencies were the same as those used for the soil ingestion equation and are presented in Table 6-1.

Table 6-1
Parameter Values Used For Intake Equations
ESSROC
Logansport, Indiana

Equation	Parameter	Typical		High End	
		Child	Adult	Child	Adult
Air Inhalation-Vapor Phase and Particulates (Equation 6-1)	CA = Concentration in Air (mg/m3)	Chemical-specific			
	FR = Fraction Respirable	100%	100%	100%	100%
	IR = Inhalation Rate (m3/hour)	0.6	0.83	0.6	0.83
	ET = Exposure Time (hours/day)	24	24	24	24
	EF = Exposure Frequency (days/year)	350	350	350	350
	ED = Exposure Duration (years)	6	30	6	30
	BW = Body Weight (kg)	15	70	15	70
	AT = Averaging Time (days)	2,190**	10,950**	2,190**	10,950**
Soil Ingestion (Equation 6-2)	CS = Average Concentration in Soil (mg/kg)	Chemical-specific			
	IR = Ingestion Rate (mg soil/day)	200	100	200	100
	CF = Conversion Factor (10^{-6} kg/mg)	0.000001			
	FI = Fraction Ingested from Contaminated Source	100%	100%	100%	100%
	EF = Exposure Frequency (days/year)	350	350	350	350
	ED = Exposure Duration (years)	6	30	6	30
	BW = Body Weight (kg)	15	70	15	70
	AT = Averaging Time (days)	2,190**	10,950**	2,190**	10,950**
Soil Dermal Contact (Equation 6-3)	CS = Average Concentration in Soil (mg/kg)	Chemical-specific			
	CF = Conversion Factor (10^{-6} kg/mg)	0.000001			
	SA = Skin Surface Area (cm^2/event)	970	1,890	2,440	4,950
	AF = Soil to Skin Adherence Factor (mg/cm^2)	0.2	0.2	0.2	0.2
	ABS = Absorption Factor (unitless)	Chemical-specific (A)			
	EF = Exposure Frequency (days/year)	350	350	350	350
	ED = Exposure Duration (years)	6	30	6	30
	BW = Body Weight (kg)	15	70	15	70
	AT = Averaging Time (days)	2,190**	10,950**	2,190**	10,950**

Table 6-1
Parameter Values Used For Intake Equations
ESSROC
Logansport, Indiana

Equation	Parameter	Typical		High End	
		Child	Adult	Child	Adult
Drinking Water Ingestion (Equation 6-4)	CW = Concentration in Water (mg/liter)	Chemical-specific			
	IR = Ingestion Rate (liters/day)	1	2	1	2
	EF = Exposure Frequency (days/year)	350	350	350	350
	ED = Exposure Duration (years)	6	30	6	30
	BW = Body Weight (kg)	15	70	15	70
	AT = Averaging Time (days)	2,190**	10,950**	2,190**	10,950**
Surface Water Ingestion (Equation 6-5)	CW = Chemical Concentration in Water (mg/l)	Chemical-specific			
	CR = Contact Rate (liters/hour)	0.05	0.05	0.05	0.05
	ET = Exposure Time (hours/event)	2.6	2.6	2.6	2.6
	EF = Exposure Frequency (days/year)	7	7	20	20
	ED = Exposure Duration (years)	6	30	6	30
	BW = Body Weight (kg)	15	70	15	70
	AT = Averaging Time (days)	2,190**	10,950**	2,190**	10,950**
Surface Water Dermal Contact (Equation 6-6)	CW = Chemical Concentration in Water (mg/l)	Chemical-specific			
	SA = Skin Surface Area Available for Contact (cm^2)	7,280	19,400	7,280	19,400
	PC = Dermal Permeability Constant (cm/hour)	Chemical-specific			
	ET = Exposure Time (hours/event)	2.6	2.6	2.6	2.6
	EF = Exposure Frequency (days/year)	7	7	20	20
	ED = Exposure Duration (years)	6	30	6	30
	CF = Volumetric Conversion Factor for Water (liter/cm^3)	0.001			
	BW = Body Weight (kg)	15	70	15	70
	AT = Averaging Time (days)	2,190**	10,950**	2,190**	10,950**

Table 6-1
Parameter Values Used For Intake Equations
ESSROC
Logansport, Indiana

Equation	Parameter	Typical		High End	
		Child	Adult	Child	Adult
Fish Ingestion (Equation 6-7)	Cf = Chemical Concentration in fish (mg/g)	Chemical-specific			
	IRf = Fish Ingestion rate (kg/kg BW/day)	0.00018	0.000102	0.00035	0.00045
	FI = Fraction ingested from contaminated source (unitless)	0.1	0.1	0.25	0.25
	EF = Exposure Frequency (days/year)	350	350	350	350
	ED = Exposure Duration (years)	6	30	6	40
	AT = Averaging Time (days)	2,190**	10,950**	2,190**	14,600**
Plant Ingestion (Equation 6-8)	Cp = Concentration in Plant (mg/kg)	Chemical-specific			
	IRp = Plant Ingestion rate (kg/kg BW/day)	Plant-specific			
	FI = Fraction ingested from contaminated source (unitless)	Plant-specific			
	EF = Exposure Frequency (days/year)	350	350	350	350
	ED = Exposure Duration (years)	6	30	6	40
	AT = Averaging Time (days)	2,190**	10,950**	2,190**	14,600**
Animal Product Ingestion (Equation 6-9)	Ct = Concentration in Animal product (mg/kg)	Chemical-specific			
	IRt = Product Ingestion rate (kg/kg BW/day)	Product-specific			
	FI = Fraction ingested from contaminated source (unitless)	Product-specific			
	EF = Exposure Frequency (days/year)	350	350	350	350
	ED = Exposure Duration (years)	6	30	6	40
	AT = Averaging Time (days)	2,190**	10,950**	2,190**	14,600**

**For carcinogens, an Averaging Time of 25,550 days (70 years times 365 days per year) is used in the intake equation.
(A) Absorption factors used are: 1% for inorganics; 10% for organics; and 3% for dioxins.

7.0 TOXICOLOGICAL EVALUATION

The purpose of the toxicological evaluation is to weigh available evidence regarding the potential for particular chemicals to cause adverse effects in exposed individuals, and to provide where possible, an estimate of the relationship between the extent of exposure to a contaminant and the increased likelihood and/or severity of adverse effects. The U.S. EPA has performed the toxicity assessment step for numerous chemicals and has made available the resulting toxicity information and toxicity values. This information is available in both the Integrated Risk Information System (IRIS, U.S. EPA 1998), a computerized toxicological database system, and the Health Effects Assessment Summary Table (HEAST, U.S. EPA 1997), which are updated quarterly. For the purposes of this risk assessment, U.S. EPA developed toxicity available in the above sources is used.

7.1 CARCINOGENS

Exposure to contaminants may elicit both carcinogenic and non-carcinogenic responses. The carcinogenic response is assumed to be a "non-threshold" effect: any exposure, no matter how small is assumed to increase the potential for cancer. Carcinogenic slope factors (both oral and inhalation) are used to quantify the risk from exposure to carcinogens. The slope factor is an upper 95% confidence limit on the probability of response per unit intake of chemical over a lifetime. The inhalation slope factor is a measure of internal dose and is expressed in units of $(mg/kg/day)^{-1}$.

In some cases, quantitative estimates of carcinogenic risk from inhalation exposures are also expressed as "unit risks" presented in units of ug/m^3. The unit risk is a measurement of the risk from exposure per unit concentration of the compound in air. For carcinogenic compounds for which only unit risks were available, the unit risks (in units of ug/m^3) were converted to inhalation slope factors (in units of $mg/kg/day)^{-1}$) using standard U.S. EPA exposure assumptions (i.e., a 70 kg body weight and 20 m^3/day inhalation rate).

7.2 NON-CARCINOGENS

For non-carcinogenic effects, protective mechanisms are believed to exist that must be overcome before an adverse effect is manifested. As a result, a range of exposures from zero to some finite value can be tolerated by an organism with little or no change of expression of adverse effects. The U.S. EPA has developed reference doses (RfD) for many compounds. The RfD is an estimate of a daily intake by people (including sensitive subpopulations) that is likely to be without an appreciable risk of adverse health effects during a lifetime.

The RfDs are based on oral and inhalation routes of exposure. The RfDs established for the oral route are used to evaluate intakes from ingestion of water, ingestion of soils, ingestion of vegetable and beef food products, and dermal absorption of contaminants through exposure to contaminated soil or water.

The inhalation RfD, like the oral RfD, represents an internal dose and is expressed in units of mg/kg/day. Additionally, the U.S. EPA has also derived inhalation reference concentrations (RfC) which are expressed in units of mg/m^3. The RfC provides an estimation of the concentration of a compound in air, which when exceeded, indicates the potential for the occurrence of noncarcinogenic adverse health effects. In order to evaluate the exposures in this risk assessment, RfCs were converted to RfDs (expressed in terms of internal doses or mg/kg/day). The inhalation RfCs were converted to inhalation reference doses using standard U.S. EPA exposure assumptions (i.e., a 70 kg body weight and 20 m^3/day inhalation rate).

7.3 TOXICITY DATA FOR CHEMICALS OF CONCERN

As described previously, toxicological data used in this risk assessment was obtained from both U.S. EPA's IRIS and HEAST databases. The most recent IRIS files were reviewed for each chemical of concern and, if toxicity values were available for a particular compound, those values were used. If toxicity values were not available in IRIS for a particular compound, the HEAST files were reviewed and relevant toxicity values presented in that source were used in the risk assessment. Additionally, if

toxicological data were not available in IRIS or HEAST, available toxicological data presented in Appendix A-3 of the U.S. EPA 1998 HHRAP guidance document was used.

Table 7-1 presents the carcinogenic and noncarcinogenic toxicity data for the chemicals identified or estimated to be emitted from the ESSROC facility. Included on this table are oral and inhalation slope factors for the carcinogenic compounds and oral reference doses and inhalation reference concentrations for noncarcinogenic compounds.

The toxicity data for some of the chemicals presented on Table 7-1 is worthy of note. Currently, toxicity data exists for only one chlorinated dibenzo-p-dioxin isomer (2,3,7,8 TCDD). However, U.S. EPA has established procedures for estimating potential risks from exposure to mixtures of chlorinated dibenzo-p-dioxins. Specifically, the U.S. EPA has developed toxicity equivalent factors (TEF) for various dioxin isomers. The TEFs were developed based on the similar structure-activity relationship between dioxin isomers. For this risk assessment, the TEF factors developed by U.S. EPA are used to determine risks for the individual dioxin and furan isomers to 2,3,7,8-TCDD equivalents.

Additionally, in evaluating the potential risks associated with exposure to carcinogenic polynuclear aromatic hydrocarbons (PAHs), the oral slope factor for benzo(a)pyrene times the relative potency factor for the particular carcinogenic PAH was used as the toxicity value.

Similarly, for noncarcinogenic PAHs with Henry's Law Constant of $1E^{-5}$ atm-m^3/mole or higher and molecular weight less than 200 g/mole and which do not have a Rfd, the Rfd for pyrene was used as a surrogate toxicity value. For all other noncarcinogenic PAH which do not have a RfD, the Rfd for fluoranthene was used as a surrogate value.

The toxicity values used to evaluate exposure to the coplanar polychlorinated biphenyls (PCB) and the individual total congener PCB classes were derived according to the methods described in the 1998 U.S. EPA HHRAP guidance document. For the coplanar PCBs, toxicity equivalency quotients (TEQ) have been derived. The potential risks associated with the coplanar PCBs are evaluated by multiplying each individual TEQ by the carcinogenic slope factor for 2,3,7,8-TCDD. For the individual classes of total PCB congeners, a carcinogenic slope factor of 2 (mg/kg/day)-1 was used. For noncarcinogenic

exposures to PCBs, the oral reference dose of 2E-5 mg/kg-day for Aroclor 1254 was used.

7.4 CHEMICALS WITH NO TOXICITY VALUES

As described in Section 3.1.2.1, there were several chemicals of potential concern for which inhalation toxicity data (both carcinogenic and noncarcinogenic) was not available in IRIS or HEAST. Because no U.S. EPA verified toxicity data is available for these chemicals, they can not be evaluated quantitatively for either the indirect of the direct exposure pathways. The absence of U.S. EPA verified toxicity data for these compounds introduces some uncertainty in this risk evaluation.

Additionally, it is noted that toxicity values (both carcinogenic and noncarcinogenic) were not available in IRIS or HEAST for lead. It is U.S. EPA's opinion that the evaluation of risks posed by this compound using standard risk assessment procedures is not appropriate. Therefore, an alternative approach using the Integrated Exposure Uptake Biokinetic Model (IEUBK) was used to evaluate exposure to lead. A description of the methods used to evaluate lead exposures and the results of the evaluation are presented in Section 8.5.

Table 7-1
Toxicity Values
ESSROC
Logansport, Indiana

Chemical	Toxicity Data												
	Carc.	Oral Rfd (mg/kg/day)		Oral CSF (mg/kg/day)-1		Inhalation Rfc (mg/m^3)		Inhalation Rfd (mg/kg/day)		Inhalation URF $(ug/m^3)^{-1}$		Inhalation CSF $(mg/kg/day)^{-1}$	
Inorganics													
Antimony	No	4.00E-04	(b)			1.40E-03	(a)	4.00E-04	(e)				
Arsenic	Yes	3.00E-04	(b)	1.5	(b)	1.05E-03	(a)			4.30E-03	(b)	1.50E+01	(b)
Barium	No	7.00E-02	(b)			2.45E-01	(a)						
Beryllium	Yes	2.00E-03	(b)	8.4	(c)	2.00E-05	(b)			2.40E-03	(b)	8.4	(c)
Cadmium	Yes	1.00E-03	(b)			2.00E-04	(a)			1.80E-03	(b)	6.3	(e)
Chromium (VI)	Yes	3.00E-03	(b)			1.40E-04	(b)			1.20E-02	(b)	4.20E+01	(e)
Chromium, total	No	1.5	(b)			5.25	(b)						
Lead	Yes												
Mercury (Elemental)	No	8.60E-05	(c)			3.00E-04							
Methyl Mercury	No	1.00E-04	(b)			3.50E-04	(a)						
Nickel	No	2.00E-02	(b)			7.00E-02	(a)						
Selenium	No	5.00E-03	(b)			1.75E-02	(a)						
Silver	No	5.00E-03	(b)			1.75E-02	(a)						
Thallium	No	8.00E-05	(c)			2.80E-04	(c)						
Organics													
Volatiles													
Acetone	No	1.00E-01	(b)			3.50E-01	(a)	1.00E-01	(e)				
Acrylonitrile	No	1.00E-03	(c)	5.40E-01	(c)	2.00E-03	(b)			6.80E-05	(c)	2.40E-01	(c)
Allyl Chloride	No					1.00E-03	(b)	2.85E-04	(e)				
Benzene	Yes			6.2	(b)					2.20E-06	(b)	2.90E-02	(c)
Bromodichloromethane	Yes	2.00E-02	(b)	6.20E-02	(b)	7.00E-02	(a)						
Bromomethane	No	1.40E-03	(b)			5.00E-03	(b)	1.40E-03	(c)				

Table 7-1
Toxicity Values
ESSROC
Logansport, Indiana

Chemical	Toxicity Data												
	Carc.	Oral Rfd (mg/kg/day)		Oral CSF (mg/kg/day)-1		Inhalation Rfc (mg/m^3)		Inhalation Rfd (mg/kg/day)		Inhalation URF $(ug/m^3)^{-1}$		Inhalation CSF $(mg/kg/day)^{-1}$	
Bromoform	Yes	2.00E-02	(b)	7.90E-03	(b)	7.00E-02	(a)			1.10E-06	(b)	3.85E-03	(e)
1,3-Butadiene	Yes									2.80E-04	(b)	9.80E-01	(e)
2-Butanone	No	6.00E-01	(b)			1	(b)	2.85E-01	(c)				
Carbon disulfide	No	1.00E-01	(b)			7.00E-01	(b)	2.00E-01	(e)				
Carbon tetrachloride	Yes	7.00E-04	(b)	1.30E-01	(b)	2.45E-03	(a)			1.50E-05	(b)	5.25E-02	(e)
Chlorobenzene	No	2.00E-02	(b)			6.00E-02	(a)	1.70E-02	(e)				
Chloroethane	No	4.00E-01	(c)			10	(c)	2.8	(e)				
Chloroform	Yes	1.00E-02	(c)	6.10E-03	(c)	3.00E-04	(c)	8.50E-07	(e)	2.30E-05	(c)	8.10E-02	(b)
Chloromethane	Yes			1.30E-02	(b)					1.80E-06	(b)	6.30E-03	(b)
Cumene (isopropylbenzene)	No	1.00E-01	(b)			4.00E-01	(b)	1.14E-02	(e)				
1,2-Dichloropropane	No												
Dimethyl disulfide	No												
Dibromochloromethane	No	2.00E-02	(b)	8.40E-02	(b)	7.00E-02	(a)	2.00E-02	(e)				
Dibromomethane	No												
1,2-Dibromomethane	No												
1,2-Dichlorobenzene	No					2.00E-01	(b)	5.70E-02	(e)				
1,3-Dichlorobenzene	No	9.00E-04	(b)			3.15E-03	(b)						
1,4-Dichlorobenzene	Yes			3.00E-02	(b)	2.50E-01	(b)	7.10E-02	(e)	6.90E-06	(b)		
1,1-Dichloroethane	No	1.00E-01	(b)			5.00E-01	(b)					9.10E-02	(c)
1,2-Dichloroethane	Yes			9.10E-02	(b)					2.60E-05	(b)	9.10E-02	(c)
1,1-Dichloroethene	Yes	9.00E-03	(b)	6.00E-01	(b)	3.15E-02	(a)	1.40E-02	(c)	5.00E-05	(b)	1.2	(b)
cis 1,2-Dichloroethene	No	2.00E-02	(b)			7.00E-02	(a)	2.00E-02	(e)				
trans 1,2-Dichloroethene	No	2.00E-02	(b)			7.00E-02	(a)	2.00E-02	(e)				
1,2-Dichloropropane	Yes			6.80E-02	(b)	4.00E-03	(b)	1.10E-03	(e)	1.90E-05	(c)	6.80E-02	(c)
cis 1,3-Dichloropropene	Yes	3.00E-04	(b)	1.80E-01	(b)	2.00E-02	(b)	5.70E-03	(e)	3.70E-05	(c)	1.30E-01	(c)
trans 1,3-Dichloropropene	No	3.00E-04	(b)	1.80E-01	(b)	2.00E-02	(b)	5.70E-03	(e)				

Table 7-1
Toxicity Values
ESSROC
Logansport, Indiana

Chemical	Toxicity Data												
	Carc.	Oral Rfd (mg/kg/day)		Oral CSF (mg/kg/day)-1		Inhalation Rfc (mg/m^3)		Inhalation Rfd (mg/kg/day)		Inhalation URF $(ug/m^3)^{-1}$		Inhalation CSF $(mg/kg/day)^{-1}$	
trans-1,4-Dichloro-2-butene	No												
Dichlorodifluoromethane	No	2.00E-01	(b)			7.00E-01	(a)	2.85E-01	(e)				
Ethylbenzene	No	1.00E-01	(b)			1	(b)						
Iodomethane	No												
Methylene Chloride	Yes	6.00E-02	(c)	7.50E-03	(c)	3	(c)			4.70E-07	(c)	1.60E-03	(c)
4-Methyl-2-Pentanone	No												
n-Hexane	No					2.00E-01	(b)	5.70E-02	(e)				
P-Cymene	No												
Styrene	No	2.00E-01	(b)			1	(b)	2.85E-01	(e)				
1,1,2,2-Tetrachloroethane	Yes			2.00E-01	(b)					5.80E-05	(b)	2.00E-01	(c)
Tetrachloroethylene	Yes	1.00E-02	(b)	5.20E-02	(c)	4.00E-01	(a)			5.80E-07	(c)	2.00E-03	(c)
1,1,1-Trichloroethane	No	3.50E-02	(c)			1.23E-01	(c)	3.50E-02	(e)				
Trichloroethene	Yes			1.10E-02	(c)					1.70E-06	(c)	6.00E-03	(c)
Trichlorofluoromethane	No	3.00E-01	(c)			7.00E-01	(b)	2.00E-01	(e)				
Toluene	No	2.00E-01	(b)			4.00E-01	(b)	1.14E-01	(e)				
Xylene (m/p)	No	2	(b)			7.00E+00	(a)	2.00E+00	(e)				
o-Xylene	No	2	(b)			7.00E+00	(a)	2.00E+00	(e)				
Vinyl acetate	No	1	(c)			2.00E-01	(b)	5.70E-02	(e)				
Vinyl chloride	Yes			1.9	(b)					8.40E-05	(c)	3.00E-01	(c)
Semi-Volatiles													
Acenaphthene	No	6.00E-02	(b)			2.10E-01	(a)						
Acenaphthylene													
Anthracene	No	3.00E-01	(b)			1.05E+00	(a)	3.00E-01	(e)				
Benzoic Acid	No	4.00E-01	(b)			1.40E+00	(a)	4.00E-01	(e)				

Table 7-1
Toxicity Values
ESSROC
Logansport, Indiana

Chemical	Toxicity Data												
	Carc.	Oral Rfd (mg/kg/day)		Oral CSF (mg/kg/day)-1		Inhalation Rfc (mg/m^3)		Inhalation Rfd (mg/kg/day)		Inhalation URF $(ug/m^3)^{-1}$		Inhalation CSF $(mg/kg/day)^{-1}$	
Benzo(a)pyrene	Yes			7.30E+00	(b)					2.10E-03	(c)	7.30E+00	(b)
Benzo(a)anthracene	Yes			7.30E-01	(b)					2.10E-04	(c)	7.30E-01	(b)
Benzo(b)fluoranthene				7.30E-01	(b)					2.10E-04	(c)	7.30E-01	(b)
Benzo(k)fluoranthene				7.30E-02	(b)					2.10E-05	(c)	7.30E-02	(b)
Benzo(g,h,i)perylene													
Benzyl Alcohol		3.00E-01	(b)										
Bis(2-ethyl hexyl)phthalate	Yes	2.00E-02	(c)	1.40E-02	(c)	7.00E-02	(c)	0.02	(e)	4.00E-06	(c)	1.40E-02	(c)
Butyl benzyl phthalate	No	2.00E-01	(b)			7.00E-01	(a)	2.00E-01	(c)				
4-Chloroaniline	No	4.00E-03	(b)			1.40E-02	(a)	4.00E-03	(e)				
2-Chloronaphthalene	No	8.00E-02	(c)			2.80E-01	(c)	0.08	(e)				
4-Chloro-3-methylphenol													
2-Chlorophenol	No	5.00E-03	(b)			1.75E-02	(a)	5.00E-03	(e)				
Chrysene				7.30E-03	(a)					2.10E-06	(c)	7.30E-03	(c)
Dibenz(a,h)anthracene	Yes			7.3	(b)					2.10E-03	(c)	7.3	(c)
Dibenzofuran													
1,2-dichlorobenzene	No	9.00E-02	(b)			3.15E-01	(a)	9.00E-02	(e)				
1,3-dichlorobenzene	No	8.90E-02	(c)			3.12E-01	(c)	8.90E-02	(c)				
1,4-dichlorobenzene	No	2.30E-01	(c)	2.40E-02	(c)	8.00E-01	(b)	2.28E-02	(e)	6.90E-03	(c)	2.40E-02	(c)
3,3-Dichlorobenzidine	Yes	4.50E-01	(c)							1.30E-04	(c)	4.50E-01	(c)
Dimethylphthalate	No	1.00E+01	(c)			3.50E+01	(c)	10	(e)				
Diethyl phthalate	No	8.00E-01	(b)			2.80E+00	(a)	8.00E-01	(e)				
2,4-Dimethylphenol	No	2.00E-02	(b)			7.00E-02	(a)	2.00E-02	(e)				
di-n-butylphthalate	No	1.00E-01	(b)			3.50E-01	(b)	1.00E-01	(c)				
Di-n-octyl phthalate	No	2.00E-02	(b)			7.00E-02	(b)	2.00E-02	(e)				
4,6-Dinitro-2-methylphenol													
2,4-Dinitrophenol	No	2.00E-03	(b)			7.00E-03	(b)	2.00E-03	(e)				

Table 7-1
Toxicity Values
ESSROC
Logansport, Indiana

Chemical	Toxicity Data												
	Carc.	Oral Rfd (mg/kg/day)		Oral CSF (mg/kg/day)-1		Inhalation Rfc (mg/m^3)		Inhalation Rfd (mg/kg/day)		Inhalation URF $(ug/m^3)^{-1}$		Inhalation CSF $(mg/kg/day)^{-1}$	
2,4-Dinitrotoluene	Yes	2.00E-03	(b)	6.80E-01	(b)	7.00E-03	(b)	2.00E-03	(e)	1.90E-04	(e)	6.80E-01	(b)
2,6-Dinitrotoluene	Yes	1.00E-03	(b)	6.80E-01	(b)	3.50E-03	(b)	1.00E-03	(e)	1.90E-04	(e)	6.80E-01	(b)
Fluoranthene	No	4.00E-02	(b)			1.40E-01	(b)	4.00E-02	(e)				
Fluorene	No	4.00E-02	(b)			1.40E-01	(b)	4.00E-02	(e)				
Hexachlorobenzene	Yes	8.00E-04	(b)	1.6	(b)	2.80E-03	(b)	8.00E-04	(e)	4.60E-04	(b)	1.6	(b)
Hexachlorobutadiene	Yes	2.00E-04	(b)	7.80E-02	(b)	7.00E-04	(a)	2.00E-04	(e)	2.20E-05	(b)	7.70E-02	(e)
Hexachlorocyclopentadiene	No	7.00E-03	(b)			7.00E-05	(b)	2.00E-05	(e)				
Hexachloroethane	Yes	1.00E-03	(b)	1.40E-02	(b)	3.50E-03	(b)	1.00E-03	(e)	4.00E-06	(b)	1.40E-02	(b)
Indeno(1,2,3-cd)pyrene	Yes			7.30E-01	(b)					2.10E-04	(b)	7.30E-01	(b)
2-Methylphenol	No	5.00E-02	(b)			1.75E-01	(a)	5.00E-02	(e)				
4-Methylphenol	No	5.00E-02	(b)			1.75E-01	(a)	5.00E-02	(e)				
2-Methylnaphthalene													
Naphthalene	No	2.00E-02	(b)			3.00E-03	(b)	8.50E-04	(e)				
2-Nitroaniline	No	6.00E-05	(b)			2.00E-04	(b)	5.70E-05	(e)				
Nitrobenzene	No	5.00E-04	(b)			2.00E-03	(b)	5.70E-04	(e)				
n-Nitrosodiphenylamine	Yes			4.90E-03	(b)					1.40E-06	(b)	4.90E-03	(b)
n-Nitroso-di-n-propylamine	Yes			7	(b)					2.00E-03	(b)	7	(b)
2,2-oxybis(1-Chloropropane)													
Pentachlorophenol	Yes	3.00E-02	(b)	1.20E-01	(b)	1.10E-01	(b)	3.10E-02	(e)	3.40E-05	(b)	1.20E-01	(b)
Phenanthrene	No	3.00E-02	(b)			1.10E-01	(b)	3.10E-02	(e)				
Phenol	No	6.00E-01	(b)			2.1	(b)	6.00E-01	(e)				
Pyrene	No	3.00E-02	(b)			1.10E-01	(b)	3.10E-02	(e)				
1,2,4-Trichlorobenzene	No	1.00E-02	(b)			2.00E-01	(b)	5.70E-02	(e)				
2,4,5-Trichlorophenol	No	1.00E-01	(b)			3.50E-01	(b)	1.00E-01	(e)				
2,4,6-Trichlorophenol	Yes			1.10E-02	(b)					3.10E-06	(b)	1.08E-02	(e)

Table 7-1
Toxicity Values
ESSROC
Logansport, Indiana

Chemical	Toxicity Data												
	Carc.	Oral Rfd (mg/kg/day)		Oral CSF (mg/kg/day)-1		Inhalation Rfc (mg/m^3)		Inhalation Rfd (mg/kg/day)		Inhalation URF $(ug/m^3)^{-1}$		Inhalation CSF $(mg/kg/day)^{-1}$	
Chlorinated dibenzo-p-dioxins (CDDs) and dibenzofurans (CDFs)													
2,3,7,8-TCDD	Yes			1.50E+05	(b)					3.30E+01	(b)	1.50E+05	(b)
2,3,7,8-PeCDD	Yes			75000	(b)							75000	(b)
2,3,7,8-HxCDD	Yes			15000	(b)							15000	(b)
2,3,7,8-HpCDD	Yes			1500	(b)							1500	(b)
OCDD	Yes			150	(b)							150	(b)
2,3,7,8-TCDF	Yes			15000	(b)							15000	(b)
1,2,3,7,8-PeCDF	Yes			7500	(b)							7500	(b)
2,3,4,7,8-PeCDF	Yes			75000	(b)							75000	(b)
2,3,7,8-HxCDF	Yes			15000	(b)							15000	(b)
2,3,7,8-HpCDF	Yes			1500	(b)							1500	(b)
OCDF	Yes			1.50E+02	(b)							150	(b)
Polychlorinated Biphenyls													
3,3'-Tetra CB	Yes			75	(d)							75	(d)
2,3,4,4',5-Penta CB	Yes			75	(d)							75	(d)
2,3',4,4',5-Penta CB	Yes			15	(d)							15	(d)
2',3,3',4,4'-Penta CB	Yes			15	(d)							15	(d)
2,3,3',4,4'-Penta CB	Yes			15	(d)							15	(d)
3,3',4,4',5-Penta CB	Yes			1.50E+04	(d)							1.50E+04	(d)
2,3',4,4',5,5'-Hexa CB	Yes			1.5	(d)							1.5	(d)
2,3,3'4,4',5-Hexa CB	Yes			75	(d)							75	(d)
2,3,3',4,4',5'_Hexa CB	Yes			75	(d)							75	(d)

Table 7-1
Toxicity Values
ESSROC
Logansport, Indiana

Chemical	Toxicity Data												
	Carc.	Oral Rfd (mg/kg/day)		Oral CSF (mg/kg/day)-1		Inhalation Rfc (mg/m^3)		Inhalation Rfd (mg/kg/day)		Inhalation URF $(ug/m^3)^{-1}$		Inhalation CSF $(mg/kg/day)^{-1}$	
3.3',4,4',5,5'-Hexa CB	Yes			1.50E+03	(d)							1.50E+03	(d)
2,2',3,4,4',5,5'-Hepta CB	Yes			1.5	(d)							1.5	(d)
2,2'3,3'4,4',5-Hepta CB	Yes			15	(d)							15	(d)
2,3,3',4,4',5,5'-Hepta CB	Yes			15	(d)							15	(b)
Total Mono CB	Yes	2.00E-05	(f)	2	(e)							2	(f)
Total Di CB	Yes	2.00E-05	(f)	2	(e)							2	(f)
Total Tri CB	Yes	2.00E-05	(f)	2	(e)							2	(f)
Total Tetra CB	Yes	2.00E-05	(f)	2	(e)							2	(f)
Total Penta CB	Yes	2.00E-05	(f)	2	(e)							2	(f)
Total Hex CB	Yes	2.00E-05	(f)	2	(e)							2	(f)
Total Hepta CB	Yes	2.00E-05	(f)	2	(e)							2	(f)
Total Octa CB	Yes	2.00E-05	(f)	2	(e)							2	(f)
Total Nona CB	Yes	2.00E-05	(f)	2	(e)							2	(f)
Total Deca CB	Yes	2.00E-05	(f)	2	(e)							2	(f)

(a) Inhalation Rfc derived from oral Rfd according to methods described in Section 7.2.
(b) Source: IRIS or 1997 HEAST
(c) 1998 HHRAP Guidance Appendix A-3
(d) Toxicity value derived by multiplying Toxicity Equivalent Factor described in 1998 HHRAP by the slope factor for 2,3,7,8 TCDD (1.5e5 mg/kg/day)-1.
(e) Inhalation Rfd or CSF derived from inhalation Rfc or unit risk value according to methods described in Section 7.0
(f) 1998 HHRAP Toxcity value for Aroclor 1254 used for PCBs.