Mayor Robert Mielke
City of Wausau

Eric Lindman, P.E.
Director of Public Works and Utilities

November 14, 2019 – PRESS RELEASE

RE: DHS Toxicologist Risk Assessment – Wauleco Dioxin Test Results

Wauleco completed their test results and final report to the DNR related to the aerial deposition model in October 2019. Once the City received these sample results they were shared with the Department of Health Services (DHS) Toxicologists and they have prepared a health risk assessment on the sample results. The DHS's findings are attached.

The City continues to work with all parties related to citizens' environmental concerns for the area. As information and test results have been received the City has initiated and requested experts in the field to review the information and provide assessments and determinations of results as requested by citizens and as required.

The attached expert conclusion, the same as the other assessments initiated by the City, is that there are no public health hazards associated with the soils sampled. The results of the dioxins, as you will read in the report, are very typical values for urban areas around the country.

Tony Evers
Governor

Andrea Palm
Secretary

State of Wisconsin
Department of Health Services

DIVISION OF PUBLIC HEALTH

1 WEST WILSON STREET
PO BOX 2659
MADISON WI 53701-2659

Telephone: 608-266-1251
Fax: 608-267-2832
TTY: 711 or 800-947-3529

November 13, 2019

Mr. Eric Lindman

Director of Public Works & Utilities
City of Wausau
407 Grant St.
Wausau, WI 54403

Subject: Updated health risk assessment on the dioxin testing results from the Wauleco Inc. aerial deposition study

Dear Mr. Lindman,

At your request, the Wisconsin Department of Health Services (DHS) reviewed recent soil testing results from the aerial deposition study completed by Wauleco Inc.

On September 27, 2019, the City of Wausau asked DHS to provide an updated health risk assessment based on the new soil testing results provided by Wauleco Inc. for the Wauleco Wood Waste Burning Sites Investigation (BRRTS # 02-37-000006) overseen by the Department of Natural Resources (DNR). DHS reviewed the new data to assess human health risks associated with dioxin in the surface soil.

Based on the current data, DHS concludes that there is no apparent public health hazard from exposure to dioxin through incidental ingestion and direct dermal contact with surface soil within the investigated area. Please find the attached document for the details of our evaluation of the data.

DHS will continue to work with the City, the Citizens for a Clean Wausau, DNR, and the Marathon Health Department to ensure the public is protected from environmental health hazards by reviewing additional data, assessing potential health risks, and responding to health related concerns or questions.

Please do not hesitate to contact me with any additional questions.

Sincerely,

Clara Jeong, PhD

Toxicologist

Bureau of Environmental and Occupational Health

Wisconsin Department of Health Services

Cc:

Robert Mielke, City of Wausau

Patrick Peckham, City of Wausau

Matt Thompson, Department of Natural Resources

Dale Grosskurth, Marathon County Health Department

Background information is available in two previous DHS' letters to the City of Wausau

1. Letter to the City of Wausau, August 20, 2018, subject line: Wausau Riverside Park Dioxin Contamination[1]

2. Letter to the City of Wausau, Faburary 7, 2019, subject line: Response to Comments on the Wisconsin Department of Health Service's Letter on Dioxin Contamination[2]

HUMAN HEALTH RISK ASSESSMENT

A. Data Review

The Wauleco Wood Waste Burning Site Investigation results provided data for 36 surface soil samples.[3] Ten samples (O-series) were collected within the area predicted to have historic dioxin aerial distribution from the Wauleco property and twenty-six samples (N-series) were collected as background samples to assess dioxin levels unlikely to be related to wood burning activities performed by Wauleco. The background samples were collected from locations near potential dioxin sources or areas representing common urban settings where dioxin background levels are expected to be higher than non-urban settings: the site of the former City Incinerator (N1), yard waste burning and residential burn barrels (N2), former Marathon Rubber facility (N3), Railroad tracks (N4), Vehicle traffic (N5), and other urban conditions (N6). One sample was collected from 117/120 River Street (N7) per DNR's request; this is the location where a residential dioxin level of 42 ng/kg was found from a previous sampling report in 2008.[4] The sampling locations and individual sampling results are summarized in Appendix A and B. The average and maximum dioxin levels detected from each location are summarized in Table 1.

We compared the levels to the EPA's regional screening level for dioxin in residential soils (4.8 ng/kg) to determine if further evaluation was needed.[5] When a contaminant concentration is above the screening level, it does not mean that health effects are expected but it does represent a point at which further evaluation is warranted.

The surface soil samples collected from the predicted maximum aerial distribution area showed dioxin levels between 0.37 and 17.45 ng/kg (average = 4.1 ng/kg). The background surface soil results ranged between 0.27 and 62.5 ng/kg (average = 10.3 ng/kg) where the highest levels were found in the railroad tracks (N4) adjacent to the Wisconsin River. A total of 14 out of 36 samples exceeded EPA's regional screening level for residential soils.

---

[1] WDHS. Letter Subject: Wausau Riverside Park Dioxin Contamination, Prepared for the City of Wausau. *Wisconsin Department of Health Services*, 2018

[2] WDHS. Letter Subject: Response to Comments on the Wisconsin Department of Health Service's Letter on Dioxin Contamination, Prepared for the City of Wausau. *Wisconsin Department of Health Services*, 2019

[3] TRC. Letter Subject: Wood Waste Burning Site Investigation Results Transmittal, Wauleco, Inc., Wausau Wisconsin. *BRRTS #02-37-000006*, September, 2019

[4] Pace Analytical, December, 2008, Report of Laboratory Analysis for PCDD/PCDF (Pace Project No: 1085806)

[5] EPA Risk Assessment: Regional Screening Levels Generic Tables: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

It should be noted that the range of dioxin levels found within the investigated area were similar to the range of background dioxin levels commonly found in urban settings. For example, in a soil dioxin study in the urban Seattle area, dioxin levels ranged from 1.7 to 110 ng/kg, with an average concentration of 19 ng/kg.[6] The US EPA Region 8 reported that the average total dioxin levels in urban areas from multiple studies ranged between 2 and 21 ng/kg.[7] Soils near railroads tend to have higher dioxin levels because railroad ties were often treated with creosote, which is a source of dioxin contamination.[8]

Table 1. Comparison of dioxin levels detected in surface soils with EPA screening levels.

Location	Sampling ID	Number of Samples	Data Type	TEQ-adjusted dioxin Result (ng/kg)	Above EPA Screening Value [a]?
Predicted Aerial Distribution Area	O	10	Average	4.10	No
			Maximum	17.45	**Yes**
City Incinerator	N1	5	Average	3.61	No
			Maximum	10.50	**Yes**
Yard Waste	N2	5	Average	12.29	**Yes**
			Maximum	21.60	**Yes**
Marathon Rubber Facility	N3	4	Average	2.39	No
			Maximum	5.36	**Yes**
Railroad Tracks	N4	3	Average	42.90	**Yes**
			Maximum	62.50	**Yes**
Vehicle Traffic	N5	4	Average	7.30	**Yes**
			Maximum	16.6	**Yes**
Urban Condition	N6	4	Average	3.15	No
			Maximum	5.97	**Yes**
117/120 River Street	N7	1	-	6.99	**Yes**

a. EPA's regional screening level (RSL) for residential soil is 4.8 ng/kg.[5]

[6] Urban Seattle area soil dioxin and PAH concentrations initial summary report. (2011) Washington State Department of Ecology, Toxics Cleanup Program. Olympia, WA. 113 pp.
[7] U.S. EPA. 2002. Denver front range study of dioxins in surface soil. U.S. Environmental Protection Agency, Region 8. Denver, CO. 125 pp.
[8] Wan and Oostdam (1995) Utility and Railway Rights-of-Way Contaminants: Dioxins and Furans, *J. Environ. Qual.*, Vol 24, 257-265.

B. Determination of exposure pathways

DHS evaluated the potential for complete exposure pathways, given the specific exposure situations at this site. The major dioxin exposure pathway for residents in the area is incidental ingestion of dioxin-containing soil through hand-to-mouth activities. While exposure through skin contact is also possible during such activities, it is considered a minor source of exposure because dioxin does not move through the skin easily. Inhalation was not evaluated because the chance of exposure to dioxin by breathing air is very low due to dioxin's chemical properties.

C. Evaluation of health effects

C-1. Evaluation of non-cancer risk

To determine whether there is a health risk, DHS compared the total estimated dioxin dose at the locations with the highest dioxin concentrations detected to the reference dose (RfD) established by EPA, which is 7.0×10^{-10} milligram dioxin per kilogram body weight per day (mg/kg/day).[9] We calculated the hazard quotient by dividing the total estimated dose by the RfD. The hazard quotient (HQ) is the ratio of the potential exposure to a substance to the level at which no harmful effect is expected. If the HQ value is greater than 1, the substance may represent a risk to human health.

For the calculation, DHS assessed the estimated dose for a child (age 0 to less than 6) and for an adult by using the highest concentration from the report (sampling location: N4) and applying conservative assumptions on how much, how often, and how long a person may come into contact with dioxin in surface soil. We calculated the total estimated doses for children and adults occasionally visiting railroad tracks and for the residents at the neighborhood. Because there are households located adjacent to the railroad, we used the maximum dioxin level found from the railroad track for residential exposure calculations. The assumptions and parameters used for the calculations are presented in detail in Appendix C and D. In this case, we estimated how much dioxin people are exposed to from accidentally ingesting dioxin-containing soil particles and from absorbing dioxin through skin by touching the contaminated soil.

Total estimated dose (mg/kg/day) = Ingestion dose + Dermal absorption dose

All calculated results showed hazard quotient values below 1. Because all other locations had dioxin levels lower than the level at the railroad sampling location, were we to calculate hazard quotients for those data, the results would similarly be below 1. Thus, we conclude that, with respect to non-cancer effects, there is no apparent public health hazard associated with exposure to dioxins in surface soil for any of the tested areas. The summary of the results are summarized in Table 2.

[9] EPA Integrated Risk Information System (IRIS) summary for 2,3,7,8-Tetrachlorodibenzo-p-dioxin: https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=1024

Table 2. Non-cancer hazard calculations resulting from exposure to dioxins in surface soils from the railroad tracks (N4), Wausau, WI.

Scenarios	Maximum Dioxin Concentration (ng/kg)	Exposure Group	Estimated Dose (mg/kg/day)			RfD (mg/kg/day)	Hazard Quotient
			Ingestion	Skin	Total		
Railroad Tracks visitors	62.5	Child	2.40E-10	2.09E-11	2.61E-10	7.0x10E-10	0.37
		Adult	2.57E-11	3.07E-12	2.88E-11		0.04
Residential		Child	4.00E-10	3.48E-11	4.34E-10		0.62
		Adult	4.28E-11	5.12E-12	4.79E-11		0.07

C-2. Evaluation of excess cancer risk

DHS evaluated the excess cancer risk for a 30-year exposure and a 70-year exposure by using a theoretical cancer risk approach established by EPA and ATSDR. Theoretical excess cancer risk is calculated by multiplying a total estimated dose of a substance by its cancer slope factor, also known as the cancer potency factor (CPF). We used the oral CPF value for both ingestion exposure pathway and dermal exposure pathway to estimate the total excess cancer risk.

An excess cancer risk that is below 1 in 1,000,000 is considered negligible and some regulatory agencies use this to establish the clean-up goal for contaminated sites.[10] A risk that is above 1 in 10,000 is considered high enough that some sort of remediation is needed.[11] For Superfund site removals process, EPA considers an excess cancer risk between 1 in 10,000 and 1 in 1,000,000 to be acceptable and states that risks slightly greater than 1 in 10,000 may be considered to be acceptable if justified based on site-specific conditions.[11,12]

For visitors occasionally spending time nearby the railroad track, the calculated excess cancer risks are $4.33x10^{-6}$ for a 30-year exposure assessment and $6.8x10^{-6}$ for a 70-year exposure. Stated another way, if one million people are exposed to the same level of dioxin over the same amount of time (30 or 70 years), we estimate that 4 to 6 additional cases of cancer might occur. For residents, calculated excess cancer risks are $6.30x10^{-6}$ for a 30-year exposure assessment and $8.9x10^{-6}$ for a 70-year exposure. Stated another way, if one million people are exposed to the same level of dioxin over the same amount of time (30 or 70 years), we estimate that 6 to 8 additional cases of cancer might occur. The results of the cancer risk assessment are summarized in Table 3.

[10] USEPA. Review of State Soil Cleanup Levels for Dioxin. In: National Center for Environmental Assessment OoRaD, ed: U.S. Environmental Protection Agency; 2009.
[11] USEPA. US EPA Risk Assessment: Regional Removal Management Levels (RMLs). 2018. URL: https://www.epa.gov/risk/regional-removal-management-levels-rmls-frequently-asked-questions#FAQ5.
[12] USEPA. 1991. Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions. Office of Solid Waste and Emergency Response, Washington, DC. OSWER Directive 9355.0-30

Table 3. Cancer hazard calculations resulting from exposure to dioxins in surface soils from the railroad tracks (N4), Wausau, WI.

Scenarios	Maximum Dioxin Concentration (ng/kg)	Exposure Group	Duration	Excess Cancer Risk (per 1,000,000)		
				Ingestion	Skin Contact	Total
Railroad Tracks	62.5	Child	5 years	2.57	0.22	2.79
		Lifetime	30 years	3.94	0.39	4.33
		Lifetime	70 years	6.15	0.65	6.80
Residential		Child	5 years	4.28	0.37	4.65
		Lifetime	30 years	5.66	0.65	6.30
		Lifetime	70 years	7.86	1.09	8.94

Based on the evaluation, we conclude that exposure to dioxins in surface soil from the investigated area is not expected to cause harm (does not cause an unacceptable increased risk of cancer). The assumptions and parameters applied for the calculations are presented in Appendix C. Because DHS applied a very conservative approach, the calculated risk may be overestimated and may not represent the actual exposure.

LIMITATIONS OF THIS ASSESSMENT

This assessment was conducted based on the surface soil samples collected in 2019. It is possible that dioxin levels in surface soil within the site changed over time due to various reasons including change of industrial operations, the type of land use in the past, migration of soils, city development, etc. Thus, DHS cannot determine whether accidental ingestion and dermal contact of dioxin in surface soil in the past could harm people's health.

DISCUSSION

In general, people get exposed to dioxin through dietary intake, drinking water, air inhalation and skin contact. For the general population, dietary intake makes up more than 90% of the total dioxin intake. Fatty foods such as meat, poultry, seafood, milk, egg and other products are the major dietary sources of dioxins. While dietary intake is the major source of dioxin exposure, the chance of coming in contact with dioxin can get higher when a source of dioxin is located nearby communities. Dioxin can be generated and released to the environment in many ways. For example:

- Dioxin can also be released as a byproduct of combustion into the air emissions from industrial incinerators and coal-fired power plants emissions and via exhaust from vehicle powered by gasoline and diesel fuel.

- Various chlorinated pesticides and herbicides contain small amount of dioxin as contaminants. The use of these products, for example on lawn areas, could release small amounts of dioxin to the environment.
- Burning of chlorinated compounds or smoking cigarettes can also generate dioxin and release them to the environment. Small ash particles released into the air from emission or combustion could travel a long distance and deposit on land or water.

Thus, soils in urban areas may contain dioxin since they are close to potential sources such as busy roads, waste dumps, and industries. Researchers found that background levels of dioxin in urban/suburban soils tend to be higher and more variable than in rural soils.[13] The dioxin levels found from the Wauleco Inc. aerial deposition study were within the range of common background levels in urban soil in the United States. Overall, the dioxin intake from accidental ingestion or dermal contact in surface soil is a minor exposure to people.

CONCLUSIONS

- DHS concludes that exposure to dioxin in surface soil within the investigated area are unlikely to cause adverse health effects to the residents and trespassers.

RECOMMENDATIONS

As a general practice, DHS recommends awareness of the major environmental sources of dioxin exposure, and steps to limit exposure. Because dioxin is ubiquitous in the environment and tends to accumulate in the body, it is important to reduce unnecessary exposure to dioxins.

- People working or playing in soil should wash their hands before eating.
- Children should be advised not eat dirt or put toys in their mouth while playing outside.
- As dioxin prefers to build up in the fatty part of food, consuming low-fat products, trimming fat from meat, and reducing cooking methods that use less amount of animal fat are ways to minimize dioxin exposure from diet.
- People who garden in urban areas can avoid exposure to various soil contaminants by creating raised beds supplemented with clean soils.

[13] Sci Total Environ. 2014 Jan 1;466-467:586-97. doi: 10.1016 https://www.ncbi.nlm.nih.gov/pubmed/23955251

APPENDICES

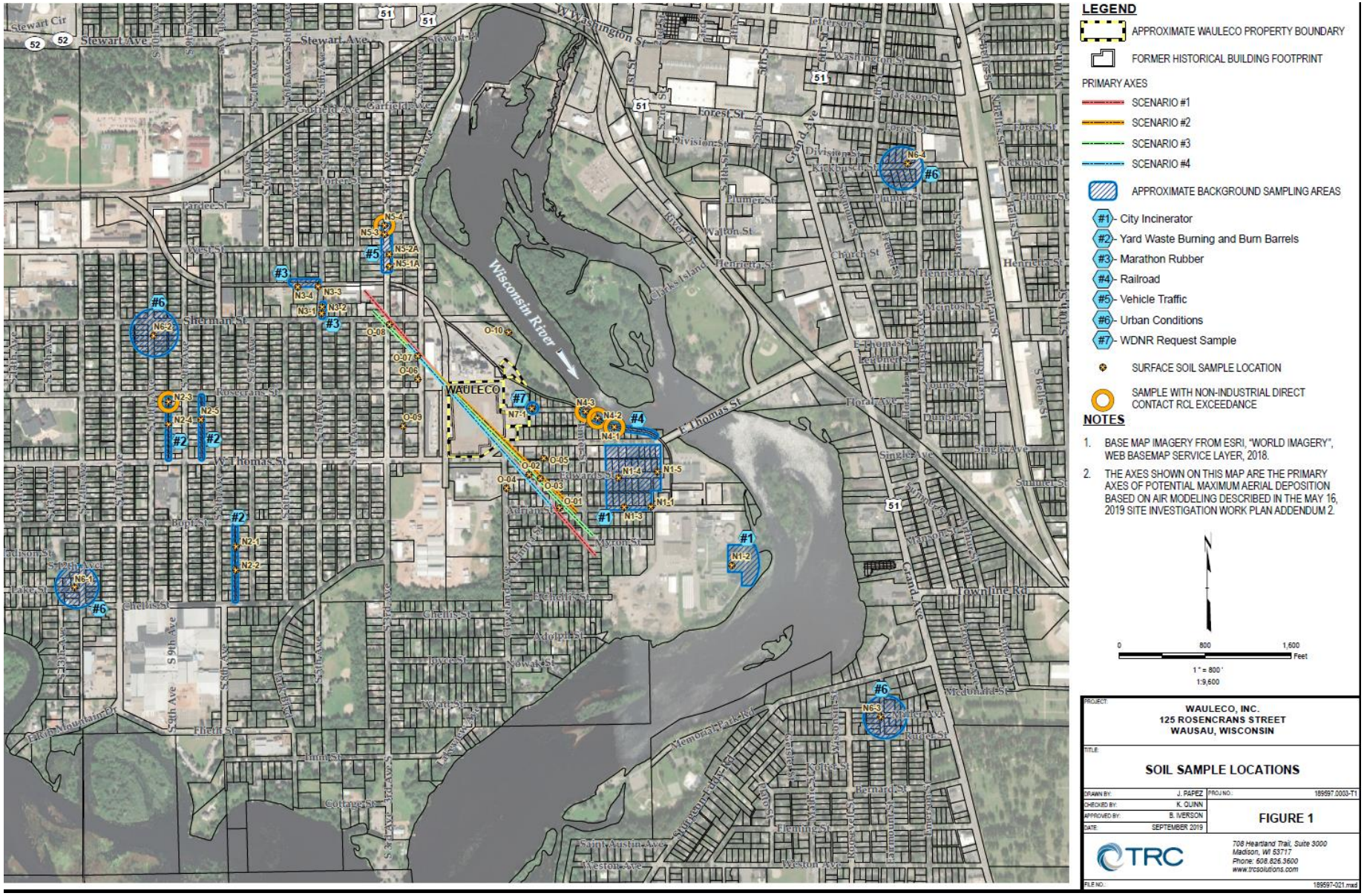
Appendix A: **Scope of the Site Including Sampling Locations**

Appendix B: **Summary of Individual Surface Soil Sampling Data**

Appendix C: **Exposure Assumptions and Parameters Used for Risk Assessments**

Appendix D: **Estimated Dose Calculations**

APPENDIX A. Scope of the Site Including Sampling locations[14]



[14] TRC. Letter Subject: Wood Waste Burning Site Investigation Results Transmittal, Wauleco, Inc., Wausau Wisconsin. *BRRTS #02-37-000006*, September, 2019

APPENDIX B. Summary of individual surface soil sampling data

Sampling location	Sample No.	TEF-adjusted Total dioxin (ng/kg)	Exceeding EPA Value[a]?
Predicted historical aerial distribution	O1	0.93	
	O2	1.26	
	O3	2.59	
	O4	3.03	
	O5	6.64	Yes
	O6	3.46	
	O7	0.37	
	O8	1.71	
	O9	17.45	Yes
	O10	3.55	
City Incinerator	N1-1	2.32	
	N1-2	10.5	Yes
	N1-3	0.99	
	N1-4	1.3	
	N1-5	2.92	
Yard waste	N2-1	2.74	
	N2-2	19.3	Yes
	N2-3	21.6	Yes
	N2-4	14.1	Yes
	N2-5	3.72	
Former Marathon Rubber	N3-1	5.36	Yes
	N3-2	3.18	
	N3-3	0.74	
	N3-4	0.27	
Railroad Track	N4-1	22.2	Yes
	N4-2	44	Yes
	N4-3	62.5	Yes
Vehicle Traffic	N5-1A	2.24	
	N5-2A	4.25	
	N5-3	6.1	Yes
	N5-4	16.6	Yes
Urban Conditions	N6-1	1.72	
	N6-2	5.97	Yes
	N6-3	2.08	
	N6-4	2.84	
117/120 River Street	N7	6.99	Yes

a. EPA's regional screening level (RSL) for residential soil is 4.8 ng/kg.

Appendix C. Exposure assumptions and parameters used for risk assessments.

Parameter	Symbol	Value		Unit	Source	Notes
maximum dioxin concentration	C	62.5		ng/kg		
conversion factor	CF	$1.00x10^{-12}$		kg/ng		Converts contaminant concentration from ng to kg
ingestion rate	IR	Child	200	mg/day	EPA[a]	Child age 0 to <6
		Adult	100			
exposure frequency	EF	railroad tracks	105	days/year		3 visits per week, 35 weeks per year
		residential	175			5 visits per week, 35 weeks per year
exposure duration	ED	Childhood	5	years		Age 0 to <6
		25-year as adult	25			assume total 30 year exposure
		65-year as adult	65			assume total 70 year exposure
body weight	BW	Child	15	kg	ATSDR[b]	Child age 0 to <6
		Adult	70			
average time (non-cancer)	$AT_{non\text{-}cancer}$	Child	1825	days		Child: 5 years
		Adult	9125			Adult: 25 years
average time (cancer)	AT_{cancer}	25550		days	EPA	Lifetime: 70 years

cancer potency factor	CPF	1.5x10^{5}		(mg/kg/day)$^{-1}$	EPA	
skin area available for contact	SA	Child	2900	cm^{2}	ATSDR	
		Adult	5700			
soil-to-skin adherence factor	AF	Child	0.2	mg/cm^{2}		
		Adult	0.07			
absorption factor	ABS	0.03		N/A	EPA	
adherence duration	AD	1		days	EPA	
oral route adjustment factor	ORAF	1		N/A		

a. EPA Exposure Factors Handbook: https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252

b. ATSDR (CDC) PHAST tool: https://sams.cdc.gov/samsportal/default.aspx

Appendix D. Estimated Dose Calculations

Total estimated dose (non-cancer) = Ingestion dose + Dermal absorption dose

Ingestion Route

$$Ingestion\ Dose_{(non-cancer\ (mg/kg/day))} = \frac{C \times CF \times IR \times EF \times ED}{BW \times AT_{non-cancer}}$$

Dermal Route

$$Dermal\ Transfer\ (DT) = \frac{C \times AF \times ABS \times AD \times CF}{ORAF}$$

$$Dermal\ Absorption\ Dose_{(non-cancer\,(mg/kg/day))} = \frac{DT \times SA \times EF \times ED}{BW \times AT_{non-cancer}}$$

Evaluation of non-cancer health Risk:

$$Hazard\ Quotient\ (HQ) = \frac{Estimated\ Dose\ (mg/kg\ /day)}{RfD\ (mg/kg/day)}$$

* The hazard quotient (HQ) is the ratio of the potential exposure to a substance to the level of which no harmful effects is expected. If the hazard quotient is greater than one, the substance may pose a health risk.

Excess cancer risk = Ingestion excess cancer risk + Dermal excess cancer risk

Ingestion Route

$$Cacner\ Risk = \frac{C \times CF \times IR \times EF \times ED \times CPF}{BW \times AT_{cancer}}$$

Dermal Route

$$Cacner\ Risk = \frac{DT \times SA \times EF \times ED \times CPF}{BW \times AT_{cancer}}$$