



Soil Quality Guidelines for Dioxins & Furans in Alberta and Saskatchewan Explained



By: Daniel Smith, B.Sc., M.Env.Sc., QP_{SASK}
Intrinsic Corp.

March 19-20 2025
SustainTech, Delta Saskatoon Downtown

Outline

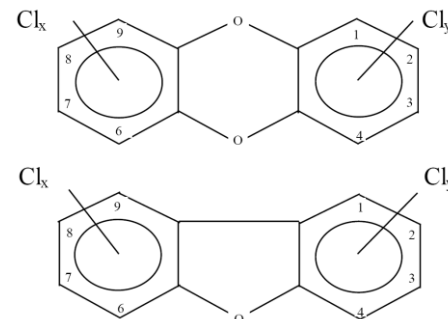
- What are dioxins & furans (and dioxin-like PCBs), and how are they evaluated?
- How are soil quality guidelines for human direct soil contact developed?
- What is Saskatchewan's guideline? What is it based on?
- What is Alberta's guideline? What is it based on?
- Simple, right?

Dioxins & Furans

- Persistent organic pollutants
- May occur at high concentrations in soil
- Typically, very low concentrations in plants and water
- Stored in fat tissue in animals and remain in the body for a long time
- All people have background exposure to dioxins and furans, over 90% of which typically comes from food (mostly meat and dairy products, fish and shellfish)

Dioxin & Furan Toxic Equivalent (TEQ)

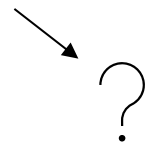
- 210 dioxin & furan congeners; 17 of which are evaluated together on a TEQ-basis
- Each congener is evaluated based on its relative toxicity to 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD)



Source: CCME (2002)

$$TEQ = \sum_{i=1}^n C_i \times TEF_i$$

$$TEQ = (2,3,7,8-TCDD \times 1) + (1,2,3,7,8-PeCDD \times 1) + (1,2,3,4,7,8-HxCDD \times 0.1) \dots (PCB 189 \times 0.00003)$$



Dioxin & Furan – Soil Quality Guidelines (SQG)

2002

CCME establishes dioxin and furan soil quality guideline for the protection of human health

June 2024

Alberta releases new guidelines which includes an updated soil guideline for dioxins and furans

April 2024

Saskatchewan aligns environmental quality guidelines with Alberta (mostly)

- Until recently, the CCME SQG had been adopted in both Saskatchewan and Alberta for the protection of human direct soil contact at environmentally impacted sites

Human Direct Soil Quality Guidelines

- Saskatchewan

- Guideline from CCME (2002)
- Based on background levels of dioxins and furans in Canadian soils

→ **4 ng TEQ/kg**

- Alberta

- Health-based guideline

→ **54 ng TEQ/kg**
(residential)

Land Use	Natural Area	Agricultural	Residential/ Parkland	Commercial	Industrial
Unit (unless otherwise indicated)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Dioxins & Furans	0.00025	0.000054	0.000054	0.000080	0.000118

Soil Quality Guideline Calculation

Estimated Daily Intake

Tolerable Daily Intake

Soil Allocation Factor

$$SRG_{HDC} = \frac{(TDI - EDI) \times SAF \times BW}{[(AF_G \times SIR) + (AF_L \times IR_s \times ET_2) + (AF_S \times SR)] \times ET_1} + [BSC]$$

Ingestion

Inhalation

Dermal Contact

CCME Guideline

- At the time, the EDI of dioxins and furans for toddlers was at or above established TDIs.

The diagram shows a red oval containing the text "Tolerable Daily Intake" and "Estimated Daily Intake". An arrow points from "Tolerable Daily Intake" to the formula, and another arrow points from "Estimated Daily Intake" to the formula. The formula is:

$$SRG_{HDC} = \frac{(TDI - EDI) \times SAF \times BW}{[(AF_G \times SIR) + (AF_L \times IR_S \times ET_2) + (AF_i$$

- In accordance with CCME protocol, the soil quality guideline was set at the background soil concentration to minimize any additional dioxin and furan exposure from a site.

CCME Guideline

- The established background value was based on limited information that may not have accurately reflected ambient background soil concentrations in Canada.

Table 4. Dioxin/furan ambient background soil concentrations in Canada (I-TEQ equivalents, dry weight)

Location	Mean (ng TEQ·kg ⁻¹ ± SD)	Range (ng TEQ·kg ⁻¹)	Sample Size	Site Description	Reference
Ontario	1.7 ^a	--	74	rural parkland	OMOEE 1993
British Columbia	5.0 ^b	0.0 - 57.0	53	background	Van Oostdam and Ward 1995
Quebec	10 ^c ± 16.5	0.0 - 99 ^d	57	background for semi-rural	Trépanier 1992

^a The OTR98 (98th percentile of the Ontario typical range) is equal to 4.8 ng TEQ·kg⁻¹.

^b Dwernychuk et al. (1991) reported a background mean value of 11.1 ng TEQ·kg⁻¹, n=14; results were included in Van Oostdam and Ward (1995).

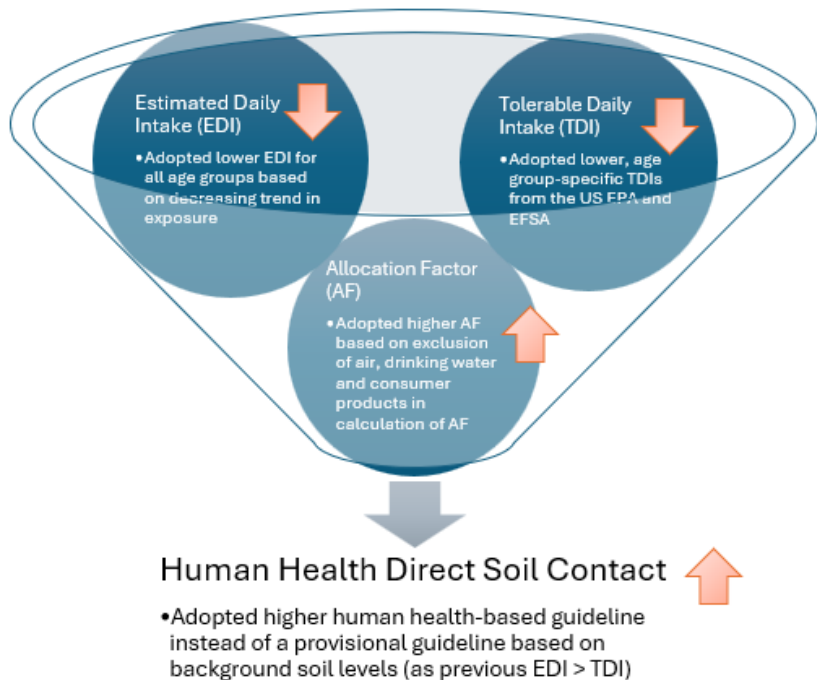
^c Geometric mean = 4.4 ng TEQ·kg⁻¹

^d Detection limits were often high, non-detected values of each congener was set equal to half the detection limit.
This could result in an overestimate of actual background concentrations.

Source: CCME (2002)

Alberta EPA Guideline

Basis of Guideline Changes



TDI	2.0 pg/kg-day	→	0.7 pg/kg-day
EDI	7.1 pg/kg-day (toddler) 1.3 pg/kg-day (adult)	→	0.2 pg/kg-day
AF	0.25 (unitless)	→	0.5 (unitless)
TEF	WHO (1998)	→	WHO (2005)

Alberta EPA Guideline – TDIs

- Most sensitive endpoint is reproductive and developmental effects.

2.0 pg/kg-day → 0.7 pg/kg-day

- Adopted two separate TDIs:

1. 0.7 pg/kg-day (US EPA 2012)
for the protection of children
less than 10 years of age.

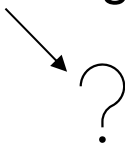


Toddler

2. 0.25 pg/kg-day (EFSA 2018)
for anyone 10+ years of age.



Adult



Alberta EPA Guideline – EDIs & AF

- Estimated Daily Intakes

7.1 pg/kg-day (toddler) 1.3 pg/kg-day (adult)	→	0.2 pg/kg-day
--	---	---------------

- Decreasing trend in exposure over time
- Suggests that the EDIs from the 1990s overstate current Canadian exposure

- Allocation Factors

0.25 (unitless)	→	0.5 (unitless)
-----------------	---	----------------

- Previously included four pathways (i.e., soil, food, drinking water, consumer products).
- Now based on soil and food alone.



Alberta EPA Guideline – TEFs

- Toxic Equivalency Factors

WHO 1998 TEFs → WHO 2005 TEFs

- Internationally established factors for consistency in assessing dioxins & furans.
- The WHO re-evaluates the key assumptions underlying these values and has established several iterations over time.
- The WHO 2005 TEFs were adopted in place of 1998 values.



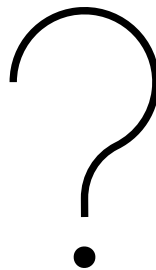
Summary

- Saskatchewan has adopted the former Alberta SQG which was adopted from CCME (2002).
- Alberta has moved towards guidelines that are:
 - Health-based
 - Land-use-specific
- While Alberta's updated guidelines have not currently been adopted in Saskatchewan, guidelines may change, and guidelines from other jurisdictions may be used with sufficient justification provided by a qualified person.

4 ng TEQ/kg → 54 ng TEQ/kg

Other Considerations

Adult Lifestage

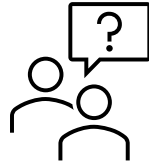


TEQ Calculation

WHO 2022 TEFs

Allocation Factors

Questions?



Dan Smith

dsmith@intrinsik.com

info@intrinsik.com

References

CCME (Canadian Council of Ministers of the Environment). (2002). Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health. Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans (PCDD/Fs).

EFSA (European Food Safety Authority). (2018). Scientific Opinion on the risk for animal and human health related to the presence of dioxins and dioxin-like PCBs in feed and food. EFSA J. 16(11): 5333.

EPA (Alberta Environment and Protected Areas). (2024a). Recommendations to Update Alberta Tier 1 Guidelines for Dioxins and Furans. Scientific Working Group for Contaminated Sites in Alberta. June 27, 2024.

EPA (Alberta Environment and Protected Areas). (2024b). Review of Alberta Tier 1 Human Health Guidelines for Dioxin and Furans. Panel Report. June 27, 2024.

Health Canada. (2005). It's Your Health: Dioxins and Furans. https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/hl-vs/alt_formats/pacrbdbgapcr/pdf/iyh-vsv/enviro/dioxin-eng.pdf

Health Canada. (2021). Federal Contaminated Site Risk Assessment in Canada: Toxicological Reference Values (TRVs). Version 3.0. March 2021.

US EPA (United States Environmental Protection Agency). (2012). EPA's Reanalysis of Key Issues Related to Dioxin Toxicity and Response to NAS Comments, Volume 1. Washington, DC: US Environmental Protection Agency. EPA/600/R-10/038F.

Woof, L., Kennedy, T.S., Du Gas, L., Bogstie, C., Wang, N.C.Y. and Schiewe, B. (2024). Soil quality guidelines for dioxins and furans in Canada: A review and international comparison, Human and Ecological Risk Assessment: An International Journal, 30:5-6, 594-614, DOI:10.1080/10807039.2024.2381789