

## APPENDIX D DERIVATION AND SIGNIFICANCE OF PHYTOTOXICOLOGY "UPPER LIMITS OF NORMAL" CONTAMINANT GUIDELINES

The MOE "Upper Limit of Normal" contaminant guidelines (ULN) shown in Tables E1, E2 and E3 represent the expected maximum concentrations of contaminants in surface soil (non-agricultural), foliage (deciduous and current year coniferous trees and shrubs), grass, moss bags and/or snow from areas of Ontario not subject to the influence of point sources of emissions. "Urban" guidelines are based upon samples collected from centres of minimum 10,000 population. "Rural" guidelines are based upon samples collected from non-built-up areas. Samples were collected by MOE personnel using standard sampling techniques as described in this Manual. Chemical analyses were performed by the MOE Laboratory Services Branch.

The guidelines were calculated by taking the arithmetic mean of available analytical data and adding three standard deviations of the mean. For those distributions that are "normal", 99% of all contaminant concentration results for samples from "background" locations (i.e. not affected by point sources nor agricultural activities) will lie below these upper limits of normal. For those distributions that are "non-normal", the calculated upper limits of normal will not actually equal the 99th percentile, but nevertheless they lie within the observed upper range of MOE results for Ontario samples. Geometric means were not employed in calculating the guidelines because: 1) tests of two representative non-normal distributions showed that normality was not significantly improved by using log-transformed data, and 2) the guideline concentrations calculated using the geometric mean were considerably higher than the maximum observed concentrations.

Due to the large variability in element concentrations which may be present across Ontario, even in background data, control samples should always be collected. This is particularly important for soils, which may show large regional variations in element composition due to differences in parent material. Species of vegetation which naturally accumulate high levels of an element also may be encountered.

It is stressed that these guidelines do not represent maximum desirable or allowable levels of contaminants. Rather, they serve as levels which, if exceeded, would prompt further investigation on a case by case basis to determine the significance, if any, of above-normal concentration(s). Concentrations which exceed the guidelines are not necessarily toxic to plants, animals or man. Concentrations which are below the guidelines would not normally be considered toxic. A brief review of world literature has shown that the guideline concentrations are generally within the ranges of results reported by other investigators.

The ULN Guidelines will be expanded, revised or replaced as more data become available.

**TABLE D1 CONTAMINANT GUIDELINES REPRESENTING THE "UPPER LIMITS OF NORMAL" FOR SOIL AND VEGETATION (CONCENTRATIONS EXPRESSED IN PPM, DRY WEIGHT)**

PARAMETER	Soil (0-5 cm)		Foliage		Grass	
	(NW)		(NW)			
	Urban	Rural	Urban	Rural	Rural	
Aluminum	a	a	500 <sup>***</sup>	500	a	
Antimony	8	1 <sup>**</sup>	0.5 <sup>**</sup>	0.3 <sup>**</sup>	a	
Arsenic	20	10	2	0.5, 2 <sup>*</sup>	c, 8 <sup>*</sup>	
Boron	15	10 <sup>**</sup>	175	75	20	
Cadmium	4	3, 4 <sup>*</sup>	2 <sup>*</sup>	1 <sup>*</sup>	0.5, 2 <sup>*</sup>	
Calcium		b	b	a	3%	a
Chloride	a	a	b	0.15%	1%	
Chromium	50	50	8	8	5	
Cobalt	25 <sup>***</sup>	25	2 <sup>***</sup>	2	2, 8 <sup>*</sup>	
Copper	100	60	20	20	7, 20 <sup>*</sup>	
Fluoride		a	a	35	15	12
Iron	3.5% <sup>***</sup>	3.5%	1000	500	500	
Lead	500	150	60	30	20	
Magnesium	a	1%	0.7%	0.7%	a	
Manganese	700	700,1000 <sup>*</sup>	100	b	50,a <sup>*</sup>	
Mercury		0.5	0.15	0.3	0.1	a
Molybdenum	3	2 <sup>**</sup>	1.5	1.5	6	
Nickel	60 <sup>***</sup>	60	7	5, 30 <sup>*</sup>	5,25 <sup>*</sup>	
Selenium	2	2	0.7	0.50	0.5	
Sodium	a	a	350	50	a	
Sulphur	a	0.1%	0.4%	0.4%	0.5%	
Vanadium	70	70	5 <sup>***</sup>	5	6	
Zinc	500	500	250 <sup>***</sup>	250 <sup>*</sup>	40,100 <sup>*</sup>	

Notes:

- NW - Not Washed.
- \* - Where two values are shown, the first is based mainly on Southern Ontario data while the second is based on Northeastern Region data. Also, there are indications that some of the guidelines, at least for foliage, may be somewhat liberal for the Northwestern Region.
- \*\* - Provisional guideline estimated from range of results, pending additional data.
- \*\*\* - Rural results higher than urban results - urban guideline based on rural results.
- + - Data for species considered to be accumulators (Populus spp., Salix spp., Betula spp.) excluded.
- a - Sample size insufficient (<30) to establish guideline.
- b - Concentration highly variable - guideline not established.
- c - 50% or more of results less than detection limit - guideline not established.

TABLE D2

**CONTAMINANT GUIDELINES REPRESENTING THE "UPPER LIMITS OF NORMAL"  
FOR SNOW MELT WATER (CONCENTRATIONS EXPRESSED IN MG/L OF MELT  
WATER)**

Parameter	Guideline	
Aluminum	0.5	
Arsenic	0.03	
Cadmium	0.003	
Calcium	2	
Chloride	4	
Chromium	0.003	
Cobalt	0.01	
Copper	0.06	
Fluoride	0.1	
Iron	0.7	
Lead	0.05	
Magnesium	0.4	
Manganese	0.02	
Mercury	0.0001	
Nickel	0.04	
Nitrogen	3	(as nitrate)
Phosphorus	0.15	
Potassium	1	
Sodium	2	
Sulphur	3	(as sulphate)
Zinc	0.3	
Alkalinity	5.5	
Conductivity	45	
Suspended solid	25	
Dissolved solids	30	
Total Solids	40	
Dissolved organic carbon	2	
Dissolved inorganic carbon	1	
Total particulate carbon	7	

\*\*\* - Snow guidelines are mg/l of meltwater, except conductivity which is  $\mu\text{mhos/cm}$ . Based mainly on NW and NE Region data.

**TABLE D3 CONTAMINANT GUIDELINES REPRESENTING THE "UPPER LIMITS OF NORMAL" FOR MOSS BAGS (CONCENTRATIONS EXPRESSED IN PPM, DRY WEIGHT UNLESS SPECIFIED OTHERWISE**

Element	Urban	Rural
Aluminum	a	1700
Antimony	2	a
Arsenic	2	1
Cadmium	4	2
Chloride	a	0.03%
Chromium	7	a
Cobalt	6	a
Copper	60	8
Fluoride	a	45
Iron	3000	1700
Lead	200	35
Mercury	a	0.2
Nickel	13	6
Selenium	a	0.6
Sulphur	a	0.1%
Zinc	800	100

a Sample size insufficient (<30) to establish guideline.