APPENDIX 2
Equations for the Development of Ingestion-Dermal Soil Remediation Standards for Residential and Non-residential Exposure

Equation 1

Residential Carcinogenic Ingestion-Dermal Human Health-based Criteria

Source: U.S. Environmental Protection Agency, Regional Screening Table, User's Guide (November 2014) (Equation 4.1.3)

$$ID_c = \frac{TR * AT * LT}{(10^{-6} kg/mg) * [(CSF_O * IFS_{adj}) + (CSF_D * DFS_{adj} * ABS_d)]}$$

Parameter	Definition	Units	Default
ID_c	Carcinogenic ingestion-dermal human health-based criterion	mg/kg	Chemical-specific
TR	Target cancer risk	unitless	10^{-6}
AT	Averaging time	days/year	365
LT	Lifetime	years	70
CSF_o	Oral cancer slope factor	$(mg/kg\text{-}d)^{-1}$	Chemical-specific
IFS_{adj}	Age-adjusted soil ingestion rate	mg/kg	36,750
CSF_D	Dermal cancer slope factor	$(mg/kg\text{-}d)^{-1}$	Chemical-specific
DFS_{adj}	Age-adjusted soil dermal contact factor	mg/kg	112,266
ABS_d	Dermal absorption fraction	unitless	Chemical-specific

Equation 2

Residential Non-carcinogenic Ingestion-Dermal Human Health-based Criteria

Source: U.S. Environmental Protection Agency, Regional Screening Table, User's Guide (November 2014) (Equation 4.1.1)

$$ID_{nc} = \frac{THQ * AT * ED * BW}{(EF * ED * 10^{-6} kg/mg) * [(\frac{1}{RfD_O} * IR) + (\frac{1}{RfD_D} * SA * AF * ABS_d)]}$$

Parameter	Definition	Units	Default
ID_{nc}	Non-carcinogenic ingestion-dermal human health-based criterion	mg/kg	Chemical-specific
THQ	Target hazard quotient	unitless	1
AT	Averaging time	days/year	365
ED	Exposure duration	years	6
BW	Body weight-child	kg	15
EF	Exposure frequency	days/year	350
RfD_O	Oral reference dose	mg/kg-day	Chemical-specific
IR	Soil ingestion rate-child	mg/day	200
RfD_D	Dermally adjusted reference dose	mg/kg-day	Chemical-specific
SA	Skin surface area exposed-child	cm^2/day	2,690
AF	Skin-soil adherence factor	mg/cm^2	0.2
ABS_d	Dermal absorption fraction	unitless	Chemical-specific

Equation 3

Non-residential Carcinogenic Ingestion-Dermal Human Health-based Criteria

Source: U.S. Environmental Protection Agency, Regional Screening Table, User's Guide (November 2014) (Equation 4.4.2)

$$ID_c = \frac{TR * AT * LT * BW}{EF * ED * 10^{-6} kg/mg * [(CSF_O * IR) + (CSF_D * SA * AF * ABS_d)]}$$

Parameter	Definition	Units	Default
ID_c	Carcinogenic ingestion-dermal human health-based criterion	mg/kg	Chemical-specific
TR	Target cancer risk	unitless	10^{-6}
AT	Averaging time	days/year	365
LT	Lifetime	years	70
BW	Body weight, adult	kg	80
EF	Exposure frequency	days/year	225
ED	Exposure duration	years	25
CSF_o	Oral cancer slope factor	$(mg/kg\text{-}d)^{-1}$	Chemical-specific
IR	Soil ingestion rate, adult	mg/day	100
CSF_D	Dermal cancer slope factor	$(mg/kg\text{-}d)^{-1}$	Chemical-specific
SA	Skin surface area exposed - adult	cm^2/day	3,470
AF	Soil-skin adherence factor	mg/cm^2	0.12
ABS_d	Dermal absorption fraction	unitless	Chemical-specific

Equation 4

Non-residential Non-carcinogenic Ingestion-Dermal Human Health-based Criteria

Source: U.S. Environmental Protection Agency, Regional Screening Table, User's Guide (November 2014) (Equation 4.4.1)

$$ID_{nc} = \frac{THQ * AT * ED * BW}{(EF * ED * 10^{-6} kg/mg) * [(\frac{1}{RfD_O} * IR) + (\frac{1}{RfD_D} * SA * AF * ABS_d)]}$$

Parameter	Definition	Units	Default
ID_{nc}	Non-carcinogenic ingestion-dermal human health-based criterion	mg/kg	Chemical-specific
THQ	Target hazard quotient	unitless	1
AT	Averaging time	days/year	365
ED	Exposure duration	years	25
BW	Body weight-adult	kg	80
EF	Exposure frequency	days/year	225
RfD_O	Oral reference dose	mg/kg-day	Chemical-specific
IR	Soil ingestion rate-adult	mg/day	100
RfD_D	Dermally adjusted reference dose	mg/kg-day	Chemical-specific
SA	Skin surface area exposed-adult	cm^2/day	3,470
AF	Skin-soil adherence factor	mg/cm^2	0.12
ABS_d	Dermal absorption fraction	unitless	Chemical-specific

Equation 5

Residential and Non-residential Non-carcinogenic Ingestion-Dermal Human Health-based Criteria for EPH

$$ID_{nc} = \frac{THQ}{\frac{f_{(1)}}{ECFV_{(1)}} + \frac{f_{(2)}}{ECFV_{(2)}} + \frac{f_{(3)}}{ECFV_{(3)}} + \frac{f_{(4)}}{ECFV_{(4)}} + \frac{f_{(5)}}{ECFV_{(5)}} + \frac{f_{(6)}}{ECFV_{(6)}} + \frac{f_{(7)}}{ECFV_{(7)}} + \frac{f_{(8)}}{ECFV_{(8)}}}$$

Parameter	Definition	Units	Default
ID_{nc}	Non-carcinogenic ingestion-dermal human health-based criterion	mg/kg	Chemical-specific
THQ	Target hazard quotient	unitless	1
f	EC weight fraction	unitless	Chemical-specific
$ECFV$	Equivalent carbon fraction value	mg/kg	Chemical-specific

ID_{nc} is the ingestion-dermal soil remediation criterion for total EPH for the EPH composition established by the eight equivalent carbon (EC) range fractions. This equation was used to calculate a single numeric total EPH soil remediation criterion for EPH (No. 2 Fuel Oil/Diesel Fuel). This equation will be used to calculate a sample-specific total EPH soil remediation criterion for all EPH (Other) using the Department's online EPH Calculator.

The equivalent carbon fraction value (ECFV) equation and default input variables are the same as used to calculate the soil remediation values noncancer for the specific individual contaminants for the ingestion-dermal absorption exposure pathway shown in Equations 2 and 4. That is, each EC range is treated as if it is a single contaminant.

If the calculated ingestion-dermal human health-based criterion for a contaminant is greater than one million mg/kg, an ingestion-dermal soil remediation standard does not apply.

If the calculated ingestion-dermal human health-based criterion for a contaminant is less than the soil reporting limit, the ingestion-dermal soil remediation standard defaults to the soil reporting limit.