Soil Residual Contaminant Level Determinations Using The U.S. EPA Regional Screening Level Web Calculator

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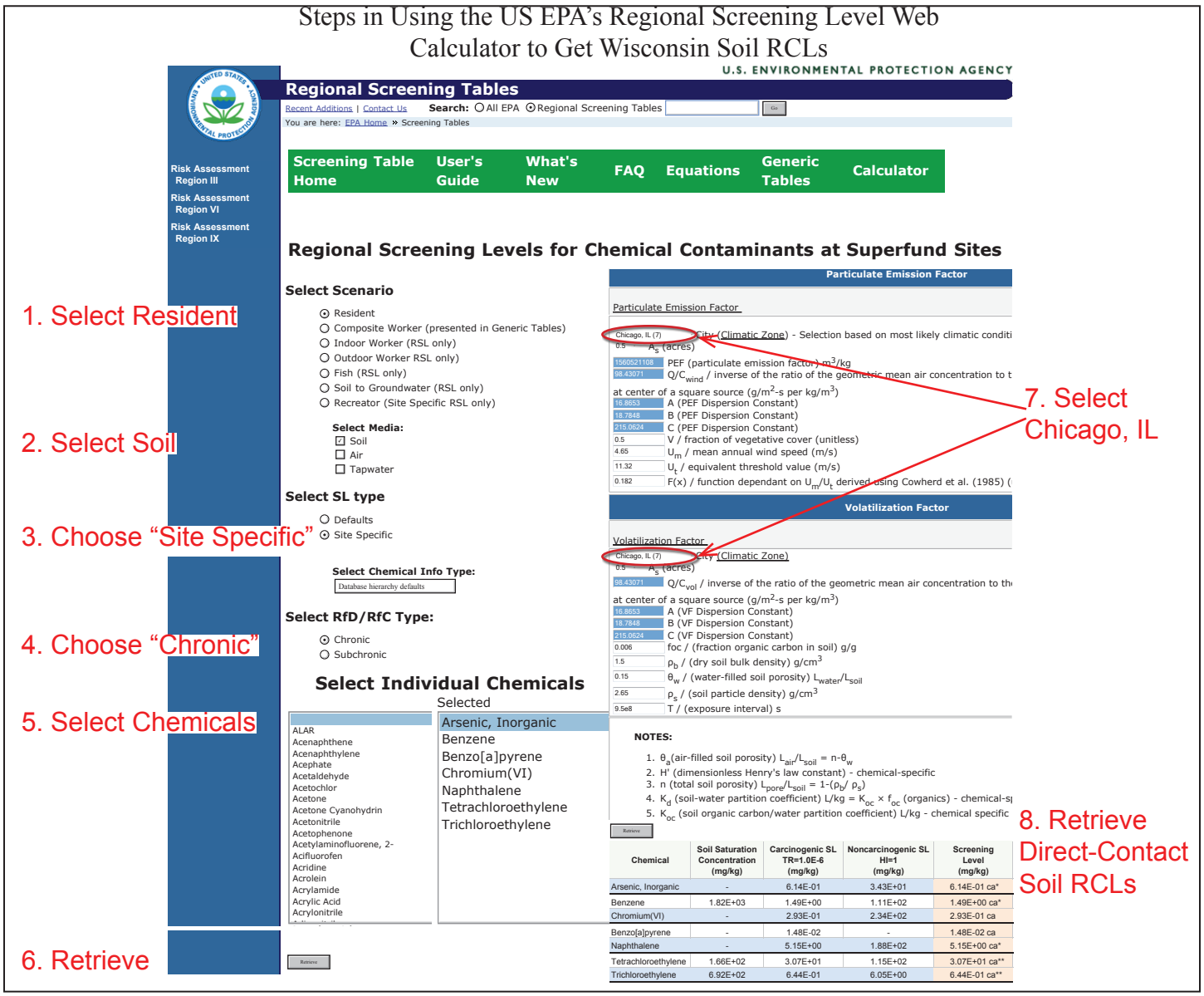

Purpose

This guidance is intended for Department of Natural Resources staff and for the public, for use in understanding and applying the administrative rules that are applicable to the cleanup of soil contamination (NR 720, Wis. Adm. Code).

Disclaimer: This document is intended solely as guidance and does not contain any mandatory requirements, except where requirements found in statute or administrative rule are referenced. This guidance does not establish or affect legal rights or obligations and is not finally determinative of any of the issues addressed. This guidance does not create any rights enforceable by any party in litigation with the State of Wisconsin or the Department of Natural Resources. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts.

Guidance Revisions

This guidance will be updated as needed. Comments and concerns may be sent to:

"Guidance Revisions"
Judy Fassbender - RR/5, DNR
P.O. Box 7921, Madison, WI 53707

Phone: (608) 266-7278
E-mail: judy.fassbender@wisconsin.gov [cc: aristeo.pelayo@wisconsin.gov]

Summary

The Remediation and Redevelopment (RR) Program of the Wisconsin Department of Natural Resources (DNR) provides a spreadsheet with soil residual contaminant levels (RCLs) that are protective of the direct-contact pathway and groundwater quality. The spreadsheet is available here. The RCL calculations are straightforward because of the web calculator developed for the U.S. EPA by a group from Oak Ridge National Laboratory. This guidance details how to use the EPA web calculator. Moreover, this guidance describes how to use the DNR RR's spreadsheet of RCLs.

Background

In 2002, the Wisconsin Department of Natural Resources (DNR or Department) issued guidance RR-682 entitled Determining Residual Contaminant Levels Using the EPA Soil Screening Level Web Site. It provided direction on how to use the calculator ("SSL web calculator") available on the website to determine generic residual contaminant levels (RCLs) consistent with the requirements in ch. NR 720, Wis. Adm. Code.

While the SSL web calculator provided a then-straightforward method for determining RCLs, over the years several concerns were identified which resulted in the Department re-thinking its recommendation to use the SSL web calculator approach. The biggest issue was that the hierarchy for selecting toxicity values going into the risk-based algorithms had become inconsistent and outdated, such that recent information sources might or might not get factored into the calculations. Additionally, the process by which a chemical's physical property or toxicity values are updated may result in the SSL web calculator not producing any result for long periods of time. The other major problem was that EPA's support for the SSL web calculator had diminished and it was becoming increasingly possible that technical support for that web calculator would no longer be provided.

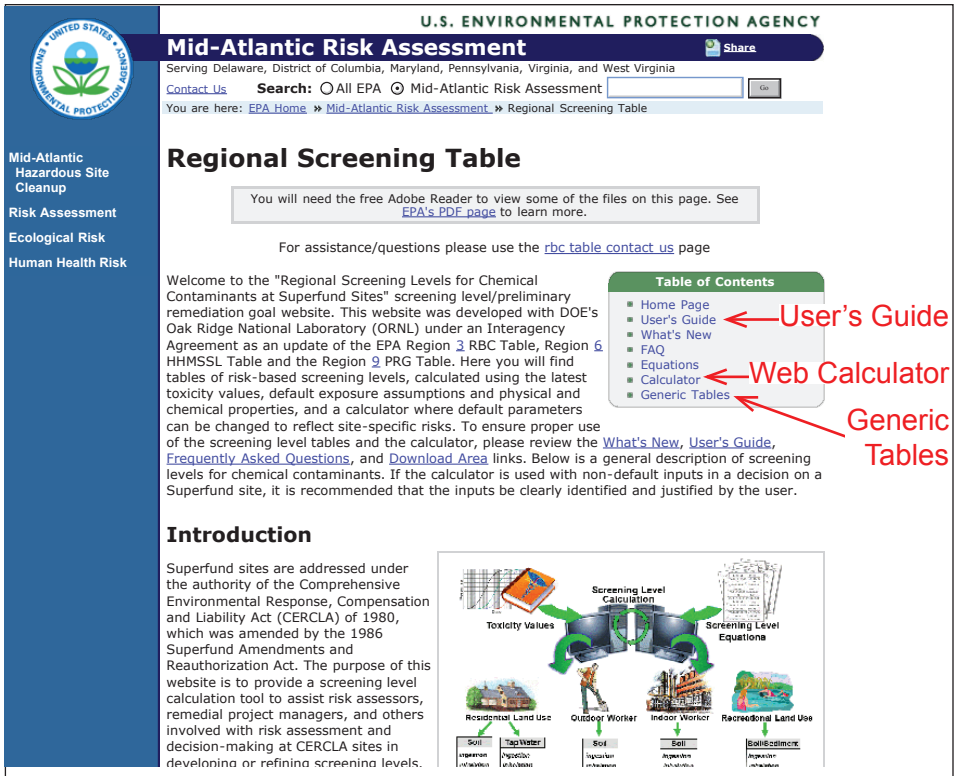

Figure 1 – US EPA's Regional Screening (Level) Table Website

The RSL home page is hosted by EPA Region 3, but the same algorithms apply to EPA Regions 6 and 9, which had provided independent calculations in the past. The RSL home page is referenced by other EPA Regions as well. The "User's Guide," "Calculator" and "Generic Tables" are click-accessible from this home page.

The Department evaluated another calculator available in the more-recent U.S. EPA Regional Screening Level (RSL) website: *www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm* (Figure 1). This RSL website – while housed in an EPA Region 3 server – updates and replaces not only EPA Region 3's RBC table, but also EPA Region 6's HHMSSL and EPA Region 9's PRG tables. So with this website, EPA intends to have uniformity across regions. It explains and implements a consistent hierarchy of the sources of toxicity values. Oak Ridge National Laboratory (ORNL)–EPA's contractor for the website– provides periodic 6-month updates to the website's database of generic tables and its web calculator since 2008. Technical support is more accessible, being readily provided by EPA or ORNL, when questions or issues are identified. The Department has concluded that the web calculator tool in the website is a much-improved alternative.

The Department sought feedback from our external stakeholders on potential options for determining RCLs. Three (3) options were laid out and presented to a joint meeting of the Technical Focus Group and the Brownfields Study Group: Option-1: SSL web calculator; Option-2: RSL web calculator; and Option-3: A State-developed web calculator. Following a discussion on the merits of each of the options, the members present generally agreed that using EPA's more-recent RSL web calculator was the best option to pursue. This document provides a step-by-step approach in using the EPA's RSL web calculator to calculate RCLs that meet the requirements set forth in ch. NR 720, Wis. Adm. Code.

The RSL Web Calculator: ***epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search***

The US EPA's Regional Screening Level (RSL) web calculator is accessible at: *epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search*. It is part of a set of EPA's risk assessment tools, and with it, users will be able to systematically combine exposure assumptions and chemical toxicity data to calculate soil regional screening levels and hence, RCLs. This guidance shows how to use it to generate RCLs that will meet the requirements in NR 720, Wis. Adm. Code. In addition, this guidance descibes the DNR Remediation and Redevelopment (RR) Program's RCL spreadsheet (available here). The RCL spreadsheet has soil results from the RSL web calculator for hundreds of contaminants. Users can enter their site soil data into the RCL spreadsheet to determine individual and cumulative exceedances. A working familiarity with the RSL web calculator is essential for understanding how the values in the RCL spreadsheet were determined. The RR Program will update this RCL spreadsheet periodically. By following this guidance, users will be able to use the web calculator and the RCL spreadsheet to calculate Department-approvable RCLs.

The web calculator (Figure 2) allows users to: a) select a human-health scenario (resident, worker, or soil-to-groundwater), b) select the chemicals of concern, c) change the exposure and soil parameters, and then d) calculate the soil regional screening levels (RSL). Most of the sections in the web calculator are left "as is" (Figure 3) so that the default values are used in determining the soil residual contaminant levels (RCLs). One explicit change is in selecting Chicago, IL, as the climatic zone. The selection "Chicago, IL" is needed in two sections so that more Wisconsin-like factors go into calculating the soil levels. Details on where and how are on page 8. The web calculator accesses a chemical database that is regularly updated (additional contaminants, new toxicity values and physical properties), and users may find the web calculator providing results that are different – but more up-to-date – than those found in the soil RSL Generic Tables (also in the EPA RSL web page). Generally, the periodic six-month web page update synchronizes the generic tables and the calculator.

This guidance document has annotated captures of web pages as Figures 1 through 3 show. Users can look at the figures as they navigate the web calculator. The annotations (in red) and figure captions highlight steps and explain outputs to help users understand what the webpage shows. The step where Chicago, IL, is selected as the climatic zone is in Figure 4. Figures 5 through 9 are also from the RSL web calculator page. Users are particularly encouraged to corroborate the RCL results shown in Figure 6 (non-industrial direct contact RCLs), Figure 8 (industrial d-c RCLs) and Figure 9 (GW-RCLs) when they initially use the web calculator.

U.S. ENVIRONMENTAL PROTECTION AGENCY

Regional Screening Tables

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Screening Table Home | User's Guide | What's New | FAQ | Equations | Generic Tables | Calculator

Risk Assessment Region III
Risk Assessment Region VI
Risk Assessment Region IX

Regional Screening Levels for Chemical Contaminants at Superfund Sites

Using the RSL Calculator

Select Scenario

- Resident
- Composite Worker (presented in Generic Tables)
- Indoor Worker (RSL only)
- Outdoor Worker RSL only)
- Fish (RSL only)
- Soil to Groundwater (RSL only)
- Recreator (Site Specific RSL only)

1. Select 1 Scenario:
   a.) "Resident" for Non-industrial D-C RCL
   b.) "Composite Worker" for Industrial D-C RCL
   c.) "Soil-to-Groundwater" for GW-protective RCL

   (Ignore "Indoor or Outdoor Worker," "Fish" and "Recreator" Scenarios.)

Select Media:

- [x] Soil
- [ ] Air
- [ ] Tapwater

2. Select "Soil."

Select SL type

- Defaults
- Site Specific

3. Choose "Site Specific."
   This will allow you to change the default parameters.
   (Database hierarchy defaults OK)

Select Chemical Info Type:

Database hierarchy defaults

Select RfD/RfC Type:

- Chronic
- Subchronic

*Chronic selection will retrieve Chronic-only

4. Choose "Chronic."

5. Select Chemicals.
   Make sure your selections are in the right-hand box.

Select Individual Chemicals

ALAR
Acenaphthene
Acenaphthylene
Acephate
Acetaldehyde
Acetochlor
Acetone
Acetone Cyanohydrin
Acetonitrile
Acetophenone
Acetylaminofluorene, 2-
Acifluorofen
Acridine
Acrolein
Acrylamide
Acrylic Acid
Acrylonitrile

Selected
Arsenic, Inorganic
Benzene
Benzo[a]pyrene
Chromium(VI)
Naphthalene
Tetrachloroethylene
Trichloroethylene

Or Select All

- [ ] ALL

Retrieve

6. Click "Retrieve."

Figure 2 – Web Calculator Page 1

The initial selections – Scenario (Step 1) and Chemicals (Step 5) – are done here. For first-time users, select "Resident" Scenario to follow what are shown in the next figures. Choose "Site Specific" (Step 3) for more options when calculating Wisconsin soil direct-contact RCLs. Default results may be looked up in the RSL Generic Tables without using the calculator.

Resident Exposure to Soil

Exposure Assessment Details

Age Segment (yr)	AF (mg/cm^2)	BW (kg)	ED (yr)	EF (day/yr)	ET (hr/event)	IRS (mg/day)	SA (cm^2/day)
0-2	0.2	15	2	350	24	200	2800
2-6	0.2	15	4	350	24	200	2800
6-16	0.07	70	10	350	24	100	5700
16-30	0.07	70	14	350	24	100	5700
Child (0-6)	0.2	15	6	350	24	200	2800
Adult (6-30)	0.07	70	24	350	24	100	5700

NOTES:

1. Input fields with a "pink" background are a required entry.
2. Input fields with a "blue" background are calculated dynamically.
3. The supporting equations below are used to compute the child and adult exposure parameters.

Ingestion, Dermal, and Inhalation Exposure

Soil Carcinogenic Dermal
Soil Carcinogenic Ingestion
Soil Carcinogenic Inhalation
Soil Carcinogenic Total
Soil Non-Carcinogenic Dermal
Soil Non-Carcinogenic Ingestion
Soil Non-Carcinogenic Inhalation
Soil Non-Carcinogenic Total

Clicking here will display the pathway equations.

361 — DFS_{adj} (age-adjusted soil dermal factor) mg-year/kg-day	1 — THQ (target hazard quotient) unitless
30 — ED_r (exposure duration - resident) year	114 — IFS_{adj} (age-adjusted soil ingestion factor) mg-year/kg-day
350 — EF_r (exposure frequency) day/year	70 — LT (lifetime - resident) year
24 — ET_r (exposure time - resident) hour	1.0E-6 — TR (target cancer risk) unitless

Mutagenic Parameters

Soil Mutagenic Dermal
Soil Mutagenic Ingestion
Soil Mutagenic Inhalation
Soil Mutagenic Total

1445 — $DFSM_{adj}$ (mutagenic age-adjusted soil dermal factor) mg-year/kg-day	489.5 — $IFSM_{adj}$ (mutagenic age-adjusted soil ingestion factor) mg-year/kg-day

Figure 3 – Web Calculator Page 2, top part.

Soil Exposure Defaults: Leave "as is" the default values in the soil section, except for the climatic zone (next figure). Parameter values shown here are for the "Resident" scenario, which in WI is equivalent to the non-industrial land-use setting.

Soil Exposure Parameters
Accept the web calculator default values.

Any change will affect soil RCL result. DNR recommends not changing these default values without prior WDNR approval.

The RSL web calculator will determine a single contaminant's level (soil concentration) of concern, but will not address cumulative concerns when multiple contaminants are present at a site. The last three figures in this guidance (Figures 10, 11 and 12) are from the RR Program's RCL spreadsheet. The RCL spreadsheet has results that are generated from the RSL web calculator. The RCL spreadsheet implements a multiple-contaminant cumulative strategy that assumes simple additivity of the hazard quotients and the cancer risks from the individual chemicals. With the RCL spreadsheet, users will not only be able to determine individual exceedances, but also cumulative exceedance for when there is a potential for direct contact of soil with multiple contaminants.

Limitations in Applying the Results from the Web Calculator. When a soil RCL that addresses the direct-contact or the soil-to-groundwater pathway is obtained from the web calculator, users should bear in mind the following limitations of the result.

- The RCL implicitly assumes a contaminated area of exposure that is no larger than half (0.5) acre. In general, however, the Department does not require adjustment to the RCL for larger sites. This is because typical soil sampling tends to follow a directed sampling technique where the focus is on areas where contamination is known or suspected. Directed sampling is based on some prior knowledge or some logical basis (*e.g.*, follow-up sampling) such that any bias does not under-represent existing contaminant levels. For example, the samples sent to the lab are typically from samples with the highest field PID readings. Comparison to the calculated RCL will determine whether additional remediation is necessary.

- The resulting RCL must be less than the ceiling concentration of 10% by weight (or 100,000 mg/kg), or if the contaminant is a volatile substance, no greater than its soil saturation concentration ("Csat"). The direct-contact assumptions for soil adherence, wind dispersion and absence of free-phase contamination would be violated at levels higher than these concentrations. Other (model) limitations may be found in the User's Guide at: *www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/usersguide.htm*. There are special-consideration contaminants (like lead, cadmium, chromium VI, and manganese) whose web calculator results (hence, their RCLs) are either: 1.) Independent of the standard equations; or 2.) Determined with standard equations, but with specific adjustment. The results are derived either from a different model (like lead's), or more typically, with adjusted factors in the standard equations, as discussed in the Special Considerations section of the RSL User's Guide.

- Results from the web calculator are not applied to pesticides. When determining pesticide RCLs, label rates, restrictions and safety factors imposed by DNR or DATCP must be followed The DNR-DATCP memorandum of understanding (*datcp.wi.gov/uploads/Environment/pdf/RR5058.pdf*) applies to pesticides.

The RSL web calculator does not address several other scenarios involving soil, so if applicable, the following pathways must be addressed separately:

- Ecological risk – A good web-database of soil ecological benchmarks is available at: *rais.ornl.gov/tools/eco_search.php*. In particular, EPA Region 5's Ecological Screening Levels (ESLs) that include soil levels can be accessed through that web-database.

- Soil background levels.

- Safety risks – For example, methane can already be at an explosive level, even when its level may still be significantly less than the inhalation level where it would be an asphyxiant.

- Indoor-air pathway – Indoor-air calculations are separate and independent of the equations that are used in soil RCLs. DNR publication RR-800 has specific details on how to address vapor intrusion/indoor air.

Utilizing the Individual RCLs. An individual RCL is a soil level determined on the basis of the physical limits and risk-based limits set in Ch. NR 720, Wis. Adm. Code, and on the basis of protecting groundwater quality set in Ch. 140, Wis. Adm. Code. The physical limits on RCLs in NR 720 include the soil background level, soil saturation concentration and ceiling concentration for the substance. Additionally in NR 720.07(1)(c), a substance's RCL must not result in vapors that will exceed the substance's lower explosive limit. The direct-contact hazard- and risk-based limits in NR 720.12(1)(a) (*i.e.*, non-cancer target hazard quotient THQ ≤ 1 and target cancer risk TCR $\leq 10^{-6}$) are used with the toxicity values of an individual substance in calculating its RCL under specific human-health exposure scenarios. Individual RCLs are useful in several assessment-type decisions when chemical-specific soil analyses are collected. For example, the tabulated RCL for a specific chemical can help in choosing the appropriate laboratory analytical method or methods so that the appropriate level of detection for the chemical is achieved.

When multiple contaminants are not a concern, an individual RCL may be directly compared to soil data collected at a contaminated site, in much the same way as an NR 140 Groundwater Enforcement Standard (ES) is directly compared to groundwater quality data. If the soil analytical data show an exceedance of a groundwater-pathway RCL, groundwater samples can be collected to determine whether the pathway has been completed. Another use for individual RCLs is in determining whether excavated soil requires management as a hazardous waste or a solid waste. RR guidance document RR-705 explains how individual RCLs are applied for such determination.

Cumulative Limits, Background Values and the Utility of RCL Spreadsheet. When the contamination at a site involves multiple contaminants, the additional cumulative limits in NR 720.12(1)(b), Wis. Adm. Code, for both the hazard index (non-cancer endpoint HI ≤ 1) and cumulative cancer risk (CCR $\leq 1\text{x}10^{-5}$) must not be exceeded. The RR Program has prepared a separate RCL spreadsheet (available here – and to be updated periodically to match results from the RSL web calculator) that users can utilize to determine any exceedance (individual or cumulative) when multiple contaminants are present. The RCL spreadsheet assumes that noncancer hazards and cancer risks are additive by category when determining whether a set of soil-contaminant concentrations will meet the required cumulative limit on the hazard index and cancer risk. In addition to the results from the RSL web calculator, the spreadsheet has a column of statewide background threshold values (BTVs) for surficial soil-metals. A simple comparison to the BTVs can be done with the spreadsheet.

Steps in Using the Web Calculator and One Acceptable Change from Default

Soil and Chemical Properties. A "default" value is an already-supplied value for a parameter used by the web calculator. The web calculator's default soil parameter values for bulk density (1.5 g/cm^3) and porosity (0.43) remain the same in all calculations. For the soil fraction organic carbon (foc) and water-filled porosity (Θ_w), the web calculator uses default values of 0.6% (foc) and 0.15 (Θ_w) in direct-contact calculations, but it defaults to 0.2% (foc) and 0.3 (Θ_w) for soil-to-groundwater calculations. These same soil default values are in NR 720.12(4), Wis. Adm. Code, and hence should apply in determining soil-RCLs applicable in Wisconsin.

Additional chemical-specific defaults are in the web calculator's database of the chemicals' human health toxicity values and the chemicals' properties (*e.g.*, whether or not the chemical is classified as volatile, its solubility in water, Henry's Law constant and diffusivities). These chemical-specific defaults will be invisible to the user until the output page. Users are recommended to refrain from changing either the soil or chemical defaults in RCL calculations, unless the justification for their change is first approved by the DNR project manager. For example, the DNR project manager may direct users to explicitly include the fact that formaldehyde is a volatile chemical in their RCL calculation.

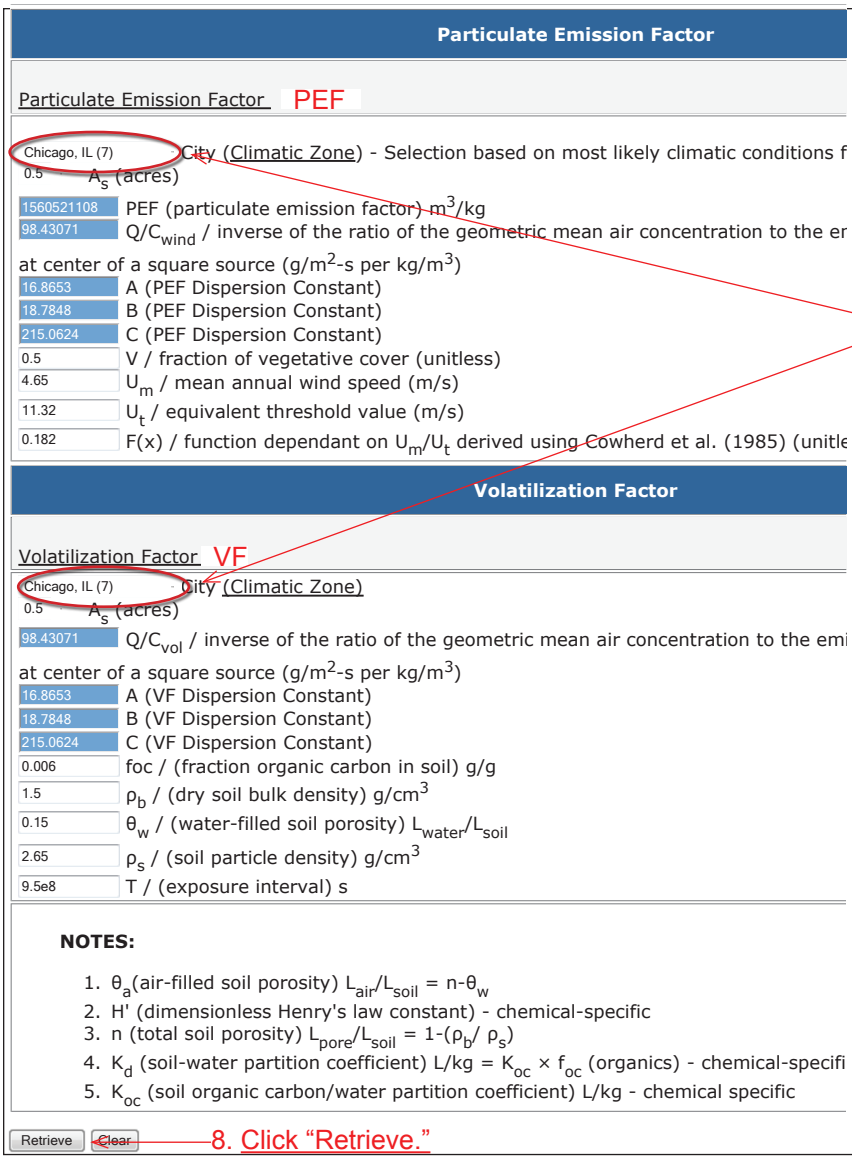

Figure 4 – Web Calculator Page 2, bottom part.

Climatic Zone: Select Chicago, IL in both the PEF and VF sections, so that both factors – important for the inhalation-pathway equations – are calculated with variables closer to Wisconsin conditions.

Direct-Contact Exposure Parameters. Each human-health scenario option in the web calculator defines a specific set of default exposure parameters. The "Resident" and "Composite Worker" scenarios make calculating Wisconsin RCLs more expedient because these scenarios will generate RCLs applicable to non-industrial setting and industrial setting, respectively. Selecting the "Resident" scenario will preset the values in the calculations such that they will be equal to the non-industrial default exposure parameters in NR 720.12(3), Wis. Adm. Code. Similarly, by selecting the web calculator's "Composite Worker" scenario, the calculations will result in RCLs with the industrial default exposure parameters in NR 720.

The RSL website has Generic Tables of screening levels for: a.) Residential Soil and b.) Industrial Soil. See Figure 1 for the link to these tables. The web calculator will be able to reproduce the same soil results in these two tables by selecting the Resident and Composite Worker scenarios, respectively, and allowing the calculations to proceed without changing any default parameter. The values available from the generic RSL tables may be used as individual RCLs at RR sites, but as shown in Figure 4, the RR Program will accept a change from the default climatic zone to a more Wisconsin-like climate ("Chicago, IL"). This zone change will affect the DC RCLs for volatile chemicals. The climate zone appears in two (2) sections near the bottom of the second page of the web calculator. Figure 4 shows where "Chicago, IL" can be selected in the Particulate Emission Factor (PEF) section and the Volatilization Factor (VF) section. The PEF and VF are factors in the soil inhalation-pathway equations. With "Chicago, IL," the resulting DC RCL for a volatile will be slightly

Figure 5 - Web Calculator Page 3, Results

The (results) web page with the soil RCLs may not be easy to read because the results are displayed in a wide table that has 27 columns and not all the columns are visible all at once. Users will need to scroll horizontally and vertically to see the "retrieved" results in the table. For volatiles, users will need to consider not only the rightmost column, but also the "Csat" column. The pertinent DC-RCLs are encircled.

(For a more reader-friendly output, scroll up towards the top of the results page to see other output options. See the next figure for a better output option.)

"Csat" Coumn

Chemical	CAS Number	Mutagen?	VOC?	Ingestion SF (mg/kg-day) -1	SFO Ref	Inhalation Unit Risk (ug/m 3) -1	IUR Ref	Chronic RfD (mg/kg-day)	RfD Ref	Chronic RfC (mg/m 3)	RfC Ref	GIABS	ABS	RBA	Volatilization Factor (m 3/kg)	Soil Saturation Concentration (mg/kg)	Particulate Emission Factor (m 3/kg)	Ingestion SL TR=1.0E-6 (mg/kg)	Dermal SL TR=1.0E-6 (mg/kg)	Inhalation SL TR=1.0E-6 (mg/kg)	Carcinogenic SL TR=1.0E-6 (mg/kg)	Ingestion SL HQ=1 (mg/kg)	Dermal SL HQ=1 (mg/kg)	Inhalation SL HQ=1 (mg/kg)	Noncarcinogenic SL HI=1 (mg/kg)	Screening Level (mg/kg)
Arsenic, Inorganic	7440-38-2	No	No	1.50E+00	I	4.30E-03	I	3.00E-04	I	1.50E-05	C	1	0.03	0.6	-	-	1.56E+09	7.12E-01	4.49E+00	8.83E+02	6.14E-01	3.91E+01	2.79E+02	2.44E+04	3.43E+01	6.14E-01 ca*
Benzene	71-43-2	No	Yes	5.50E-02	I	7.80E-06	I	4.00E-03	I	3.00E-02	I	1	-	1	5.49E+03	1.82E+03	1.56E+09	1.16E+01	-	1.71E+00	1.49E+00	3.13E+02	-	1.72E+02	1.11E+02	1.49E+00 ca*
Cadmium (Diet)	7440-43-9	No	No	-		1.80E-03	I	1.00E-03	I	1.00E-05	A	0.025	0.001	1	-	-	1.56E+09	-	-	2.11E+03	2.11E+03	7.82E+01	6.98E+02	1.63E+04	7.00E+01	7.00E+01 nc
Chromium(VI)	18540-29-9	Yes	No	5.00E-01	J	8.40E-02	S	3.00E-03	I	1.00E-04	I	0.025	-	1	-	-	1.56E+09	2.98E-01	-	1.78E+01	2.93E-01	2.35E+02	-	1.63E+05	2.34E+02	2.93E-01 ca
Chromium, Total	7440-47-3	No	No	-		-		-		-		0.013	-	1	-	-	1.56E+09	-	-	-	-	-	-	-	-	
Dichloroethane, 1,2-	107-06-2	No	Yes	9.10E-02	I	2.60E-05	I	6.00E-03	X	7.00E-03	P	1	-	1	7.11E+03	2.98E+03	1.56E+09	7.04E+00	-	6.65E-01	6.08E-01	4.69E+02	-	5.19E+01	4.67E+01	6.08E-01 ca*
Ethylbenzene	100-41-4	No	Yes	1.10E-02	C	2.50E-06	C	1.00E-01	I	1.00E+00	I	1	-	1	8.81E+03	4.80E+02	1.56E+09	5.82E+01	-	8.57E+00	7.47E+00	7.82E+03	-	9.18E+03	4.22E+03	7.47E+00 ca
Lead and Compounds	7439-92-1	No	No	-		-		-		-		1	-	1	-	-	1.56E+09	-	-	-	-	-	-	-	4.00E+02	4.00E+02 nc
Benzo[a]pyrene	50-32-8	Yes	No	7.30E+00	I	1.10E-03	C	-		-		1	0.13	1	-	-	1.56E+09	2.04E-02	5.32E-02	1.36E+03	1.48E-02	-	-	-	-	1.48E-02 ca
Naphthalene	91-20-3	No	Yes	-		3.40E-05	C	2.00E-02	I	3.00E-03	I	1	0.13	1	7.20E+04	-	1.56E+09	-	-	5.15E+00	5.15E+00	1.56E+03	4.30E+03	2.25E+02	1.88E+02	5.15E+00 ca*
Tetrachloroethylene	127-18-4	No	Yes	2.10E-03	I	2.60E-07	I	6.00E-03	I	4.00E-02	I	1	-	1	3.65E+03	1.66E+02	1.56E+09	3.05E+02	-	3.41E+01	3.07E+01	4.69E+02	-	1.52E+02	1.15E+02	3.07E+01 ca*
Toluene	108-88-3	No	Yes	-		-		8.00E-02	I	5.00E+00	I	1	-	1	6.66E+03	8.18E+02	1.56E+09	-	-	-	-	6.26E+03	-	3.47E+04	5.30E+03	5.30E+03 sat
Trichloroethylene	79-01-6	Yes	Yes	4.60E-02	I	4.10E-06	I	5.00E-04	I	2.00E-03	I	1	-	1	3.43E+03	6.92E+02	1.56E+09	3.24E+00	-	8.04E-01	6.44E-01	3.91E+01	-	7.16E+00	6.05E+00	6.44E-01 ca**
Xylenes	1330-20-7	No	Yes	-		-		2.00E-01	I	1.00E-01	I	1	-	1	9.05E+03	2.58E+02	1.56E+09	-	-	-	-	1.56E+04	-	9.44E+02	8.90E+02	8.90E+02 sat

Output generated 19JUN2013:16:03:37

Figure 6 – Web Calculator "Output to PDF" of ***Non-Industrial*** *Direct-Contact RCLs*

The Screening Level (mg/kg) column (red box in the lower table below) has soil results with important caveats. The caveats (mostly "ca" and "nc") - explained in green font below "Site-specific" - must be considered before the soil result is used as the DC RCL. A "sat" result (like for toluene and xylenes) means the result exceeds the value under the Soil Saturation Concentration (or Csat) column. A "sat" result means the individual RCL will assume the lesser Csat level (red-encircled). There are 8 columns pertaining to human toxicity values (TVs). They are also important in interpreting the soil results. Total Chromium has all of its TVs empty, so it has no RCL result. In contrast, Lead -also with all its TV columns empty- has a result (400 mg/kg). Lead's result is a "special consideration" case as explained in the RSL User's Guide. When toxicity values are added or revised, or when future special considerations are adopted for a chemical, so too will its result be revised.

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Regional Screening Levels for Chemical Contaminants at Superfund Sites

Site-specific

Resident Equation Inputs for Soil
Output to Spreadsheet
Output to PDF

"Output to PDF" will create a file that you may find easier to read.
The soil direct-contact RCL results are shown in the tables below.

Site-specific

Resident Screening Levels (RSL) for Soil
ca=Cancer, nc=Noncancer, ca* (Where nc SL < 100 x ca SL),
ca** (Where nc SL < 10 x ca SL), max=SL exceeds ceiling limit (see User's Guide), sat=SL exceeds csat,
Smax=Soil SL exceeds ceiling limit and has been substituted with the max value (see User's Guide),
Ssat=Soil inhalation SL exceeds csat and has been substituted with the csat

8 Columns with Toxicity Values and Their References

Chemical	CAS Number	Mutagen?	VOC?	Ingestion SF $(mg/kg\text{-}day)^{-1}$	SFO Ref	Inhalation Unit Risk $(ug/m^3)^{-1}$	IUR Ref	Chronic RfD (mg/kg-day)	RfD Ref	Chronic RfC (mg/m^3)	RfC Ref	GIABS	ABS	RBA	Volatilization Factor (m^3/kg)
Arsenic, Inorganic	7440-38-2	No	No	1.50E+00	I	4.30E-03	I	3.00E-04	I	1.50E-05	C	1	0.03	0.6	-
Benzene	71-43-2	No	Yes	5.50E-02	I	7.80E-06	I	4.00E-03	I	3.00E-02	I	1	-	1	5.49E+03
Cadmium (Diet)	7440-43-9	No	No	-		1.80E-03	I	1.00E-03	I	1.00E-05	A	0.025	0.001	1	-
Chromium(VI)	18540-29-9	Yes	No	5.00E-01	J	8.40E-02	S	3.00E-03	I	1.00E-04	I	0.025	-	1	-
Chromium, Total	7440-47-3	No	No	-		-		-		-		0.013	-	1	-
Dichloroethane, 1,2-	107-06-2	No	Yes	9.10E-02	I	2.60E-05	I	6.00E-03	X	7.00E-03	P	1	-	1	7.11E+03
Ethylbenzene	100-41-4	No	Yes	1.10E-02	C	2.50E-06	C	1.00E-01	I	1.00E+00	I	1	-	1	8.81E+03
Lead and Compounds	7439-92-1	No	No	-		-		-		-		1	-	1	-
Benzo[a]pyrene	50-32-8	Yes	No	7.30E+00	I	1.10E-03	C	-		-		1	0.13	1	-
Naphthalene	91-20-3	No	Yes	-		3.40E-05	C	2.00E-02	I	3.00E-03	I	1	0.13	1	7.20E+04
Tetrachloroethylene	127-18-4	No	Yes	2.10E-03	I	2.60E-07	I	6.00E-03	I	4.00E-02	I	1	-	1	3.65E+03
Toluene	108-88-3	No	Yes	-		-		8.00E-02	I	5.00E+00	I	1	-	1	6.66E+03
Trichloroethylene	79-01-6	Yes	Yes	4.60E-02	I	4.10E-06	I	5.00E-04	I	2.00E-03	I	1	-	1	3.43E+03
Xylenes	1330-20-7	No	Yes	-		-		2.00E-01	I	1.00E-01	I	1	-	1	9.05E+03

"Csat" Column

Chemical	Soil Saturation Concentration (mg/kg)	Particulate Emission Factor (m^3/kg)	Ingestion SL TR=1.0E-6 (mg/kg)	Dermal SL TR=1.0E-6 (mg/kg)	Inhalation SL TR=1.0E-6 (mg/kg)	Carcinogenic SL TR=1.0E-6 (mg/kg)	Ingestion SL HQ=1 (mg/kg)	Dermal SL HQ=1 (mg/kg)	Inhalation SL HQ=1 (mg/kg)	Noncarcinogenic SL HI=1 (mg/kg)	Screening Level (mg/kg)
Arsenic, Inorganic	-	1.56E+09	7.12E-01	4.49E+00	8.83E+02	6.14E-01	3.91E+01	2.79E+02	2.44E+04	3.43E+01	6.14E-01 ca*
Benzene	1.82E+03	1.56E+09	1.16E+01	-	1.71E+00	1.49E+00	3.13E+02	-	1.72E+02	1.11E+02	1.49E+00 ca*
Cadmium (Diet)	-	1.56E+09	-	-	2.11E+03	2.11E+03	7.82E+01	6.98E+02	1.63E+04	7.00E+01	7.00E+01 nc
Chromium(VI)	-	1.56E+09	2.98E-01	-	1.78E+01	2.93E-01	2.35E+02	-	1.63E+05	2.34E+02	2.93E-01 ca
Chromium, Total	-	1.56E+09	-	-	-	-	-	-	-	-	
Dichloroethane, 1,2-	2.98E+03	1.56E+09	7.04E+00	-	6.65E-01	6.08E-01	4.69E+02	-	5.19E+01	4.67E+01	6.08E-01 ca*
Ethylbenzene	4.80E+02	1.56E+09	5.82E+01	-	8.57E+00	7.47E+00	7.82E+03	-	9.18E+03	4.22E+03	7.47E+00 ca
Lead and Compounds	-	1.56E+09	-	-	-	-	-	-	-	4.00E+02	4.00E+02 nc
Benzo[a]pyrene	-	1.56E+09	2.04E-02	5.32E-02	1.36E+03	1.48E-02	-	-	-	-	1.48E-02 ca
Naphthalene	-	1.56E+09	-	-	5.15E+00	5.15E+00	1.56E+03	4.30E+03	2.25E+02	1.88E+02	5.15E+00 ca*
Tetrachloroethylene	1.66E+02	1.56E+09	3.05E+02	-	3.41E+01	3.07E+01	4.69E+02	-	1.52E+02	1.15E+02	3.07E+01 ca**
Toluene	8.18E+02	1.56E+09	-	-	-	-	6.26E+03	-	3.47E+04	5.30E+03	5.30E+03 sat
Trichloroethylene	6.92E+02	1.56E+09	3.24E+00	-	8.04E-01	6.44E-01	3.91E+01	-	7.16E+00	6.05E+00	6.44E-01 ca**
Xylenes	2.58E+02	1.56E+09	-	-	-	-	1.56E+04	-	9.44E+02	8.90E+02	8.90E+02 sat

larger when compared to the value in the RSL generic table. As an example, benzene's residential RSL is 1.1 mg/kg from the RSL Generic Tables. But by selecting "Chicago," the result for benzene will be 35% larger or 1.49 mg/kg. The RR Program will accept this larger 1.49 mg/kg as the direct-contact RCL for benzene at a non-industrial site.

After "Retrieve," the soil results page will have two sections, each with a table. Figure 5 (page 9) only shows the lower of the tables that become available when the calculations are done. This lower table is very wide (27 or more columns), and not all the columns will appear right away. More importantly, the soil level results (RCLs) will be in the rightmost column - so initially hidden. The user will need to scroll to the right to see the rest of the page and the results. The same results in Figure 5 would look differently when the option "Output to PDF" (at the top part of the results' page) is selected.

Figure 6 (page 10) shows how the "Output to PDF" table of results will look. The very wide table in Figure 5 is separated into two tables. With fewer columns, the user may find this output option more readable. The RCL results will most often be found under the "Screening Level (mg/kg)"column. Each value under this column is followed by an abbreviated, but important, qualifier. A shortened description of the qualifiers is shown in green fonts just above the tables with results. The typical qualifiers are abbreviated "nc" and "ca" for non-cancer and cancer endpoints, respectively. A value with "nc" or "ca" is a straightforward individual direct-contact RCL, meaning that the result is a "not-to-exceed" soil cleanup level for that chemical at the target hazard quotient of 1 or the target cancer risk of 1.e-06.

Two (2) other qualifiers next to results, "sat" and "max," signify caveats. These qualifiers indicate that the standard direct-contact pathway equations produced a result that is too high to be interpreted as the "not-to-exceed" soil cleanup level because some other physical limit has been exceeded by the result.

Two (2) chemicals - Toluene and Xylenes - in Figure 6 have "sat" next to their soil Screening Level results. The "sat" qualifier only applies to liquid volatiles. A "sat" result means that the screening level is greater than (so exceeds) the soil saturation concentration (Csat) for the volatile chemical. In case of a "sat" result, the lesser Csat value will become the volatile chemical's "not-to-exceed" RCL. The Csat value is tabulated under the "Soil Saturation Concentration (mg/kg)" column of the results page.

Although no chemical in Figure 6 is shown with the "max" qualifier, it indicates a result that may be aphysical in nature (such as a concentration >100%). It means that the calculated level violated physical limits or some implicit model assumptions that were defined and set internally in the RSL's calculations. For a "max" result, the individual RCL will assume the ceiling limit or 100,000 mg/kg (as defined in the RSL User's Guide) so that assumptions on soil-contact (*e.g.*, soil adherence and wind-borne dispersion) are not violated. In adidition to health-based soil calculations, the Csat and ceiling limit are 2 of the physical constraints in determining soil standards under NR 720.07(1)(b), Wis. Adm. Code.

Inspection of the tables in Figure 6 shows that for Total Chromium, there is no result under "Soil Screening Level." Looking into the other columns will explain why. To the right of the "CAS Number," there are eight columns that have the chemical's toxicity values (TVs) and their respective abbreviated references. A key to the abbreviations (*e.g.*, I = IRIS or US EPA's IRIS database; C = California EPA) is available in the RSL Generic Tables (see Figure 1 for link). The initial four columns contain the two (2) TVs that are necessary to determine a cancer-endpoint RCL. The next four columns have the 2 non-cancer TVs. If not one (1) of these columns has any value, then no RCL gets calculated. Hence for the case of Total Chromium, since it has no TV, there is no result.

For Lead, note that (like Total Chromium) there is no value in any of its TV columns, but (unlike Total Chromium) the web calculator has a Lead result of "4.00+E02 nc" (= 400 mg/kg non-cancer). This result for

Lead is explained in the RSL User's Guide under the "Special Considerations" section. Particularly for Lead, the result did not come from the standard pathway equations, but from a separate computation that is specific only to Lead. The "Special Considerations" list includes Cadmium, hexavalent Chromium and others where additional chemical-specific adjustments were further applied to the standard pathway equations to get their soil results from the web calculator.

It is important to note that in the future, the web calculator's result will be affected either when toxicity values are added or revised, or when special considerations are adopted for the chemical. In November 2011, the

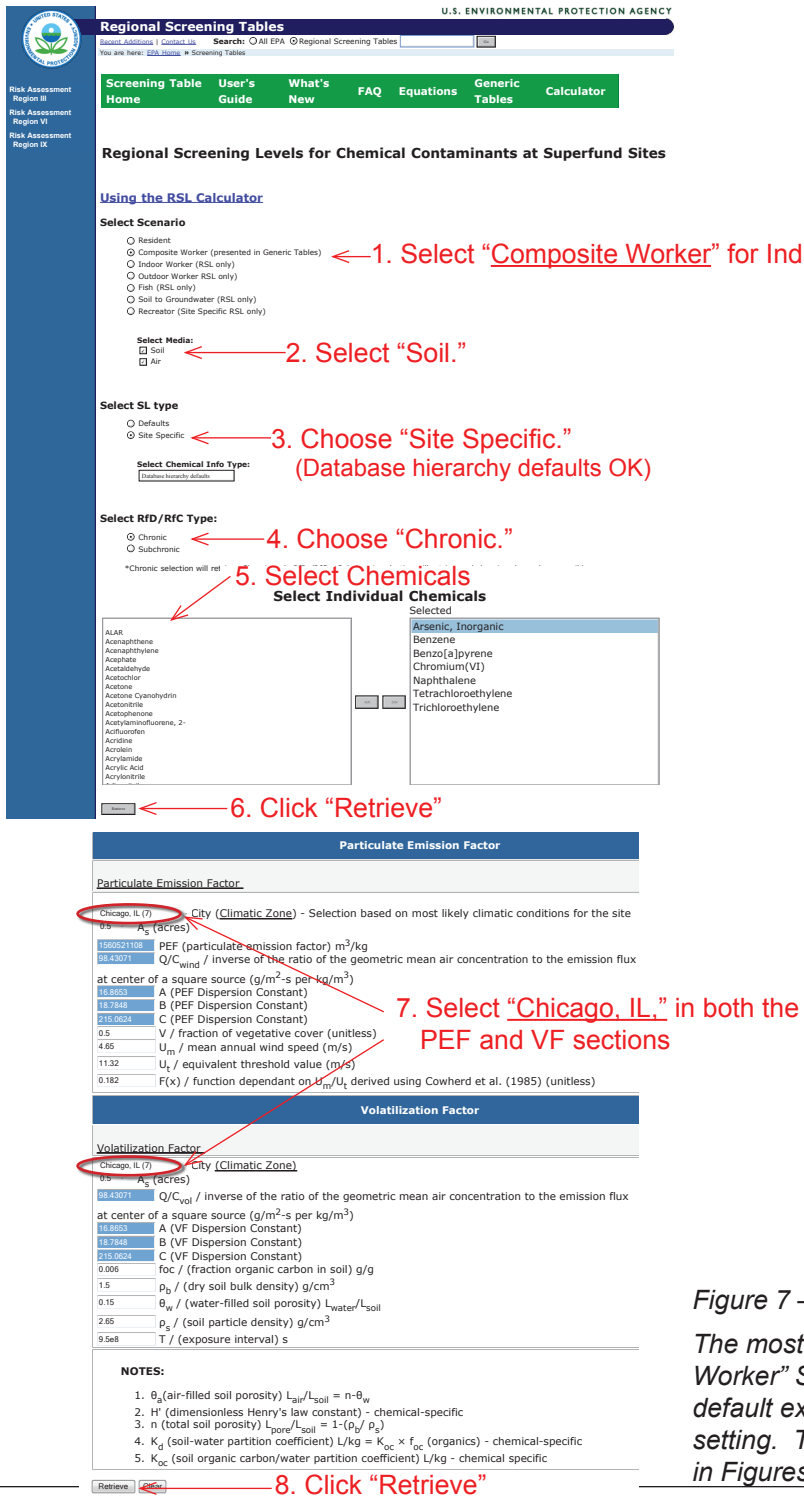

Figure 7 – Steps to Get Industrial Soil D-C RCLs

The most important first step is selecting the "Composite Worker" Scenario. This selection will fill in most of the default exposure parameters for an industrial land use setting. The rest follows the same steps as those shown in Figures 3 thru 6.

*Figure 8 – **Industrial** Direct-Contact RCLs*

The DC RCL results are: 1.) in the red box (lower table), and 2.) circled in for Toluene and Xylenes. See Figure 6 caption for explanation. The upper table has the same toxicity values (TVs) as in Figure 6. Lead has no TV; its RCL of 800 mg/kg is explained in the RSL User's Guide. An important step but not obvious below is that when the "Composite Worker" scenario is initially selected in the web calculator, the soil exposure parameters get set to values applicable to an industrial land use setting in WI. Hence, "Composite Worker" soil results are applicable as industrial direct-contact RCLs. There will be contaminants with individual industrial RCLs equal to their non-industrial RCLs. For example, when the individual non-industrial RCL is already at Csat (like toluene and xylene), then the industrial RCL will likewise be at Csat.

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Regional Screening Levels for Chemical Contaminants at Superfund Sites

Site-specific

Composite Worker Equation Inputs for Soil
Output to Spreadsheet
Output to PDF

"Output to PDF" will create a file that you may find easier to read.
The soil direct-contact RCL results are shown in the tables below.

Site-specific

Composite Worker Screening Levels (RSL) for Soil

ca=Cancer, nc=Noncancer, ca* (Where nc SL < 100 x ca SL), ca** (Where nc SL < 10 x ca SL), max=SL exceeds ceiling limit (see User's Guide), sat=SL exceeds csat, Smax=Soil SL exceeds ceiling limit and has been substituted with the max value (see User's Guide), Ssat=Soil inhalation SL exceeds csat and has been substituted with the csat

8 Columns with Toxicity Values and Their References

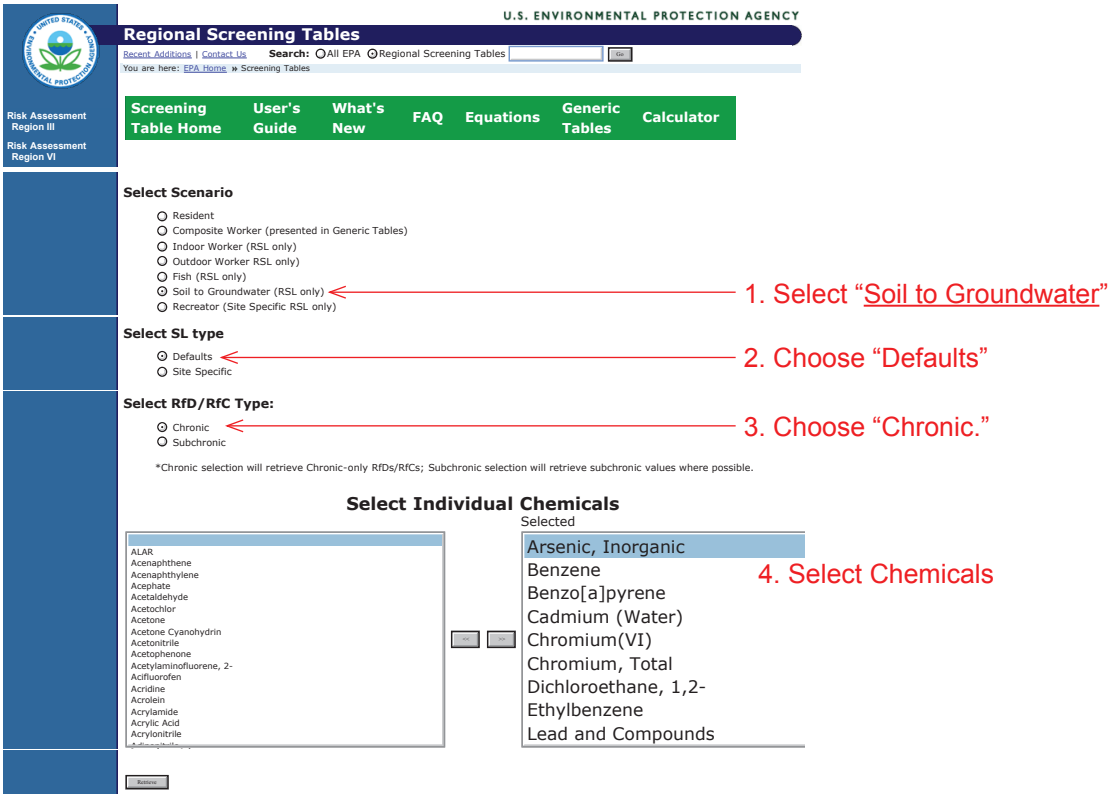
Chemical	CAS Number	Mutagen?	VOC?	Ingestion SF (mg/kg-day)$^{-1}$	SFO Ref	Inhalation Unit Risk (ug/m^3)$^{-1}$	IUR Ref	Chronic RfD (mg/kg-day)	RfD Ref	Chronic RfC (mg/m^3)	RfC Ref	GIABS	ABS	RBA	Volatilization Factor (m^3/kg)
Arsenic, Inorganic	7440-38-2	No	No	1.50E+00	I	4.30E-03	I	3.00E-04	I	1.50E-05	C	1	0.03	0.6	-
Benzene	71-43-2	No	Yes	5.50E-02	I	7.80E-06	I	4.00E-03	I	3.00E-02	I	1	-	1	5.49E+03
Cadmium (Diet)	7440-43-9	No	No	-		1.80E-03	I	1.00E-03	I	1.00E-05	A	0.025	0.001	1	-
Chromium(VI)	18540-29-9	Yes	No	5.00E-01	J	8.40E-02	S	3.00E-03	I	1.00E-04	I	0.025	-	1	-
Chromium, Total	7440-47-3	No	No	-		-		-		-		0.013	-	1	-
Dichloroethane, 1,2-	107-06-2	No	Yes	9.10E-02	I	2.60E-05	I	6.00E-03	X	7.00E-03	P	1	-	1	7.11E+03
Ethylbenzene	100-41-4	No	Yes	1.10E-02	C	2.50E-06	C	1.00E-01	I	1.00E+00	I	1	-	1	8.81E+03
Lead and Compounds	7439-92-1	No	No	-		-		-		-		1	-	1	-
Benzo[a]pyrene	50-32-8	Yes	No	7.30E+00	I	1.10E-03	C	-		-		1	0.13	1	-
Naphthalene	91-20-3	No	Yes	-		3.40E-05	C	2.00E-02	I	3.00E-03	I	1	0.13	1	7.20E+04
Tetrachloroethylene	127-18-4	No	Yes	2.10E-03	I	2.60E-07	I	6.00E-03	I	4.00E-02	I	1	-	1	3.65E+03
Toluene	108-88-3	No	Yes	-		-		8.00E-02	I	5.00E+00	I	1	-	1	6.66E+03
Trichloroethylene	79-01-6	Yes	Yes	4.60E-02	I	4.10E-06	I	5.00E-04	I	2.00E-03	I	1	-	1	3.43E+03
Xylenes	1330-20-7	No	Yes	-		-		2.00E-01	I	1.00E-01	I	1	-	1	9.05E+03

"Csat" Column

Chemical	Soil Saturation Concentration (mg/kg)	Particulate Emission Factor (m^3/kg)	Ingestion SL TR=1.0E-6 (mg/kg)	Dermal SL TR=1.0E-6 (mg/kg)	Inhalation SL TR=1.0E-6 (mg/kg)	Carcinogenic SL TR=1.0E-6 (mg/kg)	Ingestion SL HQ=1 (mg/kg)	Dermal SL HQ=1 (mg/kg)	Inhalation SL HQ=1 (mg/kg)	Noncarcinogenic SL HI=1 (mg/kg)	Screening Level (mg/kg)
Arsenic, Inorganic	-	1.56E+09	3.18E+00	9.64E+00	4.45E+03	2.39E+00	5.11E+02	1.55E+03	1.03E+05	3.83E+02	2.39E+00 ca
Benzene	1.82E+03	1.56E+09	5.20E+01	-	8.64E+00	7.41E+00	4.09E+03	-	7.22E+02	6.14E+02	7.41E+00 ca*
Cadmium (Diet)	-	1.56E+09	-	-	1.06E+04	1.06E+04	1.02E+03	3.87E+03	6.84E+04	7.99E+02	7.99E+02 nc
Chromium(VI)	-	1.56E+09	5.72E+00	-	2.28E+02	5.58E+00	3.07E+03	-	6.84E+05	3.05E+03	5.58E+00 ca
Chromium, Total	-	1.56E+09	-	-	-	-	-	-	-	-	
Dichloroethane, 1,2-	2.98E+03	1.56E+09	3.14E+01	-	3.35E+00	3.03E+00	6.13E+03	-	2.18E+02	2.10E+02	3.03E+00 ca*
Ethylbenzene	4.80E+02	1.56E+09	2.60E+02	-	4.32E+01	3.70E+01	1.02E+05	-	3.86E+04	2.80E+04	3.70E+01 ca
Lead and Compounds	-	1.56E+09	-	-	-	-	-	-	-	8.00E+02	8.00E+02 nc
Benzo[a]pyrene	-	1.56E+09	3.92E-01	4.57E-01	1.74E+04	2.11E-01	-	-	-	-	2.11E-01 ca
Naphthalene	-	1.56E+09	-	-	2.60E+01	2.60E+01	2.04E+04	2.38E+04	9.46E+02	8.71E+02	2.60E+01 ca*
Tetrachloroethylene	1.66E+02	1.56E+09	1.36E+03	-	1.72E+02	1.53E+02	6.13E+03	-	6.39E+02	5.79E+02	1.53E+02 ca**
Toluene	8.18E+02	1.56E+09	-	-	-	-	8.18E+04	-	1.46E+05	5.24E+04	5.24E+04 sat
Trichloroethylene	6.92E+02	1.56E+09	6.22E+01	-	1.03E+01	8.81E+00	5.11E+02	-	3.01E+01	2.84E+01	8.81E+00 ca**
Xylenes	2.58E+02	1.56E+09	-	-	-	-	2.04E+05	-	3.96E+03	3.89E+03	3.89E+03 sat

Figure 9 - Steps to Get Wisconsin-Default Groundwater-Protective RCLs (GW-RCLs)

Step 6 below is not part of the web calculator, but is easily performed with the "Output to Spreadsheet" option after Step 5 below. The web calculator provides 2 columns of soil-to-gw results: R and S, with Q (MCL) and P (risk-based water concentration) as their respective target gw quality levels. Step 6 is necessary because the target gw quality level required in WI is NR 140 ES. The corrective step begins by taking the ratios R/Q and S/P. They are equal, but may differ because of early truncation. Use R/Q when an MCL exists; otherwise, S/P. Multiply this ratio by ES to get the GW-RCL with a dilution factor (DF) of 1. Multiply by 2 (WI-default DF) to get the WI-default GW-RCL. Alternatively, instead of DF=2, a site-specific dilution factor (ssDF) may be used: ssDF = 1 + K i D / (R L); where: K=hydraulic conductivity; i = hydraulic gradient; D = thickness of the groundwater mixing zone; R = recharge rate; and L = longest dimension of plume delineated to NR 140 PAL. Notice that Cr(VI)'s GW-RCL (3.8 mg/kg) is much smaller than Total Cr's (360,000 mg/kg). Valence-specific Cr data will need to be collected when Cr is a concern.



5. Click "Retrieve" to get Soil-to-GW RSLs

6. Correct to ES and Apply DF of 2

Chemical	P Risk-Based Water Concentration (ug/L)	Q MCL-Based Water Concentration (ug/L)	R MCL-Based Screening Level (mg/kg)	S Risk-Based Screening Level (mg/kg)	Ratio R/Q or S/P (mg/kg *per* ug/L)	x ES NR140 ES (ug/L)	= 1DF GW-RCL (mg/kg)	x 2 = WI-Default GW-RCL (mg/kg)
Arsenic, Inorganic	4.46E-02	1.00E+01	2.92E-01	1.30E-03	0.0292	10.	0.292	**0.584**
Benzene	3.94E-01	5.00E+00	2.56E-03	2.01E-04	0.000512	5.	0.0026	**0.005**
Cadmium (Water)	6.91E+00	5.00E+00	3.76E-01	5.20E-01	0.0752	5.	0.376	**0.752**
Chromium(VI)	3.08E-02	-	-	5.92E-04	0.019221	100.	1.9221	**3.844**
Chromium, Total	-	1.00E+02	1.80E+05		1800.	100.	180,000.	**360,000.**
Dichloroethane, 1,2-	1.48E-01	5.00E+00	1.42E-03	4.19E-05	0.000284	5.	0.0014	**0.003**
Ethylbenzene	1.30E+00	7.00E+02	7.85E-01	1.45E-03	0.001121	700.	0.785	**1.57**
Lead and Compounds	-	1.50E+01	1.35E+01		0.9	15.	13.5	**27.**
Benzo[a]pyrene	2.95E-03	2.00E-01	2.35E-01	3.47E-03	1.175	0.2	0.235	**0.47**
Naphthalene	1.43E-01	-	-	4.71E-04	0.003294	100.	0.3294	**0.659**
Tetrachloroethylene	9.74E+00	5.00E+00	2.27E-03	4.43E-03	0.000454	5.	0.0023	**0.005**
Toluene	8.56E+02	1.00E+03	6.92E-01	5.92E-01	0.000692	800.	0.5536	**1.107**
Trichloroethylene	2.18E-01	5.00E+00	1.79E-03	7.79E-05	0.000358	5.	0.0018	**0.004**
Xylenes	1.89E+02	1.00E+04	9.85E+00	1.86E-01	0.000985	2,000.	1.97	**3.94**

EPA RSL website included two spreadsheets for specific use on trichloroethylene (TCE) at residential (non-industrial) settings. The TCE screening level in the residential RSL Generic Table resulted from the use of the TCE-specific spreadsheets. The web calculator, however, is not tooled to include all of the more complex evaluations. This RR guidance follows the simpler web calculator evaluation for TCE (RCL of 0.64 mg/kg) even if different from the RSL generic table value.

Industrial Direct-Contact RCLs. Figure 7 shows the steps to get industrial direct-contact RCLs from the web calculator. The key first step is in selecting the "Composite Worker" scenario. The results of industrial direct-contact RCLs are shown in Figure 8 (page 13) after retrieving and opting for the PDF output. The pdf will have results split in two tables (upper and lower tables in the figure). Figure 8's upper table is exactly the same as Figure 6's. They are so because the web calculator uses the same chemical toxicity values regardless of the scenario. Figure 8's lower table is different as it has the resulting industrial direct-contact RCLs with the set of "Composite Worker" exposure parameter values used in the web calculator. The explanation in Figure 6 regarding results and their qualifiers also applies to Figure 8. It is important to reiterate that when the value for a chemical under the Screening Level column has a "sat" qualifier, its individual "not-to-exceed" soil cleanup RCL will come from the Csat column.

Groundwater RCLs. The illustration in Figure 9 explains how the web calculator's "Soil to Groundwater" scenario results can be utilized to determine RCLs that will be protective of groundwater quality (GW-RCL). In Wisconsin, GW-RCLs will be based on NR 140, Wis. Adm. Code, Enforcement Standards (ES). The web calculator, however, does not use ES levels, using instead federal drinking-water MCLs or calculated risk-based tapwater concentrations. A simple correction procedure can be applied to the web calculator result to factor *out* the MCL (or risk-based tapwater concentration) from the result, and then replace it with the NR 140 ES to get the GW-RCL. The correction is straightforward to implement outside of the web calculator. The RR Program's RCL spreadsheet–which is discussed in the next section–implements this ES-factor correction together with using a dilution factor of 2 (rather than the web calculator default of 1).

RR Program's RCL Spreadsheet

The RR Program has prepared a spreadsheet (available here) with soil residual contaminant levels (RCLs) that were calculated using the RSL web calculator following the procedures in NR 720.12, Wis. Adm. Code, for determining soil direct-contact RCLs protective of human health, and the procedures in NR 720.10 for determining RCLs protective of the groundwater quality. Additionally, for 16 metals, their surficial soil background threshold values (BTVs) are included in a separate column in the spreadsheet for use in comparing the metal concentrations in site soils. The BTVs are the non-outlier maximum metal concentrations from 664 surficial (to 0.5 ft depth) soil background samples collected statewide in 2006 and 2007 (http://pubs.usgs.gov/sir/2011/5202/, specifically, the "Maximum detected value" in Table 1-2 of the report).

The spreadsheet has an overview sheet with 3 sections: 1.) Brief explanations of the four RCL worksheets; 2.) Example of a report summary table where highlighted soil concentrations indicate RCL exceedances; and 3.) List of abbreviations. The top 2 sections are shown in Figure 10. The brief explanation section shows which worksheet column to use when entering site soil boring data.

The four RCL worksheets consist of three DC worksheets for direct-contact evaluation (tabbed as "Non-Industrial_DC_RCLs," "Industrial_DC_RCLs" and "Summary_Soil_DC_Data"), and a fourth worksheet ("GW-RCLs") for evaluating the potential for groundwater impact from the soil data. Some color-codings are implemented in the spreadsheet. Yellow cells are reserved for user input. Soil data are entered in the yellow cells in column *H* for DC RCL worksheets and in column *K* for the GW RCL worksheet. After data entries, red fonts will appear if any exceedance is present.

Overview of the Soil RCL Worksheets

This overview has 3 sections: ❶ RCL Worksheet Descriptions and Soil Data Entry; ❷ Example SIR Summary Data Table; and ❸ List of Abbreviations.

❶

RCL Worksheet Descriptions:

1.) Sheet "**Non-Industrial DC RCLs**" is applicable at settings like private residences where children may live and play.
2.) Sheet "**Industrial DC RCLs**" is applicable at settings like a factory where access is limited and no child is expected to be present.
3.) Sheet "**Summary Soil DC Data**" reproduces the data entered in either of the DC worksheets.
(Column E in the DC RCL worksheets has the individual RCLs.)
4.) Sheet "**GW_RCLs**" has soil RCLs protective of groundwater quality under column *J*. GW-RCLs are applicable at all sites.
(Groundwater samples should be assessed separately.)

Soil Data Entry:

DC RCLs - Soil Data Entry in column *H*

Column *H*

Contaminant	CAS Number	NC RCL (mg/kg)	C RCL (mg/kg)	Not-To-Exceed D-C RCL (mg/kg)	Basis	Background Threshold Value (mg/kg)	INPUT Site Data (mg/kg)
Benzene	71-43-2	111.	1.49	1.49	ca		
Ethylbenzene	100-41-4	4,220.	7.47	7.47	ca		

Enter soil data collected from samples in the depth range 0 to 4 ft.

DC exceedance is assessed for every soil data collected in the depth range of 0 to 4 ft.
Cumulative DC exceedance is assessed for every boring by using the maximum found for the boring.
Cumulative assessment for the boring is not necessary when individual exceedance has already been found.

GW RCLs - Soil Data Entry in column *K*

Column *K*

Find							
NR140 Substance	NR 140 CAS	Fed MCL (ug/l) (If Red, MCL>ES)	NR 140 ES (ug/l)	RCL-gw (mg/kg) DF=1	Use 2, or input the calculated site-specific DF -->	2.00	INPUT NUMERIC SOIL Site Data Max (mg/kg)
Acetochlor	34256-82-1	-	7.	0.0056		0.0112	
Acetone	67-64-1	-	9,000.	1.847		3.6939	

Enter soil data collected from samples near or at the water-table.
(Soil data deeper than 4 ft should be used here, if WT is deeper.)

❷

Example SIR Soil Summary Table:

The PURPOSE of this Table is to:
1.) Display all soil data, and
2.) Highlight exceedances found when the soil data are entered in RR's spreadsheet of RCLs.

BRRTS #: ***02-35-007107***
SITE NAME: ***Leysamarte Inn***
SITE ADDRESS: ***Leysamarte, WI***

BORING #	***B-1***	**B-1**	**B-2**		**B-3**		**B-4**	...			
DEPTH to Water Table (ft BGS)	6		7		6		8				
Date Collected	**11/11/13**	**11/11/13**	**11/11/13**	**11/11/13**	**11/11/13**	**11/11/13**	**11/11/13**				
DEPTH (ft BGS)	2.5 - 4.5	5 - 7	2.5 - 4.5	5 - 7	0 - 4	6 - 8	2 - 4	**Soil RCLs (mg/kg)**			
SOIL TYPE	clay	peat	clay	silty clay	soil fill	waste fill	sandy silt	**Calculated 12/2013**		Background	Lab
	Soil Concentrations in mg/kg (or ppm)							**Non-Industrial Direct Contact**	**Soil to GW**	**Surficial BTV**	Detection Limit (mg/kg)
Benzene	0.75	< 0.005	**2.**	***0.5***	1.	***1.***	1.	1.49	0.005	-	0.005
Ethylbenzene	5.6	< 0.005	**8.**	***2.***	< 0.005	1.	1.	7.47	1.57	-	0.005
Toluene	800.	0.05	10.	***2.***	< 0.005	***2.***	2.	818.	1.107	-	0.005
Xylene	250.	3.	10.	***4.***	< 0.005	***50.***	50.	258.	3.94	-	0.005
PCE	2.	***< 0.005***	2.	***0.5***	< 0.005	***7.***	7.	30.7	0.005	-	0.005
Naphthalene	1.	< 0.005	2.	***3.***	< 0.005	***3.***	3.	5.15	0.659	-	0.005
Benzo[a]pyrene	< 0.01	< 0.01	**0.1**	***0.5***	**0.4**	0.3	**0.3**	0.015	0.47	-	0.01
Arsenic	5.	< 0.5	**10.**	***5.***	< 0.5	***8.***	8.	0.614	0.584	8.	0.5
Lead	240.	25.	100.	***50.***	< 1	***50.***	50.	400.	27.	52.	1

Exceedance Highlights:
Red font indicates DC RCL exceedance, and for metals, BTV exceedance. ***B1***: Cumulative exceedance (HI > 1), eventhough no individual DC RCL was exceeded.
Italic font indicates GW RCL Exceedance. Groundwater quality (> NR 140 ES) may be affected when GW RCLs are exceeded.

Figure 10 – Overview Page of Spreadsheet of RCLs

Two sections of the overview page are shown. The bottom part of the figure is an example summary table prepared after evaluating site soil data with the help of the spreadsheet. A 3rd section (with abbreviations and acronyms) is not included here.

The purpose of the spreadsheet is to help users evaluate soil contaminant data from each boring. Users can then use the evaluations when preparing summary soil data tables that DNR project managers expect in site investigation reports. The lower part of Figure 10 shows such a summary table. In the table, a sample concentration is highlighted if the level has exceeded the RCL in the spreadsheet. Soil quality data collected in the 0 to 4 ft depth range are compared to the DC-RCLs and BTVs. Deeper data, especially data collected near the water table, are compared to the GW-RCLs. For data entries into the worksheets, *individual* soil contaminant concentrations that exceed the RCLs will be flagged. (Note that if the detection limit for a chemical is greater than the RCL, "ND" does not mean that the RCL was not exceeded.) In addition, for the DC evaluation, there will be a flag for an occurrence where there is no individual RCL exceedance, but the levels taken collectively would trigger a *cumulative* DC exceedance. In the example summary table, boring "B-1" data show that there is no individual direct-contact RCL exceedance, but it is highlighted (*B-1*) because the spreadsheet showed that the shallow data from this boring resulted in a cumulative direct-contact exceedance.

Because the GW_RCL worksheet is shorter and simpler (than the DC_RCL worksheets), it is described here first. The GW_RCL worksheet has fewer chemicals because only chemicals with NR 140 Enforcement Standards are in it. It is simpler to use because only a one-to-one comparison is necessary between soil data and the groundwater-protective RCLs (GW-RCLs). The GW-RCLs are in the worksheet's column J, below the cell with "2.00" value, which is the default dilution factor (DF). By replacing the DF of "2.00" with "1", the values in column *F* would be reproduced; most values in column *F* are straight out of the RSL generic tables.

If warranted by appropriate site specific parameters (that are properly measured and observed and not guesses), then a higher site-specific DF [*i.e.*, $ssDF = 1 + K\,i\,D / (R\,L)$] as explained in the caption for Figure 9] may replace "2.00" in the worksheet.

With few exceptions, the soil GW-RCLs are typically less than the soil DC-RCLs; hence, when evaluating the potential for groundwater contamination, lower laboratory detection limits may be needed. As specified in NR 720.07(2)(d)2, a soil-chemical concntration reported to be below the lab's limit of quantitation may be considered to exceed the RCL when the RCL is lower than the limit of detection. Soil data exceeding GW-RCLs should provide impetus for collecting groundwater samples. Likewise, collecting groundwater samples (to show if groundwater quality is impacted or not) is good strategy when the soil GW-RCL is lower than the limit of detection for the soil contaminant.

For soil direct-contact evaluation, either the Non-Industrial or the Industrial DC worksheet is used. These worksheets have a much longer list of chemicals. The most common contaminants are near the top, with the typical VOCs first, followed by PAHs, then metals and PCBs. After the PCBs, the contaminants are arranged alphabetically. There is a "Find" macro (or CTRL-F in MS Excel) to search for less common chemical names.

The "INPUT Site Data" column (*H*) in the worksheets is where shallow soil concentration data are entered. Typically, the site data will include only a few chemicals. So after data entry, the user can click on "Get Summary" (available in Row 872) to get a list of only the chemicals for which data were entered. Figure 11 and Figure 12 (page 18) are from the "Non-Industrial_DC_RCLs" and "Industrial_DC_RCLs" worksheets, respectively. In the worksheets, each contaminant has three RCL columns: non-cancer "NC" RCL (in column *C*), cancer-endpoint "C" RCL (column *D*), and "Not-To-Exceed D-C RCL" (column *E*). The "Not-To-Exceed

Figure 11. Example Calculations Using RCL Spreadsheet.

Say that at a non-industrial site, the 13 contaminants listed below were found, each at 1 mg/kg. Comparisons show: ***4 E*** *flags or individual exceedances (not acceptable); HI (0.216)<1 (acceptable); cumulative CR* ***(7.5 e-05)****>1.0 e-05 (not acceptable) – so further cleanup is necessary. The RCL spreadsheet used below is available here. It can be used with site data to determine exceedances, and any exceedance is* ***not*** *acceptable. Cumulative exceedance is possible, even when no individual exceedance exists; for examples, see Appendix Examples 2 and 3.*

When soil concentrations are typed in the spreadsheet, the spreadsheet will do the following:

1.) Compare the concentration data to Not-to-Exceed D-C RCLs, and for metals to BTVs, to determine any individual exceedance

2.) Divide data by: ***a.) NC RCL to get hazard quotient HQ, and***
b.) C RCL to get cancer risk CR (x 1.e-6)

3.) Sum up: ***a.) individual HQs to get Cumulative Hazard Index (HI), and***
b.) individual CRs to get Cumulative Cancer Risk (CCR)

4.) Procedures 2 and 3 are done for metals only if data > BTV.

BRRTS # :
Type BRRTS No. Here (If Known)

# of Soil-Concentration Entries: 13

Number of Individual Exceedance	(Cumulative) Hazard Index	(Cumulative) Cancer Risk
4	0.2155	7.5E-05

Bottom-Line: **NO! This NON-INDUSTRIAL site sampling location will need either further cleanup to lower contaminant levels or the construction of a cap/cover to address the direct-contact pathway.**

Date of Entry: 12/5/2013.
Date of Worksheet Used: 12/04/2013.

List below only has contaminants with data.

Contaminant	CAS Number	NC RCL (mg/kg)	C RCL (mg/kg)	Not-To-Exceed D-C RCL (mg/kg)	Basis	BTV (mg/kg)	INPUTTED Site Data (mg/kg)	Flag E = Individual Exceedance!	Hazard Quotient (HQ) from Data	Cancer Risk (CR) from Data
Benzene	71-43-2	111.	1.49	1.49	ca		1.		0.009	6.7E-07
Ethylbenzene	100-41-4	4,220.	7.47	7.47	ca		1.		0.0002	1.3E-07
Toluene	108-88-3	5,300.	-	818.	Csat		1.		0.0002	
Xylenes	1330-20-7	890.	-	258.	Csat		1.		0.0011	
Dichloroethane, 1,2-	107-06-2	46.7	0.608	0.608	ca		1.	E	0.0214	1.6E-06
Trichloroethylene	79-01-6	6.05	0.644	0.644	ca		1.	E	0.1653	1.6E-06
Tetrachloroethylene	127-18-4	115.	30.7	30.7	ca		1.		0.0087	3.3E-08
Naphthalene	91-20-3	188.	5.15	5.15	ca		1.		0.0053	1.9E-07
Benzo[a]pyrene	50-32-8	-	0.015	0.015	ca		1.	E		6.8E-05
Arsenic, Inorganic	7440-38-2	34.3	0.614	0.614	ca	8.	1.			
Cadmium (Diet)	7440-43-9	70.	2,110.	70.	nc	1.	1.			
Chromium(VI)	18540-29-9	234.	0.293	0.293	ca		1.	E	0.0043	3.4E-06
Lead and Compounds	7439-92-1	400.	-	400.	nc	52.	1.			

Column values are determined from the web-calculator

Figure 12. Example Calculations Using RCL Spreadsheet.

*Same soil levels as above, but found at an industrial site. The data evaluation results in: **1 E** exceedance (BaP); no cumulative exceedance since HI (0.045)<1 and cumulative CR (5.6e-06)<1.0 e-05 – so only limited BaP cleanup or capping will be necessary. Note that soil-As data of 1 mg/kg is less than soil-As BTV (8 mg/kg), so neither HQ nor CR was calculated for that data.*

BRRTS # :
Type BRRTS No. Here (If Known)

# of Soil-Concentration Entries: 13

Number of Individual Exceedance	(Cumulative) Hazard Index	(Cumulative) Cancer Risk
1	0.0451	5.6E-06

Bottom-Line: **NO! This INDUSTRIAL site sampling location will need either further cleanup to lower contaminant levels or the construction of a cap/cover to address the direct-contact pathway.**

Date of Entry: 12/3/2013.
Date of Worksheet Used: 12/01/2013.

List below only has contaminants with data.

Contaminant	CAS Number	NC RCL (mg/kg)	C RCL (mg/kg)	Not-To-Exceed D-C RCL (mg/kg)	Basis	BTV (mg/kg)	INPUTTED Site Data (mg/kg)	Flag E = Individual Exceedance!	Hazard Quotient (HQ) from Data	Cancer Risk (CR) from Data
Benzene	71-43-2	614.	7.41	7.41	ca		1.		0.0016	1.3E-07
Ethylbenzene	100-41-4	28,000.	37.	37.	ca		1.		0.	2.7E-08
Toluene	108-88-3	52,400.	-	818.	Csat		1.		0.	
Xylenes	1330-20-7	3,890.	-	258.	Csat		1.		0.0003	
Dichloroethane, 1,2-	107-06-2	210.	3.03	3.03	ca		1.		0.0048	3.3E-07
Trichloroethylene	79-01-6	28.4	8.81	8.81	ca		1.		0.0352	1.1E-07
Tetrachloroethylene	127-18-4	579.	153.	153.	ca		1.		0.0017	6.5E-09
Naphthalene	91-20-3	871.	26.	26.	ca		1.		0.0011	3.8E-08
Benzo[a]pyrene	50-32-8	-	0.211	0.211	ca		1.	E		4.7E-06
Arsenic, Inorganic	7440-38-2	383.	2.39	2.39	ca	8.	1.			
Cadmium (Diet)	7440-43-9	799.	10,600.	799.	nc	1.	1.			
Chromium(VI)	18540-29-9	3,050.	5.58	5.58	ca		1.		0.0003	1.8E-07
Lead and Compounds	7439-92-1	800.	-	800.	nc	52.	1.			

D-C RCL" is the lowest value among: 1) NC RCL; 2) C RCL; 3) Chemical-specific Csat; and 4.) Ceiling limit (100,000 mg/kg). The "Basis" column has the abbreviation (nc = NC RCL; ca = C RCL, Csat; or ceiling) that indicates which among the four non-blank values was the lowest value for the contaminant.

Evaluations are automatically done in the purple columns of the worksheets. An E flag (in column *J*) means an individual "Not-to-Exceed D-C RCL" was exceeded. For cumulative evaluation, a "summing of ratios" algorithm is implemented in the spreadsheet. The ratio of an input soil-contaminant concentration and its NC-RCL determines its hazard quotient (HQ placed in column *K*). The ratio of the input data and its C-RCL multiplied by $1x10^{-6}$ is its cancer risk (CR placed in column *L*). The sum of the HQs is compared to a hazard index limit (HI) of 1, and the sum of CRs is compared to the cumulative cancer risk limit (CCR) of $1x10^{-5}$. If at least one of these sums is greater than its limit value, then there is a cumulative exceedance even if an individual E flag is absent.

The Appendix has several examples where evaluations were done using the spreadsheet. Examples 2 and 3 in the Appendix show no individual RCL exceedance, but there is exceedance in the cumulative hazard index (HI >1, Example 2), and the cumulative cancer risk (CCR> $1x10^{-5}$, Example 3). Example 4 shows how the RR Program will evaluate soil data from discrete boring samples using a procedure that is <u>different</u> from what is recommended – EPA recommends using either the maximum or the upper 95% confidence limit for the mean (UCL) of the concentrations – in the RSL User's Guide.

For more information, or if you have additional questions, contact Resty Pelayo at (608) 267-3539.

Appendix

Examples of how the EPA RSL web calculator affects the determination of RCLs under NR 720

The following 4 examples are intended to provide additional guidance on how the use of the RCL results from the EPA RSL web calculator will affect closure decisions. The RCL results are available in the spreadsheet that the RR program has developed.

For each example, the following assumptions apply:

- The sampling performed is adequate for the area in question, and

- These examples only address the non-industrial, direct contact pathway.

Notes in the examples call attention to some important aspects of interpreting the results.

The soil-Pb levels in the examples are greater than 52 mg/kg, so they exceed the statewide soil-Pb background threshold value (BTV).

To determine exceedance from each of the sampling locations, soil data are entered into separate DC RCL worksheets. When done, each summary worksheet will have a list of the contaminants detected, the applicable RCLs (*i.e.*, cancer, non-cancer, Csat and ceiling), a column flagging individual exceedances (with "E"), a column for the calculated hazard quotients, a column for the individual cancer risks, and a section with the cumulative hazard index and cumulative cancer risk.

Example 1 - Individual RCL Exceedances

Concentration mg/kg

S-1

Benzo(a)pyrene :	**0.029**
Benzo(k)fluoranthene :	0.96
Benz(a)anthracene :	0.137
Chrysene :	9.6
Lead :	137.

S-2

B(a)P :	0.012
Chrysene :	1.3
Lead :	93.

S-3

B(a)P :	**0.045**
B(k)F :	**3.7**
B(a)A :	**0.38**
Chrysene :	**17.8**
Lead :	**439.**

S-4

B(a)P :	**0.023**
Chrysene :	6.3
Lead :	275.

Red indicates exceedance using the EPA RSL web calculator.

Notes:

1.) Soil concentrations in mg/kg (ppm).

2.) RCL for B(a)P dropped from 0.088 to 0.015 ppm using the new calculator, so 3 locations (S-1, S-3 and S-4) now have exceedances (when before - using the old SSL calculator - their B(a)P levels would not have been).

3.) RCL for Lead increased from 250 to 400 ppm using the new calculator, so only 1 location (S-3) now has an exceedance (when before S-3 <u>and</u> S-4 would have Lead RCL exceedances).

- See Example 1 spreadsheets in the next page -

Example 1

BRRTS # :
Type BRRTS No. Here (If Known)

# of Soil-Concentration Entries: 5

Number of Individual Exceedance	(Cumulative) Hazard Index	(Cumulative) Cancer Risk
1	0.3425	4.2E-06

Bottom-Line: **NO! This NON-INDUSTRIAL site sampling location will need either further cleanup to lower contaminant levels or the construction of a cap/cover to address the direct-contact pathway.**

Date of Entry: 12/5/2013.
Date of Worksheet Used: 12/04/2013.

List below only has contaminants with data.

S-1

Contaminant	CAS Number	NC RCL (mg/kg)	C RCL (mg/kg)	Not-To-Exceed D-C RCL (mg/kg)	Basis	BTV (mg/kg)	INPUTTED Site Data (mg/kg)	Flag E = Individual Exceedance!	Hazard Quotient (HQ) from Data	Cancer Risk (CR) from Data
Benzo[a]pyrene	50-32-8	-	0.015	0.015	ca		0.029	E		2.0E-06
Benz[a]anthracene	56-55-3	-	0.148	0.148	ca		0.137			9.3E-07
Benzo[k]fluoranthene	207-08-9	-	1.48	1.48	ca		0.96			6.5E-07
Chrysene	218-01-9	-	14.8	14.8	ca		9.6			6.5E-07
Lead and Compounds	7439-92-1	400.	-	400.	nc	52.	137.		0.3425	

BRRTS # :
Type BRRTS No. Here (If Known)

# of Soil-Concentration Entries: 3

Number of Individual Exceedance	(Cumulative) Hazard Index	(Cumulative) Cancer Risk
0	0.2325	9.0E-07

Bottom-Line: Yes, levels are below direct-contact concern.

Date of Entry: 12/5/2013.
Date of Worksheet Used: 12/04/2013.

List below only has contaminants with data.

S-2

Contaminant	CAS Number	NC RCL (mg/kg)	C RCL (mg/kg)	Not-To-Exceed D-C RCL (mg/kg)	Basis	BTV (mg/kg)	INPUTTED Site Data (mg/kg)	Flag E = Individual Exceedance!	Hazard Quotient (HQ) from Data	Cancer Risk (CR) from Data
Benzo[a]pyrene	50-32-8	-	0.015	0.015	ca		0.012			8.1E-07
Chrysene	218-01-9	-	14.8	14.8	ca		1.3			8.8E-08
Lead and Compounds	7439-92-1	400.	-	400.	nc	52.	93.		0.2325	

BRRTS # :
Type BRRTS No. Here (If Known)

# of Soil-Concentration Entries: 5

Number of Individual Exceedance	(Cumulative) Hazard Index	(Cumulative) Cancer Risk
5	1.0975	9.3E-06

Bottom-Line: **NO! This NON-INDUSTRIAL site sampling location will need either further cleanup to lower contaminant levels or the construction of a cap/cover to address the direct-contact pathway.**

Date of Entry: 12/5/2013.
Date of Worksheet Used: 12/04/2013.

List below only has contaminants with data.

S-3

Contaminant	CAS Number	NC RCL (mg/kg)	C RCL (mg/kg)	Not-To-Exceed D-C RCL (mg/kg)	Basis	BTV (mg/kg)	INPUTTED Site Data (mg/kg)	Flag E = Individual Exceedance!	Hazard Quotient (HQ) from Data	Cancer Risk (CR) from Data
Benzo[a]pyrene	50-32-8	-	0.015	0.015	ca		0.045	E		3.0E-06
Benz[a]anthracene	56-55-3	-	0.148	0.148	ca		0.38	E		2.6E-06
Benzo[k]fluoranthene	207-08-9	-	1.48	1.48	ca		3.7	E		2.5E-06
Chrysene	218-01-9	-	14.8	14.8	ca		17.8	E		1.2E-06
Lead and Compounds	7439-92-1	400.	-	400.	nc	52.	439.	E	1.0975	

BRRTS # :
Type BRRTS No. Here (If Known)

# of Soil-Concentration Entries: 3

Number of Individual Exceedance	(Cumulative) Hazard Index	(Cumulative) Cancer Risk
1	0.6875	2.0E-06

Bottom-Line: **NO! This NON-INDUSTRIAL site sampling location will need either further cleanup to lower contaminant levels or the construction of a cap/cover to address the direct-contact pathway.**

Date of Entry: 12/5/2013.
Date of Worksheet Used: 12/04/2013.

List below only has contaminants with data.

S-4

Contaminant	CAS Number	NC RCL (mg/kg)	C RCL (mg/kg)	Not-To-Exceed D-C RCL (mg/kg)	Basis	BTV (mg/kg)	INPUTTED Site Data (mg/kg)	Flag E = Individual Exceedance!	Hazard Quotient (HQ) from Data	Cancer Risk (CR) from Data
Benzo[a]pyrene	50-32-8	-	0.015	0.015	ca		0.023	E		1.6E-06
Chrysene	218-01-9	-	14.8	14.8	ca		6.3			4.3E-07
Lead and Compounds	7439-92-1	400.	-	400.	nc	52.	275.		0.6875	

Example 2 - Cumulative Noncancer Hazard Index

S-1

	Concentration mg/kg	(HQ)
Benzene:	0.75	(0.0068)
Toluene:	800.	(0.1509)
Ethylbenzene:	5.6	(0.0013)
Xylene:	250.	(0.2809)
Lead (Pb):	240.	(0.6)
HI =		**1.0399**

S-2

B:	1.1	(0.0099)
T:	507.	(0.0957)
E:	3.2	(0.0008)
X:	196.	(0.2202)
Pb:	143.	(0.3575)
HI =		0.6841

S-3

B:	1.2	(0.0108)
T:	765.	(0.1443)
E:	4.9	(0.0012)
X:	255.	(0.2865)
Pb:	230.	(0.575)
HI =		**1.0178**

S-4

B:	0.83	(0.0075)
T:	625.	(0.1179)
E:	1.7	(0.0004)
X:	247.	(0.2775)
Pb:	96.	(0.24)
HI =		0.6433

Red indicates cumulative hazard index exceedance.

Notes:

1.) Hazard quotient values inside parentheses ().

2.) Hazard Index (HI) = Sum of hazard quotients.

3.) No individual contaminant exceedance, but samples S-1 and S-3 exceed the cumulative hazard index limit of 1.0.

4.) A cumulative cancer risk of 1e-05 is not exceeded at any location.

- See Example 2 spreadsheets in the next page -

Example 2

BRRTS # :
Type BRRTS No. Here (If Known)

# of Soil-Concentration Entries: 5

Number of Individual Exceedance	(Cumulative) Hazard Index	(Cumulative) Cancer Risk
0	1.0399	1.3E-06

Bottom-Line: **NO! This NON-INDUSTRIAL site sampling location will need either further cleanup to lower contaminant levels or the construction of a cap/cover to address the direct-contact pathway.**

Date of Entry: 12/5/2013.
Date of Worksheet Used: 12/04/2013.

List below only has contaminants with data.

S-1

Contaminant	CAS Number	NC RCL (mg/kg)	C RCL (mg/kg)	Not-To-Exceed D-C RCL (mg/kg)	Basis	BTV (mg/kg)	INPUTTED Site Data (mg/kg)	Flag E = Individual Exceedance!	Hazard Quotient (HQ) from Data	Cancer Risk (CR) from Data
Benzene	71-43-2	111.	1.49	1.49	ca		0.75		0.0068	5.0E-07
Ethylbenzene	100-41-4	4,220.	7.47	7.47	ca		5.6		0.0013	7.5E-07
Toluene	108-88-3	5,300.	-	818.	Csat		800.		0.1509	
Xylenes	1330-20-7	890.	-	258.	Csat		250.		0.2809	
Lead and Compounds	7439-92-1	400.	-	400.	nc	52.	240.		0.6	

BRRTS # :
Type BRRTS No. Here (If Known)

# of Soil-Concentration Entries: 5

Number of Individual Exceedance	(Cumulative) Hazard Index	(Cumulative) Cancer Risk
0	0.6841	1.2E-06

Bottom-Line: Yes, levels are below direct-contact concern.

Date of Entry: 12/5/2013.
Date of Worksheet Used: 12/04/2013.

List below only has contaminants with data.

S-2

Contaminant	CAS Number	NC RCL (mg/kg)	C RCL (mg/kg)	Not-To-Exceed D-C RCL (mg/kg)	Basis	BTV (mg/kg)	INPUTTED Site Data (mg/kg)	Flag E = Individual Exceedance!	Hazard Quotient (HQ) from Data	Cancer Risk (CR) from Data
Benzene	71-43-2	111.	1.49	1.49	ca		1.1		0.0099	7.4E-07
Ethylbenzene	100-41-4	4,220.	7.47	7.47	ca		3.2		0.0008	4.3E-07
Toluene	108-88-3	5,300.	-	818.	Csat		507.		0.0957	
Xylenes	1330-20-7	890.	-	258.	Csat		196.		0.2202	
Lead and Compounds	7439-92-1	400.	-	400.	nc	52.	143.		0.3575	

BRRTS # :
Type BRRTS No. Here (If Known)

# of Soil-Concentration Entries: 5

Number of Individual Exceedance	(Cumulative) Hazard Index	(Cumulative) Cancer Risk
0	1.0178	1.5E-06

Bottom-Line: **NO! This NON-INDUSTRIAL site sampling location will need either further cleanup to lower contaminant levels or the construction of a cap/cover to address the direct-contact pathway.**

Date of Entry: 12/5/2013.
Date of Worksheet Used: 12/04/2013.

List below only has contaminants with data.

S-3

Contaminant	CAS Number	NC RCL (mg/kg)	C RCL (mg/kg)	Not-To-Exceed D-C RCL (mg/kg)	Basis	BTV (mg/kg)	INPUTTED Site Data (mg/kg)	Flag E = Individual Exceedance!	Hazard Quotient (HQ) from Data	Cancer Risk (CR) from Data
Benzene	71-43-2	111.	1.49	1.49	ca		1.2		0.0108	8.1E-07
Ethylbenzene	100-41-4	4,220.	7.47	7.47	ca		4.9		0.0012	6.6E-07
Toluene	108-88-3	5,300.	-	818.	Csat		765.		0.1443	
Xylenes	1330-20-7	890.	-	258.	Csat		255.		0.2865	
Lead and Compounds	7439-92-1	400.	-	400.	nc	52.	230.		0.575	

BRRTS # :
Type BRRTS No. Here (If Known)

# of Soil-Concentration Entries: 5

Number of Individual Exceedance	(Cumulative) Hazard Index	(Cumulative) Cancer Risk
0	0.6433	7.8E-07

Bottom-Line: Yes, levels are below direct-contact concern.

Date of Entry: 12/5/2013.
Date of Worksheet Used: 12/04/2013.

List below only has contaminants with data.

S-4

Contaminant	CAS Number	NC RCL (mg/kg)	C RCL (mg/kg)	Not-To-Exceed D-C RCL (mg/kg)	Basis	BTV (mg/kg)	INPUTTED Site Data (mg/kg)	Flag E = Individual Exceedance!	Hazard Quotient (HQ) from Data	Cancer Risk (CR) from Data
Benzene	71-43-2	111.	1.49	1.49	ca		0.83		0.0075	5.6E-07
Ethylbenzene	100-41-4	4,220.	7.47	7.47	ca		1.7		0.0004	2.3E-07
Toluene	108-88-3	5,300.	-	818.	Csat		625.		0.1179	
Xylenes	1330-20-7	890.	-	258.	Csat		247.		0.2775	
Lead and Compounds	7439-92-1	400.	-	400.	nc	52.	96.		0.24	

Example 3 - Cumulative Cancer Risk

S-1

	Concentration mg/kg	(CR)
Benz[a]anthracene:	0.126	(8.5E-07)
Benzene:	1.2	(8.1E-07)
Benzo[b]fluoranthene:	0.129	(8.7E-07)
Benzo[k]fluoranthene:	1.3	(8.8E-07)
Benzo[a]pyrene:	0.014	(9.5E-07)
Chrysene:	13.7	(9.3E-07)
Dibenz[a,h]anthracene:	0.014	(9.5E-07)
Dimethylbenz(a)anthracene, 7,12-:	0.0004	(9.3E-07)
Ethylbenzene:	6.8	(9.1E-07)
Indeno[1,2,3-cd]pyrene:	0.137	(9.3E-07)
Methylnaphthalene, 1-:	13.9	(8.9E-07)
Naphthalene:	3.7	(7.2E-07)
Cumulative Cancer Risk =		**1.1E-05**

S-2 ND

S-3

B(a)P :	0.01
Naphtha :	3.2
Benzene :	1.37

S-4

B(a)P :	0.012
Naphtha :	2.6
Benzene :	1.11

Red indicates cumulative cancer risk exceedance.

Notes:

1.) Cancer risk (CR) values inside parentheses ().

2.) No individual contaminant exceedance based on the EPA RSL web calculator. However, due to numerous carcinogenic contaminants detected in sample S-1, the cumulative cancer risk of 1.0e-5 was exceeded.

3.) While the benzene concentrations do not exceed the RCL calculated from the EPA RSL web-calculator, all 3 (S-1, S-3 and S-4) would exceed the result from the old EPA SSL web-calculator.

- See Example 3 spreadsheets in the next page -

Example 3

BRRTS # :
Type BRRTS No. Here (If Known)

# of Soil-Concentration Entries: 12

Number of Individual Exceedance	(Cumulative) Hazard Index	(Cumulative) Cancer Risk
0	0.0356	1.1E-05

Bottom-Line: **NO! This NON-INDUSTRIAL site sampling location will need either further cleanup to lower contaminant levels or the construction of a cap/cover to address the direct-contact pathway.**

Date of Entry: 12/5/2013.
Date of Worksheet Used: 12/04/2013.

List below only has contaminants with data.

S-1

Contaminant	CAS Number	NC RCL (mg/kg)	C RCL (mg/kg)	Not-To-Exceed D-C RCL (mg/kg)	Basis	BTV (mg/kg)	INPUTTED Site Data (mg/kg)	Flag E = Individual Exceedance!	Hazard Quotient (HQ) from Data	Cancer Risk (CR) from Data
Benzene	71-43-2	111.	1.49	1.49	ca		1.2		0.0108	8.1E-07
Ethylbenzene	100-41-4	4,220.	7.47	7.47	ca		6.8		0.0016	9.1E-07
Naphthalene	91-20-3	188.	5.15	5.15	ca		3.7		0.0197	7.2E-07
Benzo[a]pyrene	50-32-8	-	0.015	0.015	ca		0.014			9.5E-07
Benz[a]anthracene	56-55-3	-	0.148	0.148	ca		0.126			8.5E-07
Benzo[b]fluoranthene	205-99-2	-	0.148	0.148	ca		0.129			8.7E-07
Benzo[k]fluoranthene	207-08-9	-	1.48	1.48	ca		1.3			8.8E-07
Chrysene	218-01-9	-	14.8	14.8	ca		13.7			9.3E-07
Dibenz[a,h]anthracene	53-70-3	-	0.015	0.015	ca		0.014			9.5E-07
Dimethylbenz(a)anthracene, 7,12-	57-97-6	-	4.31E-04	4.31E-04	ca		4.00E-04			9.3E-07
Indeno[1,2,3-cd]pyrene	193-39-5	-	0.148	0.148	ca		0.137			9.3E-07
Methylnaphthalene, 1-	90-12-0	4,010.	15.6	15.6	ca		13.9		0.0035	8.9E-07

S-2

ND

Direct-Contact ***Exceedance*** - ***Hazard*** - ***Risk*** Calculation Summary from Soil Data

BRRTS # :
Type BRRTS No. Here (If Known)

# of Soil-Concentration Entries: 3

Number of Individual Exceedance	(Cumulative) Hazard Index	(Cumulative) Cancer Risk
0	0.0294	2.2E-06

Bottom-Line: Yes, levels are below direct-contact concern.

Date of Entry: 12/5/2013.
Date of Worksheet Used: 12/04/2013.

List below only has contaminants with data.

S-3

Contaminant	CAS Number	NC RCL (mg/kg)	C RCL (mg/kg)	Not-To-Exceed D-C RCL (mg/kg)	Basis	BTV (mg/kg)	INPUTTED Site Data (mg/kg)	Flag E = Individual Exceedance!	Hazard Quotient (HQ) from Data	Cancer Risk (CR) from Data
Benzene	71-43-2	111.	1.49	1.49	ca		1.37		0.0123	9.2E-07
Naphthalene	91-20-3	188.	5.15	5.15	ca		3.2		0.017	6.2E-07
Benzo[a]pyrene	50-32-8	-	0.015	0.015	ca		0.01			6.8E-07

BRRTS # :
Type BRRTS No. Here (If Known)

# of Soil-Concentration Entries: 3

Number of Individual Exceedance	(Cumulative) Hazard Index	(Cumulative) Cancer Risk
0	0.0238	2.1E-06

Bottom-Line: Yes, levels are below direct-contact concern.

Date of Entry: 12/5/2013.
Date of Worksheet Used: 12/04/2013.

List below only has contaminants with data.

S-4

Contaminant	CAS Number	NC RCL (mg/kg)	C RCL (mg/kg)	Not-To-Exceed D-C RCL (mg/kg)	Basis	BTV (mg/kg)	INPUTTED Site Data (mg/kg)	Flag E = Individual Exceedance!	Hazard Quotient (HQ) from Data	Cancer Risk (CR) from Data
Benzene	71-43-2	111.	1.49	1.49	ca		1.11		0.01	7.4E-07
Naphthalene	91-20-3	188.	5.15	5.15	ca		2.6		0.0138	5.0E-07
Benzo[a]pyrene	50-32-8	-	0.015	0.015	ca		0.012			8.1E-07

Example 4 - Cumulative Calculation Procedures

S-1

	Conc., mg/kg	(HQ)
Benzene:	1.3	(0.012)
Toluene:	800.	(0.1521)
Ethylbenz:	7.	(0.0017)
Xylene:	240.	(0.2824)
Lead (Pb):	215.	(0.5375)
	HI =	**0.9857**

S-2

B:	1.4	(0.013)
T:	507.	(0.0964)
E:	3.	(0.0007)
X:	250.	(0.2941)
Pb:	143.	(0.3575)
	HI =	**0.7617**

S-3

B:	0.5	(0.0046)
T:	100.	(0.019)
E:	5.	(0.0012)
X:	85.	(0.1)
Pb:	350.	(0.875)
	HI =	**0.9999**

S-4

B:	0.8	(0.0074)
T:	50.	(0.0095)
E:	3.	(0.0007)
X:	50.	(0.0588)
Pb:	360.	(0.9)
	HI =	**0.9765**

The highest levels from each boring are tabulated.

Red indicates highest concentration (*max*) found for the contaminant.

Note that the *max* concentrations are from different borings.

Calculation **A***

HI is based on individual boring, so **several HI values** are calculated.

(The HI values are shown in the figure above.)

NO Exceedance since none of the HI values exceeds 1.

Calculation **B**

HI is based on *max* concentrations, regardless of location, so only **one HI value** is calculated.

(The single HI calculation is shown below.)

Exceedance since HI >1.

B:	1.4	(0.013)
T:	800.	(0.1521)
E:	7.	(0.0017)
X:	250.	(0.2941)
Pb:	360.	(0.9)
	HI =	**1.3609**

Calculation **C**

HI is based on the UCL for mean of concentrations; only **one HI value** is calculated.

(The single HI calculation is shown below.)

Exceedance since HI >1.

	ProUCL Results	UCL >*max*
B:	1.499	(0.0139)
T:	782.4	(0.1487)
E:	6.753	(0.0016)
X:	278.1	(0.3272)
Pb:	391.6	(0.979)
	HI =	**1.4704**

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* Calculation **A** is how the RR Program will proceed.

Calculation B (*max*-based) or C (UCL-based) is how the EPA RSL User's Guide (May 2012) instructs users to proceed. Note that B is "worse case" calculation: If no exceedance with B, then **A** is unnecessary. But if B shows exceedance, then **A** will be necessary to show otherwise.