CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: April 13, 2021 FILE REF: 01-71-587405, 01-71-587406

TO: Kevin McKnight
Remediation and Redevelopment

FROM: Erin Endsley
Remediation and Redevelopment

SUBJECT: Review of Groundwater Pathway Residual Contaminant Level (RCL) Calculations for PFAS for Oshkosh Defense West Plant and Waukau Lot Sites, Oshkosh

The purpose of this memo is to provide review comments on the calculation of soil to groundwater pathway RCLs (GW-RCLs) for PFAS provided in Appendix E of the *Site Investigation Report* for the above sites.

RR Program guidance document *Soil Residual Contaminant Level Determinations Using the USEPA Regional Screening Level Web Calculator* (RR-890) provides instructions on how to derive GW-RCLs for contaminants utilizing the output for the RSL calculator (Figure 9 on page 14). It appears the consultant attempted to follow the methodology in the guidance to derive GW-RCLs for two PFAS detected in site soils, PFOA and PFOS. Unfortunately, RR-890 is not very clear as to which values to select when converting the risk-based screening levels in the calculator output to WI-specific GW-RCLs, and the incorrect values were selected. The consultant also did not apply the WI-specific dilution factor (DF) of 2 in the calculation. A marked-up version of the calculations provided in Appendix E is attached, and a portion of that page is shown below. It depicts the appropriate values to be used. Specifically, when reviewing the output from the RSL calculator for the Risk-Based SL (far right column), the "nc" denotes the risk is from non-cancer effects. This allows the user to identify the appropriate SL to use in the calculation (identified by the letter "S"). This screening level is then divided by the Risk-Based Water Concentration (column "P"). The resulting ratio is then multiplied by the proposed NR 140 enforcement standard (ES), and then multiplied by the DF of 2 to derive the GW-RCL for each compound.

	P		Q	R				S				
Water	MCL-based	Noncarci	Noncarci	Carcinog	Risk-		R/Q	S/P	ES	DF = 1	WDNR	WDNR
-	-	6.29E-04	3.78E-04	-	3.78E-04	nc	#VALUE!	9.43E-04	0.02	0.0000	0.0000377	0.038
-	-	2.87E-04	1.72E-04	4.78E-04	1.72E-04	nc	#VALUE!	1.55E-04	0.02	0.00000	0.0000062	0.006

P S

ıter ıntration dult) g/L)	Water Concentration (Child) (mg/L)	Water Concentration (Cancer) (mg/L)	Maximum Contaminant Level (MCL) (ug/L)	Water Concentration (MCL) (mg/L)	MCL-based SL (mg/kg)	Noncarcinogenic Adult SL THI=1 (mg/kg)	Noncarcinogenic Child SL THI=1 (mg/kg)	Carcinogenic SL (mg/kg)	Risk-Based SL (mg/kg)
E-04	4.01E-04	-	-	-	-	6.29E-04	3.78E-04	-	3.78E-04 nc
E-04	4.01E-04	1.11E-02	-	-	-	2.87E-04	1.72E-04	4.78E-03	1.72E-04 nc

S/P x proposed ES x DF of 2 = GW-RCL

Printed on Recycled Paper

I have also attached Table 1 which depicts these concentrations, the calculations, and the results for the three PFAS compounds available in the USEPA RSL calculator. Currently, the RSL calculator only has values for PFBS, PFOA, and PFOS. Table 1 simply illustrates the same calculations performed in Appendix E and as described above, but in a clearer format.

Alternatively, it is possible to use the default equations for the groundwater pathway that are utilized in the RSL calculator to derive GW-RCLs for other PFAS compounds that are not currently included in the RSL calculator. If there is an ES or a proposed ES, and if the K_{oc} is known for the compound, the following equation can be used to calculate the GW-RCL:

Method 1

$$SSL(mg/kg) = C_{water}\left(\frac{mg}{L}\right) \times \left[K_d\left(\frac{L}{kg}\right) + \left(\frac{\left(\theta_w\left(\frac{L_{water}}{L_{soil}}\right) + \theta_a\left(\frac{L_{air}}{L_{soil}}\right) \times H'\right)}{\rho_b\left(\frac{1.5\ kg}{L}\right)} \right) \right]$$

where:

$$C_{water}\left(\frac{mg}{L}\right) = SL\left(\frac{ug}{L}\right) \times \left(\frac{1\ mg}{1000\ ug}\right) \times DAF$$

where:

$$SL\left(\frac{ug}{L}\right) = MCL\left(\frac{ug}{L}\right); RSL\left(\frac{ug}{L}\right); RML\left(\frac{ug}{L}\right); \text{or } PRG\left(\frac{ug}{L}\right)$$

and:

$$\theta_a\left(\frac{L_{air}}{L_{soil}}\right) = n\left(\frac{L_{water}}{L_{soil}}\right) - \theta_w\left(\frac{0.3\ L_{water}}{L_{soil}}\right);$$

$$n\left(\frac{L_{pore}}{L_{soil}}\right) = 1 - \left(\frac{\rho_b\left(\frac{1.5\ kg}{L}\right)}{\rho_s\left(\frac{2.65\ kg}{L}\right)}\right);$$

$$K_d\left(\frac{L}{kg}\right) = K_{oc}\left(\frac{L}{kg}\right) \times f_{oc}\left(\frac{0.002\ g\text{-}carbon}{g\text{-}soil}\right), \text{for organic compounds;}$$

K_d values for inorganic compounds are listed in the user guide.

When reviewing the site data, of the PFAS identified in site soils, only three compounds have both proposed ES values and known K_{oc} values: PFHxA, PFOS, and PFOA. Although PFOS and PFOA values can be obtained in the RSL calculator, PFHxA values are not available in the calculator. The above equation can be used to calculate the GW-RCLs for that compound. When using the proposed ES values, the K_{oc} values for each compound, and DF=2 to calculate the GW-RCLs, the following results are obtained. Note that the values for PFOA and PFOS obtained using this methodology match those obtained from using the risk-based values derived from the RSL calculator.

Compound	NR 140 ES (proposed) (µg/L)	K_{oc}	GW-RCL (µg/kg)
PFHxA	150	20.4	72.3
PFOS	0.02	372	0.038
PFOA	0.02	115	0.017

Default

Risk-Based Regional Screening Levels (RSL) for Soil to Groundwater

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Chemical	CAS Number	Mutagen?	Volatile?	Chemical Type	SF_o(mg/kg-day)$^{-1}$	SF_oRef	IUR (ug/m^3)$^{-1}$	IUR Ref	RfD (mg/kg-day)	RfD Ref	RfC (mg/m^3)	RfC Ref	GIABS	ABS	S (mg/L)	K_d (cm^3/g)	K_{oc} (cm^3/g)	Dilution Attenuation Factor (DAF) (unitless)	HLC (atm-m^3/mole)	Henry's Law Constant (unitless)	H` and HLC Ref	Normal Boiling Point BP (K)	BP Ref	Critical Temperature TC (K)
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	No	No	Organics	-		-		2.00E-05	D	-		1.00E+00	1.00E-01	6.80E+02	7.43E-01	3.72E+02	1.00E+00	-	-		5.32E+02	PHYSPROP	-
Perfluorooctanoic acid (PFOA)	335-67-1	No	No	Organics	7.00E-02	D	-		2.00E-05	D	-		1.00E+00	1.00E-01	9.50E+03	2.30E-01	1.15E+02	1.00E+00	4.00E-06	1.64E-04	ATSDR Draft Profile	4.66E+02	PHYSPROP	-

											P		Q	R			S					
Chemical	CAS Number	TC	Noncarcin	Noncarcinogenic	Carcinogenic SL	Water	Water	Water	Maximum	Water	MCL-based	Noncarci	Noncarci	Carcinog	Risk-		R/Q	S/P	ES	DF = 1	WDNR	WDNR
Perfluorooctane sulfonic acid (PFOS)	1763-23-1		6.67E-01	4.01E-01	-	6.67E-04	4.01E-04	-	-	-	-	6.29E-04	3.78E-04	-	3.78E-04	nc	#VALUE!	9.43E-04	0.02	0.0000	**0.0000377**	**0.038**
Perfluorooctanoic acid (PFOA)	335-67-1		6.67E-01	4.01E-01	1.11E+00	6.67E-04	4.01E-04	1.11E-03	-	-	-	2.87E-04	1.72E-04	4.78E-04	1.72E-04	nc	#VALUE!	1.55E-04	0.02	0.00000	**0.0000062**	**0.006**

											P		S	
Noncarcinogenic SL Adult THI=1 (ug/L)	Noncarcinogenic SL Child THI=1 (ug/L)	Carcinogenic SL TR=1E-05 (ug/L)	Water Concentration (Adult) (mg/L)	Water Concentration (Child) (mg/L)	Water Concentration (Cancer) (mg/L)	Maximum Contaminant Level (MCL) (ug/L)	Water Concentration (MCL) (mg/L)	MCL-based SL (mg/kg)	Noncarcinogenic Adult SL THI=1 (mg/kg)	Noncarcinogenic Child SL THI=1 (mg/kg)	Carcinogenic SL (mg/kg)	Risk-Based SL (mg/kg)
6.67E-01	4.01E-01	-	6.67E-04	4.01E-04	-	-	-	-	6.29E-04	3.78E-04	-	3.78E-04 nc
6.67E-01	4.01E-01	1.11E+01	6.67E-04	4.01E-04	1.11E-02	-	-	-	2.87E-04	1.72E-04	4.78E-03	1.72E-04 nc

S/P x proposed ES x DF of 2 = GW-RCL

Output generated 30NOV2020:12:34:05

Table 1.
Default Risk-Based Regional Screening Levels (RSL) for Soil to Groundwater Used to Generate WI-Default Groundwater-Protective RCLs (GW-RCLs)

			RSL				RCL
	A	B	C	D (= B/A)	E	F (= D x E)	G (= F x 2)
Chemical	Water Concentration (Child) (ug/L)	Noncarcinogenic Child SL THI=1 (mg/kg)	Risk-Based SL (mg/kg)	Ratio of Risk-Based Screening Level/Risk-Based Water Concentration (mg/kg per ug/L)	Proposed ES (ug/L)	Dilution Factor = 1 GW-RCL (mg/kg)	Dilution Factor = 2 GW-RCL (mg/kg)
Perfluorobutane sulfonic acid (PFBS)	4.01E+02	1.30E-01	1.30E-01 nc	3.24E-04	450	1.46E-01	2.92E-01
Perfluorooctane sulfonic acid (PFOS)	4.01E-01	3.78E-04	3.78E-04 nc	9.43E-04	2.00E-02	1.89E-05	3.77E-05
Perfluorooctanoic acid (PFOA)	4.01E-01	1.72E-04	1.72E-04 nc	4.29E-04	2.00E-02	8.58E-06	1.72E-05

Process:

1. Columns A, B, C are from EPA RSL calculator.
2. Risk-based SL from EPA RSL calculator is based on noncancer (nc) risk (C).
3. Non-carcinogenic child SL (B) and child water concentration (A) are used to convert SL to WI RCL (steps 4-6).
4. Determine ratio of risk-based SL (B) to risk-based water concentration (A); B/A yields the ratio in column D.
5. Multiply the ratio (D) by the proposed NR 140 ES (E) to get the GW-RCL with a dilution factor of 1 (F).
6. Multiply this value (F) by 2 (WI-default dilution factor) to get the WI-default GW-RCL (G).
7. This yields the following GW-RCLs: PFOA - 17 ppt, PFOS - 38 ppt.