



STATE OF NEW HAMPSHIRE

Date: June 28, 2016

At (OFFICE): DES-EHP

A handwritten signature in blue ink, appearing to read "D.B.L.", positioned above the "From:" field.

From: David B. Larson, M.P.H.

To: John Regan, P.G.
DES-WMD

Subject: *Direct Contact Risk-Based Soil Concentration*

Perfluorooctane Sulfonate (0.5 mg/kg)
CAS #1763-23-1

The Environmental Health Program (EHP) has derived a direct contact risk-based (DCRB) soil screening level concentration for Perfluorooctane Sulfonate (PFOS) of 0.5 mg/kg considered protective of potential exposure in a residential scenario. The DCRB soil concentration is not anticipated to present an appreciable increased health risk to individuals who are exposed through direct contact with impacted soil. The DCRB concentration accounts for exposure that may result from incidental ingestion and dermal contact with impacted soil. The DCRB concentration does not account for potential exposure via inhalation, indirect exposure pathways such as migration via runoff to nearby surface water bodies or bioaccumulation in the food chain.

The DCRB concentration was derived using the methodology that is described in Appendix A (*Methodology for Calculating Direct Contact Risk-Based Soil Concentrations*) contained in the NHDES Risk Characterization and Management Policy (RCMP). In summary, dose-response information provides a quantitative evaluation of toxicity and describes the relationship between the dose of a chemical and the potential for adverse health effects in the exposed population. The US Environmental Protection Agency (USEPA) has developed a reference dose (RfD) value for PFOS¹ that EHP has used to calculate the DCRB concentration to protect against non-carcinogenic health effects. *The reference dose is an estimate (with uncertainty spanning perhaps an order of magnitude) of the daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It can be derived from a NOAEL [No Observed Adverse Effect Level], LOAEL [Lowest Observed Adverse Effect Level], or benchmark dose, with uncertainty factors generally applied to reflect limitations of the data used.*²

Using the methodology described in Appendix A, the most sensitive receptor is the young child aged 2 – 6 years in a residential scenario. Please note that the methodology contains a 20% relative source contribution factor (RSCF) for non-carcinogenic chemicals. The RSCF is applied when the contribution from other potential sources of exposure (i.e. drinking water, food and air) to the compound is unknown. Also, the DCRB methodology assumes 100% absorption of PFOS from incidental ingestion of soil and 10% absorption of PFOS from dermal contact³ with impacted soil.

PFOS
DCRB Concentration

PFOS is extremely persistent in both the human body and the environment; thus even a short-term exposure results in a body burden that persists for years and can increase if additional exposure occurs later. The candidate RfDs developed by USEPA for PFOS are in a relatively narrow range across multiple endpoints and study durations. The RfD selected by USEPA is protective of developmental effects in the most sensitive receptor group. “Because the developing fetus and newborn are particularly sensitive to PFOS-induced toxicity, the RfD based on developmental effects also is protective of adverse effects in adults (e.g., liver and kidney toxicity).”¹ The following table summarizes the assumptions used to develop S-1 and S-2 DCRB soil concentrations.

Calculation of a Direct Contact Risk-Based Concentration (DCRB) for Perfluorooctane Sulfonate (PFOS) in Soil.

	S-1	S-2
Sensitive receptor	Young child (residential)	Maintenance worker
Concsoil (mg/kg)	0.5	4.3
RSCF	0.20	0.20
RfD (mg/kg-day)	2.0E-5	2.0E-5
CF (mg/kg)	1.0E+6	1.0E+6
IR (mg/kg)	200 ⁵	100
RAFo (unitless)	1	1
RAFd (unitless)	0.10	0.10
SA (cm ²)	2,632	3,104
AF (mg/cm ²)	0.36	0.20
EF (days/year)	160	146
ED (years)	5	25
AT (days)	1,825	9,125
BW (kg)	17	70

Where:

Concsoil = Direct Contact Risk-Based (DCRB) concentration in soil

RSCF = Relative Source Contribution Factor

RfD = Oral Reference Dose

CF = Units Conversion Factor

IR = Daily soil ingestion rate

RAFo = Relative Absorption Factor for soil ingestion

RAFd = Relative Absorption Factor for dermal contact

SA = Skin surface area available for soil contact

AF = Soil-to-Skin Adherence Factor

EF = Exposure Frequency

ED = Exposure Duration

AT = Period of exposure for non-carcinogenic effects. (ED * 365 days).

BW = Body Weight

PFOS
DCRB Concentration

$$\text{Concsoil (mg/kg)} = \frac{\text{RSCF} * \text{RfD} * \text{CF}}{[(\text{IR} * \text{RAFo}) + (\text{SA} * \text{AF} * \text{RAFd})] * [(\text{EF} * \text{ED}) / (\text{AT} * \text{BW})]}$$

$$\text{S-1} = \mathbf{0.5 \text{ mg/kg}} = \frac{0.2 * 2.0\text{E-}5 * 1.0\text{E+}6}{[(200 * 1) + (2632 * 0.36 * 0.1)] * [(160 * 5) / (1,825 * 17)]}$$

$$\text{S-2} = \mathbf{4.3 \text{ mg/kg}} = \frac{0.2 * 2.0\text{E-}5 * 1.0\text{E+}6}{[(100 * 1) + (3104 * 0.20 * 0.1)] * [(146 * 25) / (9,125 * 70)]}$$

Please contact me at 271-4773 if you have any questions regarding this memo.

EC: Dennis Pinski, EHP Supervisor

¹Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS). USEPA, Office of Water. EPA 822-R-16-004, May 2016.

²https://iaspub.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do?details=&vocabName=Risk%20Assessment%20Glossary

³EPA/540/R/99/005. OSWER 9285.7-02EP. PB99-963312. Exhibit 3-4, Semivolatile Organic Compound (SVOC) default.

The RSL workgroup coordinated with the Vapor Intrusion Screening Level workgroup to ensure a consistent approach to volatility. The following criteria are now used to define a chemical as volatile: 1) vapor pressure greater than 1 mm Hg or 2) Henry's Law Constant greater than 0.00001 atm-m³/mole. The vapor pressure for PFOS is 0.002 mm Hg at 25° C. Also, the Henry's Law Constant is not measurable. Therefore, PFOS is not classified as a Volatile Organic Compound (VOC). Due to PFOS not being considered a VOC, EHP incorporated the USEPA default dermal absorption value (0.10) for SVOCs in the calculation of the DCRB concentration.⁴

⁴Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS). USEPA, Office of Water. EPA 822-R-16-004, May 2016. Table 2-1. Chemical and Physical Properties of PFOS. (Page 17)

⁵Resident soil ingestion rate-child. USEPA 2011A (Table 5-1); "Upper-bound values" accounting for both soil and dust ingestion. OSWER Directive 9200.1-120. Human Health Evaluation, Supplemental Guidance: Update of Standard Default Exposure Factors. February 6, 2014.