Interim Specific Ground Water Quality Standard for Perfluorooctane Sulfonate (PFOS)

March 2019 *CASRN# 1763-23-1* NJDEP

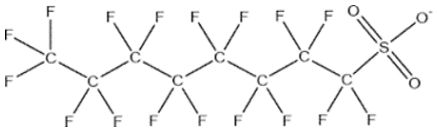
Summary of Decision: In accordance with the New Jersey Ground Water Quality Standards rules at N.J.A.C. 7:9C-1.7, the Department of Environmental Protection (Department) has developed an interim specific ground water quality criterion of 0.01 µg/L and a practical quantitation level (PQL) of 0.004 µg/L (ppb) for perfluorooctane sulfonate (PFOS). The basis for this criterion and PQL are discussed below. Pursuant to N.J.A.C. 7:9C-1.9(c), **the applicable constituent standard is 0.01 µg/L**.

Perfluorooctane Sulfonate (PFOS)

Molecular Formula:

$C_8HF_{17}O_3S$

Molecular Structure:



Background: Perfluorooctane sulfonate (PFOS) is part of a larger group of chemicals called poly- and perfluoroalkyl substances (PFAS). PFOS was produced in the U.S. for use in commercial products and industrial processes for over 50 years. Current and former uses of PFOS include as a stain/water repellant on fabrics, metal plating and finishing, food containers and contact paper, and aqueous film forming foams. PFOS is soluble in water and is extremely persistent in the environment. The main worldwide producer of PFOS completed phasing out the manufacture of PFOS and its precursors in the U.S. and some other nations in 2002. Notwithstanding, environmental contamination caused by PFOS is anticipated to continue for the foreseeable future due to its environmental persistence, formation from precursor compounds, and continued production by manufacturers in other parts of the world such as Asia.

Reference Dose: PFOS caused numerous toxicological effects in animal studies. The Reference Dose (RfD) is based on decreased plaque forming cell response in a subchronic mouse study, the most sensitive effect with the serum PFOS data needed for dose-response analysis (Dong et al. 2009). Decreased plaque forming cell response is a measure of immune suppression, specifically decreased antibody response to a foreign antigen challenge. In Dong et al. (2009), the serum PFOS level at the No Observed Adverse Effect Level (NOAEL) was 674 ng/ml. A total uncertainty factor of 30 was applied to the NOAEL to derive a Target Human Serum Level (i.e., a Reference Dose in terms of serum level) of 22.5 ng/ml (22.5 µg/L). This includes uncertainty factors of 10 for intraspecies variability and 3 for interspecies variability. The RfD of 1.8 ng/kg/day (1.8×10^{-5} mg/kg/day) is calculated from the Target Human Serum Level (ng/ml) using the chemical-specific clearance factor (CL) of 8.1×10^{-5} L/kg/day (8.1×10^{-2} ml/kg/day) developed by the USEPA (2016a, 2016b) as follows:

$$22.5 \text{ ng/ml} \times 0.081 \text{ ml/kg/day} = 1.8 \text{ ng/kg/day} = 1.8 \times 10^{-6} \text{ mg/kg/day}$$

PFOS was classified by the Department as having "suggestive evidence of carcinogenic potential" based on liver and thyroid tumors in a chronic rat study. Although it was

concluded that the cancer risk assessment is too uncertain for use as the basis of the interim specific ground water criterion, the estimated cancer risk at the criterion of 0.01 µg/L is close to the Department's cancer risk goal for ground water quality criteria of one in one million.

Derivation of Ground Water Quality Criterion: The ground water quality criterion was derived pursuant to the formula established at N.J.A.C. 7:9C-1.7(c)4ii, using 1.8×10^{-6} mg/kg/day as the Reference Dose (as explained above), and standard default assumptions:

$$\frac{1.8 \times 10^{-6} \text{ mg/kg/day} \times 70 \text{ kg} \times 0.2}{2 \text{ L/day}} = 1.3 \times 10^{-5} \text{ mg/L} = 0.013 \text{ µg/L}$$

(which rounds to 0.01 µg/L)

Where:
1.8×10^{-6} mg/kg/day = the derived RfD
70 kg = the assumed weight of an adult human
0.2 = the assumed relative source contribution (20%)
2 L/day = the assumed daily volume of water consumed

Derivation of PQL: The method detection limit (MDL) and the practical quantitation level (PQL) are performance measures used to estimate the limits of performance of analytical chemistry methods for measuring contaminants. The MDL is defined as "the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero" (40 CFR Part 136 Appendix B). The Department uses a value of five times the median as an upper boundary of the inter-laboratory MDL distribution and PQL. Establishing the PQL at a level that is five times the interlaboratory MDL provides a reliable quantitation level that most laboratories can be expected to meet during day-to-day operations.

Sufficient interlaboratory performance data was collected from thirteen (13) laboratories certified for PFOS analysis. The laboratories had similar performance values for PFOS analysis using USEPA Method 537 and/or proprietary methods. A statistical technique called the "Bootstrap estimate of a confidence interval of the mean" was calculated using the statistical package "R". USEPA also uses this method when a limited set of performance data is available (Winslow, 2004). Using this approach, the upper 95% confidence interval (UCL) of the concentration level that would encompass the certified laboratory community quantification capability value was 0.004 µg/L. **Therefore, the Department has established a PQL of 0.004 ppb or 0.004 ug/L for PFOS.**

Conclusion: Based on the information provided above (and cited below), the Department has established an interim specific ground water quality criterion of 0.01 µg/L and a PQL of 0.004 µg/L (ppb) for PFOS. Since the ground water quality criterion is higher than the PQL for this constituent, pursuant to N.J.A.C. 7:9C-1.9(c), **the applicable constituent standard for PFOS is 0.01 µg/L** .

Technical Support Documents:

Technical Support Document: Interim Specific Ground Water Criterion for Perfluorooc-

tane Sulfonate (PFOS), Brian Pachkowski, Ph.D.; Alan Stern, Dr.P.H., NJDEP, March 2019.

Interim Practical Quantitation Level (PQL) determination to support Interim Specific Ground Water Quality Standard development for Perfluorooctane Sulfonate (PFOS), R. Lee Lippincott, Ph.D., NJDEP, March 2019.

References:

Dong, G.H., Zhang, Y.H., Zheng, L., Liu, W., Jin, Y.H., and He, Q.C. (2009). Chronic effects of perfluorooctanesulfonate exposure on immunotoxicity in adult male C57BL/6 mice. Arch Toxicol. 83:805-815.

Post, G.B., Louis, J.B., Lippincott, R.L., and Procopio, N.A. (2013). Occurrence of perfluorinated chemicals in raw water from New Jersey public drinking water systems. Env. Sci. Technol. 47:13266-75.

Sanders, P.F., Lippincott, R. L., and Eaton, A. (1996). A Pragmatic Approach for Determining Quantitation Levels for Regulatory Purposes. Proceedings of the Water Quality Technology Conference, American Water Works Association, Denver, Co. Vol 2.

USEPA. (2016a). United States Environmental Protection Agency. Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS). Office of Water. EPA 822-R-16-005. May 2016.

USEPA. (2016b). United States Environmental Protection Agency. Health Effects Support Document for Perfluorooctane Sulfonate (PFOS). Office of Water. EPA 822-R-16-002. May 2016.

Winslow, S.D., Pepich, B.V., Martin, J.J., Hallberg, G.R., Munch, D.J., Frebis, C.P., Hedrick, E.J., Krop, R.A. (2004). Statistical Procedures for determination and verification of minimum reporting levels for drinking water methods." Environ. Sci. Technol. 40: 281-288.