



PFAS - Provisional Cleanup Target Levels and Screening Levels

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PROVISIONAL GROUNDWATER CLEANUP TARGET LEVEL (GCTL)

- PFOA: 70 ppt (0.07 ug/L)
- PFOS: 70 ppt (0.07 ug/L)
- PFOA + PFOS: 70 ppt (0.07 ug/L) –recommendation based on similarity in effect and potency

- These were developed using the non-cancer GCTL equation in Chapter 62-777, F.A.C. , the drinking water and body weight of a pregnant/lactating woman, and an oral RfD of 2E-05 mg/kg per day developed by the USEPA in their 2016 Drinking Water Health Advisory Levels documents. Because these assumptions are consistent with those utilized in the USEPA, the provisional GCTLs are equivalent to the HALs.

PROVISIONAL SOIL CLEANUP TARGET LEVELS (SCTL)

- PFOA: 1.3 mg/kg residential; 25 mg/kg commercial/industrial; leachability 0.002 mg/kg.
- PFOS: 1.3 mg/kg residential, 25 mg/kg commercial/industrial; leachability 0.007 mg/kg.
- These were developed using the non-cancer SCTL equation in Chapter 62-777, F.A.C., chemical-specific properties, updated exposure factors (USEPA, 2014), and an oral RfD of 2E-05 mg/kg per day developed by the USEPA in their 2016 Drinking Water Health Advisory Levels documents.

PROVISIONAL IRRIGATION WATER SCREENING LEVELS (IWSL)

| Chemical | Residential (ug/L) | Industrial (ug/L) |
|----------|-----------------------|----------------------|
| PFOA | 6.7 | 750 |
| PFOS | 72 | 370 |

- Derived using the irrigation water equations developed by the University of Florida in the January 14, 2009 IWSL letter. Uses updated assumptions from the 2011 Exposure Factors Handbook (June 28, 2016 letter) and an oral RfD of 2E-05 mg/kg-d.

SURFACE WATER SCREENING LEVELS

- For the protection of human health, surface water screening levels for the consumption of freshwater and estuarine finfish and shellfish include:
 - 0.150 ug/L for PFOA
 - 0.004 ug/L for PFOS
- Developed in consultation with the Division of Environmental Assessment and Restoration (DEAR).

HUMAN HEALTH METHODOLOGY

- We used a modified equation from the USEPA for the calculation of fish consumption limits based on concentrations of contaminants in fish tissue. We modified it by removing the drinking water component.

$$SWSL (\mu g/L) = RfD \times RSC \times \left(\frac{BW}{FI \times BAF} \right) \times CF$$

| Parameter | PFOA | PFOS | Source |
|--|-------|-------|---------------------------|
| Reference dose (mg/kg d) | 2E-05 | 2E-05 | Drinking water HALs |
| Body weight (kg) | 75 | 75 | Exposure Factors Handbook |
| Relative source contribution | 0.2 | 0.2 | Drinking water HALs |
| Freshwater and estuarine finfish and shellfish consumption rate (kg/d) | 0.029 | 0.029 | NHANES 2003-2010 |
| Bioaccumulation factor (L/kg) | 68 | 2358 | Literature review |

FINFISH CONSUMPTION RATE

| Region | NHANES 90th Percentile freshwater and estuarine finfish and shellfish consumption (g/d) | Percentage of Florida population in each region | Weighted consumption (g/d) |
|-----------------------------------|---|--|---|
| South | 26.3 | 23.6 | 6.2 |
| Gulf of Mexico | 28.6 | 31.6 | 9.0 |
| Atlantic | 30.8 | 44.8 | 13.8 |
| Total weighted consumption | | | 29.0 |

BIOACCUMULATION FACTOR

| Bioaccumulation Factor (L/kg) | PFOA | PFOS |
|---|------|------|
| Freshwater and estuarine finfish and shellfish | | |

- The BAF for PFOA of 68 L/kg is the geometric mean concentration of 12 BAFs. These BAFs represent 12 different species in 3 different studies.
- The BAF for PFOS of 2358 L/kg is the geometric mean concentration of 16 BAFs. These BAFs represent 16 species in 4 different studies.

ECOLOGICAL SURFACE WATER SCREENING LEVELS

| Chemical | SW screening levels (ug/L) |
|----------------------|----------------------------|
| PFOA in freshwater | 1,300 |
| PFOA in marine water | 140-460 |
| PFOS in freshwater | 37 |
| PFOS in marine water | 13 |

- Current methodology promulgated in Chapter 62-777, F.A.C. is a simplified version of the the USEPA derivation of ambient water quality criteria for the protection of aquatic life. Briefly, the lowest LC_{50} or IC_{25} value from non-salmonids is divided by 20.
 - Uses only one toxicity study to develop the screening level
 - Uses a default acute to chronic ratio of 20

METHOD

1. A search was performed in the USEPA's ECOTOX database for aquatic toxicity data.
2. Only North American species were retained for the analysis. Salmonids were not excluded as they represent a sensitive species.
3. The dataset was divided into acute toxicity data, chronic toxicity data, plant data. An acute study was defined as a toxicity study with a duration less than or equal to 96 hours and the chronic study was defined as a toxicity study with a duration greater than or equal to 21 days. Toxicity data with test length between 4 (96 hours) and 21 days were not utilized.

ADJUSTMENTS TO ACUTE TOXICITY DATA

4. Adjustments:

- For daphnia and water fleas: i) all acute test data from a duration less than 48 hours were removed and ii) only LC_{50} and EC_{50} data were retained
- For bivalves: i) all acute test data from a duration less than 48 hours were removed and ii) only LC_{50} and EC_{50} data were retained
- For all other animals: only LC_{50} and EC_{50} data were retained. All other endpoints were removed.

TIER I CRITERIA DEVELOPMENT

For freshwater, the USEPA requires the results of acceptable acute tests with at least one species of freshwater animal in eight different families such that all of the following are included:

- The family Salmonidae
- A second family in the class Osteichthyes
- A third family in the phylum Chordata
- A planktonic crustacean
- A benthic crustacean
- An insect
- A family in a phylum other than Arthropoda or Chordata
- A family in any order of insect or any phylum not already represented

For marine water, the USEPA requires the results of acceptable acute tests with at least one species of marine animal in eight different families such that all of the following are included:

- Two families in the phylum Chordata
- A family in a phylum other than Arthropoda or Chordata
- The Mysidae or Penaeidae family
- Three other families not in the phylum Chordata
- Any other family

SCREENING FOR TIER I CRITERIA DEVELOPMENT

- The acute datasets were screened to determine whether Tier I criteria could be developed for PFOA and PFOS.
- The PFOA freshwater acute data have six of the eight criteria. Benthic crustaceans and insects are not represented in the dataset. The PFOS freshwater acute data have five of the eight criteria. Benthic crustaceans, insects, and an extra phylum are not represented.
- There are no eligible PFOA acute marine water data. The PFOS acute marine water data has one of the eight criteria — the data include the family Mysidae.
- Tier I criteria could not be developed.

CALCULATION OF TIER II CRITERIA

- Because it was not possible to calculate Tier I criteria, Tier II criteria (secondary criteria) were developed using the USEPA methodology from the Great Lakes Initiative (USEPA, 1995).
- To calculate the Tier II secondary acute values (SAVs):
 - A species mean acute value (SMAV) was calculated for each species. The SMAV is the geometric mean of the acute toxicity data for an individual species.
 - The genus mean acute value (GMAV) was calculated for each genus. The GMAV is the geometric mean of the SMAVs for all species in the genus. If only one species from the genus is present, the SMAV for that species becomes the GMAV.
 - The lowest GMAV is divided by the secondary acute factor (SAF)

SECONDARY ACUTE FACTOR

- The secondary acute factor is an uncertainty factor used to adjust the acute value. The less criteria that are satisfied, the higher the SAF.

| Number of USEPA Tier I criteria satisfied | Secondary Acute Factor |
|---|------------------------|
| 1 | 21.9 |
| 2 | 13.0 |
| 3 | 8.0 |
| 4 | 7.0 |
| 5 | 6.1 |
| 6 | 5.2 |
| 7 | 4.3 |

SECONDARY ACUTE VALUE

| Chemical | Secondary Acute Value (µg/L) |
|--------------------------|-------------------------------------|
| PFOA freshwater | 20,000 |
| PFOA marine water | ND |
| PFOS freshwater | 530 |
| PFOS marine water | 210 |

SCREEN CHRONIC DATASET

- Based on the methodology in the USEPA's guidance for deriving numerical national water quality criteria (USEPA, 1985), only chronic toxicity tests using the following endpoints were used:
- For fish, acceptable endpoints include:
 - Survival
 - Growth
 - Maturation
 - Embryo vitality (salmonids)
 - Eggs spawned per female
 - Hatchability
- For daphnia, acceptable endpoints include:
 - Survival
 - Young per female
- For mysids, acceptable endpoints include:
 - Survival
 - Growth
 - Young per female
- For all others, only growth, reproduction, and survival data were considered
- Static tests (except for daphnia) were also omitted from the dataset

SCREEN FOR TIER I CRITERIA DEVELOPMENT

- The datasets were screened to determine whether Tier I criteria could be developed for the PFOA and PFOS freshwater chronic datasets.
- The PFOA chronic freshwater data have three of eight criteria – salmonids, planktonic crustacean, and other phylum (Rotifera). The PFOS chronic freshwater data have six of the eight criteria. Benthic crustaceans and salmonids are not represented.
- No chronic PFOA marine water data. The PFOS chronic marine water data only has one of the eight criteria, i.e., the data include the family Mysidae.
- Because it was not possible to calculate Tier I chronic criteria, Tier II chronic criteria (secondary criteria) were developed using the acute-to-chronic ratio (ACR) methodology

DEVELOPING AN ACUTE-TO-CHRONIC RATIO

1. The acute toxicity value is divided by the chronic toxicity value conducted as part of the same study or the same laboratory. If more than one acute or chronic toxicity value was available from the same laboratory, the geometric mean value was used to calculate the ACR.
2. *If acute and chronic data are not available from the same laboratory, a different laboratory may be used.*
3. For each category (fish, invertebrate, and sensitive species) a geometric mean ACR is calculated from the species-specific ACRs.
4. If these ACRs are not available for all three categories of species, a default ACR of 18 is used for each category where an ACR cannot be calculated.

ACUTE-TO-CHRONIC RATIOS

| Chemical | Fish ACR | Invertebrate ACR | Sensitive Species ACR | Geometric Mean ACR |
|----------------------|----------|------------------|-----------------------|--------------------|
| PFOA in freshwater | 18* | 11.2 | 17.7 | 15.3 |
| PFOA in marine water | ND | ND | ND | ND |
| PFOS in freshwater | 18* | 9.4 | 18* | 14.5 |
| PFOS in marine water | 18* | 11.8 | 18* | 15.6 |

* - the default ACR of 18 was used; ND – not determined

CALCULATING A CHRONIC VALUE

$$\text{Secondary chronic value} = \frac{\text{Secondary acute value}}{\text{Acute - to - chronic ratio}}$$

| Chemical | Secondary Acute Value (µg/L) | Geometric Mean ACR | Secondary Chronic Value (µg/L) |
|-----------------------------|-------------------------------------|---------------------------|---------------------------------------|
| PFOA in freshwater | 20,000 | 15.3 | 1,300 |
| PFOA in marine water | ND | ND | ND |
| PFOS in freshwater | 530 | 14.5 | 37 |
| PFOS in marine water | 210 | 15.6 | 13 |

ND – no acceptable toxicity data are available

PLANT TOXICITY

- Based on the USEPA methodology (USEPA, 1985), only the following data were used to calculate a final plant value (FPV):
 - Acute 96-hour toxicity tests conducted with algae
 - Chronic tests conducted with aquatic vascular plants

| Chemical | Final Plant Value ($\mu\text{g/L}$) |
|----------------------|---------------------------------------|
| PFOA in freshwater | 6,250 |
| PFOA in marine water | ND |
| PFOS in freshwater | 5,300 |
| PFOS in marine water | 3,200 |

ND - no acceptable plant toxicity data are available

SECONDARY CHRONIC CRITERIA

- Lower of the secondary chronic value and the plant value. In all cases, the secondary chronic value was lower.

| Chemical | Secondary Chronic Criterion (µg/L) |
|-----------------------------|---|
| PFOA in freshwater | 1,300 |
| PFOA in marine water | ND |
| PFOS in freshwater | 37 |
| PFOS in marine water | 13 |

ND – no acceptable toxicity data are available

PFOA IN MARINE WATER – METHOD I

- The first method is a modification of the Tier II screening value method. In this method, all toxicity data are retained. This allows the use of the acute toxicity data for PFOA in marine water.
- Followed USEPA Tier II methodology for the rest of the derivation.
- Acute screening value = 2,600 ug/L
- No chronic toxicity was available. Therefore, no ACR could be developed, so the default of 18 was used.
- Chronic screening value = 140 ug/L

PFOA IN MARINE WATER – METHOD 2

- Used the ratio of PFOS toxicity values between marine and freshwater as a surrogate for the ratio of PFOA toxicity values between marine and freshwater. This method is based on the data-bridging approach for aquatic toxicity (USEPA, 2010).
- The secondary chronic criterion for PFOS in freshwater of 37 $\mu\text{g/L}$ is 2.8 times larger than the secondary chronic criterion for PFOS in marine water of 13 $\mu\text{g/L}$. The aquatic toxicity of PFOA is less than PFOS and PFOA has a secondary chronic criterion in freshwater of 1,300 $\mu\text{g/L}$.
- Assuming the same ratio between marine and freshwater toxicity, PFOA in marine water would have a screening value of 460 $\mu\text{g/L}$.

SEDIMENT – PROPOSED METHOD

Taken from Region 4 ERAGS guidance:

$$SSV \left(\frac{\mu g}{kg - \%OC} \right) = SWSL \times [K_{oc} \times f_{oc} + (\theta_m / \rho_w)]$$

Where:

- SSV = sediment screening value normalized to 1% organic carbon ($\mu\text{g}/\text{kg}\text{-}\%OC$)
- SWSL = surface water screening level ($\mu\text{g}/\text{L}$), chemical-specific
- K_{oc} = organic carbon partitioning coefficient (L/kg), chemical-specific
- f_{oc} = fraction of organic carbon (0.01 for 1% OC)
- Θ_m = moisture of sediment by mass (0.3 for 30%)
- ρ_w = density of water at 20°C (0.9982)