

Response to public submissions on draft default guideline values for fluoride in freshwater

August 2024

Draft default guideline values (DGVs) for fluoride in freshwater were published on the Water Quality Guidelines website for a 3-month public consultation period. During this period, comments for the draft DGVs for fluoride in freshwater were received via public submission.

All submissions were reviewed by the Water Quality Guidelines Improvement Program technical manager. The revised technical brief was subject to re-approval by the relevant jurisdictional committees. Responses to comments are outlined in this report for public record, with the identity of submissions omitted.

Following public consultation and re-review, the default guideline values for fluoride in freshwater are now published as final. For additional information on the publication process, please refer to the pathway for toxicant default guideline value publication.

The Water Quality Guidelines Improvement Program thanks all submissions for their valuable contribution to the development of water quality assessment for the protection of ecosystem health.

Comment	Response	Action taken
<p>The respondent appreciates the work and need to derive DGVs for F in freshwaters.</p> <p>The method used to determine 4 DGVs appears to be inappropriate for the data available to determine 4 DGVs. The derivation of the DGVs at 80-99% species level protection are premature.</p> <p>1. The model used to predict the 80 to 99% species level protection is acknowledged by the authors as a poor fit yet the model is recommended to be adopted for the determination of national DGVs. This is most apparent in the F range of 1,000-5,000 micrograms where the basis for the 99, 95 and 90% DGVs are entirely inferred from limited data sets and 2 species.</p> <p>2. Toxicity modifying factors are explored and acknowledged as being significant but then not recommended for adjusting the DGVs. The steps in the raw data and consequent poor fit of the model suggest that other parameters are also important in determining toxicity of fluoride.</p> <p>Despite a poor model result and clear indication that toxicity modifying factors are important an illogical position is adopted where the model is accepted and the effect of toxicity modifying factors are dismissed or assumed to be insignificant only due to lack of information</p>	<p>The derivation of the default guideline values (DGVs) for fluoride in freshwater was consistent with the approved derivation method described in Warne et al. (2018). The derivation met the minimum requirements for using the species sensitivity distribution (SSD) approach, and the resulting DGVs are considered appropriate for adoption as DGVs under the ANZG (2018) Guidelines.</p> <p>In response to point 1, it is acknowledged that the SSD model fit was judged to be poor. However, this does not exclude the DGVs from being adopted. The fit of the SSD model contributes to the classification of the 'reliability' of the DGVs, as described in Section 3.8 of Warne et al. (2018). The other two factors that contribute to the reliability rating of the DGVs are the number and type (chronic or acute) of toxicity values in the dataset used to derive the DGVs. For fluoride in freshwater, there were 22 toxicity values all of which were representative of chronic toxicity. These three factors (number of values, type of values, SSD model fit) combined to result in the DGVs being assigned a moderate reliability rating. Moderate reliability DGVs are still acceptable as DGVs under the ANZG (2018) Guidelines, as described in the ANZG website page on Application of toxicant DGVs.</p> <p>In response to point 2, it is acknowledged that various abiotic factors (e.g. water hardness, chloride, temperature, pH) can affect the toxicity of fluoride. However, for it to be possible to incorporate adjustments for toxicity modifying factors (TMFs) into DGVs, there needs to be sufficient quantitative data characterising the effects of TMFs on fluoride toxicity to a range of species (and, preferably, Australasian species). Currently, there are insufficient such data available for fluoride chronic toxicity and, unfortunately, it was not possible to develop robust algorithms that enable the fluoride DGVs</p>	<p>Minor text edits in the Summary, Section 3 and Section 4.3 to support the conclusion that the effects of toxicity modifying factors could not be incorporated into the DGVs derivation.</p>

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Comment	Response	Action taken
	<p>to be adjusted based on levels of key TMFs. Supporting this conclusion, a recent study by Parker et al. (2022) arrived at the same conclusion for fluoride chronic toxicity; a brief reference to this study has been added to the fluoride DGVs technical brief.</p> <p>It should be noted that the ANZG (2018) Guidelines encourage the derivation and use of site-specific guideline values over DGVs, especially where ambient water quality suggests the DGVs may not be applicable. This is noted in the fluoride DGVs technical brief.</p> <p>In conclusion, there is no need to make any modifications to the fluoride in freshwater DGVs, and they are appropriate for adoption by the ANZG (2018) Guidelines. Nevertheless, minor edits have been made to the technical brief (Summary, Section 3, Section 4.3) to further support the conclusion that it was not possible to incorporate the effect of TMFs in the DGVs.</p> <p>Finally, it is important to note that the new fluoride in freshwater DGVs represent a substantial improvement over the current gap in information, given that there are no DGVs (or interim/low reliability levels) for fluoride in aquatic ecosystems under ANZG (2018) or ANZECC/ARMCANZ (2000).</p>	

Additional issues identified while addressing public comments

Issue	Response	Action taken
<p>Upon addressing jurisdictional committee comments on the final 'post-public comment' version of the draft fluoride freshwater DGVs, it became evident that the Burrlioz software yielded different DGVs depending on the units</p>	<p>Upon investigation, it was found that Burrlioz was selecting a different distribution for the two datasets; the inverse Weibull distribution was selected for the µg/L dataset while the Burr(III) distribution was selected for the mg/L dataset. While the Burr(III) distribution is the default distribution for Burrlioz, the software will select either the inverse weibull or the inverse pareto distribution if the k and c parameter estimates</p>	<p>The fluoride freshwater DGVs were re-derived using the shinyssdttools (V 0.2.0) software, and associated changes to the technical brief were made.</p>

<p>that are used for fluoride dataset (i.e. µg/L or mg/L). This should not happen and represented an unacceptable situation for the fluoride DGVs.</p>	<p>are >100 and >80, respectively. According to the Burrlioz 2.0 User Guide (Barry 2014), this is necessary to ensure numerical stability and does not have significant impacts on the results. In the case of the µg/L dataset, the k parameter exceeded 100 and the inverse Weibull distribution was selected, whereas the k parameter did not exceed 100 for the mg/L dataset and the default Burr(III) distribution was retained. This is simply a scale issue, where the k parameter for the µg/L dataset is 10³x higher than that for the mg/L dataset. This represents a flaw in the Burrlioz statistical approach that has not previously been identified through the DGV derivation process nor a comparative analysis of Burrlioz and ssdtools that was undertaken in 2023.</p> <p>The solution, which was agreed to by the jurisdictional review/approval committees, was to derive the fluoride freshwater DGVs using the shinyssdtools software (Dalgarno 2018), which the ANZG Guidelines is already in the process of transitioning to for DGV derivation. Shinyssdtools does not experience the scaling issue that was exhibited by Burrlioz 2.0.</p>	<p>Also, as a result of these revisions, all units for fluoride in the technical brief, including those for the DGVs, were reported in mg/L.</p>
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References

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- Dalgarno S (2018) ssdtools: A shiny web app to analyse species sensitivity distributions, Prepared by Poisson Consulting for the Ministry of the Environment, British Columbia, Canada. <https://bcgov-env.shinyapps.io/ssdtools/>.
- Parker SP, Wilkes AE, Long GR, Goulding NWE & Ghosh RS 2022. Development of fluoride protective values for aquatic life using empirical bioavailability models. *Environmental Toxicology and Chemistry* 41, 396–409.

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