Australian Government
Department of Climate Change, Energy, the Environment and Water

Australian & New Zealand GUIDELINES FOR FRESH & MARINE WATER QUALITY

Response to public submissions on draft default guideline values for chromium (III) in freshwater

February 2026

Draft default guideline values (DGVs) for ammonia 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 ammonia in freshwater were received via public submission.

Responses to comments and any associated edits to the draft DGV technical brief are outlined in this report, de-identified for public record. The responses and revisions have been approved by the original peer reviewers and the jurisdictional technical and policy oversight groups, and noted by the National Water Committee.

The default guideline values for chromium (III) 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 default guideline values for the protection of aquatic ecosystems.

Response to public submissions on draft default guideline values

Toxicant: Chromium (III) in freshwater

Submission 1:

Comment	Response	Action taken
1. <u>Reliability classification</u> (a) It is stated in the technical brief that "*Only three studies, comprising toxicity data for four species, reported toxicity values based on measured concentrations of total or dissolved/colloidal chromium: two microalgae (Vignati et al. 2010), a cladoceran (Ponti et al. 2014) and a fish (Stevens & Chapman 1984) species. In these studies, chromium was assumed to always be present as chromium(III). All the other studies reported nominal concentrations only. This is an important limitation of the dataset, and it is highly desirable that these tests be repeated with test concentrations measured at both the beginning and end of the toxicity tests"*. Further clarification should be provided on a) how justified the assumption that, in the three studies referred to, chromium was present as chromium(III) and b) how the nominal concentrations were calculated. Discussion on how these assumptions might have affected the reliability of the DGV derivation is recommended.	*a) how justified the assumption that, in the three studies referred to, chromium was present as chromium(III):* The tests reported by these studies were based on the addition of Cr(III) salts to synthetic water samples at known pH and hardness. Oxidation of Cr(III) by dissolved oxygen is slow and the only plausible oxidant that has been identified is colloidal or particulate MnO_2 which was absent from these samples (Vignati et al., 2008, 2010; Schroeder and Lee, 1974). No separate identification of Cr(VI) and Cr(III) was undertaken in these tests; however, in the analysis of field-collected samples it will be essential to use an analytical procedure that separates these two species. Typically this involves measurement of total chromium before and after the removal of coprecipitated Cr(III). Because Cr(VI) may be more toxic, such a discrimination is important. An overall concern is the reported losses of Cr(III) in some tests. This is greater at higher pH values and is not thought to be due to oxidation, but to hydrolysis and formation and/or precipitation of Cr(III) as $Cr(OH)_3$ and as polymers and the possibility of adsorption to surfaces (Vignati et al., 2010). This, and other factors, were recognised in the technical brief and resulted in a caveat being applied to the DGVs (see table note to Table 2). *b) how the nominal concentrations were calculated:*	Changes made to technical brief. Text was added (identified in italics) to Section 3 regarding loss mechanisms for chromium (III) and preferred procedures for dealing with this in toxicity tests. Text was also added to section 4.1 making it clear that only studies that used chromium (III) salts were considered for the derivation. Supporting references were added. No changes to technical brief.

Comment	Response	Action taken
	Nominal concentrations are simply the concentrations of chromium (III) that the test solutions were made up to, as reported in the studies that did not measure chromium. There was no calculation necessary.	
(b) As part of the reliability classification, it is stated that the sample size is 13 (good). However, only 6 of these are chronic endpoints with the remainder being acute converted to chronic. Because of these points and other limitations noted in the technical brief, it is questioned whether a reliability assessment of moderate is justified.	The reliability classification is clearly described in Warne et al. (2018, Section 3.8). The reliability rating is determined by three factors – (i) number of data, (ii) type of data (chronic and/or acute), and (iii) the fit of the SSD. For the chromium (III) DGVs, where there are between 8 and 14 toxicity values comprising both chronic and (converted) acute data, and the fit of the SSD is good, the resulting reliability rating is *Moderate*. Where the dataset has other limitations that may affect the accuracy of the DGVs, these cannot affect the final reliability rating; however, as described in Warne et al. (2018, Section 3.8), caveats associated with these limitations can be added to the DGV technical brief. The chromium (III) DGVs technical brief contains a caveat as follows (in the Table 2 footnote): "*Due to uncertainties of deriving DGVs for metals of low solubility, the lack of high quality toxicity studies, and the wide range of factors influencing chromium(III) speciation, the accuracy of the DGV may be affected.* ". Thus, there is no need to make any amendments to the text.	No changes to technical brief.
2. <u>Proposed analytical methodology</u> (a) Limited evidence is presented to justify that the DGVs applicable to total chromium (III) measured with the proposed methodology, is the most representative of the bioavailable fraction. The methodology may include some mineralised forms of chromium (III), particularly during high flow events with high loads of suspended materials. This may often be relevant to inland waters in north Western Australia and may result in the DGVs being overly conservative if	It is acknowledged that there are currently knowledge gaps relating to what constitutes the bioavailable fraction of chromium (III), and that the recommended pH 2 extraction method (e.g. as per USEPA Method 200.1 Acid-soluble metals; USEPA 1991) may measure a proportion of chromium (III) that is non-bioavailable, resulting in potentially over-conservative (over-protective) DGVs. Accordingly, it is acknowledged that there was a need to validate methods for measuring the bioavailable fraction of chromium (III), as has recently been done for aluminium (Rodriguez et al. 2019, ASTM 2024) and iron	The DGV technical brief (particularly Appendix B) has been updated to acknowledge the USEPA Method 200.1 (USEPA 1991) as well as the refined and validated pH 2 extraction method for chromium (III) (Komorova 2025), and how this should be used in conjunction with the chromium (III) in freshwater DGVs.

Comment	Response	Action taken
applied to this area. To my knowledge, little, if any, baseline and background data is currently available for this area on chromium (III) as measured with the new proposed analytical methodology, to enable site specific guidelines to be developed. Further evidence should be presented and compared to other analytical methods, to justify that the proposed methodology for total chromium (III) is the most reliable and suitable for determination of bioavailability in complex freshwater systems.	(Balsamo-Crespo et al. 2023, ANZG 2024). To address this issue for chromium (III), The USEPA (1991) pH 2 extraction method has recently been refined and validated for chromium (III) in freshwater (and marine water), with details of the method now available in Komarova (2025). The method is recommended to be used for the analysis of water samples for chromium (III) for the purposes of comparison with the chromium (III) DGVs.	
(b) In addition, it is recommended that advice is provided on sampling methodology to minimise the conversion between chromium (III) and chromium (VI) after sample collection and prior to laboratory analysis.	Regarding the request for sampling advice, the DGV technical briefs are not the appropriate place for such guidance. This guidance should be sought from commercial analytical chemistry laboratories. However, some information has been added to the technical brief regarding the analysis of chromium (III).	Text added to Section 1 regarding chromium (III) analysis method, with supporting references.
3. <u>Other factors that influence the bioavailability of chromium (III)</u>: (a) Several studies are referred to in the technical brief that demonstrate the effect of other factors on chromium (III) bioavailability, in particular water hardness and alkalinity. However, it is concluded that "*Notwithstanding the body of information on factors that modify chromium(III) toxicity, the quantitative incorporation of such factors into the DGVs was beyond the scope of the current derivation*". It is recommended that some further justification be provided for this conclusion.	There is published literature demonstrating that water quality variables such as pH, hardness, alkalinity and dissolved organic carbon can affect the bioavailability and toxicity of chromium (III). However, as the draft technical brief noted, the available information is insufficient upon which to develop robust algorithms to enable the adjustment of chromium (III) DGVs based on any of the above TMFs. This conclusion is further supported by the fact, apart from the above-mentioned USEPA (1986) hardness algorithm, that no such TMF algorithms have been developed for chromium (III) in Europe or North America, which have dominated the development of such models.	No changes to technical brief.

Comment	Response	Action taken
	Thus, while it is desirable for the chromium (III) DGVs to be able to be adjusted to be able to account for key TMFs, the current state of the science does not enable this to be done. Accordingly and appropriately, the technical brief states that: "The DGVs are based on toxicity data generated at pH 6–8.3, hardness <100 mg $CaCO_3$/L and alkalinity 18–42 mg $CaCO_3$/L, where reported. Where local water quality is outside the range of these variables, site-specific guideline values may need to be considered."	
(b) The range of water alkalinity (18–42 mg CaCO3/L) and hardness (<100 mg $CaCO_3$/L) of the dataset used to derive the proposed DGVs is very low in comparison to the natural variability of inland waters in north Western Australia. Therefore, the proposed DGVs may be overly conservative for this area. It appears from the number of studies referred to in the technical brief, that some allowance could be made for these modifying factors.	We acknowledge that the toxicity datasets used to derive DGVs may not be fully representative of different water types in Australia and New Zealand, meaning that some DGVs have the potential to be over- or under-protective depending on local water quality characteristics. Unfortunately, and as noted in the previous response, there were insufficient data to enable the development of quantitative models from which DGVs could be adjusted based on key water quality characteristics. The ANZG (2018) Guidelines acknowledge that DGVs may not be valid for all water types and, therefore, prefer that site-specific GVs are derived. The technical brief makes specific mention of the water quality bounds within which the DGVs were derived and the potential need to derive site-specific GVs if outside these bounds. Site-specific GVs can be derived via various methods, including local direct toxicity assessment, field effects assessments or the use of reference site water quality data, as described in ANZG (2018).	No changes to technical brief.
In summary the following is suggested: • Clarification on justification for moderate reliability assessment	Justification for the moderate reliability classification was provided above. Th draft DGVs were deferred until the pH 2 extraction method was validated for chromium (III). This has now occurred (see Komarova 2025).	DGVs to be published.

Comment	Response	Action taken
• Presentation of further evidence for the proposed analytical methodology to ensure the methodology can readily measure the bioavailable fraction of chromium (III). • Incorporation of other modifying factors on the bioavailability of chromium (III) into the proposed DGVs, if possible. Accordingly, it is recommended to defer the adoption of the proposed DGVs for chromium (III) until such evidence is presented.	As was explained above, the existing knowledge base does not enable the development of quantitative bioavailability models that can be used to adjust DGVs for chromium (III). Moreover, any such models would need to be validated for Australian and New Zealand species and water quality conditions before they could be adopted. In the meantime, the current DGVs fulfil the requirements of DGVs for Australia and New Zealand. It is considered appropriate to now progress and publish the draft DGVs.	

Additional improvements made while addressing public comments

Issue	Response	Action taken
The original draft chromium (III) freshwater DGVs technical brief was drafted in 2020, and did not capture toxicity data published since this time.	An additional literature search was undertaken to check for chromium (III) freshwater toxicity data published since (and including) 2021. Two relevant studies were identified, as follows: • Aharchaou et al. (2022) – contained relevant information for the technical brief but did not include relevant toxicity data. • Alho et al. (2022) – contained relevant toxicity data for the microalga, *Raphidocelis subcapitata*, although the toxicity value was not used as there was a lower value available for this species from another study. The study was added to the data quality assessment, but was not subsequently added to the data entry spreadsheet due to a non-monotonic concentration-response relationship being observed.	Relevant information from the two studies was added to the technical brief.
Difference in DGVs derived using Burrlioz 2.0 compared with shinyssdtools.	The draft DGVs were derived using Burrlioz 2.0. With shinyssdtools replacing Burrlioz 2.0 as the approved DGV derivation software, differences between the Burrlioz-derived and shinyssdtools-derived DGVs were checked. The 99% species protection DGV differed by ~6-fold, while the 95% species protection DGVs differed by ~2-fold. These differences were considered too large to warrant retaining the Burrlioz-derived DGVs, and the final DGVs were derived using shinyssdtools.	The final DGVs were derived using shinyssdtools (v 0.4.0). The associated supporting data for the derivation were included in an appendix.

References

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