Australian & New Zealand
GUIDELINES FOR FRESH & MARINE WATER QUALITY

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

July 2021

Draft default guideline values (DGVs) for glyphosate in freshwater were published on the Water Quality Guidelines website for a 4-month public consultation period. During this period, comments for the draft DGVs for glyphosate 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 Reform Committee.

The default guideline values for glyphosate 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.

Table 1. Public comments and technical brief revisions

<table>
<tr><th>Comment</th><th>Response</th><th>Action taken</th></tr>
<tr>
<td>We note the DGV for glyphosate have been assigned a ‘high’ reliability classification according to Warne et al. (2018) since the toxicity data set is comprised of 11 species (across 6 phyla) with non-extrapolated, chronic endpoints and demonstrated a good SSD fit.

To raise the reliability rating, the concluding statement of the DGV recommends additional chronic toxicity tests be conducted on plants and algae. To that end, we note there are additional studies that could be gleaned from the toxicity dataset used to derive the Canadian Water Quality Guidelines (CWQG) for glyphosate (CCME 2012). Specifically, there are 12 additional species (including 7 plant/algal species) used in CCME (2012) that were not included in the glyphosate draft DGV. We seek clarification on whether these endpoints were considered under the toxicity review and, if so, why they were not considered of acceptable quality.</td>
<td>We thank the responders for raising this issue. The DGV co-authors have re-visited the CCME (2012) dataset. The details for each of the 12 species listed in CCME (2012) but not included in the glyphosate draft DGV are provided below. In summary, data for five of the species were added to the glyphosate dataset, with four of these being new species, while the data for the remaining seven species were not. Species for which data were added and used in the derivation are highlighted in blue.

Review of data for 12 species

Graham Van Aggelen (EC), per. comm. (2007)

Oncorhynchus kisutch, 21-day ELS NOEC of 130,000 ug/L.

Oncorhynchus mykiss, 7-day NOEC (Hatching) of 150,000 ug/L.

Per. Comm data are not used in DGV derivations. Only data that are peer reviewed and publicly available are quality assessed and used in derivations. The recommended data were not used to derive the Glyphosate DGVs.

OPP PED (2007)

Pimephales promelas, 225-day NOEC of 25,700 ug/L.

At the time of searching the OPP database, this record did not appear. From the database, it is stated that the LOEC is greater than 25,700 ug/L. Thus, in the experiment neither a NOEC nor LOEC was definitively reached. There are more definitive toxicity data i.e., an acute LC50 of 84 900 ug/L. This was then converted to an estimate of chronic NOEC/EC10 of 8 490 ug/L and used in the derivation. The recommended data were not used to derive the Glyphosate DGVs.

Summit Environmental Consultants Ltd (2007)

Ceriodaphnia dubia, 7-day NOEC (Mortality) of 65,000 ug/L.

Hyalella azteca, 14-day IC10 (Dry weight) of 20,500 ug/L.

A total of 17 data points were extracted from this paper (eight for C. dubia and eight for H. azteca). The final values taken per species (by the time geomeans were</td>
<td>Data for four species (Ceriodaphnia dubia, Hyalella azteca, Scenedesmus acutus and Scenedesmus obliquus) were added to the final dataset, increasing the dataset from 11 to 15 species. The DGVs were updated accordingly. The revised DGVs are as follows:

<table>
<tr><th>Protection level</th><th>Original DGV (µg/L)</th><th>Revised DGV (µg/L)</th></tr>
<tr><td>99%</td><td>180</td><td>180</td></tr>
<tr><td>95%</td><td>300</td><td>320</td></tr>
<tr><td>90%</td><td>400</td><td>460</td></tr>
<tr><td>80%</td><td>610</td><td>760</td></tr>
</table>

With the additional data, and given the data were all chronic toxicity data, and the fit of the SSD was considered to be good, the reliability rating increased from high to very high.

The DGVs technical brief and accompanying spreadsheets were updated to reflect the data additions and associated changes to the DGVs. Associated revisions to the technical brief were made to most of the sections, including the Summary, section 2.2 (Toxicity), section 4.1 (Toxicity data used in derivation),</td>
</tr>
</table>

Comment	Response	Action taken
	accounted for) were 65 ug/L for *C. dubia* and 19,145 ug/L for *H. azteca*. These data have been included in the DGV derivation spreadsheet and were used to derive the Glyphosate DGVs. Ma et al. 2001 ***Chlorella pyrendiosa*, 96-hour EC50 (Growth inhibition) of 3,530 ug/L.** If referring to "Acute Toxicity of 33 Herbicides to the Green Alga *Chlorella pyrenoidosa" t*his value was included (data ID 618, row 39). *Chlorella pyrenoidosa* and *C. vulgaris* are the same species so their toxicity data are treated as one species. This value from Ma et al. 2001 was not the lowest value for the species and therefore was not used to calculate the Glyphosate DGVs. Also, this species was not included in the final dataset because only LOECs or EC50s were available, and only EC10s/NOECs were used to derive the DGVs. Ma et al. 2002a ***Chlorella vulgaris*, 96-hour EC50 (Growth inhibition) of 4,696 ug/L.** If referring to "Toxicity of 40 Herbicides to the Green Alga *Chlorella vulgaris*" then this value was already included (data ID 836, row 41). This value from Ma et al. 2002 was not the lowest value for the species and therefore was not used to calculate the Glyphosate DGVs. Also, this species was not included in the final dataset because only LOECs or EC50s were available, and only EC10s/NOECs were used to derive the DGVs. ***Scenedesmus obliquus*, 96-hour EC50 (Growth inhibition) of 55,858 ug/L.** This value was also included data in the derivation (data ID 614, row 252). However, the Australian and New Zealand Water Quality Guidelines consider *S. acutus* and *S. obliquus* to be the same species. Therefore, the *S. obliquus* value was combined with the *S. acutus* values. This value was not the most sensitive for this species and was an EC50, and therefore was not used to derive the glyphosate DGVs. Roshon (1997) ***Myriophyllum sibiricum*, 14-day LC50 (Growth) of 1,474 ug/L.**	section 4 (Default guideline value derivation), Appendix A (data table) and Appendix B (Modality assessment).

Comment	Response	Action taken
	The DGV authors were unable to confirm the value of 1,474 ug/L for glyphosate in the thesis (Roshon 1997) or the resulting paper (Roshon et al. 1999). However, there was a value of 1.47 mg/L available for 2,4-D acid (Roshon et al. 1999 / Roshon et al. 1999). Aside from this, there were IC50 values that passed the quality screening process for technical grade glyphosate using the following endpoints: shoot growth, root number and root length. As a result, three data were added to the DGV spreadsheet. Two of these were the equal lowest and their geometric mean was 169 ug/L but as these were preference 'two' data (chronic LOEC/EC50 type data) and there were sufficient preference 'one' data, they were not used to derive the glyphosate DGVs. Fleming et al. (1991) Toxicity data from this paper were not used in the DGV derivation because there is no active ingredient or purity information stated and therefore, they do not meet the criteria set out in Warne et al. (2018). Saenz et al. (1997) ***Scenedesmus acutus*, 96-hour MATC (population changes) of 2,000 and 4,000 ug/L.** ***Scenedesmus quadricauda*, 96-hour MATC (population changes) of 770 and 1,550 ug/L.** The NOEC, LOEC and EC50 values from this paper have now been included into the DGV spreadsheet as it passed the quality screening process for technical grade glyphosate. The toxicity values of 2,000ug/L and 770ug/L were the lowest values for the species and were therefore used to derive the Glyphosate DGVs.	
We note an inconsistency between Table 2 and Appendix A with respect to endpoint selection for *S. capicornutum*. Table 2 indicates a 2-d NOEL of 1400 µg/L based on chlorophyll-a content while Appendix	In checking the data related to this comment it was discovered that the value of 1400 ug/L for *S. capricornutum* was erroneous and should in fact have been 14 000 ug/L. Thus, the lowest value for this species became a 5-day NOEC of 10 000 ug/L. As a result, this value for this species was used in the final dataset for deriving the DGVs.	The relevant corrections have been made to the technical brief.

Comment	Response	Action taken
A indicates a 4-d NOEL of 1400 µg/L based on biomass, growth rate and area under the curve		
In contrast to the DGV endpoint selection for *S. capicornutum*, CCME (2012) used a 5-d NOEL of 10,000 µg/L. Both endpoints appear to be from the same source (i.e., USEPA Restricted database 2007 for the former, USEPA 2015 for the latter). As such, we seek clarity on the difference in endpoint selection between the two jurisdictions for *S. capicornutum*.	Both values in question are 5-day NOEL values of 10,000 µg/L. The Canadian Water Quality Guidelines (CCME 2012) does not give any information on the data point apart from it being a 5-day NOEL of 10,000 µg/L (i.e., its source or the biological endpoint that was measured). The value that used was a 5-day NOEL value of 10,000 µg/L with the endpoints being area under the growth curve, biomass, and growth rate. Therefore, it is difficult to provide a response. However, we have assumed that as the data point appears to have been obtained from the same source, that they are based on the same endpoints.	No changes made to technical brief.
According to Warne et al. (2018), we understand the data hierarchy for endpoint selection is as follows: NEC > EC/IC/LCx (x≤10) > BEC10 > EC/IC/LCx (where x > 10 and ≤ 20) > NOEC > estimated NOEC from MATC, LOEC or LC/EC50. As such, we seek clarity as to why a geomean of the IC7 and NOEC was taken for P. columella, in place of using the IC7 alone to represent this species.	The guidance in Warne et al. (2018) on the hierarchy of using data has led to two different interpretations. The sentence following the one quoted by ECCC states that: "While all of these acceptable statistical estimates of toxicity are not numerically the same, they are all treated as equivalent for the purposes of deriving GVs." This has led some to interpret that the various measures of toxicity should be combined – as was done in this case for glyphosate. There is a process currently underway to clarify the interpretation of what is meant, what is now the preferred method, and to subsequently update the Warne et al (2018) document to reflect this. However, it is unlikely that DGVs already derived, such as the glyphosate DGVs, will be updated once the guidance has been clarified unless it would make a material difference to the final DGVs.	No changes made to technical brief.
P. 6, paragraph 4, line 3 says "A modality assessment of the simazine toxicity data, undertaken … … concluded that the dataset was unimodal". We assume that 'simazine' should be replaced by 'glyphosate'.	We thank the responders for picking up this error. It has now been corrected.	The relevant correction has been made to the technical brief.

Table 2. Other significant revisions made to the technical brief that were not related to public comments

Page/section	Revision	Justification
1. Section 1 (Introduction), last paragraph (p. 2)	Text from section 4.1 relating to the ANZECC/ARMCANZ (2000) glyphosate DGVs was relocated to section 1.	This paragraph was added to section 1 because it represents contextual/background text for the glyphosate DGVs and is better located in this section than in section 4.1. Overall improves the technical brief.
2. Section 2.2 (Toxicity) (p. 3)	This section was re-written in narrative form from the original bullet point form in the draft version.	This section is intended to be a narrative rather than just a list of toxicity values, and it is now consistent with the intent and most other DGV technical briefs. Overall improves the technical brief.
3. Section 4.1 (Toxicity data used in derivation), first paragraph (p. 4)	Paragraph was revised following relocation of text from this paragraph to section 1.	See justification for #1, above.
4. Section 4.1 (Toxicity data used in derivation), firth paragraph (p. 5)	Text added to discuss low pH issues for newly added tests for *Ceriodaphnia dubia* and *Hyalella azteca*.	This text documents a professional judgement decision to include these data in the dataset. Overall improves the technical brief.
5. Appendix B (Modality assessment), (pp. 16-17)	Minor interpretation change made to the assessment, whereby previous statements that phototrophs were not more sensitive than heterotrophs was changed to statements that there appears to be a general trend of phototrophs being more sensitive than heterotrophs, although the dataset is still not considered bimodal.	The plots of the data in Figures B 2 and B 3 support the revised statement more than they do the original statement. Overall improves the technical brief.

References

ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra, ACT, Australia.

CCME 2012. Canadian water quality guidelines for the protection of aquatic life: Glyphosate. In: Canadian environmental quality guidelines, Canadian Council of Ministers of the Environment, Winnipeg.

Fleming WJ, Ailstock MS, Momot JJ & Norman CM 1991. Response of sago pondweed a submerged aquatic macrophyte to herbicides in three laboratory culture Systems. J. W. e. Al. Ed. Gorsuch, ed. Special Technical Publications, 1115. Plants for Toxicity Assessment: Second Volume. ASTM (American Society for Testing Materials). Pages 267-275.

Ma J, Liang C, Xu L, Wang S, Wei Y & Lu J 2001. Acute toxicity of 33 herbicides to the green alga *Chlorella pyrenoidosa*. *Bulletin of Environmental Contamination and Toxicology* 66,536-541.

Ma., Xu L, Wang S, Zheng R, Jin S, Huang S &. Huang Y 2002. Toxicity of 40 herbicides to the green alga *Chlorella vulgaris*. *Ecotoxicology and Environmental Safety* 51, 128-132.

OPP PED 2007. Office of Pesticide Programs Database. 2007. OPP. United States Environmental Protection Agency.

Roshon RD 1997. A toxicity test for the effects of chemicals on the non-target submersed aquatic macrophyte *Myriophyllum sibiricum* Komarov. Ph.D. thesis. University of Guelph. Guelph, Ontario.

Roshon RD, McCann JH, Thompson DG & Stephenson GR 1999. Effects of seven forestry management herbicides on *Myriophyllum sibiricum* , as compared with other nontarget aquatic organisms. Canadian Journal of Forestry Research 29, 1158-1169.

Saenz M, Di Marzio W, Alberdi J & Tortorelli M 1997. Effects of technical grade and a commercial formulation of glyphosate on algal population growth. *Bulletin of Environmental Contamination and Toxicology* 59, 638-644.

Summit Environmental Consultants Ltd 2007. Toxicity of glyphosate and thiram to aquatic invertebrates. Final Report submitted to National Guidelines and Standards Office, Environment Canada. 24 p. + appendices

USEPA 2015. Office of Pesticide Programs Database. United States Environmental Protection Agency, Office of Prevention, Pesticides, and Toxic Substances. Office of Pesticide Programs. Washington, D.C. January 23, 2004. Available from: https://ecotox.ipmcenters.org, Accessed May–September 2016.

USEPA 2007. United States Environmental Protection Agency Restricted Database. US EPA.

Warne MStJ, Batley GE, van Dam RA, Chapman JC, Fox DR, Hickey CW & Stauber JL 2018. Revised Method for Deriving Australian and New Zealand Water Quality Guideline Values for Toxicants – update of 2015 version. Prepared for the revision of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra, 48 pp.