Public Notice: Minor amendments to align the Australian Drinking Water Guidelines with updated guidance on microbial water quality

22 December 2023

Table 1. Australian Drinking Water Guidelines minor amendments and correction updates

Section	Page	Summary of Proposed Edits	Current (September 2022) Guideline text	Proposed updated Guideline text
Chapter 1	2	New text to reference that safe drinking water should include acute exposures. The phrase "short term" is used to describe acute exposures, with the WHO definition being amended accordingly. As this is new text and referenced from the 2022 WHO, the 2022 reference will be used.	Safe drinking water is essential to sustain life. Therefore, every effort needs to be taken to ensure that drinking water suppliers provide consumers with water that is safe to use.	Safe drinking water is essential to sustain life. Safe drinking water, as defined by the World Health Organization (WHO) Guidelines for Drinking Water Quality, does not represent any significant risk to health from short term and lifetime consumption (WHO 2022). Therefore, every effort needs to be taken to ensure that drinking water suppliers provide consumers with water that is safe to use.
Chapter 1	6	This new text has been added to introduce and clarify the purpose of microbial health-based targets and other guideline values provided in the Guidelines. Based on existing text in respective chapters.		1.3.2 HEALTH-BASED TARGETS Health-based targets provide quantifiable metrics for defining the safety of drinking water. In these Guidelines, health-based targets are based on health outcomes translated into performance targets for microbiological parameters, guideline values for chemical parameters and a reference value for radiological activity (Figure 1.3). The health outcome for microbiological safety is an upper limit of 1 x 10^{-6} Disability Adjusted Life Years (1µ DALY) per person per year. The target is used as the basis for defining treatment performance targets based on source water quality as discussed in Chapter 5 and Appendix 3. Health outcomes for chemical parameters (see Chapter 6) are based on: • a NOEL (no observed effect level), LOAEL (lowest observed adverse effect level) or BMD (benchmark dose) for substances with a toxicity threshold • cancer risk for genotoxic and carcinogenic substances that do not have a toxicity threshold (1 additional cancer per 1,000,000 people from a lifetime of exposure at concentrations above guideline value unless otherwise stipulated in these Guidelines) or • a benchmark dose corresponding to a defined increase in an effect (between 1 and 10% but commonly 5%) from exposure of a population to a chemical. These health outcomes are used to calculate health-based guideline values for individual chemicals. The health outcome for radiological quality is based on minimising the risk of cancer from exposure to radiological elements in drinking water (see Chapter 9). This has been translated into a reference value of 1mSv/year (ARPANSA 2017).

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Chapter 1	6	New figure 1.3 to show health-based targets for microbial, chemical and radiological parameters that are included in the Guidelines.		
Chapter 1	6	New text to introduce the concept of microbial health-based targets, based on existing content in Chapter 5.		1.3.3 MICROBIAL HEALTH-BASED TARGETS The health outcome target of 1 µDALY Disability Adjusted Life Years (1µ DALY) per person per year (pppy) is used to determine the level of treatment, expressed as log reduction values (LRVs), required to remove enteric pathogens that may be present in source waters. The rationale is that meeting identified treatment performance targets will ensure that the health outcome of 1µ DALY pppy is not exceeded. LRVs are calculated for reference pathogens selected as conservative models for the three groups of enteric microorganisms (protozoa, viruses and bacteria). In the absence of system-specific pathogen data LRVs are typically calculated on the basis of source water vulnerabilities and *E.coli* results from raw water monitoring. Where sufficient system-specific pathogen data is available to enable calculation of LRVs, as shown in Table 1.3, it is still important to undertake the default approach to support confidence in the identification of LRVs (see Box 5.7). Significant differences in the two sets of LRVs should lead to further investigations. While the aim for all drinking water supplies should be to meet the target of 1 µDALY pppy, the Guidelines incorporate a level of flexibility in meeting the target in the form of a water safety continuum. The continuum provides a basis for designing and implementing water quality improvement programs. It is essential that the continuum should only be applied in consultation with the relevant health authority or drinking water regulator. Exceeding the target of 1µ DALY pppy per person per year or a modified target based on application of the water continuum should be a signal to investigate the cause and, if appropriate, to take remedial action. See Section 5.4.3 for more information on microbial safety and the water safety continuum.
Chapter 1	6	Updated heading to clarify that the Guidelines include two different types of guideline values (both physical and chemical).	1.3.2 GUIDELINE VALUES The Guidelines include two different types of guideline value:	1.3.4 PHYSICAL AND CHEMICAL GUIDELINE VALUES The Guidelines include two different types of guideline value for physical and chemical characteristics:

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Chapter 1	7	New subsection to clarify guideline values and so that water quality characteristics covers all types of health-based targets (chemical, radiological and microbiological).		1.3.5 RADIOLOGICAL SCREENING AND REFERENCE VALUES Radiological safety is determined by firstly assessing gross alpha and beta activity. If both do not exceed the screening value of 0.5 Bq/L no further action is required. If either exceed 0.5 Bq/L further testing is required to determine the radium-226 and radium-228 activities. Additional radionuclides may also need to be considered. Safety is defined by not exceeding a reference value of 1.0 mSv/L per year. If the total annual dose is between 0.3 and 1.0 mSv/L further assessment and evaluation may be required.
Chapter 1	9	Updated NHMRC Branch and Section names.	Submissions for updating the Guidelines should be forwarded to: Public Health, Research Translation National Health and Medical Research Council GPO Box 1421 Canberra ACT 2601	Submissions for updating the Guidelines should be forwarded to: Environmental Health, Research Quality and Advice National Health and Medical Research Council GPO Box 1421 Canberra ACT 2601
Chapter 1	9	New reference corresponds to in-text citation on page 2.		WHO (2022) Guidelines for Drinking Water Quality, 4th Edition (incorporating the first and second addenda). World Health Organization, Geneva, Switzerland.
Chapter 2	15	Clarify purpose of Guidelines, framework and guideline values.	• promotes public health by assuring safer drinking water for consumers ... • provides quantitative microbial health-based targets to ensure that the level of treatment is appropriate to the level of contamination for a given water supply ... • provides the opportunity for various agencies and stakeholders to identify their areas of responsibility and become involved, and offers the outcome of a cooperative and coordinated approach with improved understanding of the responsibilities of all parties	• protects and promotes public health by assuring safe and aesthetically pleasing drinking water for consumers ... • provides health-based and aesthetic guideline values including microbial health-based targets to ensure that preventive strategies, such as multiple barriers, for managing water quality risk and protecting public health are robust and reliable ... • supports various agencies and stakeholders to better understand and identify their areas of which enables a cooperative and coordinated approach
Chapter 2	15	Correction to text.	Health departments generally take a leading role in regulation; however, in some areas, specific water regulators may be established.	Health authorities generally take a leading role in regulation; however, in some areas, specific water regulators may be established.
Chapter 2	16	Correction to text.	It is proposed that the Health Department, as the agency with responsibility for protecting public health, will have a key coordinating role in ensuring effective implementation and operation of the Framework.	It is proposed that the Western Australia Department of Health, as the agency with responsibility for protecting public health, will have a key coordinating role in ensuring effective implementation and operation of the Framework.

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Chapter 3	26	New paragraph to reflect updates to microbial health-based targets within Chapter 5	However, although it is not possible to control consumers' actions, suppliers should consider how drinking water quality may be affected in private plumbing systems and provide appropriate information to consumers. Additional guidance on this element is provided in the Appendix.	However, although it is not possible to control consumers' actions, suppliers should consider how drinking water quality may be affected in private plumbing systems and provide appropriate information to consumers. The assessment should include the vulnerability classification of the catchment, the microbial band allocation, the required treatment required to achieve microbial safety and whether the total log reductions claimed meet those required to meet health-based targets (see Chapter 5). Additional guidance on this element is provided in the Appendix.
Chapter 3	29	Clarifies context for Quantitative Microbial Risk Assessment Basics (QMRA); strengthens alignment to Chapter 5 which introduces the use of QMRA.	QMRA involves quantifying each component of the exposure pathway, together with the estimated health outcome	QMRA involves quantifying each component of the exposure pathway, together with the estimated health outcome for specific reference pathogens (currently representatives for human enteric viruses, bacteria and parasitic protozoa).
Chapter 3	37	Reflects updates to microbial health-based targets within Chapter 5.	Summary of actions • Identify procedures required for processes and activities from catchment to consumer.	Summary of actions • Identify procedures required for processes and activities from catchment to consumer, including microbial health-based targets.
Chapter 3	39	Inclusion of health-based target to align with Chapter 5.	Examples of possible corrective actions include: • selection of an alternative raw water source if available;	Examples of possible corrective actions include: • selection of an alternative raw water source if available and able to meet the health-based targets;
Chapter 3	42	Clarification of health-based target.	It includes regular sampling and testing to assess whether water quality is meeting guideline values, health-based targets and any regulatory requirements or agreed levels of service.	It includes regular sampling and testing to assess whether water quality is meeting guideline values, microbial health-based targets and any regulatory requirements or agreed levels of service.
Chapter 3	44	Updated text to reflect inclusion of health-based targets to align with information in Chapter 5.	Corrective actions should be developed in consultation with regulatory and other stakeholders. Examples include: • disinfection of tanks; … Significant system failures that could pose a health risk or adversely affect water quality for an extended period require an immediate response and should also be reported to the relevant health authority (see Section 3.6).	Corrective actions to restore operation of treatment barriers should be developed in consultation with relevant health authority or drinking water regulator and other stakeholders. Other examples include: • disinfection of tanks; … Significant system failures that could pose a health risk or adversely affect water quality for an extended period require an immediate response and should also be reported to the relevant health authority or drinking water regulator (see Section 3.6).
Chapter 3	45	New text to reflect inclusion of health-based target to align with Chapter 5.	The development of appropriate protocols involves a review of the hazards and events that can lead to emergency situations, such as: • non-conformance with guideline values or other requirements;	The development of appropriate protocols involves a review of the hazards and events that can lead to emergency situations, such as: • non-conformance with guideline values or other requirements, or not meeting microbial health-based targets;

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Chapter 3	48	New text to reflect inclusion of health-based target to align with Chapter 5.	All employees of the drinking water supplier should be aware of: • the organisation's drinking water quality policy; • characteristics of the water supply system and preventive strategies in place throughout the system; • regulatory and legislative requirements; • roles and responsibilities of employees and departments; • how their actions can impact on water quality and public health.	All employees of the drinking water supplier should be aware of: • the organisation's drinking water quality policy; • characteristics of the water supply system and preventive strategies in place throughout the system; • the application of health-based targets; • regulatory and legislative requirements; • roles and responsibilities of employees and departments; • how their actions can impact on water quality and public health.
Chapter 3	54	New text to reflect inclusion of health-based target to align with Chapter 5.	The aim of process validation is to ensure effective operation and control. Historical data and operational experience can also be useful sources of information.	The aim of process validation is to ensure effective operation and control. Historical data and operational experience can also be useful sources of information. It is important that the validation considers the totality of multiple treatment barriers in achieving the health-based targets.
Chapter 4	63	Proposed text to cross-reference Chapter 5.	The principal risk to human health from drinking water is the presence of pathogenic microorganisms. Thus, to ensure safe water, the focus in small supplies should be on regular inspection of the system to check for any direct or potential sources of contamination, and on the use of a clean and unpolluted water source. The following sections explain how these requirements for small water supplies can be achieved in the context of the Framework.	The principal risk to human health from drinking water is the presence of pathogenic microorganisms. Thus, to ensure safe water, the focus in small supplies should be on regular inspection of the system to check for any direct or potential sources of contamination, and on the use of a clean and unpolluted water source (see Box 5.4). The following sections explain how these requirements for small water supplies can be achieved in the context of the Framework.
Chapter 4	64	New text to align and cross-reference advice in Chapter 5.	The types of barriers and the preventive measures required will depend on the characteristics of the source water and the associated catchment.	The types of barriers and the preventive measures required will depend on the characteristics of the source water and the associated catchment (the principles and approach for assessing the contamination of source waters and management of those risks are set out in Sections 5.4, 5.5 and 5.6).
Chapter 4	64	New text to align with updated advice in Chapter 5.		The starting position is always to assume that a groundwater source is unprotected until objective credible evidence can conclusively demonstrate otherwise. More information on understanding and managing bore water safely can be found in Box 5.2.
Chapter 4	65	New text to align and cross-reference advice in Chapter 5.	After treatment or disinfection, water should be protected during delivery to consumers in the same manner as groundwater, by ensuring that distribution systems are enclosed.	After treatment or disinfection, water should be protected during delivery to consumers in the same manner as groundwater, by ensuring that distribution systems are enclosed. See Section 5.4.2 for information on contamination of source waters with enteric pathogens.
Chapter 4	66	Clarification of text.	Where sampling is less frequent than recommended, sanitary inspections should be more frequent, to provide assurance on the integrity and normal operation of the system.	Where sampling is less frequent than recommended, sanitary inspections should be more frequent, to provide assurance on the integrity and normal operation of the system. A greater focus on operational monitoring may also be required.
Chapter 5	91	Correction to the text.	The total $\log_{10}$ (calculated by summing the log10 reduction credits of individual treatment or environmental barriers) must meet or exceed the LRV required in Table 5.5.	The total $\log_{10}$ reduction (calculated by summing the log10 reduction credits of individual treatment or environmental barriers) must meet or exceed the LRV required in Table 5.5.

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Chapter 5	92	Corrections to Table 5.6 (Indicative pathogen LRV potentially attributable in treatment barriers): Sedimentation removed from direct filtration. Additional corrections include deleting arrows from chloramine entry, and removing incorrect zeros in the inactivation of viruses at pH 9.		
Chapter 6	106	Correction to be consistent with modern convention.	Factors affecting the formation of disinfection by-products include: ... • the time available for reaction (C.t or contact time).	Factors affecting the formation of disinfection by-products include: ... • the time available for reaction (contact time).
Chapter 8	128	Correction to be consistent with modern convention.	Information on occupational exposure to drinking water treatment chemicals resulting from their manufacture, transportation or use should be obtained from the manufacturer and Material Safety Data Sheets (MSDS), or from the appropriate state or territory occupational health and safety authority (see Section 8.9).	Information on occupational exposure to drinking water treatment chemicals resulting from their manufacture, transportation or use should be obtained from the manufacturer and Safety Data Sheets (SDS), or from the appropriate state or territory occupational health and safety authority (see Section 8.9).
Chapter 8	129	Updated to correct information, as suspended particles above 1 micron may not cause turbidity.	Chemical treatment processes are used to: ... • remove turbidity and colour;	Chemical treatment processes are used to: ... • remove colour;
Chapter 8	129	Updated to correct information, as suspended particles above 1 micron may not cause turbidity.	The primary use of coagulant and flocculant chemicals is in the removal of suspended and colloidal solids such as clays.	The primary use of coagulant and flocculant chemicals is in the removal of suspended and colloidal solids that cause turbidity such as clays.
Chapter 8	131	Table 8.1 updated to reflect correct State and Territory fluoride legislation and regulations		
Chapter 8	141	Correction to the step numbers and units in Box 8.3 (Sample calculation for determining the lead recommended maximum impurity concentration in Alum).		
Chapter 8	144-147	Section 8.9 (Useful Contacts) updated with most recent contact details.		
Chapter 9	152	New text to align and cross-reference advice in Chapter 5.	The single most important monitoring activity is therefore to ensure that microbial contamination does not cross barriers and enter the drinking water supply.	The single most important monitoring activity is therefore to ensure that microbial contamination does not cross barriers and enter the drinking water supply and hence meeting microbial health based targets (see Chapter 5).

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Chapter 9	153	New text to align with advice in Chapter 5.	Key characteristics related to health include: • microbial indicator organisms and disinfectant residuals; • any known characteristics that can be reasonably expected to exceed the guideline value, even if occasionally;	Key characteristics related to health include: • microbial indicator organisms and disinfectant residuals to determine if microbial health-based targets are being met; • any known physical and chemical or radiological characteristics that can be reasonably expected to exceed the guideline value, even if occasionally;
Chapter 9	159	New text to align with advice in Chapter 5.	The characteristics selected for operational monitoring should provide useful information concerning operational activities and performance.	The characteristics selected for operational monitoring should provide useful information concerning operational activities and performance and to confirm the effectiveness of preventive measures and barriers.
Chapter 9	163	Updated Table 9.2 (Example of an operational monitoring program) with corrections to some of the characteristics		
Chapter 9	172-173	Updated legislation	The Trade Practices Act 1974 requires plumbing and fittings to be fit for purpose, and that purpose includes being fit for the safe conveyance, storage and use of water of a chemistry as supplied within a particular area. … The Trade Practices Act 1974 requires water supplied by water suppliers to be fit for purpose, including the conveyance, storage and use of that water within approved plumbing assets, fittings and plumbed-in systems available in water supply areas.	The Competition and Consumer Act 2010 requires plumbing and fittings to be fit for purpose, and that purpose includes being fit for the safe conveyance, storage and use of water of a chemistry as supplied within a particular area. … The Competition and Consumer Act 2010 requires water supplied by water suppliers to be fit for purpose, including the conveyance, storage and use of that water within approved plumbing assets, fittings and plumbed-in systems available in water supply areas.
Chapter 9	174	Advised that the 15 NTU limit was no longer appropriate.	A beneficial outcome of the incident has been the increased knowledge of water quality risks associated with the catchments and improved disinfection validation information. In particular, Melbourne Water has established a specific public health limit of 15 NTU for turbidity for its unfiltered, protected catchment sources, this being the point at which the UV dose was reduced to near critical limits.	A beneficial outcome of the incident has been the increased knowledge of water quality risks associated with the catchments and improved disinfection validation information.
Chapter 10	185	Updated to include reference to microbial health-based targets.	In the short term, monitoring results should be reviewed promptly to assess performance against target criteria and critical limits, guideline values, or agreed levels of service.	In the short term, monitoring results should be reviewed promptly to assess performance against target criteria and critical limits, guideline values, microbial health-based targets or agreed levels of service.
Chapter 10	186	Updated Box 10.1 (Priorities for attention where operational criteria are not met) to include reference to microbial health-based targets.		5. deviations that could have a direct impact on not meeting the microbial health based targets.
Chapter 10	198	New text to align and cross-reference Chapter 5.	Any significant hydrological or other events should be reviewed to assess any associations that may relevant to system management (e.g. the response of turbidity and E. coli to rainfall events; the response of algae to increases in reservoir water temperatures).	Any significant hydrological or other events should be reviewed to assess any associations that may relevant to system management (e.g. the response of turbidity and E. coli to rainfall events; the response of algae to increases in reservoir water temperatures) and if a reclassification of the catchment may be required to meet microbial health-based targets (See Chapter 5).

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Chapter 10	204	Correction - the extra 'and' in heading and first paragraph is an error and will be removed.	10.3.7 SUMMARY OF GUIDELINE VALUES FOR MICROBIAL,CHEMICAL AND PHYSICAL AND CHARACTERISTICS Tables 10.5 and 10.6 summarise the guideline values for microbial, chemical and physical and characteristics of water to provide a ready reference when monitoring results are being evaluated.	10.3.7 SUMMARY OF GUIDELINE VALUES FOR MICROBIAL,CHEMICAL AND PHYSICAL CHARACTERISTICS Tables 10.5 and 10.6 summarise the guideline values for microbial, chemical and physical characteristics of water to provide a ready reference when monitoring results are being evaluated.
Chapter 10	204	Updated Table 10.6 (Guideline values for physical and chemical characteristics) with correction of the guideline value for amitrole, which is given as 0.009 mg/L, but it should be (and is correctly given in the factsheet as) 0.0009 mg/L (i.e., missing one zero) Correction also of carfentrazole-ethyl, which is not placed at the right spot alphabetically - it should come after carboxin		
Information Sheets	228, 233, 238, 241 & 245	Tables IS1.3.1, IS1.4.1, IS1.5.1, IS1.6.1 and IS1.7.1 updated to ensure consistency with the $\log_{10}$ removal values (LRVs) used for health-based targets.		
Information Sheets	228	New text to align with updated Table IS1.3.1 which includes 4 log reduction.	Table IS 1.3.1 presents published C.t values ... achieving a two log reduction in the target microorganism.	Table IS 1.3.1 presents published C.t values ... achieving a two and four log reduction in the target microorganism.
Information Sheets	229	Updates to the Ct values in Information Sheet 1.3 (page 229) to 6 and 25 (from Table 4.7B the liner regression data from Keegan et al – this is the data that is generally used).	Increasing the turbidity from <1 to 20NTU increased the Ct for 2 log inactivation of CB5 from 3.29 to 5.95 mg.min/L at pH 7 (Keegan et al. 2012).	Increasing the turbidity from <1 to 20NTU increased the Ct for 4 log inactivation of CB5 from 6 to 25 mg.min/L at pH 7 (Keegan et al. 2012).
Information Sheets	231	Update of reference list (removal of Korich et al., and LeChevallier et al., and addition of WHO reference) to reflect in-text citations.	Korich DG, Mead JR, Madore MS, Sinclair NA and Sterling CR (1990). Effects of ozone, chlorine dioxide,chlorine, and monochloramine on Cryptosporidium parvum oocyst viability. Applied and Environ Micro.56, 1423-1428. LeChevallier MW and Au K-K. (2004). Water treatment and pathogen control. World Health Organization, Geneva, Switzerland.	WaterVal (2017). WaterVal Chlorine disinfection Validation protocol. Australian Watersecure Innovations Ltd 2017.
Information Sheets	233	New text to align with updated Table IS1.4.1 which includes 4 log reduction.	Table IS 1.4.1 presents published C.t values ... achieving a two log reduction in the target microorganism.	Table IS 1.4.1 presents published C.t values ... achieving a two and four log reduction in the target microorganism.

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Information Sheets	232	Update to in-text citations.	Formation and stability of monochloramine is favoured at Cl2/NH3 ratios of 3 to 5 (with 4 typically used) and a pH above 8 (UWRAA 1990, USEPA 1999). ... The influence of pH on the effectiveness of disinfection appears to be variable (UWRAA 1990, USEPA 1999, Cromeans et al. 2010) and could depend on the target microorganism.	Formation and stability of monochloramine is favoured at Cl2/NH3 ratios of 3 to 5 (with 4 typically used) and a pH above 8 (UWRAA 1990, USEPA 1999, Keegan et al. 2012). ... The influence of pH on the effectiveness of disinfection appears to be variable (UWRAA 1990, USEPA 1999, Cromeans et al. 2010, Keegan et al. 2012) and could depend on the target microorganism.
Information Sheets	236	Update of reference list (removal of LeChevallier et al., and addition of WHO reference) to reflect in-text citations.	LeChevallier MW and Au K-K. (2004). Water treatment and pathogen control. World Health Organization, Geneva.	WaterVal (2017). WaterVal Chlorine disinfection Validation protocol. Australian Watersecure Innovations Ltd 2017.
Information Sheets	238	New text to align with updated Table IS1.5.1 which includes 4 log reduction.	Table IS 1.5.1 presents published C.t values for chlorine dioxide that have been demonstrated as achieving a two log reduction in the target microorganism.	Table IS 1.5.1 presents published C.t values for chlorine dioxide that have been demonstrated as achieving a two and four log reduction in the target microorganism.
Information Sheets	241	New text to align with updated Table IS1.6.1 and Table 5.6	Table IS 1.6.1 presents published C.t values for ozone that have been demonstrated as achieving a two log reduction in the target microorganism. ... These values are supplied for illustrative purposes only.	Table IS 1.6.1 presents published C.t values for ozone that have been demonstrated as achieving a two and four log reduction in the target microorganism. ... These values are supplied for illustrative purposes only and are consistent with Table 5.6.
Information Sheets	241	Correction and clarification of text.	The important conclusion to draw from Table IS1.6.1 is that ozone is more effective than chlorine, chloramines, and chlorine dioxide for the inactivation of viruses, Cryptosporidium, and Giardia.	The important conclusion to draw from Table IS1.6.1 is that ozone is more effective than chlorine, chloramines, and chlorine dioxide for the inactivation of viruses, and protozoa.
Information Sheets	241	Correction and clarification of text.	Turbidity should be less than 1 NTU at the time of ozonation.... The pH should be less than 8 for effective disinfection because ozone is unstable above pH 8. ... Due to its low solubility in water and instability above pH 8...	Turbidity should be less than or equal to 1 NTU at the time of ozonation.... The pH should be less than 9 for effective disinfection because ozone is unstable above pH 9 (note that at pH 8, half of the ozone is lost in less than 30 minutes) ... Due to its low solubility in water and instability above pH 9...
Information Sheets	243	Update of reference list (removal of USEPA and Wickramamayake et al., and addition of WaterVal reference) to reflect in-text citations.	United States Environmental Protection Agency (USEPA) (1999). Alternative disinfectants and oxidants guidance manual. Washington DC. United States Environmental Protection Agency USEPA (2010). Long term 2 enhanced surface water treatment rule toolbox guidance manual. Washington DC. Wickramamayake GB, Rubin AJ, Sproul OJ. (1984). Inactivation of Naegleria and Giardia cysts in water by ozonation. Journal of the Water Pollution Control Federation, 56:983–988.	WaterVal (217c). WaterVal ozone disinfection: validation protocol. Australian Watersecure innovations LTD 2017.

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Information Sheets	245	New text to align with updated Table IS1.7.1 and Table 5.6.	Table IS1.7.1 presents published dosage rates for UV light that have been demonstrated as achieving a two log reduction in the target microorganism. ... These values are supplied for illustrative purposes only.	Table IS1.7.1 presents published dosage rates for UV light that have been demonstrated as achieving a two and four log reduction in the target microorganism. ... These values are supplied for illustrative purposes only and is consistent with Table 5.6.
Information Sheets	245	Update to in-text citations.	Further information can be obtained from a review of existing data on the effectiveness of UV light against a range of specific pathogens undertaken by Chevrefils et al. (2006).	Further information can be obtained from a review of existing data on the effectiveness of UV light against a range of specific pathogens undertaken by WaterVal (2017b).
Information Sheets	245	Clarification of text.	The performance of UV disinfection is not affected at turbidity levels of 1 NTU, ... and UV light may remain effective at higher turbidities than 1 NTU,	The performance of UV disinfection is not affected at turbidity levels of up to 1 NTU, ... and UV light may remain effective at higher turbidities greater than 1 NTU,
Information Sheets	247	Update of reference list (removal of Chevrefils et al., and Hijnen et al., and addition of WaterVal reference) to reflect in-text citations.	Chevrefils G and Caron E (2006). UV Dose Required to Achieve Incremental Log Inactivation of Bacteria, Protozoa and Viruses, Trojan Technologies Inc., London, ON, Canada. Hijnen WAM, Beerendonk EF and Medema G.J. (2006). Inactivation credit of UV radiation for viruses,bacteria and protozoan (oo)cysts in water: A review. Water Research 40: 3-22.	WaterVal (2017b). WaterVal Ultraviolet disinfection: Guidance document. Australian Watersecure Innovations LTD 2017
Information Sheets	264	Updated heading and subheadings.	**Statistics - Assessing performance** ... Assessing Performance Against a Maximum Value ... Assessing Performance Against a Mean ... Assessing Performance Against a Percentile	**Statistics - Assessing data** ... Assessing Data Against a Maximum Value ... Assessing Data Against a Mean ... Assessing Data Against a Percentile

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Information Sheets	265	New text to align with advice in Chapter 5.		ASSESSING MICROBIAL HEALTH-BASED TARGET MICROBIAL BAND ALLOCATION DATA A microbial band allocation is used to provide a measure of the overall level of faecal contamination of the source water using E. coli as the microbial indicator. It is an important step in establishing the category of the source water and subsequently the required level of treatment to meet the microbial health-based targets. Chapter Section 5.3 describes this process in more detail. The suggested monitoring period to characterise microbial risk in the source water is two years, which would provide at least 100 data points with weekly sampling. The maximum E. coli results should be used for the allocation of the microbial band (Walker, et al, 2015) unless the dataset is robust enough to use the 95th percentile. Adoption of a percentile should first be discussed with the relevant health authority or drinking water regulator to determine if this is an appropriate option.
Information Sheets	265	Update of reference list (addition of Walker et al.) to reflect in-text citations.		Walker E, Canning A, Angles M, Ball A, Stevens M, Ryan G, Liston C, Deere D (2015). Semi Quantitative Assessment of Microbial Source Risk. Australian Experience from Pilots of implementing a Health Based Target for Microbial Water Quality, Occasional Paper, Water Research Australia. Available at http://www.waterra.com.au/publications/latest-news/2015/new-occasional-papersemi-quantitative-assessment-of-microbial-source-risk/.
Fact Sheets	311	Correction to remove italics from 'campylobacters'.	Thermophilic *campylobacters* have been found in crude sewage sludge, but were not detectable in digested conditioned sludge or filter effluent.	Thermophilic campylobacters have been found in crude sewage sludge, but were not detectable in digested conditioned sludge or filter effluent.
Fact Sheets	1040	Correction of text.	There are three distinct aspects to turbidity to be considered within the catchment-to-consumer risk management framework: ... • the impact of turbidity on the efficiency of disinfection processes;	There are three distinct aspects to turbidity to be considered within the catchment-to-consumer risk management framework: ... • the impact of turbidity on the efficacy of disinfection processes;
Fact Sheets	1041	Correction of text.	This intensity or operational monitoring is strongly recommended to ensure that any performance issues related to individual filters are detected and addressed proactively (USEPA 2004, Mosse 2009).	This intensity of operational monitoring is strongly recommended to ensure that any performance issues related to individual filters are detected and addressed proactively (USEPA 2004, Mosse 2009).

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Appendix 1	1142	Update to reflect inclusion of microbial health-based targets.	Much of the necessary information may be available in existing documentation from studies carried out previously or from external agencies. Sources of useful information can include: • land use surveys and catchment maps • sanitary	Much of the necessary information may be available in existing documentation from studies carried out previously or from external agencies. Sources of useful information can include: • land use surveys and catchment maps • sanitary surveys and/or vulnerability classifications and microbial band allocations as used for microbial health-based target determination ....
Appendix 1	1144	Additional example given to help understand 'specific events'.	Water quality data should be reviewed both over time and following specific events (heavy rainfall) to identify those aspects of the system that require improvement.	Water quality data should be reviewed both over time and following specific events (e.g. heavy rainfall, natural disasters) to identify those aspects of the system that require improvement.
Appendix 1	1148	New paragraph to align with updated text within Chapter 5.		Chapter 5 introduces the use of quantitative microbial risk assessment (QMRA) which investigates the likelihood of disease along a risk pathway from the point at which pathogen concentration is quantified (e.g. in a water source) to the receptor (e.g. a consumer of drinking water). QMRA involves quantifying each component of the exposure pathway, together with the estimated health outcome. The outcome of a QMRA is a quantitative assessment of risk and is most applicable for answering quantitative questions such as: "What is safe?" and "How much treatment is required to achieve safety?". Figure A3.1 in Appendix 3 provides an overview of the QMRA process
Appendix 1	1150	Update to reflect inclusion of microbial health-based targets.	Summary of actions • Identify existing preventive measures from catchment to consumer for each significant hazard and event. • Determine the residual risk. ...	Summary of actions • Identify existing preventive measures from catchment to consumer for each significant hazard and event. • Determine the residual risk and assess that microbial, chemical and radiological health-based targets are met. ...
Appendix 1	1150	New text to cross reference Section 1.3 information on health-based targets.		The combination of preventive measures applied for each drinking water systems should achieve compliance with identified microbial, chemical and radiological health-based targets (see Section 1.3).
Appendix 1	1154	Table A1.8 (Estimated removals of enteric pathogens using multiple barriers) updated in regard to catchment protection, reservoir detention, filtration, disinfection and achievable LRB target information.		

Section	Page	Summary of Proposed Edits	Current (September 2022) Guideline text	Proposed updated Guideline text
Appendix 1	1155	New dot point to cross-reference health-based targets information in Section 3.4	Summary of actions • Assess preventive measures from catchment to consumer to identify critical control points. • Establish mechanisms for operational control (see Section 3.4 Operational procedures and process control). • Document the critical control points and criteria.	Summary of actions • Assess preventive measures from catchment to consumer to identify critical control points. • Identify procedures required for processes and activities from catchment to consumer, including microbial health-based targets (see Section 3.4 Operational procedures and process control)... • Document the critical control points and criteria.
Appendix 1	1155	New text to include information regarding LRVs to align with Chapter 5.	Table A1.9 provides examples of potential sources of Giardia, preventive measures and potential critical control points from catchment to consumer for a river system. Table A1.10 provides further detail on potential critical control points and operational criteria.	Table A1.9 provides examples of potential sources of Giardia, preventive measures and potential critical control points from catchment to consumer for a river system. In combination, these need to achieve the LRVs described in Table 5.5. Table A1.10 provides further detail on potential critical control points and operational criteria.
Appendix 1	1161	Table A1.11 (Chlorination as a critical control point) updated in regard to temperature target criteria and in-text citation.		
Appendix 1	1162	Updated reference and cross reference to Table A1.12.	Tables of C.t values for various temperatures and pHs for the inactivation of Giardia and viruses by free chlorine and other disinfectants have been published by the United States Environmental Protection Agency (eg see Table A1.12 and USEPA 1999)	Tables of C.t values for various temperatures and pHs for the inactivation of Giardia and viruses by free chlorine and other disinfectants have been published (e.g. see Table A1.12).
Appendix 1	1163	Table A1.12 updated to include C.t 4 log inactivation values.		
Appendix 1	1163	Update to reflect inclusion of microbial health-based targets.	The chlorination process should be verified by supplementing with: ... • performance evaluation and operational audit to confirm that objectives are being met. This entails the periodic review of operational monitoring, drinking water quality monitoring data and consumer satisfaction, logbook records of planned and unplanned maintenance and calibration, and operating procedures.	The chlorination process should be verified by supplementing with: ... • performance evaluation and operational audit to confirm that objectives are being met. This entails the periodic review of operational monitoring, drinking water quality monitoring data and consumer satisfaction, logbook records of planned and unplanned maintenance and calibration, and operating procedures, including microbial health-based targets.

Section	Page	Summary of Proposed Edits	Current (September 2022) Guideline text	Proposed updated Guideline text
Appendix 1	1163	Update of reference list (addition of USEPA, Keegan et al., and WaterVal references) to reflect in-text citations.		A1.9 References USEPA (1999). Disinfection Profiling and Benchmarking Guidance Manual, EPA 81S-R-99-013 Keegan A, Wati S, Robinson B. (2012). Chlor(am)ine disinfection of human pathogenic viruses in recycled waters. Smart Water Fund Project WF62M- 2114, Smart Water Fund, Melbourne, Australia; WaterVal (2017). WaterVal Chlorine disinfection Validation protocol. Australian Watersecure Innovations Ltd 2017. Available at http://www.waterra.com.au/_r7273/media/system/attrib/file/1707/201702_WaterVal_Validation-Protocol_Chlorine-Disinfection.pdf
Glossary	1190	Updated term or definition.	**biofilm**: microbial populations that grow on the inside of pipes and other surfaces.	**biofilm**: microbial populations that may include captured suspended particles that grow on the inside of pipes and other surfaces.
Glossary	1190	Updated term or definition.	**chlorine demand**: the difference between the amount of chlorine added to water and the amount of residual chlorine remaining after a given contact time. Chlorine demand may change with dosage, time, temperature, pH, and the nature and amount of any impurities in the water.	**chlorine demand**: the difference between the amount of chlorine added to water and the amount of residual chlorine.
Glossary	1191	Updated term or definition.	**Cryptosporidium:** microorganism commonly found in lakes and rivers that is highly resistant to disinfection. Cryptosporidium has caused several large outbreaks of gastrointestinal illness, with symptoms that include diarrhoea, nausea and stomach cramps. People with severely weakened immune systems (ie. severely immunocompromised people) are likely to have more severe and more persistent symptoms than healthy individuals (adapted from United States Environmental Protection Agency).	**Cryptosporidium:** a microscopic parasite that causes diarrheal disease (cryptosporidiosis), stomach cramps, nausea, vomiting and other gastrointestinal illness. People with severely weakened immune systems (ie. severely immunocompromised people) are likely to have more severe and more persistent symptoms than healthy individuals (adapted from United States Environmental Protection Agency).
Glossary	1192	Updated term or definition.	***Giardia lambia:*** A protozoan frequently found in rivers and lakes. If water containing infectious cysts of Giardia is ingested, the protozoan can cause a severe gastrointestinal disease called giardiasis.	***Giardia lambia:*** a microscopic parasite that causes diarrheal disease (giardiasis), stomach cramps, nausea, vomiting and other gastrointestinal illness.
Glossary	1193	Updated term or definition.	**health-based targets:** According to the World Health Organization health-based targets are: *"measurable health, water quality, or performance objectives that are established based on a judgement of safety and on risk assessments of waterborne hazards".*WHO (2010), Health-based targets, World Health Organization Geneva Switzerland.	**health-based targets:** measurable health, water quality, or performance objectives that are established based on a judgement of safety and on risk assessments of waterborne hazards (adapted from World Health Organization (WHO 2010)).
Glossary	1194	Updated term or definition.	**log_{10} removal value (LRV)**: Target log_{10} reduction values (LRVs) are the estimates of pathogen removal/ inactivation required to achieve the health-based target of $1x10^{-6}$ DALY pppy. LRVs are also used to measure pathogen removal/inactivation attributable to common treatment barriers.	**log_{10} reduction value (LRV)**: Target log_{10} reduction values (LRVs) are the estimates of pathogen removal/ inactivation required to achieve the health-based target of $1x10^{-6}$ DALY pppy. LRVs are also used to measure pathogen removal/inactivation attributable to common treatment barriers.

Section	Page	Summary of Proposed Edits	Current (September 2022) Guideline text	Proposed updated Guideline text
Glossary	1194	New definition to support advice in Chapter 5.		**microbial indicators:** microorganisms such as bacteria and viruses, with certain characteristics (e.g. not pathogenic, have no or minimal growth in water and be reliably detectable in water), which are used either as a surrogate of pathogen behaviour (e.g. log-reduction estimation) in a system or to index the concentration of pathogens in a water body.
Glossary	1195	Updated to correct inconsistent formatting.	**oocyst:** A hardy, thick-walled stage of the life cycle of particular microorganisms. This is the stage that is shed in the faeces of people infected with parasites such as *Cryptosporidium*.	**oocyst:** a hardy, thick-walled stage of the life cycle of particular microorganisms (the stage that is shed in the faeces of people infected with parasites such as *Cryptosporidium*).
Glossary	1195	Updated term or definition.	**opportunistic pathogens:** microorganisms that may cause disease opportunistically humans depending on the exposure scenario.	**opportunistic pathogens:** microorganisms that generally do not cause disease in most people but can opportunistically cause disease to people with heightened vulnerability (e.g. due to immunosuppression).
Glossary	1195	Updated term or definition.	**pathogen:** a disease-causing organism (eg bacteria, viruses and protozoa).	**pathogen:** a disease-causing organism.
Glossary	1196	New definition to support advice in Chapter 5.		**source water category:** categorisation of source water for determining the treatment target as a log reduction value in the application of microbial health based targets.

Table 2. Australian Drinking Water Guidelines additional edits, which have multiple occurrences within the Guidelines.

	Proposed additional edits
1	In instances throughout Guidelines where reference is only to 'health authority', proposed to change to 'health authority and/or drinking water regulator', which is consistent with current convention in Guidelines and with current regulatory arrangements for water in the Australian context.
2	Within the Microorganism Fact Sheets that refer to the monitoring of barriers to ensure effectiveness, the phrase "and that microbial health-based targets are being met" will be added. Example shown below: **Microorganisms,** Bacteria, Escherichia coli (E. coli) (pathogenic) *on page 313* "Operation of barriers should be monitored to ensure effectiveness and that microbial health-based targets are being met."
3	General corrections that relate to: (1) punctuation, (2) words spelt incorrectly, and (3) formatting of words and text.