DRAFT SOUTH AFRICAN STANDARD (DSS):
PUBLIC ENQUIRY STAGE

Document number	SANS 241ED7		
Reference	SABSTC147/SANS 241		
Date of circulation	11 July 2024	**Closing date**	11 September 2024

Number, edition and title: **SANS 241ED7;** *Drinking water*

Remarks:

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ISBN 978-0-626-

SANS 241:20xx
Edition 7

SOUTH AFRICAN NATIONAL STANDARD

Drinking water quality

WARNING
This document references other documents normatively.

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Table of changes

Change No.	Date	Scope

Foreword

This South African standard was prepared by National Committee SABS/TC 147, *Water*, in accordance with procedures of the South African Bureau of Standards, in compliance with annex 3 of the WTO/TBT agreement.

This document was approved for publication in Xxxxx 20xx.

This document supersedes SANS 241-1:2015 (edition 2) and SANS 241-2:2015 (edition 2).

This document is referenced in the Regulations relating to the compulsory national standards and measures to conserve water, as published by Government Notice No. 509 (Government Gazette No. 22355) of 8 June 2001, the Water Services Act, 1997 (Act No. 108 of 1997, the Foodstuffs, Cosmetics and Disinfectants Act, 1972 (Act No. 54 of 1972), the National Health Act, 2003 (Act No. 61 of 2003).

Annexes A, B, C, D and E are for information only.

Compliance with this document cannot confer immunity from legal obligations.

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Drinking water quality

1 Scope

1.1 This standard specifies the minimum requirements for safe drinking water supply to consumers. This includes:

a) water quality numerical limits defined in terms of microbiological, chemical, radiological, operational and aesthetic parameters; and

b) the minimum water quality management system requirements needed to achieve safe drinking water.

NOTE 1 The water quality requirements defined in this standard are to be achieved at the point of consumption. The responsible body is to ensure that drinking water up to the point of delivery to the consumer, meets the requirements of this standard.

NOTE 2 This standard supports proactive risk management to ensure the supply of safe drinking water to consumers. Risk management is to be implemented to ensure that all risks applicable to the supply system are identified and controlled. To confirm effectiveness of the control measures, care is to be taken to maintain a water quality management system which not only meets the minimum requirements of this standard, but which is suitable to monitor and manage the risks.

1.2 The World Health Organization (2022) guidelines were adopted for all parameters that pose a health risk. The numerical limits for operational risk parameters or aesthetic risk parameters were derived by taking local conditions into account where applicable. The water quality numerical limits in this standard take precedence over any other guideline limits.

NOTE The water quality numerical limits in this standard were derived from the World Health Organization (2022), *Guidelines for drinking-water quality*, fourth edition incorporating the first and second addenda.

1.3 The World Health Organization (2022) guidelines apply for any parameter not listed in this standard that may pose a water quality risk to a supply system as identified during the water quality risk assessment.

1.4 This standard applies to all water supply systems or borehole systems that provide drinking water to consumers.

1.5 Water that complies with the numerical limits in this standard or the World Health Organization (2022) at the point of consumption, and where the water quality management system requirements have been met, is deemed to be safe.

2 Normative references

The following referenced documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document (including any amendments) applies. Information on currently valid national and international standards can be obtained from the South African Bureau of Standards.

Other publications

SANAS TR 26, *Criteria for validation of methods used by chemical laboratories in the coal, oil, petroleum, metals and minerals, food, pharmaceutical, water and related industries*.

SANAS TR 28, *Criteria for validation, verification, uncertainty of measurement and quality assurance in microbiological and molecular testing*.

World Health Organization (WHO) (2022), *Guidelines for drinking-water quality*, fourth edition incorporating the first and second addenda.

Available at https://www.who.int/publications/i/item/9789240045064.

3 Terms, definitions, and abbreviations

For the purposes of this standard, the following terms, definitions, and abbreviations apply.

3.1 Terms and definitions

3.1.1
acute health risk parameter
parameter that poses an immediate health risk if present at a value exceeding the relevant numerical limits in this standard or the World Health Organization (2022) guidelines

3.1.2
aesthetic risk parameter
parameter that taints water with respect to acceptability (taste, odour, and/or colour) but does not pose a health risk if present at a value exceeding the relevant numerical limits in this standard or in the World Health Organization (2022) guidelines.

3.1.3
brackish water
water that is saltier than fresh water, but not as salty as seawater

NOTE Brackish water has a conductivity of ≥ 154 mS/m.

3.1.4
borehole system
asset system that utilises groundwater of low water quality variability, where disinfection is practised, serving a maximum population of 5 000

NOTE 1 Sampling points of a borehole system includes the final water and a limited number of distribution network sample points.

NOTE 2 Systems that utilise groundwater where water quality varies or serves populations exceeding 5 000 people needs to meet the requirements for a water supply system.

3.1.5
catchment
geographic area from where water drains or is conveyed to the raw water source

3.1.6
chronic health risk parameter
parameter that poses a health risk if ingested over an extended period at a value exceeding the relevant numerical limits in this standard or the World Health Organization (2022) guidelines

3.1.7
consumer
person that ingests or uses drinking water

3.1.8
contact time
measure of the length of time it takes for chlorine or other water treatment disinfectants to destroy or inactivate (or both) enteric pathogens at a given disinfectant concentration

3.1.9
corrosive water
water with low or no mineral content that can dissolve pipe materials

NOTE 1 Corrosive water also known as aggressive water.

NOTE 2 Chloride or sulphate values (or both) above 50mg/L are also indicative of potentially corrosive water.

3.1.10
critical distribution network sample point
subset comprising 20 % of the distribution network sample points that provide the most information on spatial and temporal risks and where a noticeable deterioration in water quality or increased risk is anticipated

NOTE 1 Critical distribution network sample points can include reservoirs, dead-ends, points of delivery, points of consumption such as high occupancy buildings, hospitals, or schools.

NOTE 2 During the risk analysis (see 5.2), critical distribution network sample points in supply systems are analysed for all the parameters listed in table 2. Monitoring of confirmed risks will continue at the critical distribution network sample points as part of the routine monitoring programme (see 7.4).

3.1.11
desalination water treatment plant
system that removes salts from seawater, brackish surface water or brackish groundwater to produce safe drinking water

3.1.12
disinfection
process that destroys, inactivates, or removes microorganisms

3.1.13
distribution network
asset system, sometimes owned and operated by different responsible bodies, used for the distribution and storage of drinking water

3.1.14
distribution network sample point
sample point within the distribution network after the final water where water quality is monitored to ensure complete representation of the entire geographical distribution network and weighted according to population density

NOTE A distribution network sample point can be a reservoir, a dead end, a point of delivery, points of consumption such as a high occupancy building, a hospital, or a school.

3.1.15
drinking water
water intended for human consumption

3.1.16
drinking water quality advisory notice
boil water notice or do not use water notice

NOTE 1 "A boil water notice" is issued when the quality of drinking water poses a health risk which can be adequately addressed by boiling the water in accordance with the notice prior to human consumption.

NOTE 2 "A do not use water notice" is issued when there is a health risk which cannot be adequately mitigated by means of household treatment.

3.1.17
enteric viruses
viruses inhabiting the gastrointestinal tract that are primarily transmitted via the faecal-oral route

3.1.18
final water
drinking water that is supplied from the water treatment plant after treatment

3.1.19
fortnightly
frequency of every two weeks

3.1.20
genome copies
GC
presence of specific pathogenic genes that are identified in various water sources through molecular detection methods such as Polymerase Chain Reaction (PCR)

NOTE Molecular detection methods require additional processes to provide information on the viability of the microorganisms tested.

3.1.21
groundwater
water that exists underground in saturated zones beneath the land surface

3.1.22
incident
exceedance of the numerical limits of this standard indicating a loss of control over the water treatment plant or the integrity of the distribution network

NOTE See tables 1 or 2.

3.1.23
incident management protocol
documented steps to be implemented following the occurrence of a confirmed incident with the aim of providing safe drinking water

3.1.24
indicator
measurement or value which can be used to determine possible presence of other parameters or organisms of concern

3.1.25
mandatory process risk parameter
parameter deemed to pose a risk in all supply systems and that is routinely monitored as part of the routine monitoring programme at prescribed locations and sampling frequencies to provide information on treatment efficiency, microbiological re-growth in the distribution network and the adequacy of disinfectant residuals

3.1.26
non-compliant result
parameter concentration that is non-compliant to the numerical limit for the parameter

NOTE A non-compliant result occurs when a parameter concentration exceeds the numerical limit for the parameter in column 4 of tables 1 and 2. In the case of pH, a non-compliant result is a pH value either below or above the allowable range, and in the case of disinfectant residuals, a non-compliant result is when the disinfectant residual concentration is below the operational risk limit or above the chronic health limit.

3.1.27
numerical limit
water quality parameter value/concentration in this standard or the World Health Organization (2022) guidelines

NOTE See tables 1 and 2 for the parameter concentrations that should not be exceeded or range that should be maintained.

3.1.28
operational risk parameter
parameter that is essential for assessing the efficiency of the water treatment process and identification of risks within the supply system

3.1.29
parameter
microbiological, chemical, radiological, operational and aesthetic parameter of which the hazard if confirmed a risk, is classified as acute health, chronic health, aesthetic or operational (or both)

3.1.30
parameter of concern
parameter increasingly detected at low concentrations in surface water and groundwater and recommended for monitoring due to increased health concerns

NOTE 1 Parameters of concern are currently non-mandatory parameters. Concern for the health risks posed by these parameters has increased over the years. Where possible, the parameters are recommended for inclusion during the water quality risk assessment and if confirmed a risk, the routine monitoring programme. Parameters of concern are earmarked for inclusion in future editions of this standard

NOTE 2 See annex A for a list of parameters of concern.

3.1.31
point of consumption
point within the distribution network where a consumer uses the water

3.1.32
point of delivery
point within the distribution network where a different responsible body receives water

3.1.33
raw water
water that enters a water treatment plant for treatment

NOTE Raw water is untreated surface water, groundwater, or water effluent.

3.1.34
responsible body
entity or person that has legal responsibility for providing or planning to provide drinking water

NOTE Responsible bodies can be water services authorities, water services providers or water services intermediaries.

3.1.35
risk
likelihood and consequence of the presence of an identified hazard in the water supply system at concentrations that are non-complaint to the numerical limits in this standard or in the World Health Organization (WHO) (2022) guidelines

NOTE Hazard is a parameter or condition that may adversely affect the supply of safe drinking water.

3.1.36
water reuse
reclaiming of water effluent from a variety of sources, followed by treatment and possible reuse as drinking water

NOTE "Water reuse" is also known as water recycling or water reclamation.

3.1.37
routine monitoring programme
ongoing monitoring programme that takes into account parameters, location of sampling points, and sampling frequency, with the objective of validating the effectiveness of control measures and assessing the quality of drinking water

NOTE Routine monitoring programmes consist of monitoring for mandatory process risk parameters (see table 1) and confirmed system specific risk defined parameters (see table 2 and clause 5). Monitoring is required to comply with the requirements of clause 7.

3.1.38
safe drinking water
water that complies with the numerical limits of this standard or with the World Health Organization (2022) guidelines, meets the requirements of the water quality management system, and does not pose a significant risk to the health of the consumer over a lifetime of consumption

NOTE 1 The numerical limits are set to be protective for the most susceptible sub-populations.

NOTE 2 Lifetime consumption implies an average consumption of 2 L of water per day for 70 years by a person who weighs 60 kg.

3.1.39
saline water
water that contains a high concentration of dissolved salts

3.1.40
sampling frequency
time interval between consecutive sampling events at a specific sampling point

3.1.41
sampling point
location as defined by its geographical co-ordinates, where recordings are carried out and a representative sample is collected to determine water quality

NOTE 1 A sampling point can be the raw water, final water, or a distribution network sample point.

NOTE 2 Monitoring requirements in this standard apply to the raw water, final water, and the distribution network. This standard does not stipulate the in-process monitoring requirements for water treatment plants.

3.1.42
scaling
precipitation of calcium and iron minerals onto internal pipe surfaces where water contains higher concentrations of calcium ions (supersaturated with calcium carbonate)

3.1.43
static tank
stand-alone small-scale tank, less than 10 000 L in capacity that is used in the supply of safe drinking water

3.1.44
surface water
any body of water found on the earth's surface, including water in rivers, streams, dams, and seawater

3.1.45
system specific risk defined parameter
parameter that has been assessed to pose a risk in a specific water supply system

NOTE System specific risk defined parameters (see table 2), once confirmed to be a risk during the water quality risk assessment (see 5.2 and 5.3) are monitored as part of the routine monitoring programme (see 7.4 and table 6) in all water supply systems and borehole systems.

3.1.46
verification of water quality
calculation of compliance with the numerical limits in this standard and the water quality management system

3.1.47
water safety plan
comprehensive risk assessment and risk management approach from catchment to consumer, with the aim of consistently ensuring the safety and acceptability of a drinking water supply

3.1.48
water supply system
asset system that includes the raw water abstraction point, the water treatment plant up to the final water, and the distribution network up to the point of delivery to consumers

NOTE 1 Within the same area of supply, water quality within a water supply system could differ owing to the geographical location, age of the infrastructure, distance from the water treatment plant, supplied from multiple water treatment plants, or a combination of these.

NOTE 2 Each water supply system that presents with a different water quality is managed as a separate water supply system. Distribution network sample points are selected to be representative of each water supply system.

3.1.49
supply system
water supply system or borehole system

3.1.50
water treatment chemicals
chemicals used for the treatment of water

NOTE 1 This applies to treatment chemicals that comply with either the relevant South African National Standard (SANS) or NSF/ANSI 60.

NOTE 2 Refer to annex B for a list of water treatment chemicals.

3.1.51
water treatment plant
asset system that treats raw water from surface water or groundwater, and that consists of singular or multiple water treatment processes to produce safe drinking water

NOTE Monitoring each water treatment process within the water treatment plant for operational efficiency falls outside the scope of this standard. Final water from a water treatment plant is monitored as per the requirements of this standard for compliance purposes.

3.1.52
water treatment process
barrier or series of barriers used to treat raw water to a quality that renders it safe to drink

NOTE Barriers may include coagulation, sedimentation, filtration, pH correction, ion exchange, activated carbon, membranes, and disinfection. Source water protection is the first barrier to ensure safe drinking water as part of the water safety planning process.

3.1.53
water quality risk assessment
risk analysis and risk verification of water quality risks within the water supply system

3.2 Abbreviations

CFU Colony Forming Unit

DBP Disinfection By-Product

E. coli *Escherichia coli*

GC Genome copies

HPC Heterotrophic Plate Count

ILAC International Laboratory Accreditation Corporation

L Litre

LOQ Limit of Quantification

mg/L Milligram per Litre

MIB 2-Methylisoborneol

mL Millilitre

MPN Most Probable Number

ng/L Nanograms per Litre

mS/m MilliSiemens per Meter

NTU Nephelometric Turbidity Unit

pH Potential of Hydrogen

PCR Polymerase Chain Reaction

PFU Plaque Forming Unit

Pt-Co Colour Unit (Platinum-Cobalt scale)

THM Trihalomethane

TOC Total Organic Carbon

µg/L Micrograms per Litre

UoM Uncertainty of Measurement

WHO World Health Organization

4 Application of the standard

4.1 A proactive risk-based management approach shall be used to ensure that safe drinking water is supplied at all times and that consumer health is protected.

4.2 This standard provides a numerical limit for each parameter that, if met, will safeguard the health of the consumer over a lifetime of consumption. The numerical limits are set to be protective for the most susceptible sub-population.

4.3 Water safety plans shall be established, implemented, maintained, and reviewed on an ongoing basis. Application of, and compliance with this standard does not imply that all the requirements of a water safety plan have been met. The application of this standard is, however, a compulsory input for the water safety planning process.

4.4 This standard provides for water quality parameter numerical limits (clause 6) and the key elements of the water quality management system that comprises:

a) water quality risk assessment (clause 5);

b) water quality monitoring (clause 7);

c) management of water quality non-compliant results (clause 8); and

d) verification of water quality (clause 9).

4.5 This standard entails the principles depicted in figure 1.

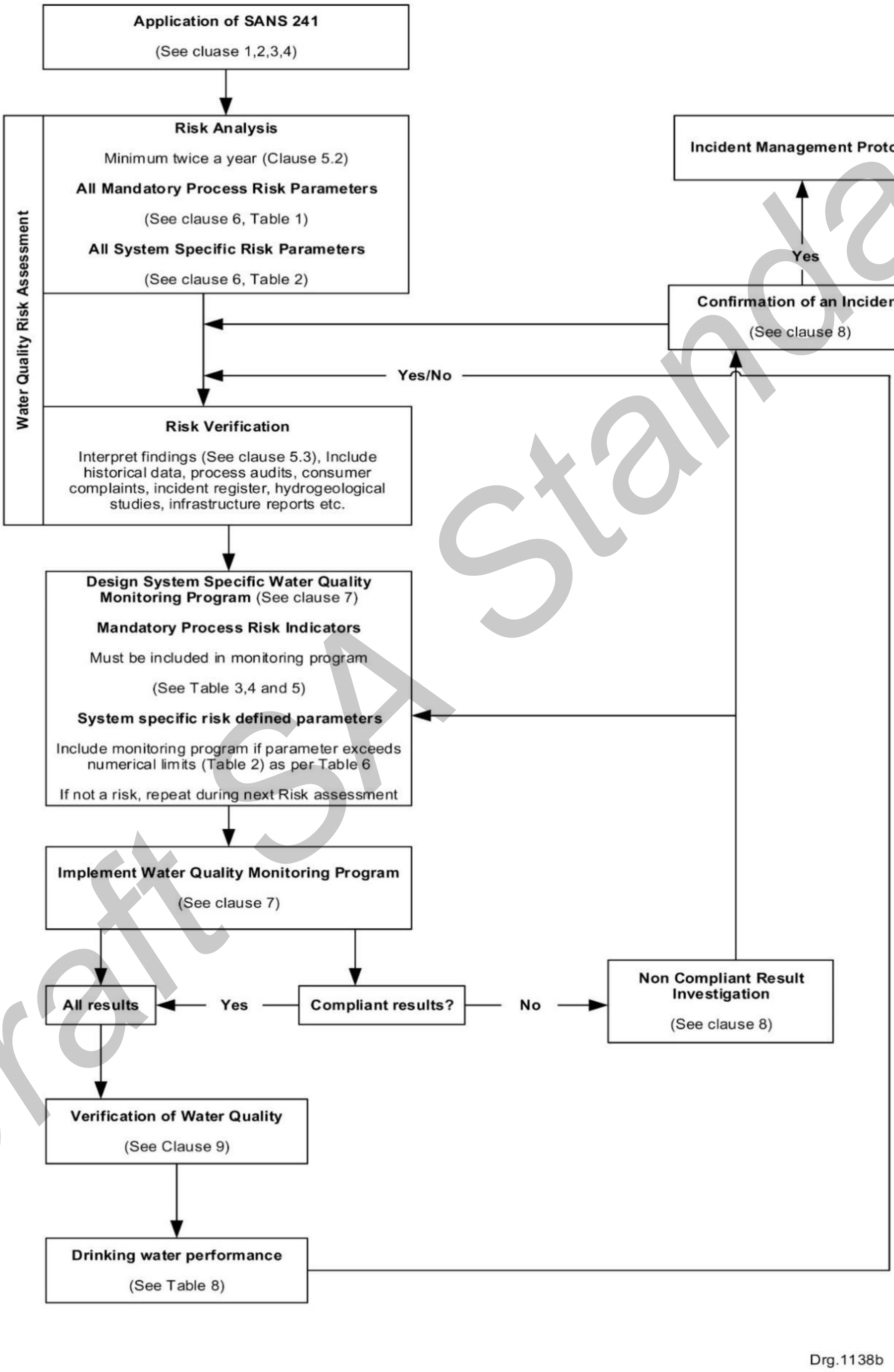

Figure 1 — Implementation of the processes detailed in the standard

5 Water quality risk assessment

5.1 General

5.1.1 The aim of the water quality risk assessment is to ensure that all risks applicable and specific to a water supply system or borehole system are identified, controlled and monitored as part of the routine monitoring programme.

5.1.2 Some risks apply to all water supply systems and borehole systems as they provide information on overall treatment efficiency, adequacy of disinfection and disinfectant residuals, microbiological re-growth or contamination in the distribution network (or both). Risks deemed applicable to all water supply systems and borehole systems are listed in this standard as mandatory process risk parameters (see table 1). Mandatory process risk parameters shall be included in the routine monitoring programmes of all water supply systems (see 7.2) and borehole systems (see 7.3).

NOTE Refer respectively to columns 5 and 6 of table 1 for mandatory process risks parameters applicable to water supply systems versus borehole systems.

5.1.3 In addition to monitoring for the mandatory process risk parameters, the water quality risk assessment entails risk analysis as specified in 5.2 and risk verification as specified in 5.3 of the parameters given in table 2. The outcome of the water quality risk assessment shall determine which parameters in addition to the mandatory process risk parameters are to be included in the routine monitoring programme as system specific risk defined parameters.

5.1.4 The water quality risk assessment shall be an ongoing process to allow for the continual assessment of risks as they may occur from time to time or at different locations (or both). The water quality risk assessment requirements detailed in 5.2 and 5.3 are the minimum requirements that shall be implemented in all water supply systems and borehole systems.

5.1.5 As and when new risks become apparent, the routine monitoring programme shall be amended to include new system specific risk defined parameters (see 7.4).

5.1.6 Where a water quality risk assessment has not been conducted for a water supply system or borehole system, all the parameters listed in table 2 in addition to the mandatory process risk parameters (see table 1) shall be monitored as part of the routine monitoring programme as the lack of information presents a risk to consumers.

5.2 Risk analysis

5.2.1 Risks may be natural, industrial or agricultural in origin. The risk analysis requires testing for all the parameters listed in table 2 to determine the likelihood and consequence that the parameter poses a risk in the specific supply system.

NOTE Refer respectively to columns 5 and 6 of table 2 for parameters that are applicable respectively to water supply systems or borehole systems. Additional information in column 7 of table 2 further clarifies when a parameter may not be applicable to a certain supply system or water treatment plant (or both).

5.2.2 Risks identified in the catchment that are not listed in this standard shall be monitored in accordance with the World Health Organization (2022) guidelines. Should it become evident that any parameters listed in the World Health Organization (2022) guidelines but not listed in this standard pose a risk in the water supply system or borehole system, the parameter shall be included as a system specific risk parameter as part of the routine monitoring programme at self-defined locations and frequencies.

NOTE Water reuse supply systems need to ensure that all risks applicable to the water supply system, are identified. Refer to World Health Organization (2017), *Potable reuse, guidance for producing safe drinking water* for risks that may apply to water reuse supply systems but not listed in this standard.

5.2.3 Concern for the parameters listed in annex A has increased over the years. If it becomes evident that any of the parameters of concern pose a risk in the water supply system or borehole system, further routine monitoring is recommended at self-defined locations and frequencies.

NOTE While it is not currently mandatory in this standard to test for the parameters listed in annex A, due to a lack of capacity of methods and instrumentation as part of the risk analysis or a routine monitoring programme, it is recommended that capacity to test for these parameters be prioritised since parameters of concern are earmarked for inclusion in future editions of this standard.

5.2.4 In water supply systems, the risk analysis for the parameters given in table 2 shall be conducted at least twice a year at the following sample points:

a) water abstracted for treatment (raw water);

b) final water emanating from a water treatment plant; and

c) critical distribution network sample points.

NOTE Refer to the additional information in column 7 of table 2 for parameters to be monitored during specific conditions, for example, total microcystin, geosmin and MIB.

5.2.5 In borehole systems, the risk analysis shall entail:

a) analysis at least twice a year for heterotrophic plate count, arsenic, fluoride, iron, manganese, nitrate and nitrite on the final water; and

b) bi-annual analysis for parameters given in table 2 on the final water.

NOTE Refer to columns 6 of table 2 for the system specific risk defined parameters applicable to borehole systems.

5.2.6 Water quality can be impacted by a number of factors. The risk analysis shall be completed at times and locations when, and where these factors will result in the worst water quality. Consideration shall be given to:

a) characteristics of the different sources of raw water;

b) seasonal changes in the raw water quality and times when elevated concentrations of the parameters are most likely to occur;

NOTE 1 Risks can occur due to seasonal extremes (mid-winter, mid-summer), dam (impoundment) stratification events and storm events that disturb sediment.

NOTE 2 Increased incidence of extreme weather events due to climate change resulting in a water treatment plant operating outside its design capacity for extended duration.

c) proximity to and nature of potential anthropogenic, industrial, agricultural, mining or geological contamination sources which can affect the raw water quality for example, effluent from wastewater treatment plants including sludge irrigation, urban runoff, water treatment residues, effluent from industries, runoff from agriculture, and runoff from mining activities;

d) changes in catchment land-use activities over time and space that may affect the raw water quality;

e) treatment processes used or changed and the effectiveness of the treatment processes to remove risks present in the raw water;

f) parameters that can be added or formed as part of the water treatment process and the treatment chemicals used;

g) parameters that can form in the distribution network. Water quality can change over time and space (when and where elevated concentrations of the parameters are most likely to occur);

h) parameters that can enter the distribution network;

i) changes that can occur to the distribution network water quality during peak and minimum user demand conditions;

j) activation of additional pressure management strategies due to extreme operational challenges for example, drought, treatment chemical shortages, loadshedding, water shifting and intermittent water supply; and

k) parameters that show a sustained increase in the concentration over time, as this may indicate changes to the raw water quality, treatment process failures or water quality deterioration in the distribution network.

5.2.7 Information on the water supply system or borehole system, for example, historic water quality data and all other water quality information, for example, water safety plans, process audits, hydrogeological studies shall be used during the risk analysis to ensure that all risks have been identified and are being monitored at all the required locations and frequencies.

5.2.8 The risk analysis shall be repeated in the event of:

a) changes in the catchment that could impact raw water quality;

b) changes in the raw water source;

c) sustained failures of a water treatment process which could introduce new risks into the water supply system or borehole system;

d) utilisation of groundwater sources beyond the drawdown limits;

e) a new water treatment plant being commissioned;

f) a different water treatment chemical or water treatment process being used;

g) a refurbished or unused water treatment plant being recommissioned; and

h) a distribution network being altered or recommissioned.

5.3 Risk verification and development of a routine monitoring programme

5.3.1 Information from the risk analysis shall be used to define risks as system specific risk defined parameters for inclusion in the routine monitoring programme (see 7.4).

5.3.2 If the final water and critical distribution network sample points in water supply systems, or final water in borehole systems, comply with the numerical limits in this standard, the risk is deemed low. Analyses for the compliant parameter shall, at minimum, be repeated as part of the next water quality risk assessment.

5.3.3 In water supply systems, parameters that exceeded the numerical limits in this standard during the risk assessment shall be interpreted as follows:

a) if the parameter exceeds the numerical limits in the raw, final water and the distribution network, it implies that the existing water treatment plant, or operation thereof, is inadequate. Appropriate mitigation control measures shall be put in place to ensure that the numerical limit is met. The parameter shall be included as a system specific risk defined parameter (see 7.4) in the routine monitoring programme on the raw water, final water, and critical distribution network sample points.

b) if a parameter which exceeded the numerical limit in the raw water is removed in the final water to the extent that the parameter complies with this standard, it implies that the installed water treatment plant and operation thereof is adequate. To verify that ongoing optimised operation of the water treatment plant is sustained, the parameter shall be included as a system specific risk defined parameter (see 7.4) in the routine monitoring programme on the raw and final water.

c) if a parameter exceeds the numerical limit in the distribution network, it implies that the parameter formed in the distribution network over time and space (for example, nitrite and trihalomethanes), or was introduced into the drinking water due to the nature of the distribution network (for example, lead, nickel, or copper). Appropriate mitigation control measures shall be put in place to ensure that the numerical limit is met. The parameter shall be included as a system specific risk defined parameter (see 7.4) in the routine monitoring programme on the final water and critical distribution network points.

5.3.4 In borehole systems, parameters that exceeded the numerical limits in this standard during the risk assessment on the final water, shall be included as a system specific risk defined parameter (see 7.4) in the routine monitoring programme on the final water.

5.3.5 If a new risk, or risks previously identified as low, become apparent prior to the next water quality risk assessment, the parameter shall immediately be included as a system specific risk defined parameter (see 7.4) in the routine monitoring programme.

6 Water quality parameter numerical limits

6.1 Suitability and acceptability

6.1.1 The assessment of the suitability and acceptability of water for drinking purposes shall be conducted on consideration of its microbiological, chemical, physical, aesthetic, and operational quality in accordance with tables 1 and 2 or the World Health Organization (2022) guidelines.

6.1.2 Additional information in tables 1 and 2 shall be read in conjunction with the requirements of clause 5 and 7.

6.2 Microbiological parameters

Safe drinking water shall comply with the numerical limits for the microbiological parameters listed in table 1. When a microbiological parameter that poses an acute health risk, exceeds the numerical limit given in column 4 of table 1, an immediate, unacceptable human health risk is implied. As the microbiological value increases, an increasing risk to health is implied.

6.3 Chemical parameters

6.3.1 Safe drinking water shall comply with the numerical limits for inorganic, and organic chemical parameters given in column 4 of tables 1 and 2.

6.3.2 The organic parameters listed in this standard, representing pollution from industrial and agricultural activities, or natural chemicals, shall be used as indicators for the possible presence of other parameters similarly categorised.

6.4 Aesthetic and operational parameters

6.4.1 Safe drinking water shall comply with the numerical limits for the aesthetic, and operational parameters given in column 4 of tables 1 and 2.

6.4.2 The appearance, taste and odour of drinking water shall be acceptable to the majority of consumers. A consumer complaints register shall be kept of all consumers complaints.

6.5 Disinfection residuals and disinfection treatment by-products

6.5.1 Disinfection shall be sustained to ensure a disinfectant residual at a level not less than a value defined within the water supply system or borehole system such that all microbiological limits listed in this standard are achieved throughout the supply system on a continuous basis.

6.5.2 Disinfectant residual concentrations for chlorine and chloraminated systems given in this standard are minimum requirements to ensure microbiological compliance. Disinfection shall not be compromised. Disinfection will kill or deactivate (or both) all bacterial pathogens and greatly reduce viral load.

6.5.3 Safe drinking water shall comply with the numerical limits given in this standard for disinfection by-products relevant to the choice of disinfection for the supply system. Most disinfectants used to render drinking water safe from microorganisms will produce by-products in the disinfection process. This is due to organic and inorganic matter reacting with the disinfectant and producing disinfection by-products (DBP). The decay of disinfectants may also result in the formation of non-desirable by-products. Control of DBP production can be achieved by reducing total organic carbon, optimising the disinfection processes and addition of chemicals. Although it is important to keep DBPs low, sufficient, and proper disinfection should not be compromised as this presents possible unacceptable human health risks from microorganisms.

6.6 Protection of infrastructure

6.6.1 Most water requires chemical stabilisation prior to discharge into a distribution network to ensure that the water does not corrode the concrete or metal pipe (corrosive or aggressive) or cause undue precipitation of calcium and iron minerals on the walls of the pipes (scaling) thereby reducing the pipe volume. It is preferable to stabilise the water to a slight degree of supersaturation with respect to calcium carbonate.

6.6.2 Corrosive water has the potential to cause deterioration of pipe systems and fittings and is a major source of metals in the distribution network which can lead to indirect health risks. Water with low or no mineral content such as boreholes, desalinated water, water generated from reverse osmosis and low hardness (soft) surface water shall be stabilised to ensure that no corrosive water is introduced into the distribution network.

6.6.3 Water which has the potential to cause significant scaling in the network such as dolomitic groundwater water (high calcium, hardness and alkalinity) can cause precipitation of calcium and iron minerals onto the pipe surface which over time may reduce pipe diameter.

6.6.4 An appropriate set of analyses and associated calculation at self-defined locations and frequencies shall be used to determine the potential corrosivity of the water. Corrosion assessment tools include computational chemical modelling and indices such as the Langelier Saturation Index, Ryzar Saturation Index, Calcium Carbonate Precipitation Potential, Aggressive Index, Larson Index or Riddick Corrosion Index. Parameters used in calculating these indices include pH, alkalinity, conductivity, hardness, calcium, magnesium, and temperature and shall be be monitored regularly on the final water as well as within the distribution network.

6.6.5 Treatment options to treat corrosive water include chemical stabilisation and pH adjustment. When selecting a suitable treatment option to achieve the required corrosivity index range, ensure that neither the disinfection process nor any other water quality requirements are compromised.

Table 1 — Mandatory process risk parameters for water supply systems and borehole systems

1	2	3	4	5	6	7
Parameter	**Risk**	**Unit**	**Standard limit**	**Water supply systems**	**Borehole system**	**Additional information**
Escherichia coli	Acute health	Count per 100 mL (Most Probable Number (MPN) or Colony Forming Unit (CFU) or genome copies (GC)	Not detected	Yes	Yes	*Escherichia coli* (*E. coli*) is the definitive, preferred indicator of faecal pollution. The presence of *E. coli* in drinking water indicates that the water poses an immediate, human health risk.
Intestinal enterococci	Acute health	Count per 100 mL (MPN or CFU or GC)	Not detected	Yes	Yes	Only supply systems receiving saline water or brackish raw water with a conductivity of ≥ 154 mS/m (or both) shall monitor for intestinal enterococci in addition to *E. coli*.
Protozoan parasites *Cryptosporidium spp.* *Giardia spp.*	Acute health	Count per 10 L (count / GC)	Not detected	Yes	No	Protozoa, particularly *Cryptosporidium spp*. are not readily inactivated by chlorination. Their removal is primarily achieved by optimisation of water treatment processes such as filtration, UV irradiation, ozonation and pH control. The detection of one or both protozoan parasites in the final water confirms faecal pollution and indicates an immediate human health risk. Turbidity monitoring will provide additional information on the efficiency of the water treatment plant/treatment processes to continuously remove protozoan parasites. It is recommended that final water turbidity be maintained at 0,20 NTU average and 0,30 NTU for 95 % of the time to ensure successful removal of protozoan parasites.

Table 1 *(continued)*

1	2	3	4	5	6	7
Parameter	**Risk**	**Unit**	**Standard limit**	**Water supply systems**	**Borehole system**	**Additional information**
Heterotrophic plate count (HPC) at 35 °C to 37 °C (±2°C)	Operational	Count per 1 mL (CFU)	≤ 1 000	Yes	No	Heterotrophic plate count is a process indicator that provides information on the efficacy of the treatment processes (including disinfection), and the integrity of the distribution network (after growth due to inadequate disinfectant residuals).
Total coliforms	Operational	Counts per 100 mL (MPN or CFU)	≤ 10	Yes	Yes	Total coliforms provide information on treatment efficiency (their presence after disinfection indicates inadequate treatment) and cleanliness/integrity of the distribution network. It is recommended after disinfection that total coliforms should be non-detected in 95 % of final water samples.
Somatic coliphages	Operational	Count per 10 mL (PFU)	Not detected	Yes	No	Somatic coliphages are a group of bacteriophages that infect coliform bacteria, including *E. coli*. Somatic coliphages are valuable indicators of faecal contamination. Evaluating for the prevalence and behaviour of somatic coliphages offers an inexpensive and technically-sound way to assess risk and the ability of the water treatment processes to successfully remove/eradicate human enteric viruses.
Conductivity at 25 °C (Electrical)	Aesthetic	mS/m	≤ 170,0	Yes	Yes	Electrical conductivity is an important general measure of water quality and an indication for total dissolved solids. Individual water bodies tend to have a relatively constant range of conductivity, that once established, can be used as a baseline for comparison. Conductivity can be used to detect changes in water quality and provide and early warning of potential pollution associated with anthropogenic activity, industrial or wastewater discharges.
pH at 25 °C	Operational	pH units	≥ 5,0 to ≤ 9,7	Yes	Yes	pH is an important operational parameter in achieving disinfection efficiency and corrosion potential.
Turbidity	Operational	NTU	≤ 1,00	Yes	Yes	Turbidity provides information on the efficiency of the treatment processes (particle removal) and disinfection (values more than > 1,00 NTU may negatively impact disinfection). In addition, turbidity indicates rapid changes in raw water quality and distribution network integrity that requires investigation and potential treatment actions.

Table 1 *(continued)*

1	2	3	4	5	6	7
Parameter	**Risk**	**Unit**	**Standard limit**	**Water supply systems**	**Borehole system**	**Additional information**
Apparent colour	Aesthetic	mg/L Pt-Co	≤ 15	Yes	Yes	Apparent colour is the colour of the water observed by the consumer. Apparent colour (unfiltered sample), consists of colour due to both dissolved and suspended components.
True colour	Operational	mg/L Pt-Co	≤ 15	Yes	No	True colour is measured by filtering the water sample to remove all suspended material. True colour measures only dissolved species in water, namely natural organic matter, minerals, or chemicals.
Disinfectant residual Chlorinated system: Free chlorine as Cl_2	Operational	mg/L	≥ 0,50 for final water	Yes	Yes	Chlorination is the process of adding chlorine or sodium hypochlorite or calcium hypochlorite for the purpose of disinfection. Disinfection destroys or inactivates harmful microorganisms which cause illnesses such as cholera and typhoid. To ensure effective disinfection, residual concentrations of free chlorine as Cl_2 shall be sustained at a level not less than a value defined within the water supply system or borehole system such that all microbiological limits listed in this standard are achieved throughout the system on a continuous basis (see 6.5.2). It is required to maintain: a) a minimum ≥ 0,50 mg/L free chlorine as Cl_2 disinfectant residual at the water treatment plant after at least 30 min contact time within a recommended pH range of 7,0 and 9,0; and b) a minimum ≥ 0,10 mg/L free chlorine as Cl_2 disinfectant residual throughout the distribution network and at points of delivery to consumers.
	Operational	mg/L	≥ 0,10 for the distribution network	Yes	Yes	
	Chronic health	mg/L	≤ 5,00	Yes	Yes	

Table 1 *(continued)*

1	2	3	4	5	6	7
Parameter	**Risk**	**Unit**	**Standard limit**	**Water supply systems**	**Borehole system**	**Additional information**
Disinfectant residual Chloraminated system: Sum of free chlorine and monochloramine as Cl_2	Operational	mg/L	≥ 0,10 for the distribution network	Yes	No	Monochloramine (chlorine and ammonia) is added during disinfection (a water treatment process) to destroy or deactivate harmful micro-organisms. In chloraminated systems, the sum of free chlorine as Cl_2 and monochloramine as Cl_2 shall be reported. To ensure effective disinfection, residual concentrations of monochloramine shall be sustained at a level not less than a value defined for the entire water supply system or borehole system such that all microbiological limits listed in this standard are achieved (see 6.5.2). Monochloramine, ideally should not be used as a primary disinfectant. If final water is required to be chloraminated, then a preceding disinfection step shall be undertaken using free chlorine with a minimum ≥ 0,50 mg/L free chlorine after at least 30 min contact time within a recommended pH range of 7,0 and 9,0. This standard requires a minimum ≥ 0,10 mg/L monochloramine throughout the distribution network and at points of delivery to consumers.
	Chronic Health	mg/L	≤ 4,10	Yes	No	
Disinfection by-product Bromate as BrO_3^-	Chronic health	µg/L	≤ 10	Yes	No	Bromate shall only be monitored as a disinfection by-product in water supply systems supplied from desalination water treatment plants, on-site hypochlorite generation systems (OSEC) or water supply systems using ozone or sodium hypochlorite as a disinfectant.
Disinfection by-product Chlorite as ClO_2^-	Operational	mg/L	≤ 0,70	Yes	No	Chlorite / chlorate shall be monitored as a disinfection by-product, and the sum of chlorite and chlorate calculated, in systems using chlorine dioxide as disinfectant. Chlorate shall be monitored as a disinfection by-product in systems using hypochlorite as disinfectant. It is recommended that responsible bodies strive for a lower value without compromising disinfection.
Disinfection by-product Chlorate as ClO_3^-	Operational	mg/L	≤ 0,70	Yes	No	
Sum of chlorite and chlorate	Operational	mg/L	≤ 0,70	Yes	No	The sum of chlorite and chlorate shall not exceed 0,7 mg/L.

Table 1 *(concluded)*

1	2	3	4	5	6	7
Parameter	**Risk**	**Unit**	**Standard limit**	**Water supply systems**	**Borehole system**	**Additional information**
Disinfection by-products Trihalomethanes Bromodichloromethane Bromoform Dibromochloromethane Chloroform	Chronic health	µg/L	≤ 60 ≤ 100 ≤ 100 ≤ 300	Yes	No	Trihalomethanes (THM) shall be monitored as a disinfection by-product, and the trihalomethane ratio calculated, in water supply systems using chlorine hypochlorite and chloramination as disinfectant.
Trihalomethane ratio	Chronic health	Ratio	≤ 1,0	Yes	No	See annex C for calculation example.
Treatment chemicals	Chronic health / Aesthetic / Operational	See table 2		Yes	No	Numerous chemicals are utilised in the production of safe drinking water. Maintain a list of all the treatment chemicals utilised in the process of producing safe drinking water. Monitor for all parameters that may indicate overdosing of treatment chemicals and all parameters that may form because of the use of treatment chemicals. Primary coagulation may require the use of inorganic salts such as aluminium sulphate, ferric chloride, or sulphate. When used, aluminium and/or iron shall be monitored as a treatment chemical. Where polymeric organic coagulants containing aluminium are utilised, monitor aluminium as a treatment chemical. In chloraminated systems, the operational risk posed by ammonia shall be monitored as a treatment chemical. See annex B for a list of treatment chemicals.
Parameters in this table shall be included in the routine monitoring programmes of all water supply systems in accordance with 7.2, and in accordance with 7.3 in borehole systems. Refer to column 6 for parameters to monitor in borehole systems.						

Table 2 — System specific risk defined parameters

1	2	3	4	5	6	7
Parameter	**Risk**	**Unit**	**Standard limit**	**Water supply systems**	**Borehole system**	**Additional information**
Chemical — Macro parameters						
Ammonia as N	Aesthetic	mg/L	≤ 1,5	Yes	Yes	An indicator of possible wastewater and industrial discharges, or intensive animal agriculture. Ammonia may be associated with microbiological contamination.
	Operational	mg/L	≤ 0,30	Yes	No	In addition to assessing the aesthetic risk posed by ammonia, the operational risk posed by ammonia shall only be monitored in chloraminated systems (see table 1 treatment chemicals). With concentrations likely to change after treatment, the distribution network shall be monitored. Chloraminated systems shall maintain an ammonia level that does not compromise disinfection efficiency or result in excessive nitrate formation in the distribution network. The Cl_2: NH_3 ratio should be maintained in the range of 4,5:1 to 5:1 (NH_3 as nitrogen) or 2,5:1 to 4:1 (NH_3 as ammonia). The ratio is system specific and shall be defined and documented.
Chloride as Cl^-	Aesthetic	mg/L	≤ 250	Yes	Yes	Risks might be higher in supply systems receiving effluent from wastewater discharges, industrial effluent, and runoff from human settlements.
Fluoride as F^-	Chronic health	mg/L	≤ 1,5	Yes	Yes	Risks associated with this naturally occurring parameter might be higher in groundwater.
Nitrate as N Nitrate as NO_3	Acute health	mg/L	≤ 11 ≤ 50	Yes	Yes	Nitrate and nitrite and the calculated nitrate/nitrite ratio shall be analysed in all supply systems. In chloraminated water supply systems where concentrations are likely to change after treatment, monitoring shall include the entire water supply system, focusing on points of delivery to consumers. Free ammonia, after treatment, should be as close as possible to zero. The ratio of chlorine to ammonia dosage shall be defined for local conditions such that free chlorine and free ammonia are as close as possible to zero.
Nitrite as N Nitrite as NO_2	Acute health	mg/L	≤ 0,9 ≤ 3	Yes	Yes	
Nitrate/Nitrite Ratio	Acute health	Ratio	≤ 1,0	Yes	Yes	See annex C for calculation example.

Table 2 *(continued)*

1	2	3	4	5	6	7
Parameter	**Risk**	**Unit**	**Standard limit**	**Water supply systems**	**Borehole system**	**Additional information**
Sodium as Na (dissolved)	Aesthetic	mg/L	≤ 200	Yes	Yes	Risks might be higher in groundwater. Increased concentrations result from anthropogenic activity, industrial or wastewater discharges.
Sulfate as SO_4^{2-}	Aesthetic	mg/L	≤ 250	Yes	Yes	Risks might be higher in groundwater. Increased concentrations result from anthropogenic activity, industrial or wastewater discharges.
Zinc as Zn (acid soluble)	Aesthetic	mg/L	≤ 3	Yes	Yes	Risks might be higher in distribution networks of supply systems where potential dissolution of zinc from metal plumbing and fittings can occur.
Chemical — Micro parameters						
Aluminium as Al (acid soluble)	Operational	µg/L	≤ 200	Yes	Yes	Aluminium is a naturally occurring parameter that can pose a risk in all supply systems. If aluminium-based coagulants are used as a treatment chemical, aluminium shall be monitored as a mandatory process risk parameter (see table 1 for information on treatment chemicals).
Antimony as Sb (acid soluble)	Chronic health	µg/L	≤ 20	Yes	Yes	Risks might be higher in distribution networks of supply systems where potential dissolution of antimony from metal plumbing and fittings can occur.
Arsenic as As (acid soluble)	Chronic health	µg/L	≤ 10	Yes	Yes	Risks associated with this naturally occurring parameter might be higher in groundwater.
Barium as Ba (acid soluble)	Chronic health	µg/L	≤ 1 300	Yes	Yes	Naturally occurring parameter that can pose a risk in all supply systems.
Boron as B (acid soluble)	Chronic health	µg/L	≤ 2 400	Yes	Yes	Naturally occurring parameter that can pose a risk in all supply systems. The risk might be higher in groundwater.
Cadmium as Cd (acid soluble)	Chronic health	µg/L	≤ 3	Yes	Yes	Risk might be higher in supply systems receiving effluent from industry, runoff from human settlements and wastewater discharges. The risk to groundwater increases at a pH < 6,5 and is system specific.

Table 2 *(continued)*

1	2	3	4	5	6	7
Parameter	**Risk**	**Unit**	**Standard limit**	**Water supply systems**	**Borehole system**	**Additional information**
Chromium as Cr (acid soluble)	Chronic health	µg/L	≤ 50	Yes	Yes	Risk might be higher in supply systems receiving effluent from industry or runoff from human settlements wastewater discharges. The risk to groundwater increases at a pH < 6,5 and is system specific.
Copper as Cu (acid soluble)	Chronic health	µg/L	≤ 2 000	Yes	Yes	Risk might be higher in corrosive water and at points with standing or partially flushed water. Potential dissolution of copper from metal plumbing and fittings can occur. Care shall be taken to assess the risk, especially to bottled fed infants. The risk to groundwater increases at a pH < 6,5 and is system specific.
Iron as Fe (acid soluble)	Aesthetic	µg/L	≤ 300	Yes	Yes	Iron is a naturally occurring parameter that may pose a risk in all supply systems. If iron-based coagulants are used as a treatment chemical, iron shall be monitored as a mandatory process risk parameter (see table 1 for information on treatment chemicals).
Lead as Pb (acid soluble)	Chronic health	µg/L	≤ 10	Yes	Yes	Risk might be higher in supply system using lead pipes, lead solder or fittings. Care shall be taken to assess the risk, especially to bottled fed infants and small children.
Manganese as Mn (acid soluble)	Aesthetic	µg/L	≤ 100	Yes	Yes	Risk associated with impurities in water treatment chemicals, namely coagulants and with anthropogenic activities and geology of the source.
Mercury as Hg (acid soluble)	Chronic health	µg/L	≤ 6	Yes	Yes	Risk associated with the inorganic form of mercury in surface water and groundwater. Mineral deposits can produce higher concentrations in groundwater. Supply systems receiving effluent from industry, mining, or runoff from human settlements are at risk.
Nickel as Ni (acid soluble)	Chronic health	µg/L	≤ 70	Yes	Yes	Risks might be higher in supply systems receiving effluent from industry. The risk to groundwater increases at a pH < 6,5 and is system specific.
Selenium Se (acid soluble)	Chronic health	µg/L	≤ 40	Yes	Yes	Naturally occurring parameter that may pose a risk in all supply systems.

Table 2 *(continued)*

1	2	3	4	5	6	7
Parameter	**Risk**	**Unit**	**Standard limit**	**Water supply systems**	**Borehole system**	**Additional information**
Uranium as U (acid soluble)	Chronic health	µg/L	≤ 30	Yes	Yes	Risk associated with combustion of coal and other fuels, mining, nuclear and manufacturing activities, and application of phosphate fertilisers. If the risk assessment indicates potential radioactivity (uranium non-compliant to the limit in this standard at either the raw water, final water, or within the distribution network), further testing for gross alpha and beta radioactivity shall be undertaken. If the radioactivity concentrations exceed the limits in this standard, then a full radionuclide analysis shall be undertaken.
NOTE When the parameter is a metal, ensure that the sample is not filtered but acidified to pH < 2 to determine the acid soluble metal present.						
Organic — Chemical parameters						
Total organic carbon (TOC) as carbon	Chronic health	mg/L	≤ 10,0	Yes	Yes	With concentrations likely to change, risk assessment monitoring shall consider seasonal and temporal changes. TOC is a reliable parameter that acts as an indicator to estimate the amount of organic content present in the water.
Benzene	Chronic health	µg/L	≤ 10	Yes	Yes	Benzene is an indicator of the possible presence of other organic chemicals. Benzene is a by-product of organic chemical production and water sources situated close to petrochemical industries and landfills are at high risk of contamination. If assessed a risk, monitor as a system specific risk defined parameter. In addition, extend the risk assessment to include other potential industrial chemical risks.

Table 2 *(concluded)*

1	2	3	4	5	6	7
Parameter	**Risk**	**Unit**	**Standard limit**	**Water supply systems**	**Borehole system**	**Additional information**
Atrazine and its chloro-*s*-triazine metabolites (cumulative)	Chronic health	µg/L	≤ 100	Yes	Yes	Atrazine, and its metabolites, is an agricultural herbicide. Timing and frequency of monitoring shall account for the seasonal variation associated with application in agricultural activities. If atrazine and its metabolites are not used in a particular catchment area, the risk assessment shall assess the potential for other agricultural chemical risks by monitoring for those chemicals which are used in the catchment (see table 8.13 of the World Health Organization (WHO) (2022) guidelines)).
Dichlorodiphenyltrichloroethane (DDT) and metabolites (cumulative)	Chronic health	µg/L	≤ 1	Yes	No	DDT and its metabolites shall be monitored as part of the risk assessment in all systems receiving runoff from agriculture where DDT is used to control malaria causing mosquitoes. The timing and frequency of monitoring shall account for seasonal variations in spraying activities.
Total microcystin	Chronic health	µg/L	≤ 1	Yes	No	Total microcystin shall be monitored when an algal bloom (> 20 000 cyanobacteria cells per millilitre/ > 20 µg/L chlorophyll-a) is present in a raw water source. In the absence of algal monitoring, an algal bloom is deemed to occur where the surface water is visibly green in the vicinity of the abstraction point, or samples have a strong musty odour. Cyanotoxins, other than microcystin, may also be associated with algal blooms in South African freshwaters. During an algal bloom (>20 000 cyanobacteria cells per millilitre / or > 20 µg/L chlorophyll-a) it is advisable to determine which cyanobacteria are responsible for the bloom. After the cyanobacterium is identified, the concentration for the associated cyanotoxin(s) can be determined, refer to annex A for guideline concentrations and annex E for examples of toxin-producing cyanobacteria.
Geosmin	Aesthetic	ng/L	≤ 10	Yes	No	Geosmin and MIB are odour compounds that may be detected by the consumer at very low concentrations. Geosmin and MIB monitoring shall be triggered by an algal bloom in the raw water source (> 20 000 cyanobacteria cells per millilitre / > 20 µg/L chlorophyll-a) or an increase in consumer complaints (see 6.3.2).
2-Methylisoborneol (MIB)	Aesthetic	ng/L	≤ 10	Yes	No	
Parameters in this table shall be monitored during the risk analysis (see 5.2). Parameters assessed as risks during the risk assessment (see 5.3), shall routinely be monitored as a system specific risk defined parameters as part of the routine monitoring programme (see 7.4). Refer to column 6 for parameters to monitor bi-annually as part of the full risk assessment in borehole systems.						

6.7 Analysis

6.7.1 The use of any method of analysis shall be permitted if the method, with regard to trueness, precision and limit of quantification, offers the necessary level of performance that comply with the requirements of this standard and the requirements of SANAS TR 26 and SANAS TR 28 for chemical and microbiological requirements, respectively.

6.7.2 As technology advances, more methods are becoming available and can be used if they offer the required performance with validated data. Simpler methods may be used to verify the quality of the drinking water.

NOTE See annex D for validated test methods.

6.7.3 Presence/absence testing for faecal indicator bacteria or microbiological test kits for specific bacteria can be used as a simpler, faster, and less expensive method of detecting bacteria whilst reducing plastic waste. However, presence/absence testing when using enzyme substrate methods, is appropriate only in a system where most tests for indicator organisms provide negative results. All positive (presence) tests shall be confirmed with a quantitative method.

6.8 Handling of numeric uncertainties

6.8.1 Uncertainty of measurement (UoM)

A simple acceptance decision rule shall apply to all chemistry parameters. Under such a rule, the producer and user (consumer) of the measurement result agree, implicitly or explicitly, to accept as conforming (and reject otherwise) an item whose property has a measured value in the tolerance interval. The maximum allowed uncertainty of measurement should be ≤ 10% at 95 % confidence interval.

NOTE For additional information see SANS 17025 and ILAC-G8:09.

6.8.2 Decimal points

Results shall be reported in the same unit and with the same number of decimal points as specified in tables 1 and 2 or the World Health Organization (2022) guidelines (see also SANS 17025).

6.8.3 Limit of quantification

6.8.3.1 The limit of quantification (LOQ) shall be less than the required limit in tables 1 and 2 or the World Health Organization (2022) guidelines. Furthermore, the LOQ shall not fall within the UoM band for that parameter.

NOTE LOQ does not apply to microbiological parameters.

6.8.3.2 Results that are measured as less than the LOQ shall be reported at a value equal to the LOQ (for example, < 1,0 mg/L shall be reported as 1,0 mg/L).

7 Water quality monitoring

7.1 General

7.1.1 Implement and maintain a routine monitoring programme that includes the monitoring of the mandatory process risk parameters and the system specific risk defined parameters assessed a risk to the particular water supply system or borehole system during the risk assessment (see clause 5).

7.1.2 The routine monitoring requirements detailed in this standard are the minimum requirements to characterise and assess risks associated with the raw water, assess ongoing levels of operational efficiency in the water treatment plant, and to verify safe drinking water.

7.1.3 The routine monitoring programme for water supply systems shall at minimum comply with the requirements for parameters, sampling points and frequency of analyses as specified for the mandatory process risk parameters (see table 1) as specified in 7.2 (see tables 3 and 4) and in accordance with 7.4 for the system specific risk defined parameters (see tables 2 and 6).

7.1.4 The routine monitoring programme for borehole systems shall, at minimum, comply with the requirements for parameters, sampling points and frequency of analyses as specified for the mandatory process risk parameters (see table 1) as specified in 7.3 and accordance with 7.4 for the system specific risk defined parameters (see tables 2 and 6).

7.1.5 The monitoring requirements for mobile tankers (see 7.5) and static tanks (see 7.6) shall apply in all supply systems where mobile tankers and static tanks are used.

7.1.6 The routine monitoring programme shall be amended to include the monitoring of additional parameters, or to increase the monitoring frequencies for parameters already included in the routine programme (or both), if situations occur that require additional information to confirm to ongoing safety of the drinking water. Situations that may trigger additional monitoring include non-compliant results in the final water or distribution system as detailed in clause 8, consumer complaints, or algal blooms in the raw water source (or both). This reactive monitoring is a proactive measure to quantify the increased risk and to guide mitigation measures during abnormal operating conditions associated with a deterioration of raw water quality or a loss of process control.

7.2 Routine monitoring of mandatory process risk parameters in water supply systems

7.2.1 The table 1 mandatory process risk parameters shall be monitored in all water supply systems in accordance with the requirements of tables 3 and 4.

7.2.2 Sampling points for the table 1 parameters shall include the raw water, final water and points within the distribution network. Care shall be taken to ensure that:

a) parameters listed in table 3 are monitored at all distribution network sample points; and

b) parameters listed in table 4 are monitored at critical distribution network sample points.

7.2.3 The number of results required for *E. coli* in the distribution network, as well as intestinal enterococci in the case of saline water or brackish water (or both), shall at minimum comply with the requirements of table 5. The table 5 *E. coli* / intestinal enterococci result numbers can be adopted, provided that:

a) the monitoring requirements of table 3 for pH, turbidity, and disinfectant residuals are complied with, and

b) the monthly compliance requirements of clause 9 and table 8 are met for *E. coli*, and intestinal enterococci in saline water or brackish water (or both), as well as pH, turbidity, and disinfectant residuals.

7.2.4 The sampling frequency for *E. coli* in the distribution network, as well as intestinal enterococci in saline water or brackish water (or both), shall increase and be maintained on a fortnightly basis (see table 3) until the next risk assessment if the monthly compliance requirements of clause 9 and table 8 are not met for *E. coli*, intestinal enterococci, pH, turbidity or disinfectant residuals (or both).It shall be proven at the next risk assessment that measures to control the microbiological risks are effective before the sampling frequency can again be reduced in accordance with table 5.

Table 3 — Minimum routine monitoring frequency for the table 1 parameters at the raw water, final water, and all distribution network sample points

1	2	3	4
Minimum monitoring frequency / **Parameter**	**Raw water** [a]	**Final water**	**Distribution network sample points**
E. coli	Recommended weekly to confirm treatment efficiency	Weekly	Fortnightly [b] (see table 5)
Intestinal enterococci	Recommended weekly to confirm treatment efficiency	Weekly	Fortnightly [c] (see table 5)
Heterotrophic plate count	Not applicable	Weekly	Fortnightly
Total coliforms	Not applicable	Weekly	Fortnightly
Conductivity	Daily	Daily	Fortnightly
pH value	Daily	Once per shift [d]	Fortnightly
Turbidity	Daily	Once per shift [d]	Fortnightly
Disinfectant residual in a chlorine system: Free chlorine as Cl_2	Not applicable	Once per shift [d]	Fortnightly
Disinfectant residual in a chloraminated system: Sum of free chlorine and monochloramine as Cl_2	Not applicable	Once per shift [d]	Fortnightly

[a] Raw water monitoring is for risk characterisation and to assess the ongoing levels of operational efficiency in the water treatment plant. Raw water monitoring is not for compliance calculations.

[b] For distribution network *E. coli* sample numbers, refer to table 5.

[c] Water supply systems receiving saline water or brackish raw water (or both) shall monitor for intestinal enterococci in addition to *E. coli* in accordance with table 5.

[d] A shift is defined as an eight-hour work period. Once per shift monitoring applies to all water supply systems serving ≥5 000 populations. Daily monitoring applies in water supply systems serving <5 000 populations.

Table 4 — Minimum routine monitoring frequency for the table 1 parameters at the raw water, final water, and critical distribution network sample points

1	2	3	4
Minimum monitoring frequency / **Parameter**	**Raw water** [a]	**Final water**	**Critical distribution network sample points**
Protozoan parasites *Cryptosporidium spp.* *Giardia spp*.	Recommended monthly as a pair with final water, to confirm treatment efficiency	Monthly	Not applicable
Somatic coliphages	Recommended monthly as a pair with final water to confirm treatment efficiency	Monthly	Not applicable
Apparent colour	Not applicable	Monthly	Monthly
True Colour	Weekly	Weekly	Not applicable
Disinfectant by-product Bromate as BrO_3^- [b]	Not applicable	Monthly	Monthly
Disinfectant by-product Chlorite as ClO_2^- [c]	Not applicable	Monthly	Monthly
Disinfectant by-product Chlorate as ClO_3^- [c]	Not applicable	Monthly	Monthly
Sum of chlorite and chlorate	Not applicable	Monthly	Monthly
Disinfectant by-products Trihalomethanes [d] Bromodichloromethane Bromoform Dibromochloromethane Chloroform	Not applicable	Monthly	Monthly
Trihalomethane ratio	Not applicable	Monthly	Monthly
Treatment chemicals	Weekly [e]	Weekly	Monthly if non-compliant in the final water [f]

[a] Raw water monitoring is for risk characterisation and to assess the ongoing levels of operational efficiency in the water treatment plant. Raw water monitoring is not for compliance calculations.

[b] The disinfectant by-product, bromate, shall be monitored in all desalination water treatment plant systems, on-site hypochlorite generation systems (OSEC) and water supply systems using ozone or sodium hypochlorite as a disinfectant.

[c] The disinfectant by-products, chlorite and chlorate, shall be monitored in all chlorine dioxide and hypochlorite disinfection systems.

[d] The disinfectant by-product, trihalomethanes, shall be monitored in all chlorine, hypochlorite and chloraminated disinfection systems.

[e] In addition to final water monitoring, raw water monitoring is recommended for all parameters that are added as a treatment chemical (see table 1 for examples). If a parameter is monitored as a treatment chemical, the monitoring frequencies of table 4 supersedes the monitoring frequencies of table 6.

[f] If a parameter added as a treatment chemical exceeds the numerical limits in this standard or the World Health Organization (2022) guidelines in the final water, include monitoring of the treatment chemical on the critical distribution network sample points.

Table 5 — Minimum number of *E. coli* / intestinal enterococci results required in distribution networks

1	2
Population served	**Total number of results per year** [a b]
< 5 000	12 [c]
5 000 to 100 000	12 per 5 000 population
> 100 000 to 500 000	12 per 10 000 population plus an additional 120 samples
> 500 000	12 per 50 000 population plus an additional 600 samples

[a] The monitoring requirements of table 5 excludes final water *E. coli* / intestinal enterococci results.

[b] The *E. coli* / intestinal enterococci monitoring requirements of table 5 apply to the entire distribution network. Where a responsible body provides drinking water to another that then provides the drinking water to consumers, the combined result numbers of both entities shall comply with table 5.

[c] This implies a minimum monthly monitoring frequency.

7.3 Routine monitoring of mandatory process risk parameters in borehole systems

7.3.1 The mandatory process risk parameters listed in table 1, marked applicable to borehole systems (see column 6), shall be monitored monthly on the final water in all borehole systems.

NOTE The final water sample point can be the holding tank at the water treatment plant. Multiple boreholes can feed into one holding tank.

7.3.2 Monitoring of borehole systems with piped distribution networks, shall include monthly monitoring of at least one distribution network sample point. Systems utilising groundwater serving populations ≥ 5 000 are classified as water supply systems and shall comply with the requirements for water supply systems.

7.3.3 The minimum monthly *E. coli* monitoring frequency, and monthly intestinal enterococci monitoring frequency for saline water or brackish borehole water, can be adopted, provided that:

a) The monthly monitoring requirements for pH, turbidity, and disinfectant residuals are complied with on the final water, and in the case of piped distribution networks, on the distribution network sample point, and

b) The compliance requirements of clause 9 and table 8 are met for *E. coli*, and intestinal enterococci for saline water or brackish borehole water, as well as pH, turbidity, and disinfectant residuals on a continual basis on all the sampled points.

7.3.4 The routine sampling frequency for *E. coli*, and intestinal enterococci for saline water or brackish borehole water, shall increase to fortnightly on the final water and the distribution network sample points if the compliance requirements of clause 9 and table 8 are not met for *E. coli* and/or intestinal enterococci, pH, turbidity and/or disinfectant residuals on a continual basis.

7.4 Routine monitoring of system specific risk defined parameters

7.4.1 The parameters given in table 2 identified as risks during the risk assessment (see 5.2 and 5.3), shall routinely be monitored as system specific risk defined parameters in the routine monitoring programme of all water supply systems and borehole systems. The routine monitoring programme shall be amended to include new risks as and when identified.

7.4.2 Risks not listed in this standard shall be monitored as system specific risk defined parameters in the routine monitoring programme at self-defined locations and frequencies. The monitoring frequencies of table 6 shall apply to parameters that pose a similar risk.

7.4.3 Sampling points for the system specific risk defined parameters in water supply systems shall be selected in a manner that will ensure that the quality of the water can be verified throughout the entire water supply system. Sampling points shall include the raw water, final water, and critical distribution network sample points.

7.4.4 Sampling points for the system specific risk defined parameters in borehole systems shall include the final water, and at least one distribution network sample point in borehole systems with piped distribution networks.

7.4.5 If a risk assessment has not been done in a supply system, all the parameters listed in table 2 shall be monitored as system specific risk defined parameters in accordance with the frequencies and locations of table 6.

Table 6 — Minimum routine monitoring frequency for system specific risk defined parameters

1	2	3	4
Risk	**Frequency**		
	Raw water	**Final water**	**Critical distribution network sample point**
Chemical parameters (Macro and micro)			
Chronic health	Monthly	Monthly	Monthly
Aesthetic	Monthly	Monthly	Quarterly
Operational	Weekly	Weekly	Monthly
Organic: Chemical parameters			
Total organic carbon (TOC) as carbon	Monthly	Monthly	Monthly
Benzene**,** Atrazine and its chloro-*s*-triazine metabolites, and Dichlorodiphenyltrichlorethane (DDT) and metabolites	Quarterly	Quarterly	Quarterly if detected in the final water
Total microcystin	Weekly, when algal bloom occurs	Weekly, when algal bloom occurs	Weekly, if total microcystin non-complaint in the final water
Geosmin/MIB	Weekly, when algal bloom occurs	Weekly, when algal bloom occurs	Weekly, if geosmin and MIB non-complaint in the final water

7.5 Monitoring mobile tankers

7.5.1 Water from mobile tankers intended for drinking water purposes shall be safe and shall comply with the requirements of this standard. Mobile tankers, where in use, shall be declared suitable for drinking water distribution. Mobile tankers used for supplying drinking water shall be dedicated to the purpose of supplying drinking water, and shall be disinfected prior to commissioning.

7.5.2 Mobile tankers shall only be filled at a dedicated point where the drinking water supply is safe. These dedicated points include final water or critical distribution network sample points.

7.5.3 A self-defined representative sample of mobile tankers shall be monitored fortnightly for *E. coli*, disinfection residuals, pH, turbidity, and conductivity.

7.5.4 The monitoring requirements for mobile tankers prescribed in this standard is not about monitoring individual mobile tankers but to obtain information on the overall sanitary condition of the tankers. Should the water quality in the tanker be found to be non-compliant, the tanker shall be disinfected again and the water from the tanker tested prior to being put in-use. An investigation shall also be undertaken to ensure that water supplied by other mobile tankers are safe.

7.5.5 Tankers shall be disinfected and water quality tests done (*E. coli*, disinfection residuals, pH, turbidity and conductivity) prior to use, or when the tanker could have been compromised after standing for three or more days.

7.5.6 To ensure a representative sample, water samples shall be drawn from the tanker outlet.

7.6 Monitoring static tanks

7.6.1 Water from tanks to be used for drinking shall be safe.

7.6.2 A representative number of static tanks shall be monitored monthly for *E. coli*, disinfection residuals, pH, turbidity and conductivity. When determining a representative sample size, consider tanks that are:

a) constructed of different materials (for example, plastics, fiberglass, concrete, stone, or steel);

b) impacted by different conditions (for example, exposed to direct sunlight or not);

c) of different ages (new versus old) and frequency of use; and

d) of different sizes.

7.6.3 The monitoring of static tanks shall be in accordance with the requirements of table 7.

7.6.4 A cleaning programme shall be developed and implemented for all the tanks to ensure that the drinking water is safe.

Table 7 — Minimum sample numbers for static tanks

1	2
Number of tanks	**% tanks per month to test**
1 to 5	100 %
6 to 20	5 + 50 % of balance
21 to 50	12 + 25 % of balance
> 50	20 + 10 % of balance

8 Management of drinking water quality non-compliant results

8.1 General

8.1.1 Management of a non-compliant result is an essential component of the water safety planning process (see clause 4).

8.1.2 When a water quality result from a drinking water sample exceeds the numerical limit for the parameter listed in this standard, the non-compliant result shall be investigated to determine the risk. The nature and urgency of the required investigation will vary depending on the risk posed, or indicated by, the non-compliant parameter(s).

NOTE Parameters may pose a direct or indirect risk to human health or indicate a loss in process control or the integrity of the distribution network.

8.1.3 The process to manage a non-compliant result(s) shall be documented in an incident management protocol. The incident management protocol shall be:

a) parameter management specific for all acute health risk parameters (microbiological and chemical) listed in this standard;

b) parameter management specific for all chronic health risk, aesthetic risk, and operational risk parameters listed in table 1; and

c) category risk management specific for parameters given in table 2 (chronic health risk, aesthetic risk, and operational risk).

8.1.4 The incident management protocol shall at minimum, provide information related to the following:

a) a protocol to investigate and confirm a non-compliant result(s);

b) appropriate response action(s), for example, re-sampling, increased monitoring or other corrective actions such as treatment process control optimisation (or both);

c) roles and responsibilities, both internally and externally, to manage the non-compliant result(s) or an incident (or both); and

d) strategies for communicating internally, with external parties, or the public consumer (or both).

8.1.5 The incident management protocol shall provide for the establishment of a non-compliant water quality result register to document all non-compliant results and the process followed to manage the non-compliant result(s).

8.1.6 Risk to the consumer increases with:

a) an increased deviation from the numerical limit listed in this standard;

b) an increase in the number of recurrent non-compliant results for the same parameter at the same sample point;

c) more than one non-compliant parameter on a sample; and

d) one or more parameters non-compliant at multiple sample points during the same sampling event.

8.1.7 A single non-compliant result for an acute health parameter can pose an unacceptable health risk.

8.2 Confirmation of an incident

8.2.1 Confirmation of an acute health microbiological (*E. coli* or intestinal enterococci) incident

8.2.1.1 To confirm if a non-compliant result should be classified as an incident, the following applies:

a) if turbidity or disinfectant residual (or both) is non-compliant on the same sample then a risk is confirmed; or

b) initiate re-sampling within 24 h of receipt of the non-compliant result(s). If the re-sample result is non-compliant, then a risk is confirmed.

8.2.1.2 Following confirmation of the risk, assess the water quality at sample points in the same vicinity of the non-compliant result to determine the spatial extent of the potential risk to human health.

8.2.1.3 Declare an incident and implement the documented steps for managing acute health microbiological parameter risks as detailed in the incident management protocol.

8.2.2 Confirmation of an acute health protozoan parasite (*Cryptosporidium spp.* or *Giardia spp.*) incident

8.2.2.1 To confirm if a non-compliant result should be classified as an incident, the following applies:

a) If the final water protozoan parasite result(s) is non-compliant, implement re-sampling of both the raw water and final water within 24 h of receipt of the non-compliant result(s); and

b) If the results are non-compliant in the raw or final water resample (or both), then a risk is confirmed.

8.2.2.2 Following confirmation of the risk, assess effectiveness of the filtration process. An increasing trend in turbidity (especially > 0,3 NTU) on the filtered water, or the filtered water turbidity is elevated above the normal operating limits, confirms the potential risk to human health.

8.2.2.3 Declare an incident and implement the documented steps for managing the acute health risks associated with protozoan parasites as detailed in the incident management protocol.

8.2.3 Confirmation of an acute health chemical parameter incident

8.2.3.1 To confirm if a non-compliant result should be classified as an incident, the following applies:

a) if the acute health chemical parameter is non-compliant (for example, nitrate, nitrite or nitrite/nitrite ratio (or both), conduct a situational analysis using associated water quality data such as conductivity and ammonia on the same sample;

b) re-analyse the same sample for the non-compliant result as well as conductivity and ammonia. If the non-compliant result is confirmed, then a risk is confirmed; and

c) initiate re-sampling within 24 h of receipt of the non-compliant result(s). The risk is confirmed with another acute health chemical parameter non-compliant result.

8.2.3.2 Assess the spatially associated sample points, to determine the spatial extent of the potential risk to human health.

8.2.3.3 Review historical data to assess temporal trends within the data set for the non-compliant parameter and associated data in the distribution system sampling points.

8.2.3.4 Declare an incident and implement the documented steps for managing acute health chemical parameter risks as detailed in the incident management protocol.

8.2.4 Confirmation of a chronic health, operational or aesthetic incident

8.2.4.1 To confirm if a non-compliant result should be classified as an incident, the following applies:

a) if a sample result is non-compliant, assess associated water quality data;

b) re-analysis and resampling are at the discretion of the responsible body; and

c) review all available historical data to assess spatial and temporal trends for the non-compliant parameter and associated water quality data.

8.2.4.2 Declare an incident, and implement the documented steps for management of chronic health, operational or aesthetic risks as detailed in the incident management protocol.

8.3 Data management

8.3.1 All results will remain on the database and shall be submitted for inclusion into the compliance calculation, irrespective of root cause identification.

8.3.2 Data for all non-compliant water quality results shall be used for water quality verification (see clause 9). A compliant follow-up sample result shall not replace the non-compliant result.

9 Verification of water quality

9.1 General

9.1.1 Verification of the fitness for use of drinking water against the parameter numerical limits in this standard or the World Health Organization (2022) guidelines, expressed as a percentage compliance, provides an assessment of the overall performance of the water supply system or borehole system and a minimum assurance that the water is safe.

9.1.2 Verification shall include results from all samples taken at the final water and in the distribution network.

NOTE 1 Raw water results or in-process water treatment plant results (operational monitoring) are not included in the verification calculations.

NOTE 2 Only results from the distribution network will be used for nitrite and the nitrite/nitrate ratio compliance calculations.

9.1.3 Verification shall include results for all the table 1 and 2 parameters tested as part of the risk assessment and routine monitoring programme. Non-compliant results and results from follow-up sampling shall be included in the verification calculations.

NOTE 1 It is recommended that separate verification and reporting be done for parameters not listed in this standard but identified and monitored as risks in accordance with the World Health Organization (2022) guidelines or annex A.

9.1.4 Compliance calculations for bacteriological parameters (for example, *E. coli*) shall include presence or absence test results. However, if positive, a quantitative test shall be done for inclusion in the verification calculations.

9.1.5 Verification shall be calculated:

a) per individual parameter listed in tables 1 and 2 and against the numerical limits in this standard (calculated each month);

b) on a monthly basis using all the parameter results for the past month; and

c) on a rolling 12-month basis using all the parameter results for the past 12 months (calculated each month).

9.2 Calculation of drinking water quality compliance

9.2.1 Individual parameter verification

Using equation 1, compliance shall be calculated for each individual parameter (tables 1 and 2) tested per water supply system or borehole system:

$$P = \frac{N}{T} \times 100 \qquad (1)$$

where

P is the parameter compliance;

N is the number of complaint parameter results;

T is the total number of parameter results.

9.2.2 Category specific index verification

9.2.2.1 General

Using equations 2 to 6, five category specific index verifications shall be calculated for each water supply system or borehole system. The risk category for each parameter is listed in column 4 of tables 1 and 2.

9.2.2.2 Acute health microbiological compliance

$$A = \frac{N_1}{T_1} \times 100 \qquad (2)$$

where

A is the acute health microbiological compliance;

N_1 is the number of complaint acute health microbiological results;

T_1 is the total number of acute health microbiological results.

9.2.2.3 Acute health chemical compliance

$$B = \frac{N_2}{T_2} \times 100 \qquad (3)$$

where

B is the acute health chemical compliance;

N_2 the number of compliant acute health chemical results;

T_2 the total number of acute health chemical results

9.2.2.4 Chronic health chemical compliance

$$C = \frac{N_3}{T_3} \times 100 \qquad (4)$$

where

C is the chronic health chemical compliance;

N_3 is the number of compliant chronic health chemical results;

T_3 is the total number of chronic health chemical results.

9.2.2.5 Aesthetic compliance

$$D = \frac{N_4}{T_4} \times 100 \qquad (5)$$

where

D is the aesthetic compliance;

N_4 is the number of compliant aesthetic results;

T_4 is the total number of aesthetic results.

9.2.2.6 Operational compliance

$$E = \frac{N_5}{T_5} \times 100 \qquad (6)$$

where

E is the operational compliance;

N_5 is the number of compliant operational results;

T_5 is the total number of operational results.

9.2.3 Overall compliance verification

9.2.3.1 The overall compliance shall be calculated for each water supply system or borehole system using the outcomes of equations 2 to 6 in equation 7:

$$F = (0{,}4 \times A)+(0{,}2 \times B) +(0{,}1 \times C) +(0{,}1 \times D) +(0{,}2 \times E) \qquad (7)$$

where

F is the overall compliance;

A is the acute health microbial compliance;

B is the acute health chemical compliance;

C chronic health chemical compliance;

D is the aesthetic compliance;

E is the operational compliance.

9.2.3.2 In situations where a number of water supply systems or borehole systems (or both) are managed by a responsible body, flow-weighted overall drinking water quality compliance shall be calculated to report the overall performance of the relevant responsible body.

9.3 Performance categorisation and reporting

9.3.1 The performance of the water supply system or borehole system for each parameter (see 9.2.1), category specific indexes (see 9.2.2) and overall compliance shall be categorised according to the percentage of samples complying and the population served as shown in in table 8.

9.3.2 All parameters (using equation 1) with a compliance categorisation below the performance descriptor specified for unacceptable water quality in table 8 shall routinely be monitored at an increased frequency.

9.3.3 All parameters (using equation 1) and category specific indexes (using equation 2 to 6) with a compliance categorisation below the performance descriptor specified for unacceptable water quality given in table 8 shall be investigated and corrected in accordance with clause 8. A drinking water quality advisory notice shall be issued to consumers in all instances if the drinking water poses a health risk.

9.3.4 Drinking water quality cannot be assessed against insufficient data. In instances where the monitoring requirements of clause 7 are not being met, drinking water shall be deemed unsafe.

Table 8 — Categorisation of performance

1	2	3	4
Performance indicator	**Performance descriptor**	**Proportion of compliant results %**	
		Population size	
		Up to 100 000	**> 100 000**
Acute health microbiological (see equations 1 and 2) Calculate as A	Excellent	≥ 97	≥ 99
	Good	≥ 95	≥ 97
	Unacceptable	< 95	< 97
Acute health chemical (see equations 1 and 3) Calculate as B	Excellent	≥ 97	≥ 99
	Good	≥ 95	≥ 97
	Unacceptable	< 95	< 97
Chronic health chemical (see equations 1 and 4) Calculate as C	Excellent	≥ 95	≥ 97
	Good	≥ 93	≥ 95
	Unacceptable	< 93	< 95
Aesthetic (see equations 1 and 5) Calculate as D	Excellent	≥ 93	≥ 95
	Good	≥ 90	≥ 93
	Unacceptable	< 90	< 93
Operational compliance (see equations 1 and 6) Calculate as E	Excellent	≥ 93	≥ 95
	Good	≥ 90	≥ 93
	Unacceptable	< 90	< 93
Overall (see equation 7) Calculate as F	Excellent	≥ 97	≥ 99
	Good	≥ 95	≥ 97
	Unacceptable	< 95	< 97

Annex A
(informative)

Parameters of concern

Parameters of concern are currently non-mandatory parameters. However, concern for the health risks posed by these parameters has increased over the years. Where possible, the parameters are recommended for inclusion during the water quality risk assessment and routine monitoring programme. These parameters of concern are earmarked for inclusion in future editions of this standard. Standard limits are from WHO Guidelines for Drinking Water Quality, 2022 unless otherwise referenced.

Table A.1 — Parameters of concern

1	2	3	4	5
Parameter	**Risk**	**Unit**	**Standard limit**	**Additional information**
Natural chemical 17β-estradiol (E2)	Chronic health	µg/L	≤ 0,175	E2 and EE2 are endocrine disrupting compounds, and should be monitored as part of the risk assessment in all water supply systems receiving municipal sludge or wastewater discharges.
Synthetic chemical 17α-ethinylestradiol (EE2)	Chronic health	µg/L	1,5	
Industrial chemical Acrylamide	Chronic Health	µg/L	0,50	Conventional water treatment processes do not remove acrylamide. Where polyacrylamide is used for conditioning of water treatment residue and the supernatant is returned to the head of works, acrylamide should be monitored.

Table B.1 *(continued)*

1	2	3	4	5
Parameter	**Risk**	**Unit**	**Standard limit**	**Additional information**
Enteric viruses Adenovirus Astrovirus Norovirus Sapovirus Hepatitis E Enterovirus Parechovirus Hepatitis A Rotavirus	Acute health	Cytopathic effect (CPE) positive / Genomic detection (GC)	Not detected	Monitoring for viruses currently provides the only direct indication of the overall efficacy of a water treatment plant to remove viruses and is recommended for inclusion wherever possible. If the catchment survey reveals that the raw water is likely to be affected by faecal pollution or there has been a previous waterborne disease outbreak due to viruses, then test for enteric viruses on the final water. Viability of enteric viruses is assessed by tissue culture. Cytopathic effect (CPE) is visible structural changes induced by viral infections when propagated in specific tissue culture cell lines. If the infected cell lines are CPE positive, the water samples analysed comprise viable (replicative competent) enteric viruses. However, if genomic identification is utilised as the method of detection, results shall be interpreted with caution, as enteric viral presence does not necessarily indicate viability. In such a scenario, should enteric viral genomes be detected in the final water (post-disinfection), assess disinfection dosage and the residual disinfection concentrations to interpret the level of risk to the consumer. In addition, as contact time is integral to disinfection kinetics and is affected by parameters such as turbidity (dense particulate matter requires higher levels of disinfection), the chlorine contact time should be used to determine the probability of viral inactivation. Successful enteric virus inactivation may be achieved if a free chlorine residual concentration is applied at ≥1,0 mg/L for 30 min at a turbidity of ≤ 1,0 NTU and a pH of < 8,0.
Cyanotoxin Anatoxin (includes the congeners anatoxin-a, homoanatoxin-a, dihydroanatoxin-a and dihydrohomoanatoxin-a)	Chronic health	µg/L	No WHO guideline value	The Water Services (Drinking Water Standards for New Zealand) Regulation 2022 allows a maximum of 6 µg/L.
Industrial chemical Bisphenol- A	Chronic Health/ Industrial marker	µg/L	No WHO guideline value	BPA is ubiquitous in the environment and therefore a good chemical marker for pollution. BPA is associated with the manufacture of thermal paper, food can liners, dental sealants, epoxy resins and polycarbonate plastics. It may also be present in samples collected from taps connected to PVC pipes and water filter devices.

Table B.1 *(continued)*

1	2	3	4	5
Parameter	**Risk**	**Unit**	**Standard limit**	**Additional information**
Natural chemical Caffeine	Human marker		No WHO guideline value	Caffeine is a good chemical marker for pollution, especially wastewater effluent and is an emerging contaminant of concern for biota. Caffeine occurs naturally in approximately 60 plant species, and it is a highly used stimulant contained in coffee, tea, caffeinated beverages as well as in several pharmaceutical products. Due to its high consumption coupled with its relative stability under environmental conditions, it is currently recognized as a marker of anthropogenic activity.
Cyanotoxin Cylindrospermopsin	Chronic health	µg/L	No WHO guideline value	The Water Services (Drinking Water Standards for New Zealand) Regulation 2022 allows a maximum of 0,8 µg/L.
Industrial chemical Epichlorohydrin (ECH)	Chronic Health	µg/L	0,10	ECH is used to make various cationic copolymers, notably epichlorohydrin dimethylamine copolymer (epi-DMA). Epichlorohydrin polymers that contain amine monomers are known as polyamines. However, polyamines in general do not necessarily contain epichlorohydrin.
Industrial chemical Gross alpha activity Gross beta activity	Chronic health	Bq/L	0,5 1	Risk might be higher in groundwater and in areas where mining activities and manufacturing take place. If alpha and beta activity is exceeded, a full nuclide analysis is required. The WHO assessment methodology for controlling radionuclide health risks from drinking water should be used for continued assessment of the risks posed by radioactivity (see figure 9.2 and Box 9.4 of the World Health Organization (2022) guidelines.
Disinfectant by-products Haloacetic acids (HAAs) Dichloroacetic acid (DCA) Trichloroacetic acid (TCA) Monochloroacetic acid (MCA)	Chronic health	µg/L	≤ 50 ≤ 200 ≤ 20	Haloacetic acids are the second most prevalent group of disinfection by-products in disinfected water. They are formed by the reaction of chlorine, chloramines, chlorine dioxide and ozone with natural organic matter and bromide. Their concentrations may vary in drinking water, due to differences in source water characteristics (dissolved organic carbon concentrations, composition of natural organic matter (NOM), seasonal variations.

Table B.1 *(continued)*

1	2	3	4	5
Parameter	**Risk**	**Unit**	**Standard limit**	**Additional information**
Pharmaceuticals Ibuprofen Carbamazepine Cinchonidine Cinchonine Paracetamol Diclofenac Bezafibrate Sulfamethoxazole (SMX) Antiretroviral (ARVs): a) Stavudine; b) Lamivudine	Chronic health	ng/L	50-100	Human and veterinary pharmaceuticals entering surface water and groundwater are from treated and untreated municipal wastewater effluent discharges and improper disposal of pharmaceutical waste and excess medication by consumers and health care and veterinary facilities into sewers and drains. Well designed and quality controlled investigative studies of catchments are required to assess the potential human health risks arising from exposure through drinking water. Knowledge gaps exist in terms of assessing risks associated with long-term exposure to low concentrations of pharmaceuticals and the combined effects of mixtures of pharmaceuticals. Conventional treatment processes with chlorination (free chlorine) can remove about 50 % of these compounds, whereas advanced treatment processes, such as ozonation, advanced oxidation, activated carbon and membranes (for example, reverse osmosis, nanofiltration), can achieve higher removal rates; reverse osmosis, for example, can remove more than 99 % of large pharmaceutical molecules. Pharmaceuticals in surface waters groundwater and partially treated water are typically less than 100 ng/L, and concentrations in treated water are generally below 50 ng/L. (WHO Pharmaceuticals in Drinking Water, 2012),
Transformation product n-nitrosodimethylamine (NDMA)	Chronic Health	µg/L	0,10	NDMA has been identified as a disinfection by-product of chloramination (by the reaction of monochloramine with dimethylamine, especially where raw water is affected by wastewater discharges). NDMA can also be formed as a by-product of anion exchange treatment of water and is also a contaminant of certain pesticides.
Cyanotoxin Nodularin	Chronic health	µg/L	No WHO guideline value	The Water Services (Drinking Water Standards for New Zealand) Regulation 2022 allows a maximum of 1 µg/L.

Table B.1 *(concluded)*

1	2	3	4	5
Parameter	**Risk**	**Unit**	**Standard limit**	**Additional information**
Industrial chemicals Per- and polyfluoroalkyl substances (PFAS) Perfluorooctanesulfonic acid (PFOS) Perfluorooctanoic acid (PFOA) Perfluorononanoic acid (PFNA) Perfluorohexanesulfonic acid (Phis) Perfluoroheptanoic acid (PFHpA) Perfluorobutanesulfonic acid (PFBS)	Acute health	ng/L	70	Per- and polyfluoroalkyl substances (PFAS) are a wide range of synthetic chemicals with varying chemical and physical properties. The listed six PFAS are more widely studied than other PFAS. However, in general all PFAS have similar health effects. High exposure to PFAS can adversely affect the human immune, endocrine, reproductive, and respiratory systems. High PFAS exposure may lead to asthma, liver damage, thyroid disease, reduced response to vaccines, and decreased fertility and birth weights. (USEPA limit is used here as no WHO limits exists.)
Pesticide Terbuthylazine	Chronic health	ug/L	7	Terbuthylazine and simazine and their metabolites are pesticides utilised in the South Africa agricultural sector. Timing and frequency of monitoring should account for the seasonal variation associated with application in agricultural activities. (See table 8.13 of the World Health Organization (2022 guidelines).
Pesticide Simazine	Chronic health	ug/L	2	
Cyanotoxin Saxitoxin	Chronic health	µg/L	No WHO guideline value	The Water Services (Drinking Water Standards for New Zealand) Regulation 2022 allows a maximum of 3 µg/L.

Annex B
(informative)

Recommended water treatment chemicals and materials

The chemicals and materials given in column 1 of table B.1 may be used for water treatment to render it safe for human consumption.

Table B.1 — Water treatment chemicals

1	2	3
Chemical/material	**SANS number**	**Title of the standard**
Aluminium sulfate	SANS 50878	Chemicals used for treatment of water intended for human consumption – Aluminium sulfate.
Aluminium iron (III) sulfate	SANS 50887	Chemicals used for treatment of water intended for human consumption – Aluminium iron (III) sulfate.
Aluminium iron (III) chloride (monomeric) and aluminium iron (III) chloride hydroxide (monomeric)	SANS 50935	Chemicals used for treatment of water intended for human consumption – Aluminium iron (III) chloride (monomeric) and aluminium iron (III) chloride hydroxide (monomeric).
Aluminium bases coagulants	SANS 51302	Chemicals used for treatment of water intended for human consumption – Aluminium bases coagulants -Analytical methods.
Anionic and non-ionic polyacrylamides	SANS 51407	Chemicals used for treatment of water intended for human consumption – Anionic and non-ionic polyacrylamides.
Ammonia solution	SANS 52122	Chemicals used for treatment of water intended for human consumption – Ammonia solution.
Aluminium chloride anhydrous, aluminium chloride basic, dialuminium chloride pentahydroxide and aluminium chloride hydroxide sulfate	SANS 57034	Chemicals used for treatment of water intended for human consumption – Aluminium chloride anhydrous, aluminium chloride basic, dialuminium chloride pentahydroxide and aluminium chloride hydroxide sulfate.
Bentonite	SANS 53754	Chemicals used for treatment of water intended for human consumption – Bentonite.
Calcium carbonate, high-calcium lime, half-burnt dolomite, magnesium oxide, calcium magnesium carbonate and dolomitic lime	SANS 52485	Chemicals used for treatment of water intended for human consumptio – Calcium carbonate, high-calcium lime, half-burnt dolomite, magnesium oxide, calcium magnesium carbonate and dolomitic lime- Test methods.
Calcium hypochlorite	SANS 50900	Chemicals used for treatment of water intended for human consumption – Calcium hypochlorite.
Carbon dioxide	SANS 50936	Chemicals used for treatment of water intended for human consumption – Carbon dioxide.
Cationic polyacrylamides	SANS 51410	Chemicals used for treatment of water intended for human consumption – Cationic polyacrylamides.
Chlorine	SANS 50937	Chemicals used for treatment of water intended for human consumption – Chlorine.
Chlorine dioxide generated in situ	SANS 52671	Chemicals used for treatment of water intended for human consumption – Chlorine dioxide generated in situ.
Copper sulfate	SANS 52386	Chemicals used for treatment of water intended for human consumption – Copper sulfate.

Table B.1 *(continued)*

1	2	3
Chemical/material	**SANS number**	**Title of the standard**
Hexaflourosilic acid	SANS 12175	Chemicals used for treatment of water intended for human consumption – Hexaflourosilic acid.
Hydrogen peroxide	SANS 50902	Chemicals used for treatment of water intended for human consumption – Hydrogen peroxide.
Inorganic supporting and filtering materials	SANS 52901	Products used for treatment of water intended for human consumption – Inorganic supporting and filtering materials – Definitions.
Inorganic and supporting filtering materials methods	SANS 52902	Products used for treatment of water intended for human consumption – Inorganic and supporting filtering materials methods.
Iron (III) chloride	SANS 50888	Chemicals used for treatment of water intended for human consumption – Iron (III) chloride.
Iron (III) chloride sulfate	SANS 50891	Chemicals used for treatment of water intended for human consumption – Iron (III) chloride sulfate.
Iron (III) sulfate solution	SANS 50890	Chemicals used for treatment of water intended for human consumption – Iron (III) sulfate solution.
Oxygen	SANS 52876	Chemicals used for treatment of water intended for human consumption – Oxygen.
Ozone	SANS 51278	Chemicals used for treatment of water intended for human consumption – Ozone.
Polyamines	SANS 51409	Chemicals used for treatment of water intended for human consumption – Polyamines.
Polyaluminium chloride hydroxide and poly aluminon chloride hydroxide sulfate	SANS 50883	Chemicals used for treatment of water intended for human consumption – Polyaluminium chloride hydroxide and poly aluminon chloride hydroxide sulfate.
Polyaluminium chloride hydroxide silicate	SANS 50885	Chemicals used for treatment of water intended for human consumption – Polyaluminium chloride hydroxide silicate.
Polyaluminium hydroxide silicate sulfate	SANS 50886	Chemicals used for treatment of water intended for human consumption – Polyaluminium hydroxide silicate sulfate.
Potassium permanganate	SANS 52672	Chemicals used for treatment of water intended for human consumption – Potassium permanganate.
Powdered activated carbon	SANS 52903	Products used for treatment of water intended for human consumption – Powdered activated carbon.
Reactivated granular activated carbon	SANS 52915-2	Products used for treatment of water intended for human consumption – Granular activated carbon – Part 2: Reactivated granular activated carbon.
Silica sand and silica gravel	SANS 52904	Products used for treatment of water intended for human consumption – Silica sand and silica gravel.
Sodium hexaflourosilic acid	SANS 12174	Chemicals used for treatment of water intended for human consumption – Sodium hexaflourosilic acid.
Sodium aluminate	SANS 50882	Chemicals used for treatment of water intended for human consumption – Sodium aluminate.
Sodium carbonate	SANS 50897	Chemicals used for treatment of water intended for human consumption – Sodium carbonate.

Table B.1 *(concluded)*

1	2	3
Chemical/material	**SANS number**	**Title of the standard**
Sodium chlorite	SANS 50938	Chemicals used for treatment of water intended for human consumption – Sodium chlorite.
Sodium fluoride	SANS 12173	Chemicals used for treatment of water intended for human consumption – Sodium fluoride.
Sodium hydrogen carbonate	SANS 50898	Chemicals used for treatment of water intended for human consumption – Sodium hydrogen carbonate.
Sodium hydroxide	SANS 50896	Chemicals used for treatment of water intended for human consumption – Sodium hydroxide.
Sodium hypochlorite	SANS 50901	Chemicals used for treatment of water intended for human consumption – Sodium hypochlorite.
Sodium silicate	SANS 51209	Chemicals used for treatment of water intended for human consumption – Sodium silicate.
Sodium dichloroisocyanurate, anhydrous	SANS 52931	Chemicals used for treatment of water intended for human consumptio – Chemicals for emergency use – Sodium dichloroisocyanurate, anhydrous.
Sodium dichloroisocyanurate, dihydrate	SANS 52932	Chemicals used for treatment of water intended for human consumption – Chemicals for emergency use – Sodium dichloroisocyanurate, dihydrate.
Trichloroisocyanuric acid	SANS 52933	Chemicals used for treatment of water intended for human consumption – Chemicals for emergency use – Trichloroisocyanuric acid.
Trichloroisocyanuric acid	SANS 52933	Chemicals used for treatment of water intended for human consumption – Chemicals for emergency use – Trichloroisocyanuric acid.

Annex C
(informative)

Nitrate/Nitrite ratio and Trihalomethane (THM) ratio calculation examples

The numbers in tables C.1 and C.2 are given for the purpose of demonstrating the calculations only.

Table C.1 — Example of Nitrate/Nitrite ratio calculation

1	2	3	4	5
Compound	**Limit** mg/L	**Measured Value** mg/L	**Ratio**[a]	**Complies** Yes/No
Nitrate as N	≤ 11	1,1	0,1	Yes
Nitrite as N[a]	≤ 0,9	0,45	0,5	Yes
Sum of ratios		**0,6**		**Yes**

[a] Only results from the distribution network are used for nitrite and the nitrite/nitrate ratio compliance calculations.

Table C.2 — Example of Trihalomethane (THM) ratio calculation

1	2	3	4	5
Compound	**Limit** µg/L	**Measured value** µg/L	**Ratio**[a]	**Complies** Yes/No
Chloroform	≤ 300	180	0,60	Yes
Bromoform	≤ 100	2	0,02	Yes
Dibromochloromethane	≤ 100	4	0,04	Yes
Bromodichloromethane	≤ 60	25	0,42	Yes
Sum of ratios		**1,08**		**No**

[a] If THMs are detected at concentrations below the quantification limit, then the quantification limit is used in the calculation.

Annex D
(informative)

Recommended test methods

The test methods listed in table D.1 are available for use and are recommended for use in the testing of drinking water. The user should, however, ensure that the analytical method chosen provides the required performance.

Table D.1 — Test methods

1	2	
Parameter	**Test method**	
	References	**APHA-AWWA-WEF[a]**
Aluminium	SANS 381, SANS 6169, SANS 11885	3500–Al Aluminium
Ammonia	SANS 5217	4500–NH_3 Nitrogen (Ammonia)
Antimony	SANS 379	3500–Sb Antimony
Arsenic	SANS 376, SANS 11885	3500–As Arsenic
Bacteriological quality	SANS 5221	
Barium	ASTM D4382	
Boron	SANS 6053	
Cadmium	SANS 5201, SANS 11885	3500–Cd Cadmium
Chloride	SANS 163-1, SANS 374	4500–Cl^- Chloride
Chromium	SANS 6054, SANS 11885	3500–Cr Chromium
Colour	SANS 7887	2120 Colour
Copper	SANS 5203, SANS 11885	3500–Cu Copper
Cryptosporidium oocysts and Giardia cysts	ISO 15553	
Dissolved solids	SANS 5213	
E. coli and coliforms (memberane filtration)	SANS 9308-1	
E. coli and coliforms (MPN)	SANS 9308-2	
Electrical conductivity	SANS 7888	
Fluoride	SANS 163-1, SANS 10359-1, SANS 10359-2	4500–F^- Fluoride
Iron	SANS 382, SANS 5207, SANS 11885	3500–Fe Iron
Lead	SANS 384, SANS 5208, SANS 11885	3500–Pb Lead
Manganese	SANS 5209, SANS 11885	3500–Mn Manganese
Mercury	SANS 6059	3500–Hg Mercury
Nickel	SANS 6171, SANS 11885	3500–Ni Nickel
Nitrate and nitrite	SANS 5210	4500–$N0_3^-$ Nitrogen (Nitrate) 4500–$N0_2^-$ Nitrogen (Nitrite)
Odour		2150 Odor
pH	SANS 5011	4500–H^+ pH value

Table D.1 *(concluded)*

1	2	
Parameter	**Test method**	
	References	**APHA-AWWA-WEF**[a]
Selenium	SANS 377, SANS 11885	3500–Se Selenium
Sodium	SANS 6050, SANS 11885	3500–Na Sodium
Sulfate	SANS 163-1, SANS 6310	4500–SO_4^{2-} Sulfate
Taste		2160 Taste
Total organic carbon	ASTM D4129, ASTM D7573	
Turbidity	SANS 375, SANS 5197	2130 Turbidity
Uranium	ISO 13166	
Viruses	ISO/TS 15216-1, ISO/TS 15216-2	
Zinc	SANS 383, SANS 5214, SANS 11885	3500–Zn Zinc
[a] Standard methods on the examination of water and wastewater.		

Annex E
(informative)

Toxin-producing cyanobacteria

The table E.1 lists potentially toxin-producing cyanobacteria most of which are common in South African freshwaters.

Table E.1 — Toxin-producing cyanobacteria

1	2
Cyanoacteria	**Cyanotoxin(s) produced**
Cylindrospermopsis, *Aphanizomenon*, *Raphidiopsis* and *Umezakia*	Cylindrospermopsin
Microcystis, Dolichospermum (Anabaena), Planktothrix (Oscillatoria), Nostoc, Anabaenopsis and *Radiocystis*	Microcystin
Nodularia	Nodularin
Dolichospermum (Anabaena), *Lyngbya, Planktothrix (Oscillatoria)*, *Cylindrospermopsis*, *Cylindrospermum* and *Aphanizomenon.*	Anatoxin-a (including associated congeners)
Dolichospermum (Anabaena), *Lyngbya, Planktothrix (Oscillatoria)*, *Cylindrospermopsis*, *Cylindrospermum* and *Aphanizomenon*	Saxitoxin

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SANS 5201, *Water – Cadmium content.*

SANS 5203, *Determination of copper content in different water matrices using air-acetylene flame atomic adsorption spectroscopy (FAAS).*

SANS 5207, *Determination of iron content in different water matrices using air-acetylene flame atomicadsorption spectroscopy (FAAS).*

SANS 5208, *Determination of lead content in different water matrices using air-acetylene flame atomic adsorption spectroscopy (FAAS*).

SANS 5209, *Determination of manganese content in different water matrices using air-acetylene flame atomic adsorption spectroscopy (FAAS).*

SANS 5210, *Determination of nitrate and nitrite in water samples.*

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