National Drinking-Water Quality Standards

Ministry of Industry and Handicrafts

Contents

Annexes

List of Table

Abbreviations

NDWQS	National Drinking-Water Quality Standards
GFS	Gravity fed system
HWTS	Household water treatment and safe storage
INGO	International non-governmental organisation
mg/l	mili grams per litre
MIH	Ministry of Industry and Handicrafts
MoH	Ministry of Health
NGO	Non-governmental organisation
TWG	Technical Working Group
WHO	World Health Organisation
WSP	Water safety plan(s)

1. Introduction

1. Access to safe water is essential to health, providing tangible benefits to health and a vital component of public health protection policies.
2. The NDWQS supersede the January 2004 “Drinking Water Quality Standards”.
3. The Ministry of Industry and Handicrafts (MIH) shall enforce issues of standard related to urban water supply systems as defined in Paragraph 14.
4. The aim of the NDWQS is to contribute to the protection of public health through providing safe water.
5. Objectives of the NDWQS are to establish and define:
    - measures for water quality comparison and actions related to water quality
    - the minimum requirement for monitoring and surveillance, the stakeholder’s roles and responsibilities, enforcement regulations
6. The NDWQS accepts that resources are limited, prioritising those parameters presenting the greatest risk to public health within realistic constraints in Cambodia at the time of the NDWQS

2. Implementation timelines and exemptions

7. Urban water supply systems shall comply with this standard according to the timelines set out in Table 2.1.

Table 2-1: Peri-urban and Urban Water supply System Timelines

Description	Minimum Compliance Timeline from issue of the standard
New or upgraded water treatment plants	To be compliant with standards at commencement of operations
Water supply system with less than 1,000 connections	1 year 6 months
Water supply System from 1001 to 3000 connections	1 year
Water supply system with more than 3001 connections	6 months

8. **Exemptions at Peri-urban and Urban:** Public Water Supply Authority, Public Water Supply, Private Water Providers at Peri-urban and Urban shall make request to the Potable Water Supply Department, MIH, for exemptions in part or in full for the starting date to comply with the provisions of the standards, or for exceptions on treatment system cases or part of network to which the standard shall apply. All exemptions must be applied according to specific parameter and location.

9. The operators must justify the basis of the exemption and provide a timed improvement program to rectify known problems which reasonably make it impossible for the operator to comply with the standards without an exemption.

10. Such applications, if granted by MIH, must stipulate a time period by which the exemption will cease. Exemptions shall state conditions under which the exemption is granted.

3. General clause

3.1 Scope

11. The NDWQS must be applied for Peri-urban and Urban water supply systems as defined in Paragraph 14.

12. Urban -water supply systems are required to comply with the standards.

3.2 Sampling Point

13. The NDWQS apply to Peri-urban and Urban water supply systems. These include any tap connected to the network, or any point within the piped network or at the outlet of any water tanker operated by the water service provider. Paragraph 33 outlines the principles to be used in selecting the sampling point.

3.3 Definitions

14. **Urban water supply systems:** refers to piped water systems operated by Public Autonomy or Public Operators or Private Operators regulated as such by the Ministry of Industry and Handicrafts. They operate as a commercial business for supplying water through network systems including water supply tankers for the operator or other water-supply means in case water pipes networks cannot be set up in any specific operating area.

15. **Water service provider(s)** are the commercial business operators referred to in Paragraph 14

16. **Household water treatment and safe storage (HWTS).** This is a water treatment and safe storage used at the household, after water collection, and before consumption to achieve the desired water quality. Examples are ceramic filters, boiling, SODIS (Solar disinfection), arsenic removal filters and sand filters.

17. **Surveillance:** Refers to routine collection of water samples for analysis to determine water quality, by water service provider. Section 4 specifies the parties responsible for monitoring for peri-urban and urban systems.

18. **Water Safety Plan (WSP):** A WSP refers to a comprehensive risk assessment approach that encompasses all aspects of a water supply, from catchment to consumers. Its aim is to consistently ensure the safety of water for its intended use. Its key objectives are typically to:

    - Prevent contamination of raw water sources
    - Treat water to reduce or remove contaminates
    - Prevent re-contamination during storage, distribution and handling of treated water.

19. **Threat to public health:** refers to any event or circumstance, which is likely to:

    a) Damage, injure or affect public health; or

    b) Prevent or restrict the improvement of public health.

4. Roles and responsibilities

4.1 General

20. The following entities are to apply the NDWQS:

    - The Ministry of Industry and Handicrafts (MIH)
    - Operators, entrepreneurs, multilateral agencies, INGOs, local NGOs, and others responsible for the design, construction, operation and management of water supply system and domestic water supplies.

4.2 Peri-urban and Urban Water Service Providers

21. Peri-urban and Urban water service provider's key roles and responsibilities are to comply with the standards specified in NDWQS except where exemptions are granted.

22. Key roles and responsibilities include:

- Ensure to provide safe water to all customers
- Developing, implementing and reporting on a surveillance and testing program for their water supply system
- Reporting to MIH and Local Authority on immediately becoming aware that water which it supplies is, or is likely to become, a threat to public health
- Not falsifying information on the water quality provided to customers
- Granting access to MIH to inspect its operations, records, laboratories and to take independent samples for water quality control purposes, with or without advance notice.

4.3 Ministry of Industry and Handicrafts (MIH) - Department of Potable Water Supply

23. Roles and responsibilities of Department of Potable Water Supply include:

- Acting as the Surveillance Authority for peri-urban and urban water systems represented by Technical Office (Refer to Section 7)
- Reviewing and updating of the standards every five years
- Providing guidance in water safety matters to peri-urban and urban water service providers or other agencies involved in peri-urban and urban water supply
- Providing technical support to laboratories.

24. MIH's Department of Portable Water Supply or its authorised agents have the right to inspect water service provider's plans and records in surveillance as well as to inspect water source, check laboratories, to test water quality and take samples for independent analysis.

5. Urban drinking-water

5.1 Parameters

25. Table 5-1 shows the table of parameters, target types, exceptions and examination frequency for peri-urban and urban water supply systems.

Table 5-1: Urban water system parameters

Parameter	Parameter		Exception	Formal Monitoring Examination level		
	Unit	Permissible limite		A	B	C
				Daily	Quarterly	Annually
Microbial						
E.Coli or thermoteloerant	CFU or MPN / 100 ml	0			B	
Chemical						
Aluminium (Al)	mg/l	0.2	in the case that alum is used		B	
Ammonia (NH_3)	mg/l	1.5			B	
Arsenic (As)	mg/l	0.05	for the case of groundwater source			C
Barium (Ba)	mg/l	0.7				C

Parameter	Parameter		Exception	Formal Monitoring Examination level		
	Unit	Permissible limite		A	B	C
				Daily	Quarterly	Annually
Cadmium (Cd)	mg/l	0.003				C
Chloride (Cl^-)	mg/l	250			B	
Chlorine Cl_2 * (free residual)	mg/l	0.1-1.0	for the case of using chlorine for disinfectant	A		
Chromium (Cr)	mg/l	0.05				C
Copper (Cu)	mg/l	2	for the case that household plumbing uses copper pipes			C
Fluoride (F)	mg/l	1.5	for the case of groundwater source			C
Total hardness as $CaCO_3$	mg/l	300	For the case of groundwater source		B	
Iron (Fe)	mg/l	0.3	case of groundwater		B	
Lead (Pb)	mg/l	0.05				C
Manganese (Mn)	mg/l	0.1	case of groundwater			C

Parameter	Parameter		Exception	Formal Monitoring Examination level		
	Unit	Permissible limite		A	B	C
				Daily	Quarterly	Annually
Mercury (Hg)	mg/l	0.006				C
Nitrate (NO_3^-)	mg/l	50				C
Nitrite (NO_2^-)	mg/l	3				C
Sodium (Na)	mg/l	250	case at coastal areas			C
Sulfate ion (SO_4^{2-})	mg/l	500			B	
Zinc (Zn)	mg/l	3				C
Physical						
Colour	TCU	5		A		
pH	n/a	6.5-8.5		A		
TDS or Conductivity	mg/l or µS/cm	800 or 1600		A		
Turbidity	NTU/FTU	5		A		
Taste and Odour	-	Acceptable		A		

*Residual chlorine must be daily analysed in production system and fortnightly (two weeks) at end points of networks (water supply system with more than 3001 connections). The number of samples is dependent on situations of end points of networks of each unit or service provider. We can analyse thermoteloerant coliform bacteria for E Coli. Conductivity is an acceptable alternative to TDS. The above limits assume that Conductivity is twice TDS, but this relationship should be confirmed at each site if conductivity is used. Whether the analysis of taste and odour by operators is acceptable depends on users.

26. Pesticides – refer to Section 9.3. The guideline values in current version of WHO's Water Guidelines shall be used for permissible limits.

27. Every effort should be made to prevent algal blooms in surface layer of water source or to minimize algal extraction at the extraction point as this is the primary management approach for algal toxins. The service provider must develop appropriate guidelines for algal management where algal grows. The guideline values in current editions of WHO's Water Guidelines shall be used for allowable limits for algal toxins.

5.2 Surveillance frequency

28. Table 5-1 shows the minimum frequency of formal surveillance for reporting purposes by the peri-urban and urban water supplier operator for the parameters shown.

29. Before commissioning of water production-corporation or improved water supply system, operators must test its water for all parameters that have potential high-risk to public health.

30. Be ready to have more frequent monitoring than what are indicated in Table 5 1 where a parameter fails, it has an increasing trend of concentration, or pollution activities in a catchment (e.g. mining or agriculture) cause concern in maintaining water quality to the acceptable NDWQS.

31. It is recommended that analysis of water sources be carried out at planning and design phases for all new water systems, and do it annually for all systems.

5.3 Number and location of samples

32. In peri-urban and urban piped network systems, the number of samples taken and analysed shall be no less than that shown in table 5-2 Reference source not found.

Table 5-2: Minimum number of sample points for surveillance in peri-urban and Urban Water Supply systems

No of connections	Number of sampling point in piped network	
	Microbial parameters	**Other parameters**
Less than or equal to 500	One sampling point	One sampling point
501 to 1000	Two sampling points	One sampling point
1001 to 2000	Two sampling points	Two sampling points
2001 to 5000	Three sampling points	Two sampling points
5001 to 10,000	Four sampling points	Three sampling points
More than 10,001	One per 10,000 connections (or part thereof) plus 10	One per 50,000 connections plus four

33. The sampling points must be spatially representative and must take into account the population served and network layout. End points of networks should be used unless there is good reason for other locations. Paragraph 37 specifies how these sampling points are to be identified in reports.

34. Service providers should monitor at the source and treatment plant for critical control parameters in their monitoring program on a more regular basis.

5.4 Record keeping and reporting of monitoring data

35. Each peri-urban and urban water service provider shall maintain a data base of its monitoring. It shall report the monitoring results to the responsible officials of the Department of Portable Water Supply at least three monthly.

36. The report must indicate the schematic location of the sample sites on a map of the entire network. The reporting must compare the results against the standards and report on corrective action taken or proposed where deviation from the standard is noted. It must also provide a summary of any water quality trends and a summary of issues affecting water quality.

37. The annual reports of each operator must include summary statements on water quality issues.

38. When water tests show values exceeding the permissible limits or the operator becomes aware of an event or circumstance that may cause the water to be threat to public health, the water service provider shall take every effort to identify the cause of the problem and take appropriate action to rectify and retest (refer to Paragraph 22).

6. Approved sampling and analytical methods

39. Annex B specifies approved sampling and testing methods.

7. Surveillance and control programs

7.1 General

40. The aim of surveillance is to undertake routine independent assessments of the water supply from a public health perspective. It includes two aspects:

- Checking and reporting if the monitoring by water service providers conforms to the NDWQS
- Determining if there are other actions that would lead to improvement in water safety

41. The first aspect of surveillance can be either an audit-based approach or independent sampling and testing carried out by a third party laboratory. The second aspect may require proactive investigation in collaboration with other agencies to investigate if additional parameters are of health concern in water; for examples, pesticide contamination, and contamination from mining activities or any other parameter in the current WHO Water Quality Guidelines.

42. The responsible officials must prepare an annual report. The report must include summaries of the compliance and non-compliance with the NDWQS, progress towards meeting the implementation goals stated in Section 2, major water quality issues of concern, and implications of its findings.

7.2 Pesticides and algal toxins

43. NDWQS acknowledges that analysis of organics and pesticides is expensive and requires a large capital investment and more training. In particular, the nature of pesticide use is such that concentrations in surface water may be highly variable and intermittent, making sampling programs difficult.

44. In accordance with paragraph 43, MIH must review and monitor existing concentrations of pesticides or organics or algal toxins in surface and ground waters where realistic concerns exist about possible pesticides or algal in water and other emerging water quality issues to make evidence based decisions about additional monitoring and surveillance. Collaborative efforts between a range of government ministries is encouraged to undertake this review.

8. General requirements

45. The NDWQS are not intended to specify water quality for specialised needs (e.g. immune suppressed people, kidney dialysis patients).

46. It is forbidden for individual, operators, entrepreneurs and organisations to take any action which contaminates sources of water and water for domestic or similar use by microbes or chemicals or other dangerous contaminates which are toxic and dangerous to human health.

47. When becoming aware of water borne disease outbreak, or in the event of a known event potentially seriously compromising water quality, the responsible service provider must immediately inform the competent authority, local authority, and relevant units.

9. General water practice recommendations

9.1 General

48. All peri-urban and urban water reservoirs and water treatment systems shall be monitored for level of turbidity, colour, chlorine residual, conductivity and pH on a daily basis.

9.2 Water Safety Plans

49. An important management tool that has been introduced in the Cambodian water sector called Water Safety Plan (WSP). The implementation of WSPs are recommended to ensure good water safety management and protection of the health of consumers.

9.3 Pesticides and algal toxins

50. The risk of pesticides being present at high concentrations can usually be assessed through a detailed risk-based survey of an area (e.g. sanitary survey).

Chemical analysis for pesticides is generally not necessary. Pesticides used in paddy fields can be a particular serious problem where there is overflow or drainage into water bodies that may be used as water sources.

51. If a pesticide is properly used, it does not necessarily imply that water will be contaminated to levels of concern as many of the pesticides in current use are broken down rapidly in the environment.

52. Water sources management is the primary management approach for pesticides hazards. Key risk factors in relation to pesticides to be avoided are:

- Storing and mixing pesticides with no appropriate precautions which lead pesticides to spill out of pesticides containers.
- Using unapproved pesticides
- Applying pesticides at higher than the recommended application rates
- Applying pesticides immediately before heavy rainfall, directly to the soil immediately before irrigation, or to crops before spray irrigation
- Using pesticides where the soil is thin and bedrock is exposed or on very sandy soil or near open wells, sinkholes or other features that allow direct access to the water source.
- Directly disposing of unused pesticide or washings from containers in water source or to soak away or in other circumstances that will lead to rapid transfer to groundwater.

53. Blue-green algae (cyanobacteria) can occur in surface water bodies used for water supply. Some species of cyanobacteria contain toxins of concern to human health (e.g. microcystins), and these can be released when algal cell walls are ruptured. There is a wide range of potential toxic algaes.

54. Blooms of blue-green algae occur in appropriate weather conditions in still or slow flowing bodies of water with high phosphate and nitrate concentrations that either occur naturally or are from human-made sources.

55. Toxins such as microcystin LR and associated substances can be very difficult to analyse at low concentrations in water. Therefore, it is preferable to control blue-green algae by preventing algal blooms in source waters. There are treatment options for microcystin LR and related substances, but these require careful assessment; for example, it is particularly important to ensure that algal cells are removed.

56. Every effort should be made to prevent alga from blooming, which is the primary management approach. Where there are heavy algal blooms, it is best to consider an alternative source of water unless appropriate treatment is available.

10. Penalties and awards

10.1 Peri-Urban and Urban Water System

57. Unless exemptions are granted by MIH, the standards apply in full to all public and private service providers.

58. Table 10-1 classifies the types of violations in urban systems into three grades: A, B and C.

Table 10-1: Types of violations in urban systems

Classifications of violations	Description
A	• Failure to immediately notify MIH and Local Authority after becoming aware of water which it supplies can be a threat to public health (refer to Paragraph 19) • Falsifying information on the water quality provided to customers • Failure to comply with monitoring and reporting requirements • Failure to consistently provide residual chlorine in the network • Failure to meet the conditions granted by an exemption • Failure to provide full 24 hour water and pressures at end networks probably half of bar (pushing water pressure about 4 to 5 metres)
B	• Failure to use approved sampling or testing methods. Failure to maintain pH, turbidity, arsenic, fluoride and microbial parameters within the permissible limits
C	• Failure to maintain other parameters within the permissible limits and other failure by operator

Table 10-2 Penalty Units

Table 10-2: Penalty Units

Classifications of violation	Penalty Units
A	Maximum of 5 penalty units per 100 customers
B	Maximum of 2 penalty units per 100 customers
C	Maximum of 1 penalty units per 100 customers

59. Penalty unit is that 1 unit equals to 50 000 Riels (Fifty Thousand Riels).

60. MIH may provide awards and incentives for operators which demonstrate excellent practice in water quality management.

11. Reviews

61. NDWQS must be reviewed and revised no later than five years from the start of its implementation. Particular issues that should be considered in the new revised NDWQS are outlined below:

62. Emerging Water Quality Issues: The NDWQS should be revised to reflect emerging water quality issues and increased awareness of water quality issues in Cambodia.

63. Testing methods: Future upgrades of the NDWQS should consider making more stringent conditions for testing at independently accredited laboratories.

Annex

Annex A

Glossary of common technical water quality terminology

Acceptability parameter: A parameter that indicates the acceptability of water to a consumer or user and it is not of direct health concern.

CFU : Coliform or E.coli forming unit

MPN : Coliform or E.coli forming unit

Coliforms, fecal : Subgroup of coliform bacteria or thermoteloerant coliforms associated with fecal contamination from warm-blooded humans and animals; can ferment lactose at 44.5 T during analysis (virus forming).

Disinfecting : Treatment of water to inactivate microorganisms using chlorine, chlorine dioxide, chloramines, ultraviolet radiation, ozone, or other disinfectant. Boiling is popular at household level.

Drinking-water : Water that is suitable for human consumption such as drinking and cooking.

Escherichia coli (E. coli) : Indicator of pathogenic bacteria found in human intestines

Grab sample : A one-time sample collected using a dipper at that particular deep.

HWTS : Household water treatment and safe storage

Microbial parameters : A parameter which indicates the presence of pathogens

Monitoring : Routine collection of water samples for analysis to determine water quality.

Pesticides : Agricultural chemicals used to kill pests.

pH : A measure of acidity or alkalinity of water neutrality. if ph<7, it is acidity; if ph>7, it is alkalinity; and if ph=7, it is neutrality.

Physical parameters : Characteristics of water that can be detected by the senses including taste, odour, colour and turbidity.

Raw water : Untreated, un-disinfected surface water or groundwater

Residual Chlorine : Excess chlorine in treated water, usually between 0.1 to 1.0 mg/L, which indicates sufficiency of chlorination and an assurance of protection from pathogens.

Surveillance : Process of checking if monitoring of water supplies conforms to the NDWQS. Usually conducted by government authority and may include sanitary inspection, water monitoring, data processing, and report.

Thermotolerant-coliforms: known as fecal coliforms, which can grow at 44-45^{0}C. Indicator of fecal contaminations.

True Colour Unit (TCU) : Measure of colour of filtered water sample that could come from iron or dissolved organic substances, also quoted in Hazen unit.

Turbidity : Characteristics of cloudiness of water. The amount of solid particles that are suspended in water that can cause scattering of light. Low turbidity is essential for effective disinfection.

Water Safety Plan : A comprehensive risk assessment approach that encompasses all aspects of a water supply, from catchment to consumers. Its aim is to consistently ensure the safety of water for its intended use.

Annex B

Sampling and testing methods

Annex B – Sampling and Testing Methods; Administrative arrangements for Urban Water Supply Providers

At three monthly or annual sampling periods, sampling and testing will be organised by officials of Departments of Industry Mines and Energy under the direction of specialized officials of the Technical Office of Department of Portable Water Supply in cooperation with the service provider. The cost of the sampling and testing will be borne by the operator.

Methods of sampling for bacteriological quality for laboratory testing

The sample tested should be representative of the raw water sources under examination and contamination during collection or storage and transport should be avoided.

The tap where sample is collected should be cleaned and free from attachments and fully opened with water allowed to run to waste for a sufficient time to permit the flushing/clearing of the service lines. Flaming of the tap is not necessary. Taps with a history of previous contamination shall be disinfected with cleaning alcohol. No samples shall be taken from leaking taps.

Sterilized glass bottles, provided with plastic screw caps, should be used for collection of samples. A neck of the bottle shall be covered by a plastic or a thin aluminum foil. For waters that have been chlorinated, bottles containing 0.1 mL of a 3% solution of sodium thiosulfate for every 100 mL of water sample should be used**.**

The bottle should be kept unopened until it is ready for filling. During collection of samples, the bottle cap should be removed and the bottle should be filled half full and closed for a few times for rinsing. It should not be filled full until water reaches cap and ample space must be left for mixing samples. The bottle should be properly covered.

The bottle with the water sample should be placed in the cooler and transported to the laboratory no later than 8 hours.

Methods of sampling for physical and chemical analysis for laboratory testing

The actual collection of the water sample is a matter of considerable importance. Refer to the table below for additional guidance. The following procedures should be observed for sampling:

a) Collect samples from wells only after the well has been pumped sufficiently to ensure that the sample represents the quality of the groundwater that feeds the well. Sometimes it will be necessary to pump at a specified rate to achieve a characteristic drawdown as part of the sample record. New wells will require sufficient utilization and abstraction before sampling. Collect samples from open shallow wells by taking a composite sample(s).

b) When samples are collected from a river or stream, it is best to take a composite sample from three depths (top, middle and bottom). In this way the sample becomes representative. If only a grab or catch sample can be collected, it is best to take in the middle of the stream and at mid depth.

c) When sampling stream, lakes, canals, and natural reservoirs, which are naturally subjected to considerable variations from normal causes, the choice of location, depth, and frequency of sampling will depend on the local conditions and the purpose of the investigations.

d) Before samples are collected from distribution systems, flush the lines sufficiently to ensure that the sample is representative of the supply, taking into account the diameter and length of the pipe to be flushed and the velocity of flow.

Sample Size for laboratory testing

A one (1) liter sample should suffice for most physical and chemical analyses but it could vary depending on the requirement of the laboratory.

However, do not use the sample for microbiological and microscopic examinations because the methods of collection and handling are different.

Testing and other general sampling requirements for laboratory testing or field test kits.

Ref: "Standard Methods for the Examination of Water and Wastewater"-APHA, AWWA & WEF, 20th Edition Sl. No.

Parameters	Laboratory method	Field Test Kit method	Sampling and Testing Methods			
			Type of Sample Container	Sample preservation	Holding time rec/req	Minimum sample (ml)
Microbial						
E.Coli	MPN or CFU/ 100ml	Trawass Delagua Wagtech	Glass	Cooler	6 hours	100 ml
Chemical						
Aluminium (Al)	AAS Spectro	Colorim. Spectro	Plastic	Add H_2SO_4 pH<2	2-4 h	250 ml
Ammonia (NH_4)	Spectro ...	Colorim. Spectro	Plastic	Add H_2SO_4 pH<2	2-4 h or 1 month	250 ml
Arsenic (As)	AAS Spectro	Field kit	Plastic	Add H_2SO_4 pH<2	2-4 h or 1 month	250 ml
Barium (Ba)	AAS	AAS	Plastic	Add H_2SO_4 pH<2	2-4 h or 1 month	250 ml
Cadmium (Cd)	AAS	None	Plastic	Add H_2SO_4 pH<2	2-4 h or 1 month	250 ml

Parameters	Laboratory method	Field Test Kit method	Sampling and Testing Methods			
			Type of Sample Container	Sample preservation	Holding time rec/req	Minimum sample (ml)
Chloride	Titrate Spectro	Spectro	Plastic	Cooler	1 week	250 ml
Chlorine, free residual	DPD	DPD	Plastic		Analyse immediately	250 ml
Chromium (Cr)	AAS Spectro		Plastic	Add H_2SO_4 pH<2	2-4 h or 1 month	250 ml
Copper (Cu)	AAS Spectro		Plastic	Add H_2SO_4 pH<2	2-4 h or 1 month	250 ml
Cyanide (CN)	Spectro	Spectro	Plastic		2-4 h	250 ml
Fluoride (F)	AAS Spectro	Spectro	Plastic		28 days	250 ml
Hardness	Titrate Spectro	Spectro	Plastic		1 week	250 ml
hydrogen sulfide (H_2S)	Spectro	Spectro	Plastic		2-4 h	250 ml

Parameters	Laboratory method	Field Test Kit method	Sampling and Testing Methods			
			Type of Sample Container	Sample preservation	Holding time rec/req	Minimum sample (ml)
Iron (Fe)	AAS Spectro	Spectro	Plastic	Add H_2SO_4 pH<2	2-4 h 28 days	250 ml
Lead (Pb)	AAS		Plastic	Add H_2SO_4 pH<2	2-4 h 28 days	250 ml
Manganese (Mn)	FAAS Spectro	Spectro	Plastic	Add H_2SO_4 pH<2	2-4 h 28 days	250 ml
Mercury (Hg)	AAS		Plastic	Add H_2SO_4 pH<2	2-4 h 28 days	250 ml
Nitrate(NO_3)	Spectro	Spectro	Plastic	Cooler	2-4 h	250 ml
Nitrite (NO_2)	Spectro	Spectro	Plastic	Cooler	2-4 h	

Parameters	Laboratory method	Field Test Kit method	Sampling and Testing Methods			
			Type of Sample Container	Sample preservation	Holding time rec/req	Minimum sample (ml)
Nickel (mg/l)	AAS		Plastic	Add H_2SO_4 pH<2	2-4 h 28 days	250 ml
Na	Spectro	Spectro	Plastic	Cooler	2-4 h	250 ml
Sulfate (mg/l)	Spectro	Spectro	Plastic	Cooler	2-4 h	250 ml
Selenium (Se)	AAS		Plastic	Add H_2SO_4 pH<2	2-4 h 28 days	250 ml
Zinc (Zn)	AAS		Plastic	Add H_2SO_4 pH<2	2-4 h 28 days	250 ml
Physical						
pH	Electrode	Electrode	Plastic	Analyse immediately		

Parameters	Laboratory method	Field Test Kit method	Sampling and Testing Methods			
			Type of Sample Container	Sample preservation	Holding time rec/req	Minimum sample (ml)
Total Dissolved Solid (TDS)	Dried Electrode	Electrode	Plastic			
Colour (true colour unit)	Spectro	Compare color	Plastic	Refrigerate	2-4 h	250 ml
Turbidity (NTU) or (FTU)	Spectro	Compare color	Plastic	Analyse immediately		
Taste	taste					
Odour	smell					

Notes:

P : Plastic (polyethylene or equivalent)

G- : Glass

P(A)- : Rinsed with I + HN03 I

G(A) - : Rinsed with I + HN03 I

Rec/Req : Recommended/required

Stat : No storage allowed; analyze immediately

asap : As soon as possible

n/a : not used

If samples cannot be returned to the laboratory in less than 6 hours and holding time exceeds this limit, the final reported data should indicate the actual holding time.