



# SOUTHERN SUDAN WATER QUALITY GUIDELINES



**October 2008**

Juba – Southern Sudan

UNICEF Juba

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## INTRODUCTION

Water is an essential element that all life forms. From a human perspective; having adequate amount of water for drinking and personal hygiene is fundamental, but quantity by itself is not sufficient to address these needs. The quality of water is also of vital health concern. The judgment of safety; or what is an acceptable level of risk in particular circumstances - is a matter in which society as a whole has a role to play. Every effort should thus be made to achieve a drinking-water quality as high as practicable.

As much as possible, water sources must be protected from contamination by human and animal waste, which can contain a variety of bacterial, viral, protozoan pathogens and helminthes parasites. Failure to provide adequate protection and effective treatment will expose the community to the risk of outbreaks of intestinal and other infectious diseases. Those at greatest risk of waterborne disease are infants and young children, people who are debilitated or living under unsanitary conditions, the sick, and the elderly. For these people, infective doses are significantly lower than for the general adult population.

In nature, water does not occur in its pure form; but contains a variety of dissolved substances. Water quality is used to describe the physical, chemical and microbiological characteristics of water that determine its fitness of use. People generally have their own notion of whether the water is of a "good" or a "bad" quality. Water which is clear with no unpleasant taste or smell is quickly accepted as clean, while that which is coloured, or with an unpleasant taste or smell is considered bad. These assumptions are not always correct as coloured water may not necessarily be unsafe to drink while that which is clear may contain disease causing microorganisms which are not visible to the naked eye.

The potential consequences of microbial contamination are such that its control must always be of paramount importance and must never be compromised. In general terms, the greatest microbial risks are associated with ingestion of water that is contaminated with human and animal excreta. There are few chemical constituents of water that can lead to acute health problems except through massive accidental contamination of a water supply. Moreover, experience shows that, in such incidents, the water usually becomes undrinkable owing to unacceptable taste, odour, and appearance. The fact that chemical contaminants are not normally associated with acute effects; this places them in a lower priority category than microbial contaminants, whose effects are usually acute and widespread. Indeed, it can be argued that chemical standards for drinking-water are of secondary consideration in a supply subject to severe bacterial contamination. The problems associated with chemical constituents of drinking-water however arise primarily from their ability to cause adverse health effects after prolonged periods of exposure. Of particular concern are contaminants that

have cumulative toxic properties, such as heavy metals, and substances that are carcinogenic.

The purpose of recommending guidelines for drinking water quality is to protect public health. It is important to endeavour for a drinking water quality that is as safe as it is realistic. Common water related health problems have a direct link to microbial contamination, closely followed by chemical contamination. The guidelines are meant to describe minimum realistic values for indicators of water quality in the present context of Southern Sudan.

WHO defines safe water as; “water that does not represent any significant risk to health over a lifetime of consumption, including different sensitivities that may occur between life stages.”

The proposed national drinking water quality guidelines are made simple for immediate implementation. Priority should be given in the remedy of urgent problems such as faecal contamination and subsequently put in place incremental improvements towards long term targets of water quality monitoring. The guidelines are therefore applicable to a range of piped and non piped drinking water supply systems; as well as in individual households.

## **1.2 The nature of the guideline values**

Guideline values are proposed for potentially harmful water constituents and are meant to provide a basis for assessing drinking-water quality. In using the guidelines, the following assumptions apply:

(a) A guideline value represents the concentration of a constituent that does not result in any significant risk to the health of the consumer over a lifetime of consumption.

(b) The quality of water defined by the Guidelines for drinking-water quality is also suitable for other domestic purposes, such as cooking, laundry and personal hygiene.

(c) When a guideline value is exceeded, this should be a signal to investigate the cause and take the necessary remedial action to protect public health.

(d) Short-term deviations above the guideline values do not necessarily imply that the water is unsuitable for consumption. Instead, surveillance on the source of contamination and its potential health effects should be undertaken and remedial measures implemented.

## **The physical, chemical and microbiological properties of water**

### **Physical quality**

Refers to the water quality properties such as pH, conductivity and turbidity. These properties affect the aesthetic quality of water which includes taste, odour and appearance.

### **Chemical quality**

Refers to the type and concentration of dissolved substances such as salts, metals and organic chemicals. Many of the chemicals are naturally found in water though high concentrations affect the palatability of water and may cause affect health.

### **Microbiological quality**

Refers to the presence of microscopic organisms such as viruses, bacteria and protozoa. Most of the microbes found in water are potential pathogens for waterborne infections such as cholera, typhoid and gastro-enteritis.

### **Important water quality parameters for drinking water use**

Many substances are found in the different types of drinking water resources. However, only a few will be of urgent health concern in any given circumstance. The most important substances to evaluate are those that occur in concentrations high enough to have negative health and aesthetic implications. Substances that are important monitoring benchmarks for drinking water quality are given in tables 1-4.

Table 1: General indicators of water quality

<b>Group A</b> <i>Group A substances indicate potential problems and should be tested frequently at all sampling points in the water supply system.</i>			
Parameter	WHO GV mg/l	SS GV mg/l	Description
pH	6.5 - 8.5	6.0 - 8.5	Affects the taste of water. Indicates potential corrosion problems.
Electrical conductivity (mS/m)	NS	150	An indicator of total dissolved solids (TDS). Informs if the water is drinkable.
Turbidity	≤	≤5	Affects the appearance of the water, thus if the water is aesthetically acceptable.
Faecal coliforms	0	0 -10	An indicator of faecal pollution and presence of potential disease causing microorganism in the water source
Residual chlorine (For treated water)	5	0.2 – 0.6	A measure of the effectiveness of disinfection.

Table 2: Substances commonly present at concentration that can be harmful to health

<b>Group B</b> <i>Group B substances (presence/concentration) should be determined before the water is supplied. The frequency of testing depends on the source and the treatment applied. Substances of concerned due to localized pollution sources may be added to this group</i>			
Parameter	WHO GV	SS GV	Description
Arsenic	0.01	≤0.05	May be present in groundwater. Can lead to arsenic poisoning.
Chloride	250	200	Elevated in hot, arid areas. May cause nausea and vomiting at high concentrations.
Fluoride	1.5	1	Elevated in groundwater in hot, arid areas. Causes browning of teeth and damage the skeleton.
Nitrate	50	30	Common in groundwater, particularly in areas of intensive agriculture or where pit latrines are used. May lead to severe toxic poisoning in infants.
Total Coliforms	0	0-50	A measure of the effectiveness of disinfection. Indicates the presence of disease causing micro organisms.

Table 3: Substances which occur less frequently at concentrations harmful to health

Parameter	WHO GV	SS GV	Description
Cadmium	0.003	0.003-0.005	Occurs in acidic waters where it may have been dissolved from appliances.
Copper	2	1.5	Occurs when copper piping is used to carry water with a low pH. Affects the colour of the water and may cause stomach upsets.

Table 4: Substances commonly present at concentration of aesthetic or economic concern

<b>Group D</b> <i>Group D substances should be determined at least when assessing the water for the first time. Thereafter, they can be included if there is reason to suspect their concentration are reaching unsafe levels</i>			
Parameter	WHO GV	SS GV	Description
Manganese	0.4	0.4	Results in brown/black discolouration of pipe fittings. May cause stains in laundry. Common in mining areas.
Zinc	3	3	Affects the taste of water. Usually caused when acidic water dissolves zinc from galvanized pipes.
Iron	0.3	0.5	Common in mining areas. May cause a reddish brown discolouration and affect the taste of water. Presence of iron encourages the growth of slimes made up iron reducing bacteria.
Potassium	NS (Part of TDS)	25-50	Affects the taste of water which can be bitter at high concentrations.
Sodium	NS (Part of TDS)	100	Affects the taste of water especially in groundwater found in hot, arid areas.
Calcium	100-200	80-150	Reduces lather in soap and cause scaling in electrical appliances.
Magnesium	NS (Part of TDS)	30-70	Affects the taste of water which can be bitter at high concentrations. It steps up the effect of calcium.
Hardness (Total)	200	200	This is expressed as a combination of calcium and magnesium. It is also associated with reducing lathering of soap and scaling of appliances.

Table 5. Constituents to consider when assessing drinking water quality from different water types.

SUBSTANCE	SOURCE			TREATMENT FACILITY	POINT OF USE
	River, well, stream, spring	Dam	Borehole		
<b>GROUP A</b>					
pH	••••	••••	••••	••••	••••
Electrical conductivity	••••	••••	••••	••••	••••
Turbidity	••••	••••	••••	••••	••••
Faecal coliforms	••••	••••	••••	••••	••••
Residual chlorine	NA	NA	NA	••••	••••
<b>GROUP B</b>					
Arsenic	••	••	••	••	••
Chloride	••	••	••	••	••
Fluoride	•	•	••••	••••	••••
Nitrate/Nitrite	•	•	••••	••	••
Sulphate	••	••	••	••	••
Total coliforms	••	••	••	••	••
<b>GROUP C</b>					
Cadmium	•	•	•	••	••
Copper	•	•	•	••	••
<b>GROUP D</b>					
Manganese	•	••	••	•	•
Zinc	•	•	•	••	••
Iron	•	••	••	•	•
Potassium	•	•	•	•	•
Sodium	•	•	•	•	•
Calcium	•	•	•	•	•
Magnesium	•	•	•	•	•
Total Hardness	•	•	•	•	•

•••• = Must be assessed.

•• = Important to include. Area specific.

• = Useful, for provision of more information

NA = Not applicable

## **How to decide which constituents should be included in the assessment**

The following factors will influence the choice of constituents to be measured:

1. The location of the water i.e. at the source, treatment facility or at the point of use.
2. The type of the water source, i.e. borehole, river, stream or harvested rain water etc.
3. The pollution problems in the monitoring area.
4. The type of water problems experienced in the bordering areas.

A systematic guideline of the type of constituents to consider when assessing different types of water sources is given in Table 5 above. Annex 1, Table 6 gives a comparison of the different Guideline Values from other countries.

## ANNEX 1

Table 6. A comparison of Drinking Water Quality Guideline Value (GV) with those proposed for Southern Sudan.

Parameter	WHO GV (mg/l)	N. Sudan GV (mg/L)	S. Sudan GV (mg/L)	Rationale for proposed Southern Sudan GV
<b>Physical</b>				
Taste	Acceptable	Unobjectionable	Acceptable	The taste should not be offensive to the consumer and within a taste range considered as acceptable.
Odour	Acceptable	Unobjectionable	Acceptable	The odour should not be offensive to the consumer and within an odour range considered as acceptable.
Colour (NTUs)	≤15	≤15	≤15	Most people can detect colours above 15 NTUs in a glass of water.
Appearance	Clear	Clear	Clear	An acceptable quality
Turbidity	1	≤5.0	≤5.0	Slight risk of potential health effects. Water has acceptable transparency.
pH	6.5 - 8.0	6.5 - 8.5	6.5 - 8.5	No health effects and aesthetically acceptable.
TDS	≤600	80-500	≤1000	Water tastes good and has an insignificant effect on sensitive age groups.
Conductivity	NS	NS	1500	Insignificant effects on sensitive groups.

<b>Chemical</b>				
Aluminium	0.1- 0.2	0.2	0.2	Practical level to minimise health concerns. Acceptable colour and turbidity.
Antimony	0.02	0.004	0.005	Practical level to minimise health concerns.
Arsenic	0.01	0.005	≤0.05	Insignificant health effects in all age groups
Barium	0.7	0.5	0.7	Practical level to address health concerns.
Boron	0.5	0.2	0.5	Practical level to address health concerns.
Cadmium	0.003	0.003	0.003-0.005	Insignificant health effects in all age groups
Calcium	100-200	NS	80-150	Insignificant health effects. Acceptable taste.
Chloride	250	250	200	Insignificant health risk. Acceptable taste.
Chlorine (Residual)	5	NS	0.2-0.6	Provides for adequate disinfection and an insignificant risk of health effects. Slight disinfectant like taste and odour at higher concentrations.
Chromium	0.05	0.04	0.05	Unlikely to give rise to significant health risks.
Copper	2	1.5	1.5	Insignificant health effects. Very slight metallic taste
Cyanide	0.07	0.05	0.05	Reasonable level for the protection of public health
Fluoride	1.5	0.6	1	Insignificant health effects in sensitive groups. Insignificant tooth staining.
Iron (Total)	0.3	0.3	0.5	No health effects. Slight metallic taste and may give the water a brownish discoloration.
Lead	0.01	0.007	0.01	Insignificant health effects in all age groups
Magnesium		NS	30-70	No health effects. Acceptable taste.
Manganese	0.4	0.5	0.4	Insignificant health effects. May impart a metallic taste. Brown/black discoloration of water may be noted.
Mercury (Total)	0.006	0.0007	0.006	Practical level to minimise health concerns.
Molybdenum	0.07	0.05	0.07	Within the range of safe levels in drinking water
Nickel	0.07	0.014	0.07	Provides sufficient protection for individuals who are sensitive to nickel.
Nitrate (NO <sup>3</sup> )	50	20	30	Insignificant health risk. No aesthetic effects.
Nitrite (NO <sup>2</sup> )	3	0.5	0.5	Negligible health effects. No aesthetic effects.
Potassium		NS	25-50	Insignificant health effects. Acceptable taste.
Selenium	0.01	0.007	0.01	Levels in drinking water are usually much less.
Silver	ND	0.05	0.1	Up to 1 mg/L can be tolerated without risk to health
Sodium	ND	ND	100	Negligible health effects. No aesthetic effects.

Sulphate	250	250	200	No health effects. No aesthetic effects.
Total Hardness as CaCO <sup>3</sup>	200	≤200	200	No health effects. Acceptable taste.
Uranium (DU)	0.015	NS	0.015	Negligible health effects. No aesthetic effects.
Zinc	3	3	3	No health effects. No aesthetic effects.

<b>Microbiological</b>						
			Permissible compliance contribution (100%)			
			95% min	4% max	1% max	
Total Coliforms (cfu/100ml)	0	0	0	10	50	Clinical infections unlikely in healthy adults, but may affect some sensitive groups.
Faecal Coliforms (cfu/100ml)	0	0	0	1	10	Clinical infections unlikely in healthy adults, but may affect some sensitive groups.
Heterotrophic Plate Count (cfu/1ml)	NS	NS	100	1000	10000	Useful in assessing the effectiveness of treatment and disinfection.
Guinea worm (Cyclops)	NS	NS	0	0	0	The presence of one infective cyclop in drinking water has the potential to start an outbreak

cfu = colony forming units  
NS = Not Specified

GV = Guideline Value  
mg/l = milligram per litre

ND = Not Determined  
ml = millilitre