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Compulsory Ethiopian Standard

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Ambient Surface Water for Recreation— Requirements

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Foreword

This Ethiopian Standard has been prepared under the direction of the Technical Committee for water quality (TC 78) and published by the Institute of Ethiopian Standards (IES).

Application of this standard is compulsory with respect to clauses of biological requirements.

A Compulsory Ethiopian Standard shall have the same meaning, interpretation and application of a "Technical Regulation" as implied in the WTO – TBT Agreement.

Implementation of this standard shall be effective as of ----------

In preparing this standard the following reference is used:

- Health Canada. (2012). Guidelines for Canadian recreational water quality. Health Canada.
- United States Environmental Protection Agency (2025). Recreation Water Quality Criteria and method.
- World Health Organization (2021). Guidelines for recreational water quality: Volume 1: Coastal and fresh waters [Recreational Water].
- Water Quality Guidelines for South Africa (1996): Volum e 2 (Recreation).

Acknowledgement is made for the use of information from the above publications. The MoWE and WLRC are acknowledged for preparing the draft standard document with financial and technical support.

Ambient Surface Water for Recreation— Requirements

1. Scope

This Ethiopian standard specifies the physical, chemical, and biological requirements of Ambient Surface Water for Recreational Use.

2. Normative References

The following referenced documents referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

- ES ISO 7027-1:2016: Water quality — Determination of turbidity — Part 1: Quantitative methods.
- ES ISO 7888:2024. Water quality — Determination of electrical conductivity.
- ES ISO 9308-3:2015. Water quality — Detection and enumeration of *Escherichia coli* and coliform bacteria.
- ISO 10260:2007. Water quality — Measurement of biochemical parameters — Spectrometric determination of chlorophyll-a concentration.
- ISO 5814:2012. Water quality - Determination of dissolved oxygen - Electrochemical probe method.

3. Terms and Definitions

For the purpose of this standard, the following definitions and terms, as defined in ES ISO 6107:2021(en), US EPA Terms & Acronyms and WHO, shall apply.

3.1

Ambient Surface Water

Natural, untreated water found on the earth including rivers, lakes, streams, ponds, wetlands, and reservoirs.

3.2

Biological Requirements

Biological indicators used to determine water quality for recreation.

3.3

Chemical Requirements

The set of chemical parameters and associated limit values established to ensure that the chemical composition of surface water is suitable for its designated uses.

3.4

Designated Uses

Specific beneficial purposes for recreation requiring defined water quality criteria.

3.5

Heavy Metals

Dense metallic elements toxic to living organisms even at low concentrations.

3.6

Permissible Limits

The maximum or minimum allowable concentration or range of a physical, chemical, or biological parameter in surface water that shall not be exceeded in order to protect designated water uses**.**

3.7

Physical Characteristics

The specified limits or ranges for measurable physical properties of ambient surface water that must be met to ensure the water is suitable for its designated uses without causing adverse effects.

3.8

Recreational Water

Surface water used for primary contact activities such as swimming, wading, or fishing, subject to quality standards that protect human health.

3.9

Water Quality Requirements

Set of defined parameters characterizing the quality of water to assess its suitability for specific uses.

4. Requirements and Their Limits

4.1.

Physical Requirements

Table 1: Physical requirements of surface water for recreational use.

Parameters	**Permissible Limit**	**Test Method**
Turbidity (NTU)	≤50	ISO 7027-1; APHA 2130 B
Colour (TCU)	≤15	APHA 2120 B
Temperature (°C)	≤35	APHA 2550
Odour	Unobjectionable	APHA 2150
Electrical Conductivity (µS/cm)	≤3000	APHA 2510 B; ISO 7888
Total Dissolved Solids (mg/L)	≤1000	APHA 2540 C

4.2.

Chemical Requirements

4.2.1.

General Chemical Indicators

Table 2: General chemical indicator requirements of surface water for recreational use.

Parameters	**Permissible Limit**	**Test Method**
Alkalinity (as $CaCO_3$) mg/L	≤750	APHA 2320 B
Hardness (as $CaCO_3$) mg/L	≤500	APHA 2340 C
Dissolved Oxygen (DO) mg/L	>4	ISO 5814: 2012
pH	6–9	APHA 4500-H+ B

4.2.2.

Inorganic Chemicals

Table 3: Inorganic chemical requirements of surface water for recreational use.

Parameters	**Permissible Limit (mg/L)**	**Test Method**
Aluminum (Al^{3+})	≤18	APHA 3500-Al B
Chloride (Cl^-)	≤400	APHA 4500-Cl^- B
Sulfate (SO_4^{2-})	≤400	APHA 4500-SO_4^{2-} E
Nitrate (NO_3^-)	≤50	APHA 4500-NO_3^- E
Nitrite (NO_2^-)	≤3.5	US EPA Method 353.2
Cyanide (CN^-)	≤0.1	US EPA Method 335.4

Total Phosphorus	≤0.01	APHA 4500-P

4.2.3.

Heavy Metals

Table 4: Heavy metal requirements of surface water for recreational use.

Parameters	**Permissible Limit (mg/L)**	**Test Method**
Chromium (Cr)	≤1 (total Cr)	USEPA 2000; APHA 3500-Cr B
Arsenic (As)	≤0.2	USEPA; APHA 3114 B
Lead (Pb)	≤0.2	APHA 3113 B
Cadmium (Cd)	≤0.06	APHA 3111 B; 3120 B; 3113 B; 3125 B
Nickel (Ni)	≤1.4	APHA 3111 B; 3113 B; 3125 B
Copper (Cu)	≤40	APHA 3500-Cu B
Manganese (Mn)	≤8	APHA 3111 B; APHA 3120 B; APHA 3125 B

4.2.4

Organic Chemicals

4.2.4.1

Pesticides

Table 5: Pesticide requirements of surface water for recreational use.

Parameters	**Permissible Limit (µg/L)**	**Testing methods**
DDT (Total)	≤3	US EPA Method 8081B
Chlorpyrifos	≤2	US EPA Method 8141B; US EPA Method 525.2
Glyphosate	≤200	US EPA Method 536
Endosulfan (alpha/beta)	≤40	US EPA Method 8081B; US EPA Method 525.2

2,4-D (2,4-Dichlorophenoxyacetic acid)	≤100	US EPA Method 515.4; US EPA Method 515.3

4.2.4.2

Other Organic Compounds

Table 6: Other organic compound requirements of surface water for recreational use.

Parameters	**Permissible Limit (mg/L)**	**Test Method**
Benzene	≤0.2	US EPA 502.2; ASTM D5765
Toluene	≤14	US EPA 502.2; ASTM D5765
Xylene	≤10	US EPA 502.2; ASTM D5765
Grease& Oils	≤10	US EPA 1664

4.3.

Biological Requirements

Table 7: Biological requirements of surface water for recreational use.

Parameters	**Permissible Limit**	**Test methods**
Escherichia coli (E. coli) (CFU/100 mL)	≤150	APHA 9222 B
Enterococci (CFU/100 mL)	≤35	APHA 9230 C
Chlorophyll-a (Algal Biomass) (µg/L)	≤10	APHA 10200 H; ISO 10260:2007
Cyanobacteria (cells/mL)	≤20,000	US EPA 546
Microcystin (µg/L)	≤10	US EPA 546

Pathogenic Bacteria (Salmonella, Shigella, Vibrio)	absent	WHO, 2006; APHA, 2017
Protozoan Parasites (Giardia, Cryptosporidium)	absent	WHO, 2006; APHA, 2017

Annex A

(Informative)

Glossary of Terms

This glossary defines key terms used in the document to ensure clarity and consistent understanding among stakeholders.

A.1 Dissolved Oxygen (DO): The amount of oxygen present in water, which is essential for the survival of aquatic life.

A.2 pH: A measure of the acidity or alkalinity of water on a scale from 0 to 14, with 7 being neutral.

A.3 Recreational Use: Water body use for activities such as swimming, boating, or fishing that involve direct or indirect human contact.

A.4 Surface Water: Water found on the surface of the earth, such as rivers, lakes, reservoirs, and wetlands.

A.5 Threshold Limit: The maximum or minimum concentration of a parameter allowed in water to ensure it remains safe for a designated use.

A.6 Turbidity: A measure of the cloudiness or haziness of water, typically caused by suspended particles, affecting light penetration and aquatic life.

A.7 Wetlands: Areas of land where water saturation is the dominant factor controlling the environment and the associated plant and animal life, often acting as natural filters.

Annex B

(Informative)

Parameters – Sources and Impacts

B.1 Physical Parameters

Parameters	Sources	Effects on Recreation
Temperature	Seasonal variation, industrial effluents, deforestation, shallow surface runoff, damming (Chapman, 1996; Wetzel, 2001)	Warm water promotes microbial growth; reduces user comfort and safety (WHO, 2003)
Turbidity	Soil erosion, runoff from agriculture and construction, mining activities, algal blooms (Chapman, 1996; USEPA, 2006)	Diminishes water clarity and aesthetic appeal; may signal microbial contamination (WHO, 2017)
Color	Decaying organic matter, industrial discharge (e.g., pulp and textile), iron and manganese in water (Chapman, 1996; WHO, 2003)	Reduces visual quality; discolored water deters swimmers and suggests pollution (WHO, 2017)
Odour	Decaying vegetation, algae blooms (geosmin), industrial discharges, sewage.	Unpleasant for swimming; often the first indicator of a harmful algal bloom (HAB) (US EPA, 2019).
Electrical Conductivity (EC)	Natural weathering of rocks, fertilizers, saline intrusion, industrial effluents (Hem, 1985; Chapman, 1996)	Not directly harmful, but may signal pollution or salinity concerns (WHO, 2017)
Total Dissolved Solids (TDS)	Mineral dissolution, wastewater discharge, fertilizers, road salts (Hem, 1985; Crittenden et al., 2012)	Affects water taste and clarity; contributes to scaling and discomfort (WHO, 2003)

B.2 Inorganic Chemicals

Ions	Sources	Effects on Recreation
Aluminum	Natural mineral weathering, industrial discharges, mine drainage.	Generally low risk at neutral pH, but potential neurotoxicity concerns if water is used for drinking at source.
Alkalinity	Natural source include limestone, dolomite, carbonate rocks. Inaddition, anthropogenic source includes wastewater, agricultural runoff (lime, bicarbonates)	Generally low health risk; very high alkalinity can cause taste issues in drinking/recreation water. WHO (2017)
Hardness	Dissolved calcium and magnesium from soil and rock erosion (limestone, dolomite).	Causes scaling on boat hulls and pool equipment; reduces soap lathering.
Dissolved oxygen	Thermal and Physical Factors, Chemical Oxygen Demand, Toxic Chemicals, Eutrophication / Algal Blooms and High Biochemical Oxygen Demand.	Low DO usually coincides with poor water quality. WHO (2003)
pH	Natural Sources/ Carbonate rocks, Organic acids from decomposing vegetation (humic and fulvic acids) lower pH, photosynthesis by aquatic plants and algae consumes CO_2 → raises pH (more alkaline), respiration and decomposition produce CO_2 → lowers pH (more acidic). acidic effluents, alkaline effluents	6 – 9 pH outside this range can irritate skin and eyes; very acidic or very alkaline water can be hazardous. WHO (2003; 2017)
Chloride (Cl^-)	Rock salt deposits, domestic wastewater, industrial discharges, irrigation return flow (UNEP, 2006; Chapman, 1996)	High concentrations affect taste and may cause skin and eye irritation (WHO, 2003)

Sulfate (SO_4^{2-})	Weathering of gypsum and pyrite, industrial effluents, acid rain (Boyd, 1990; Chapman, 1996)	High levels can cause taste issues and gastrointestinal discomfort if ingested (WHO, 2003)
Nitrate (NO_3^-)	Agricultural runoff (fertilizers), septic systems, sewage, atmospheric deposition (UNEP, 2006; Allan & Castillo, 2007)	Health hazard if ingested (e.g., through accidental swallowing), especially for children (WHO, 2003)
Nitrite (NO2)	ntermediate product of nitrification, fertilizer runoff, sewage, septic systems.	Major health concern. Causes methemoglobinemia ("blue baby syndrome") if ingested; indicates poor sanitary condition (WHO, 2017).
Cyanide	Industrial discharges (metal plating, mining), plastic manufacturing, firefighting runoff.	Severe restriction. Extremely toxic to humans and animals; water body should be immediately closed (WHO, 2017).
Total Phosphorus	Fertilizers, detergents, sewage, industrial discharges (UNEP, 2006; Chapman, 1996)	Promotes microbial growth, leading to foul odors and algal mats in recreational waters (WHO, 2003)

B.3 Heavy Metals

Heavy Metals	**Sources**	**Effects on Recreation**
Lead (Pb)	Battery manufacturing, mining, lead-based paints, fuel combustion, and old plumbing systems (Alloway, 2013; WHO, 2017)	Harmful if ingested or through skin contact; linked to neurological and reproductive disorders (WHO, 2011)
Cadmium (Cd)	Electroplating, batteries, phosphate fertilizers, sewage sludge, and industrial effluents (Alloway, 2013; Jarup, 2003)	Chronic exposure can cause kidney damage and bone demineralization in humans (WHO, 2003)
Chromium (Cr, esp. Cr^{6+})	Tanning industries, electroplating, dyes, corrosion inhibitors (WHO, 2003;	Cr^{6+} is carcinogenic; exposure through skin or ingestion poses serious health risks (WHO,

	Shanker et al., 2005)	2011)
Arsenic (As)	Natural geological sources, mining, pesticides, and industrial waste (Smedley & Kinniburgh, 2002; WHO, 2011)	Skin lesions and cancer risk from long-term contact or ingestion (WHO, 2017)
Copper (Cu)	Mining, plumbing, pesticides, algicides, and industrial discharge (USEPA, 2009; ATSDR, 2004)	Ingestion or contact at elevated levels can cause nausea, irritation, and staining (WHO, 2003)
Nickel (Ni)	Electroplating, fossil fuel combustion, steel manufacturing, industrial runoff (WHO, 2005; Alloway, 2013)	Causes skin sensitization and allergic dermatitis with repeated exposure (WHO, 2011)
Manganese (Mn)	Natural geological sources, mining, steel production, industrial runoff (WHO, 2011; Alloway, 2013)	Aesthetic issues (taste, odor, staining); may cause neurological effects at high doses (WHO, 2011)

B.4 Pesticides Contaminants

Contaminants	**Type**	**Sources**	**Effects on Recreation**
DDT (Dichlorodiphenyl trichloroethane)	Organochlorine insecticide	Historical use in agriculture and malaria control; persistent in environment (ATSDR, 2002; UNEP, 2021)	Long-term health risks including cancer and neurological effects; hazardous through contact or ingestion (WHO, 2003)
Chlorpyrifos	Organophosphate insecticide	Applied to vegetables, cereals, and fruits; enters water via spray drift and runoff (USGS, 2014; UNEP, 2021)	Toxic via skin contact or inhalation; harmful especially to children (WHO, 2003)
Glyphosate	Broad-spectrum herbicide	Used in agriculture and landscaping; runoff and spray drift into surface waters	Low acute toxicity, but linked to skin and eye irritation; chronic effects

		(Giesy et al., 2000; UNEP, 2021)	under review (WHO, 2021)
Endosulfan	Organochlorine insecticide	Formerly used in cotton and horticulture; persists in soil and sediment (Weber et al., 2010; UNEP, 2021)	Dangerous through inhalation or skin contact; linked to neurological and hormonal disorders (WHO, 2003)
2,4-D (2,4-Dichlorophenoxyacetic acid)	Herbicide	Used on cereals, pastures, and lawns; enters water through drift and leaching (Booth et al., 2007; UNEP, 2022)	Skin and eye irritant; suspected endocrine disruptor with chronic exposure (WHO, 2021)

B.5 Hydrocarbons and Related Compounds

Contaminant / Group	**Sources**	**Effects on Recreation**
Benzene	Fuel leaks, petroleum refining, industrial solvents (ATSDR, 2007; UNEP, 2021)	Inhalation and dermal contact cause neurological and reproductive harm (WHO, 2003)
Toluene	Paints, adhesives, gasoline, industrial effluents (UNEP, 2021; ATSDR, 2017)	Volatile; causes dizziness, skin/eye irritation (WHO, 2003)
Xylene	Paint thinners, gasoline, varnishes, solvents (WHO, 2004; ATSDR, 2007)	CNS effects; inhalation risk during recreational use (WHO, 2003)
Grease & Oils	Domestic wastewater, abattoirs, stormwater runoff (UN-Habitat, 2008; EPA, 2012)	Aesthetic degradation and health risk due to slick surfaces (WHO, 2003)

B.6 Biological Parameters

Parameters	Sources	Effects on Recreation
Escherichia coli (E. coli)	Fecal contamination from humans, livestock, wastewater, and surface runoff (Cabral, 2010; WHO, 2003)	Strong association with gastrointestinal illness in swimmers (EPA, 2012)
Enterococci	Human and animal feces, wastewater discharge, stormwater runoff (Byappanahalli et al., 2012)	Primary indicator of marine recreational water quality (EPA, 2012; WHO, 2003)
Chlorophyll-a (Algal Biomass)	Nutrient loading (nitrogen, phosphorus), wastewater, surface runoff (Carpenter et al., 1998; Dodds et al., 1998)	Reduces clarity, causes odor and skin irritation (WHO, 2003)
Cyanobacteria	Nutrient-rich (phosphorus/nitrogen) lakes and ponds, warm, calm water.	Causes unsightly scums and foul odors; water contact should be avoided during blooms (WHO, 2003).
Microcystin	Produced by certain species of cyanobacteria (e.g., *Microcystis*) during blooms.	High risk of liver toxicity from ingestion during swimming; primary contact recreation should be banned during blooms (WHO, 2003).
Pathogenic Bacteria (Salmonella, Shigella, Vibrio)	Raw sewage, agricultural runoff, fecal pollution (Leclerc et al., 2001; Feachem et al., 1983)	Significant public health risk through dermal and accidental oral exposure (WHO, 2003)
Protozoan Parasites (Giardia, Cryptosporidium)	Sewage, feces, animal waste, runoff (Smith & Nichols, 2010)	Cause diarrhea and serious illness via recreational water contact (EPA, 2012)

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