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Ambient Surface Water for Aquatic Life Protection — Requirements

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Ambient Surface Water for Aquatic Life Protection — Requirements

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 DO, Nitrate, Nitrite, Cyanide, Total Phosphorus, DDT, Endosulfan, As, Cd, Pb, and Cr for aquatic life protection.

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 references were used:

- United States Environmental Protection Agency (2026). National Recommended Water Quality Criteria: Aquatic Life and Human Health Criteria Tables
- Australian & New Zealand (2023). Guidelines for fresh & Marine Water quality for the protection of aquatic ecosystem.
- Canadian Environmental Quality Guidelines (1999). Canadian Council of Ministers of the Environment.
- South Africa Water Quality Guidelines (1996): Volume 7 (Aquatic Ecosystems).

Acknowledgement is made for the use of information from the above publications. The Ministry of Water and Energy (MoWE) and Water and Land Resource Center (WLRC) are acknowledged for preparing the draft standard document with financial and technical support.

1. Scope

This Ethiopian standard specifies the physical, chemical, and biological requirements of Ambient Surface Water for Aquatic Life Protection.

2. Normative references

The following referenced documents are cited in the text in such a way that some or all of their contents 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 7888:2024. Water quality — Determination of electrical conductivity.
- ISO 18857-2:2009(en). Water quality — Determination of selected alkylphenols — Part 2: Gas chromatographic–mass spectrometric method.
- ISO 18856:2004(en). Water quality — Determination of selected phthalates using gas chromatography–mass spectrometry (GC-MS).
- ISO 25101:2009. Water quality — Determination of perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) — Method using solid-phase extraction and liquid chromatography–tandem mass spectrometry (LC-MS/MS).
- ISO 10260:2007. Water quality — Measurement of biochemical parameters — Spectrometric determination of chlorophyll-a concentration.
- ISO 10870:2012. Water quality — Guidelines for the selection of sampling methods and devices for benthic macroinvertebrates in fresh water.
- ISO 5814:2012 Water quality — Determination of dissolved oxygen — Electrochemical probe method

3. Terms and Definitions

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

3.1

Ambient Surface Water

The natural untreated water found on the Earth's surface including rivers, lakes, streams, ponds, wetlands, and reservoirs.

3.2

Aquatic Life

Aquatic life includes plants, animals, and microorganisms inhabiting freshwater ecosystems, relying on them for survival, growth, reproduction, and sustaining ecological integrity.

3.3

Biological Requirements

Biological indicators used to determine water quality for aquatic life protection.

3.4

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 use.

3.5

Designated Use

Specific beneficial purposes for aquatic life protection.

3.6

Emerging Contaminants

Chemicals and other substances that have been recently "discovered" in natural streams, and potentially cause deleterious effects in aquatic life at environmentally relevant concentrations.

3.7

Heavy Metals

Metallic elements with high atomic weight and density that are toxic even at low concentrations and tend to accumulate in living organisms.

3.8.

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 aquatic life.

3.9

Physical Requirements

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

3.10

Water Quality Requirement

Set of defined parameters characterizing the quality of water to assess its suitability for aquatic life protection.

4. Requirements and Their Limits

4.1.

Physical Requirements

Table 1: Physical requirements of surface water for aquatic life protection.

Parameters	**Permisible Limit**	**Test Method**
Colour (TCU)	≤15	APHA 2120 B
Temperature (°C)	15–35	APHA 2550
Odour	Unobjectionable	APHA 2150
Electrical Conductivity (µS/cm)	≤1000	APHA 2510 B; ISO 7888
Total Dissolved Solids (mg/L)	≤500	APHA 2540 C

4.2.

Chemical Requirements

4.2.1.

General chemical indicators

Table 2: General chemical indicator requirements of surface water for aquatic life protection.

Parameter	**Permissible Limit (mg/L)**	**Test Method**
Alkalinity (as $CaCO_3$)	20-750	APHA 2320 B
Hardness (as $CaCO_3$)	20-100	APHA 2340 C
Dissolved Oxygen (DO)	> 6.0	ISO 5814:2012

pH	6–9	APHA 4500-H+ B

4.2.2.

Inorganic Chemicals

Table 3: Inorganic chemical requirements of surface water for aquatic life protection.

Parameter	Permissible Limit (mg/L)	Test Method
Aluminium (Al^{3+})	0.2	APHA 3500-Al B
Chloride (Cl^{-})	≤ 230	APHA 4500-Cl^{-} B
Sulfate (SO_4^{2-})	≤ 200	APHA 4500-SO_4^{2-} E
Nitrate (NO_3^{-})	≤ 13	APHA 4500-NO_3^{-} E
Nitrite (NO_2^{-})	0.2	EPA Method 353.2
Total ammonia nitrogen (TAN)	1.9	EPA Method 350.1
Cyanide (CN^{-})	0.0052	EPA Method 335.4
Fluoride (F^{-})	0.12	APHA Method 4500-F-C
Total Phosphorus (TP)	0.02	APHA Method 4500-P

4.2.3.

Heavy Metals

Table 4: Heavy metal requirements of surface water for aquatic life protection.

Parameter	Permissible Limit (µg/L)	Testing Method
Chromium (Cr)	≤ 11 Cr (VI) ≤ 74 Cr (III)	USEPA 2000; APHA 3500-Cr B
Arsenic (As)	≤ 150	USEPA; APHA 3114 B
Lead (Pb)	≤ 5	APHA 3113 B
Mercury (Hg)	≤ 0.77	APHA 3112 B; APHA 3112 D APHA 3125 B
Cadmium (Cd)	≤ 0.37	APHA 3111 B; 3120 B; 3113 B; 3125 B
Nickel (Ni)	≤ 52	APHA 3111 B; 3113 B; 3125 B
Copper (Cu)	≤ 1.5	APHA 3500-Cu B

Zinc (Zn)	≤ 120	APHA 3500-Zn E; APHA 3500-Zn F
Manganese (Mn)	≤ 430	APHA 3111 B; APHA 3120 B; APHA 3125 B
Boron (B)	1500	APHA 4500-B B
Cobalt (Co)	4	APHA 3111 B; APHA 3113 B; APHA 3120 B; APHA 3125 B
Iron (Fe)	≤1000	APHA 3111 B; APHA 3113 B; APHA 3120 B; APHA 3125 B; APHA 3500-Fe B
Uranium (U)	15	US EPA 900.0
Selenium (Se)	5	APHA 3114 B; 3125 B

4.2.4.

Organic Chemicals

4.2.4.1

Pesticides

Table 5: Pesticide requirements of surface water for aquatic life protection.

Parameters	**Permissible Limit (µg/l)**	**Testing methods**
Atrazine	1.8	US EPA Method 525.2; US EPA Method 544
2,4-D	4	US EPA Method 515.4; US EPA Method 515.3
Aldrin	3 (acute)	US EPA Method 525.2; US EPA Method 608
Chlorpyrifos	0.041	US EPA Method 8141B; US EPA Method 525.2
DDT (Total)	0.01	US EPA Method 8081B
Demeton	0.1	US EPA Method 525.2; US EPA Method 8141B
Diazinon	0.17	US EPA Method 525.2; US EPA Method 8141B
Dieldrin	0.056	US EPA Method 525.2; US EPA Method 608
Endosulfan (alpha/beta)	0.056	US EPA Method 8081B; US EPA Method 525.2
Endrin	0.036	US EPA Method 525.2; US EPA Method 608
Glyphosate	800	US EPA Method 536
Heptachlor	0.0038	US EPA Method 505; US EPA Method 608

Heptachlor Epoxide	0.0038	US EPA Method 525.2; US EPA Method 608
Lindane	0.01	US EPA Method 505; US EPA Method 608
Malathion	0.1	US EPA Method 8141B; US EPA Method 525.2
Metolachlor	7.8	US EPA 525.3
Mirex	0.001	US EPA Method 525.2; US EPA Method 608

4.2.4.2

Other organic compounds

Table 6: Other organic compounds requirements of surface water for aquatic life protection.

Parameter	**Permissible Limit (µg/L)**	**Test Method**
Phenol	4	US EPA 420.1 (Total phenol); ASTM D5466
Benzene	370	US EPA 502.2; ASTM D5765
Toluene	10	US EPA 502.2; ASTM D5765
Xylene	30	US EPA 502.2; ASTM D5765
Aniline	2.2	US EPA 8270D; ASTM D4763
Grease & Oils	10 mg/L (total)	US EPA 1664 Extractible Material

4.2.5.

Emerging contaminants

Table 7: Emerging contaminant requirements of surface water for aquatic life protection.

Parameter	**Permissible Limit (µg/L)**	**Test Methods**
Perfluorooctanoic Acid (PFOA)	100	US EPA Method 533
Perfluorooctane Sulfonate (PFOS)	0.25	US EPA Method 1633
Bisphenol A (BPA)	3.5	ISO 18857-2; US EPA Method 528
Di(2-ethylhexyl) Phthalate (DEHP)	16	ISO 18856; US EPA 8061A
Di-n-butyl Phthalate (DBP)	19	US EPA Method 606

Diclofenac	0.05	ISO 25101; US EPA 1694
17α-Ethinylestradiol (EE2)	0.000017	US EPA Method 1694
17β-Estradiol (E2)	0.00018	US EPA Method 1694

4.3

Biological Requirements

Table 8: Biological requirements of surface water for aquatic life protection.

Parameters	**Permissible Limit**	**Test methods**
Chlorophyll-a (Algal Biomass) (μg/L)	8	APHA 10200 H; ISO 10260:2007
Macro invertebrate Community Index (MCI) (Stark & Maxted, 2004, 2007)	> 100	ISO 10870:2012; EPA 841-B-99-002; New Zealand MCI Starks et al., 1986

(Informative)

Glossary of Terms

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

A.1 Aquatic Ecosystem: A water-based environment that includes living organisms (such as fish, plants, and microorganisms) and the physical and chemical conditions that support them.

A.2 Dissolved Oxygen (DO): The amount of oxygen present in water, which is essential for the survival of aquatic life.

A.3 Ecosystem Protection: Safeguarding the structure, function, and biodiversity of natural ecosystems, particularly aquatic environments, from degradation due to pollution or other human activities.

A.4 Macroinvertebrate Community Index (MCI): It is a biological indicator used to assess the ecological health and water quality of freshwater streams and rivers. It is based on the presence and abundance of benthic macroinvertebrates (such as insects, worms, snails, and crustaceans), which vary in their tolerance to pollution. Each taxon is assigned a score reflecting its sensitivity to organic enrichment and pollution; the overall index is calculated from the community composition at a site.

A.5 Nutrients: Chemical elements such as nitrogen and phosphorus that are essential for plant growth but can cause eutrophication when present in excess in water bodies.

A.6 pH: A measure of the acidity or alkalinity of water on a scale from 0 to 14, with 7 being neutral.

A.7 Surface Water: Water found on the surface of the earth, such as rivers, lakes, reservoirs, and wetlands.

A.8 Threshold Limit: The maximum or minimum concentration of a parameter allowed in water to ensure it remains safe for a designated use.

A.9 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 Effects

B.1 Physical Parameters

Parameters	Common Sources	Effects on Aquatic Life
Temperature	Seasonal variation, industrial effluents, deforestation, shallow surface runoff, damming (Chapman, 1996; Wetzel, 2001)	Alters metabolic rates and reproduction in aquatic organisms; decreases dissolved oxygen levels; leads to thermal pollution (Allan & Castillo, 2007)
Colour	Decaying organic matter, industrial discharge (e.g., pulp and textile), iron and manganese in water (Chapman, 1996; WHO, 2003)	Indicates dissolved organic carbon or chemical pollution; may affect aquatic species indirectly (Crittenden et al., 2012)
Odour	Decaying vegetation, algae blooms (geosmin), industrial discharges, sewage.	Can indicate pollution or algal blooms; unpleasant for aquatic life but usually not directly toxic; often associated with low dissolved oxygen (WHO, 2017).
Electrical Conductivity (EC)	Natural weathering of rocks, fertilizers, saline intrusion, industrial effluents (Hem, 1985; Chapman, 1996)	Reflects ion concentration; high salinity disrupts osmoregulation in aquatic species (Boyd, 1990)
Total Dissolved Solids (TDS)	Mineral dissolution, wastewater discharge, fertilizers, road salts (Hem, 1985; Crittenden et al., 2012)	Alters water density and osmotic pressure; affects fish and invertebrates (Boyd, 1990)

B.2 General Chemical Indicators

Parameters	Common Sources	Effects on Aquatic Life
Alkalinity	Natural weathering of rocks (limestone), soil respiration, wastewater.	Buffers against pH changes; prevents acidification; essential for healthy aquatic life (CCME, 2010). Extremely high levels can increase metal toxicity.
Hardness	Dissolved calcium and magnesium from soil and rock erosion (limestone, dolomite).	Essential for fish bone development and invertebrate shells; reduces toxicity of certain metals (like copper) to fish (CCME, 2010).
Dissolved oxygen	Diffusion from atmosphere, photosynthesis of aquatic plants and algae.	Low DO (hypoxia) causes fish kills, releases sediment-bound toxins, and favors tolerant, often undesirable, species (CCME, 2010).
pH	Natural CO2 absorption, acid rain, mine drainage, industrial discharges, photosynthesis/respiration.	Extremes (<5 or >9) are lethal to aquatic life; affects solubility and toxicity of other parameters (e.g., metals become more toxic at low pH) (CCME, 2010).

B.3. Inorganic Chemicals

Inorganic Chemicals	Common Sources	Effects on Aquatic Life
Aluminium (Al^{3+})	Natural mineral weathering, industrial discharges, mine drainage.	Toxic to fish in acidic water (low pH), causing gill damage and ion loss; can accumulate in plants (Gensemer & Playle, 1999).
Chloride (Cl^{-})	Rock salt deposits, domestic wastewater, industrial discharges, irrigation return flow (UNEP, 2006; Chapman, 1996)	Toxic at high levels to aquatic life, especially freshwater species (UNEP, 2006; Chapman, 1996)
Sulfate (SO_4^{2-})	Weathering of gypsum and pyrite, industrial effluents, acid rain (Boyd, 1990; Chapman,	Excess sulfate can stress aquatic life and may promote oxygen depletion in sediments (Chapman, 1996)

	1996)	
Nitrate (NO_3^-)	Agricultural runoff (fertilizers), septic systems, sewage, atmospheric deposition (UNEP, 2006; Allan & Castillo, 2007)	Promotes eutrophication; toxic to aquatic organisms at high levels (Allan & Castillo, 2007; UNEP, 2006)
Nitrite (NO_2)	Intermediate product of nitrification, fertilizer runoff, sewage, septic systems.	Highly toxic to aquatic life (especially fish) by binding to hemoglobin, preventing oxygen transport ("brown blood disease") (CCME, 2010).
Total Ammonia Nitrogen (TAN)	It is combination of unionized form (NH_3) and $NH4^+$, which may come from agricultural runoff (fertilizers and animal waste), Municipal wastewater treatment plants (sewage), industrial effluents (food processing, chemical plants), decomposition of organic matter (dead plants and animals), and Aquaculture operations (fish excrement) (USEPA, 2015)	• Highly toxic to fish and invertebrates. The unionized form (NH_3) is particularly lethal, damaging gills and impairing oxygen uptake. • Causes convulsions, coma, and death in vertebrates. • Acts as a nutrient, leading to excessive algal blooms. When algae die, decomposition depletes dissolved oxygen, creating "dead zones." • Causes hyperplasia (excessive tissue growth) in gill epithelium, leading to suffocation.
Cyanide (CN^-)	Industrial discharges (metal plating, mining), plastic manufacturing, firefighting runoff.	Extremely lethal to aquatic life, interfering with cellular respiration, even at very low concentrations (CCME, 2010).
Fluoride (F^-)	Natural erosion, industrial discharge (fertilizer, aluminum production), water additive.	Can cause mottling of fish teeth and bones; highly toxic at elevated levels; can accumulate in plants (Camargo, 2003).
Total phosphorus (TP)	Fertilizers, detergents, sewage, industrial discharges (UNEP, 2006; Chapman, 1996)	Major contributor to algal blooms and eutrophication; oxygen depletion affects aquatic life (Chapman, 1996; UNEP, 2006)

B.4 Heavy metals

Heavy Metal	Common Sources	Effects on Aquatic Life
Lead (Pb)	Battery manufacturing, mining, lead-based paints, fuel combustion, and old plumbing systems (Alloway, 2013; WHO, 2017)	Highly toxic; bioaccumulates in aquatic organisms, affecting reproduction, behavior, and enzyme systems (Tchounwou et al., 2012)
Cadmium (Cd)	Electroplating, batteries, phosphate fertilizers, sewage sludge, and industrial effluents (Alloway, 2013; Jarup, 2003)	Bioaccumulates in fish and invertebrates; causes oxidative stress and disrupts aquatic food chains (Kalay et al., 1999)
Chromium (Cr, esp. Cr^{6+})	Tanning industries, electroplating, dyes, corrosion inhibitors (WHO, 2003; Shanker et al., 2005)	Cr^{6+} is highly toxic; causes gill damage, oxidative stress, and mortality in aquatic species (USEPA, 1998)
Mercury (Hg)	Gold mining, coal combustion, industrial discharge, medical waste (UNEP, 2013; Driscoll et al., 2013)	Methylmercury bioaccumulates and biomagnifies in aquatic food webs; affects fish, birds, and mammals (Boening, 2000)
Arsenic (As)	Natural geological sources, mining, pesticides, and industrial waste (Smedley & Kinniburgh, 2002; WHO, 2011)	Toxic to aquatic life; alters microbial communities and causes mutations (Chapman, 1996; Ravenscroft et al., 2009)
Zinc (Zn)	Galvanized pipes, mining, fertilizers, and industrial effluents (Alloway, 2013; ATSDR, 2005)	Essential at trace levels; toxic at high concentrations—affects fish gills and aquatic invertebrates (Sprague, 1986)
Copper (Cu)	Mining, plumbing, pesticides, algicides, and industrial discharge (USEPA, 2009; ATSDR, 2004)	Required in small amounts; toxic at high levels—causes fish gill damage and liver dysfunction (Chapman, 1996)
Nickel (Ni)	Electroplating, fossil fuel combustion, steel manufacturing, industrial runoff (WHO, 2005; Alloway, 2013)	Toxic to aquatic life; causes oxidative stress, gill lesions, and reproductive effects (Pane et al., 2003)
Iron (Fe)	Natural weathering, mining,	Excess Fe promotes microbial overgrowth

	industrial discharge, corroded pipelines (Chapman, 1996; WHO, 2003)	and oxygen depletion in sediments (Wetzel, 2001)
Manganese (Mn)	Natural geological sources, mining, steel production, industrial runoff (WHO, 2011; Alloway, 2013)	Essential at low levels; toxic in excess—affects fish nervous system and behavior (Santamaria, 2008)
Boron (B)	Natural weathering (volcanic rocks), industrial discharges, cleaning agents, seawater.	Essential in trace amounts but toxic to many plants at very low concentrations; can accumulate in sediments (CCME, 2009).
Cobalt (Co)	Natural weathering, mining operations, industrial effluent.	Essential in trace amounts for vitamin B12 synthesis, but toxic at high levels to algae and fish, affecting blood cells (CCME, 2010).
Selenium (Se)	Natural weathering of shales, agricultural drainage (irrigation of seleniferous soils), coal mining.	Bioaccumulates in the food chain; causes reproductive failure, deformities, and toxicity in fish and waterfowl at very low water concentrations (Lemly, 2004).
Uranium (U)	Natural weathering of soil and minerals, uranium mining and milling, nuclear fuel production, phosphate fertilizer application, industrial discharges (WHO, 2011; Alloway, 2013)	Chemotoxic and radiotoxic; bioaccumulates in gills, bones, and intestines; causes cell deformation, impairs reproduction, and exhibits dose- and time-dependent toxicity to algae and fish; toxicity is mitigated by higher water hardness and alkalinity (Li et al., 2024).

B.5 Pesticides

Pesticides	Type	Common Sources	Effects on Aquatic Life
Aldrin	Organochlorine insecticide	Historical agricultural use; enters water through soil runoff and sediment resuspension	Highly toxic to fish and aquatic invertebrates; bioaccumulates and affects nervous system

		(ATSDR, 2022; UNEP, 2019).	function (USEPA, 2004).
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)	Disrupts aquatic plant growth; toxic to fish at elevated concentrations (Gross et al., 1990)
Atrazine	Herbicide	Used in maize and sorghum farming; enters water through agricultural runoff (Giddings et al., 2005; UNEP, 2022)	Endocrine disruptor; causes reproductive and developmental effects in aquatic species (Hayes et al., 2011)
Chlorpyrifos	Organophosphate insecticide	Applied to vegetables, cereals, and fruits; enters water via spray drift and runoff (USGS, 2014; UNEP, 2021)	Neurotoxic; inhibits acetylcholinesterase in fish and aquatic invertebrates (Jokanović, 2001)
DDT (Dichlorodiphenyl trichloroethane)	Organochlorine insecticide	Historical use in agriculture and malaria control; persistent in environment (ATSDR, 2002; UNEP, 2021)	Bioaccumulates in food chains; causes egg thinning in birds and reproductive harm in fish (van den Berg, 2009)
Demeton	Organophosphate insecticide	Agricultural pesticide; enters water via runoff and spray drift (FAO, 2002; UNEP, 2019).	Highly toxic to aquatic organisms; inhibits acetylcholinesterase leading to neurotoxicity (WHO, 1997).
Diazinon	Organophosphate insecticide	Widely used insecticide in agriculture and urban pest control; enters water through runoff (USGS, 2014; UNEP, 2019).	Toxic to fish and aquatic invertebrates; disrupts nervous system function (USEPA, 2006).
Dieldrin	Organochlorine insecticide	Degradation product of aldrin; persists in sediments and aquatic systems (ATSDR, 2022; UNEP, 2019).	Extremely toxic to aquatic organisms; causes neurological impairment and bioaccumulation (USEPA, 2004).

Endosulfan	Organochlorine insecticide	Formerly used in cotton and horticulture; persists in soil and sediment (Weber et al., 2010; UNEP, 2021)	Highly toxic to fish and amphibians; endocrine disruption and reproductive harm (USEPA, 2002)
Endrin	Organochlorine insecticide	Historical pesticide use; enters aquatic systems via soil erosion and runoff (ATSDR, 2021; UNEP, 2019).	Highly toxic to fish; causes convulsions and death even at low concentrations (USEPA, 2004).
Glyphosate	Broad-spectrum herbicide	Used in agriculture and landscaping; runoff and spray drift into surface waters (Giesy et al., 2000; UNEP, 2021)	Alters algal communities; chronic exposure affects amphibian development (Solomon & Thompson, 2003)
Heptachlor	Organochlorine insecticide	Termiticide and agricultural pesticide; enters water through runoff and atmospheric deposition (ATSDR, 2017; UNEP, 2019).	Persistent and bioaccumulative; toxic to fish, causing liver damage and reproductive effects (USEPA, 2004).
Heptachlor Epoxide	Organochlorine insecticide (degradation product)	Formed from heptachlor in the environment; persists in sediments (ATSDR, 2017; UNEP, 2019).	Highly bioaccumulative; toxic to aquatic life with long-term ecological impacts (USEPA, 2004).
Lindane	Organochlorine insecticide	Used in agriculture and pharmaceuticals; enters water via runoff and improper disposal (WHO, 2022; UNEP, 2019).	Toxic to fish and invertebrates; affects nervous system and may bioaccumulate (USEPA, 2004).
Malathion	Organophosphate insecticide	Agricultural use and public health mosquito control; enters water via drift and drainage (ATSDR, 2003; UNEP, 2022)	Toxic to aquatic invertebrates and fish; causes oxidative stress and enzyme disruption (EPA, 2006)
Metolachor	Herbicide	Agricultural herbicide runoff	Toxic to aquatic plants (algae) at

		(corn/soybean fields).	low concentrations; potential endocrine disruptor in fish; persists in groundwater (CCME, 2010).
Mirex	Organochlorine insecticide	Formerly used for fire ant control; highly persistent in the environment (ATSDR, 2020; UNEP, 2019).	Bioaccumulates in aquatic organisms; causes chronic toxicity and reproductive impairment (USEPA, 2004).

B.6 Emerging contaminants

Compound	**Type / Use**	**Common Sources**	**Effects on Aquatic Life**
PFOA (Perfluorooctanoic acid)	Synthetic surfactant (PFAS group)	Non-stick cookware, fire-fighting foams, water-resistant textiles, industrial discharge (UNEP, 2013; Wang et al., 2017)	Persistent and bioaccumulative; toxic to aquatic life, affecting liver, thyroid, and immune systems (USEPA, 2023; Giesy & Kannan, 2001)
PFOS (Perfluorooctane Sulfonate)	Synthetic surfactant (PFAS group)	Firefighting foam (AFFF), industrial sites (non-stick coatings, textiles), landfill leachate.	Persistent, bioaccumulative, and toxic. Causes immune suppression, reproductive toxicity, and liver damage in wildlife (US EPA, 2022).
Bisphenol A (BPA)	Plasticizer and epoxy resin component	Plastic bottles, food can linings, thermal papers, landfill leachate (Staples et al., 1998; UNEP, 2021)	Disrupts endocrine function in fish and amphibians; affects reproduction and development (Flint et al., 2012; Corrales et al., 2015)
Di(2-ethylhexyl)	Plasticizer in PVC, cosmetics, and	Leaching from packaging, tubing, toys,	Endocrine disruptor; alters fish reproduction and organ

phthalate (DEHP)	packaging	cosmetics, medical waste (Taddesse & Mekonnen, 2021; Wormuth et al., 2006)	development (Oehlmann et al., 2009; USEPA, 2022)
Di-n-butyl Phthalate (DBP)	Plasticizer and solvent commonly used in consumer products such as paints, adhesives, inks, sealants, and particularly in cosmetics (nail polish)	Industrial plasticizer (PVC), personal care products, adhesives, industrial runoff.	Endocrine disruptor; affects reproduction and development in aquatic invertebrates and fish; toxic to algae (Oehlmann et al., 2009).
Diclofenac	Non-steroidal anti-inflammatory drug (NSAID)	Hospital and household wastewater, pharmaceutical industry discharge (UNEP, 2017; aus der Beek et al., 2016)	Highly toxic to fish and scavenger birds; causes kidney damage and hormonal disruption (Schwaiger et al., 2004; Oaks et al., 2004)
17α-Ethinylestradiol (EE2)	Synthetic estrogen (contraceptive)	Human excretion via urine; wastewater from households and sewage systems (Ternes et al., 1999; UNEP, 2021)	Extremely potent endocrine disruptor; causes feminization of male fish and intersex conditions (Kidd et al., 2007; EFSA, 2022)
17β-Estradiol (E2)	Naturally occurring estrogenic hormone in humans	Human and animal waste (sewage treatment plants, CAFOs).	Causes feminization of male fish, intersex characteristics, and reproductive failure at extremely low (ng/L) concentrations (Kidd et al., 2007).

B.7 Hydrocarbons and related compounds

Contaminant / Group	Common Sources	Effects on Aquatic Life
Phenols	Petrochemical industries, coal processing, paper mills, disinfectants (Mohan & Pittman, 2007; WHO, 2003)	Highly toxic to aquatic biota; inhibits enzyme activity, reproduction, and photosynthesis (Babich & Davis, 1981)
Benzene	Fuel leaks, petroleum refining, industrial solvents (ATSDR, 2007; UNEP, 2021)	Carcinogenic; causes hematological toxicity and bioaccumulates in aquatic organisms (Neff, 1985; USEPA, 2002)
Toluene	Paints, adhesives, gasoline, industrial effluents (UNEP, 2021; ATSDR, 2017)	Affects behavior, reproduction, and metabolism in aquatic fauna (Call et al., 1983)
Xylene	Paint thinners, gasoline, varnishes, solvents (WHO, 2004; ATSDR, 2007)	Impairs enzyme systems and cellular respiration in fish and invertebrates (Neff, 1985)
Aniline	Dye manufacturing, rubber processing, explosives (UNEP, 2017; ATSDR, 2002)	Reduces oxygen transport in aquatic life; highly toxic to fish (Snyder, 1991)
Grease & Oils	Domestic wastewater, abattoirs, stormwater runoff (UN-Habitat, 2008; EPA, 2012)	Forms surface films; smothers aquatic fauna and reduces oxygen exchange (Chapman, 1996)

B.8 Biological parameters

Parameter	Common Sources	Effects on Aquatic Life
Chlorophyll-a (Algal Biomass)	Nutrient loading (nitrogen, phosphorus), wastewater, surface runoff (Carpenter et al., 1998; Dodds et al., 1998)	Indicates eutrophication; leads to oxygen depletion and algal blooms (Smith et al., 1999)
Macroinvertebr	Pollution, habitat alteration, flow change	Decrease in diversity signals

ate Community Index (MCI)	decrease the index (Boothroyd & Stark, 2000; Barbour et al., 1999)	pollution and ecological degradation (Rosenberg & Resh, 1993)

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INSTITUTE OF ETHIOPIAN STANDARDS

Organization and Objectives

The Institute of Ethiopian Standards (IES) is the national standards body of Ethiopia. IES is re-named by the proclamation number 1263/2021, from Ethiopian Standards Agency (ESA) to Institute of Ethiopian standards, with the mandate Given by the regulation Number, 193/2010 and proclamation number, 1263/2021.

IES's objectives are፡

- Develop Ethiopian standards and establish a system that enable to check whether goods and service are in compliance with the required standards,
- Facilitate the country's technology transfer Through the use of standards,
- Develop national standards for local products and services so as to make them competitive in the international market.
- Conduct standards related research And provide training and technical support.

Ethiopian Standards

The Ethiopian Standards are developed by national technical committees which are composed of different stakeholders consisting of educational and research Institutes, governmental organizations, certification, Inspection, and testing organizations, regulatory bodies, consumer association etc. The requirements and/ or recommendations contained in Ethiopian Standards are consensus based that reflects the interest of the TC representatives and also of comments received from the public and other sources. Ethiopian Standards are approved by the National Standardization Council and are kept under continuous review after publication and updated regularly to take account of latest scientific and technological changes.

Orders for all Ethiopian Standards, International Standard and ASTM standards, including electronic versions, should be addressed to the Documentation and Publication Team at the Head office and Branch (Liaisons) offices). A catalogue of Ethiopian Standards is also available freely and can be accessed from our website.

 International Involvement IES, representing Ethiopia, is a member of the International Organization for Standardization (ISO), International Electro-technical Commission (IEC) and Codex Alimentarius Commission (CODEX). It also maintains close working relations with the American Society for Testing and Materials (ASTM). It is a founding member of the African Regional Organization for standardization (ARSO).

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