Environmental Flows

Environmental flows describe the quantity, timing, and quality of water flows required to sustain **aquatic ecosystems** and the **human livelihoods** and **well-being** that depend on these ecosystems.

Water for people

Humans use water to sustain communities, altering natural river flow.

Flow regulation
Dams and other structures alter the timing and magnitude of flow to produce energy

Climate change is changing river flow

Water taking
From rivers to use in agriculture, forestry, oil and gas industries, sewage treatment, and for drinking water

Recreational use
Such as canoeing, swimming and fishing

Increased flow
Due to urban infrastructure and stormwater

Water for nature

The seasonal high and low flows of rivers are important to sustain ecosystems and species that have adapted to the river.

During floods, gravel, logs and nutrients are moved across the floodplain making more available habitat for species

Reservoirs and groundwater are replenished

Birds can feed on exposed mudflats and fertile land allows plants to sprout after the waters recede

Dry periods can help purge aquatic weeds

Unsaturated Zone
Saturated Zone
Groundwater

Flow events

Overbank flow
A high flow event that breaches river banks
Annual/Biennial

High flow
Occur during or after rainstorm events
Short-duration

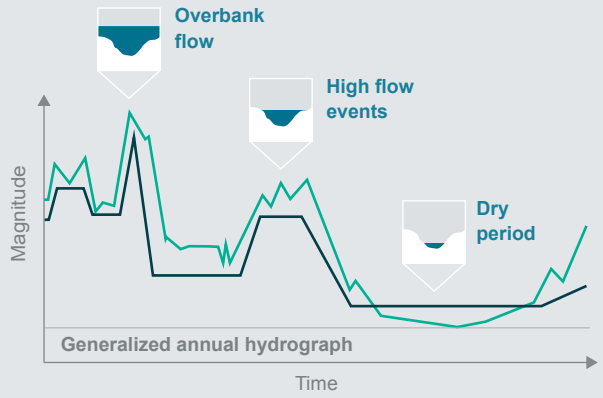
Base flow
Sustained mostly by discharge from groundwater, lakes, or from snowmelt
Most of the time

Natural low flow
Occur naturally and allow plants to grow on exposed land, creating complex habitats
Infrequent

Mimic natural flows

Environmental flows mimic the natural flow of a river, which supports ecosystem functions and allows for human water consumption.

Environmental flow patterns



Ecosystem base flow
A low-flow threshold below which all water withdrawals should cease. Below this threshold aquatic life requires all of the available water in a river. This occurs very infrequently, in very, very dry years.

Natural flow regime
Environmental flow
Ecosystem base flow

Five key components of environmental flow

Hydrology

To describe the movement of water over time by quantifying the magnitude, timing, duration, frequency, and rate of change of flow events.

Hydrological connectivity

Longitudinal
Upstream to downstream

Lateral
Ability to connect with the floodplain

Temporal
Flow connected over time

Vertical
Between groundwater and surface water

Geomorphology

To document the composition and shape of stream channels and floodplains and evaluate the physical processes that form and maintain them.

Sediment movement

Overbank flow
Sediment and nutrients are carried inland

Floodplain

Erosion

Higher stream power moves larger material

Base Flow

Erosion

Floodplain

Deposition of sediments

Base flows create pool habitat favoured by juvenile fish and minnows

Biology

To consider the interaction between river flow and the number and type of species found in the aquatic environment.

Riparian zones
Act as natural biofilters, protecting the aquatic environment from erosion and polluted runoff

Riparian ecosystem

Life cycle
Freshwater mussels require flows that support the presence of host fish

Larvae attach to host fish
Juvenile mussels settle
Breeding
Larvae released into the water

Water quality

To study the physical, biological and chemical attributes of water and the connections to hydrological and biological aspects.

Nutrient cycle

Microscopic bacteria break down dead or inorganic material into nutrients.

Physical	Biological	Chemical
Temperature	Viruses	Dissolved oxygen
Clarity	Bacteria	Carbon dioxide
Odour	Algae	Nutrients
Taste	Zooplankton	Heavy metals
		Other chemicals

Connectivity

To analyse the movement of organisms, energy and matter through the river system, as well as the impacts of natural and artificial barriers by considering connections among hydrologic, geomorphic, biological and chemical aspects.

Loss of connectivity

Dam
Fish habitat not connected anymore
Sediments deposit

Altered Connectivity

Flows and connectivity can be altered through manmade infrastructure promoting the spread of invasive species

Canal

Integrating environmental flows into water management decisions ensures that resilient communities can co-exist with healthy freshwater ecosystems.

For more information, visit
WWF.CA/CONSERVATION/FRESHWATER