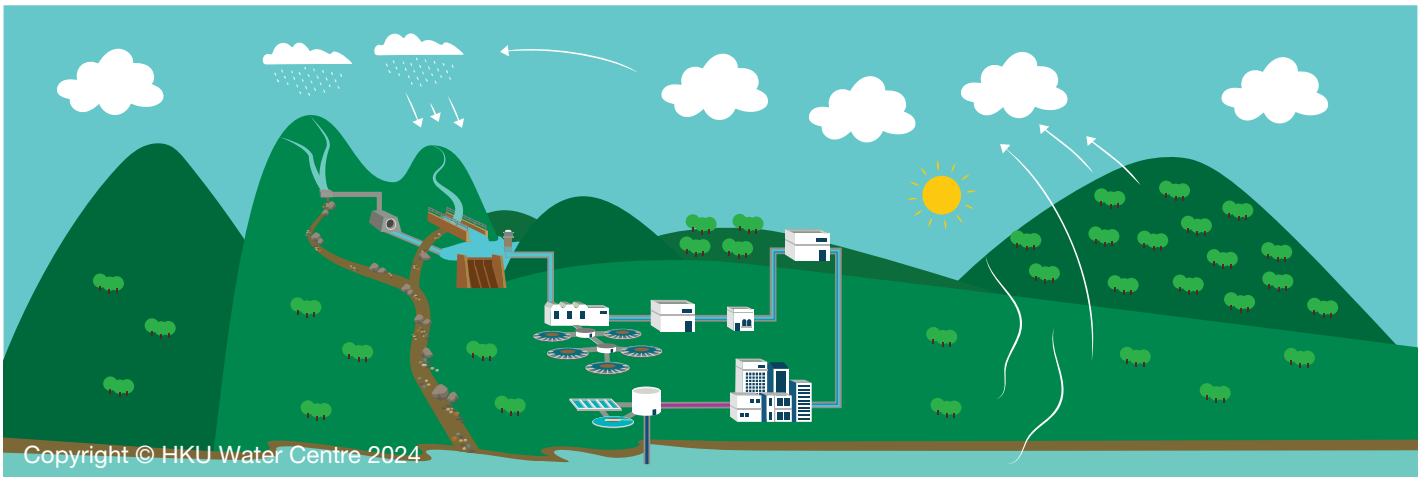
Water Cycle



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Foreword

The notion of water sustainability underpins the key messages that we want to convey to the readers through the Water Resources Information Portal. In order to help spotlight the significance of achieving water sustainability goals in our city, we would need to refer to, briefly, two inter-connected conceptual-cum-policy frameworks that are perched, respectively, at the global and the national levels.

The essence of the global agenda on water sustainability has been crystallized in Sustainable Development Goal #6 (SDG #6). Asides from highlighting the centrality of ensuring access to clean water and sanitation for all, the multiple sub-goals of SDG #6 remind us that managing the world's water resources in a sustainable manner will yield substantial cross-sectoral benefits. Conserving water at the city and the country scale, through policy measures and behavioural changes, could help protect global biodiversity as well as mitigate greenhouse gases emissions' impact on the global climate system.

The country's national agenda on water sustainability, on the other hand, has been articulated in the 14th Five-Year Plan for Water Security, promulgated in 2021 by the National Development and Reform Commission (NDRC). One of the NDRC Plan's guiding principles accords a higher degree of preference to demand management measures (i.e., water conservation) than the conventional supply augmentation approach. The NDRC Plan also, for instance, prioritizes, for municipal water managers' attention, the reduction of water losses emanating from the water supply networks under their charge. Moreover, in line with the spirit and the letter of the national goal of building an ecological civilization, the Plan accentuates the importance of incorporating the safeguarding of freshwater biodiversity into sustainable water resources management practices at the national, provincial and municipal scale.

Translating the aforementioned goals of the global and national agendas on water sustainability into impactful local actions is a challenging task. The difficulty stems from a relatively low degree of water literacy detected among the general public. Water literacy goes beyond people's knowledge of water issues; it also entails their attitudes toward water conservation ethics and their ability to appreciate and enact meaningful changes in their own water usage behaviour. Early empirical evidence, however, suggests that the mastery of water literacy amongst our community's diverse social groups is wanting. Against this backdrop, the Water Resources Information Portal has thus been created by the Centre for Water Technology and Policy to help nurture a water-literate community in our city.

Our efforts in assembling the Information Portal are guided by one fundamental belief: Embracing a river basin-oriented perspective is essential for us to comprehend the challenges in, and opportunities for, managing water resources sustainably in the 21st century. Through imparting individuals with essential water knowledge and encouraging them to consider water resources management matters from a river basin angle, we aim at broadening our community's collective understanding and sharpening their vision for managing water resources in a sustainable manner. This approach, fully aligned with the global and national water sustainability agendas, aspires to foster an active participation of Hong Kong people from all walks of life in the global water stewardship project.

1. Water cycle

While all water originates from nature and circulates through the Earth's interconnected system, human intervention is necessary to modify and manage the natural water cycle to secure adequate good quality freshwater to meet the demand of humans and ecosystems.

Natural water cycle

1.1 What is the natural water cycle?

The natural water cycle denotes the circulation process of water through the Earth’s interconnected system, which entails land masses, water bodies, living organisms and the atmosphere. In this process, water takes on a different form in each stage.

1.2 Where does rain come from?

Rain ensues from the evaporation of water from soil and water bodies such as oceans, seas, rivers and lakes. It also results from the transpiration of plants.

Evaporated water vapour condenses to form clouds. When clouds are saturated with water droplets, the latter falls to the ground as rain.

1.3 What is a drainage basin?

A drainage basin, also known as a catchment area, is an area of land mass where water ensuing from precipitation, such as rain or snow, drains into a common outlet, such as a river, a lake, a sea or an ocean.

A basin is typically enclosed by a watershed formed by hill ridges.

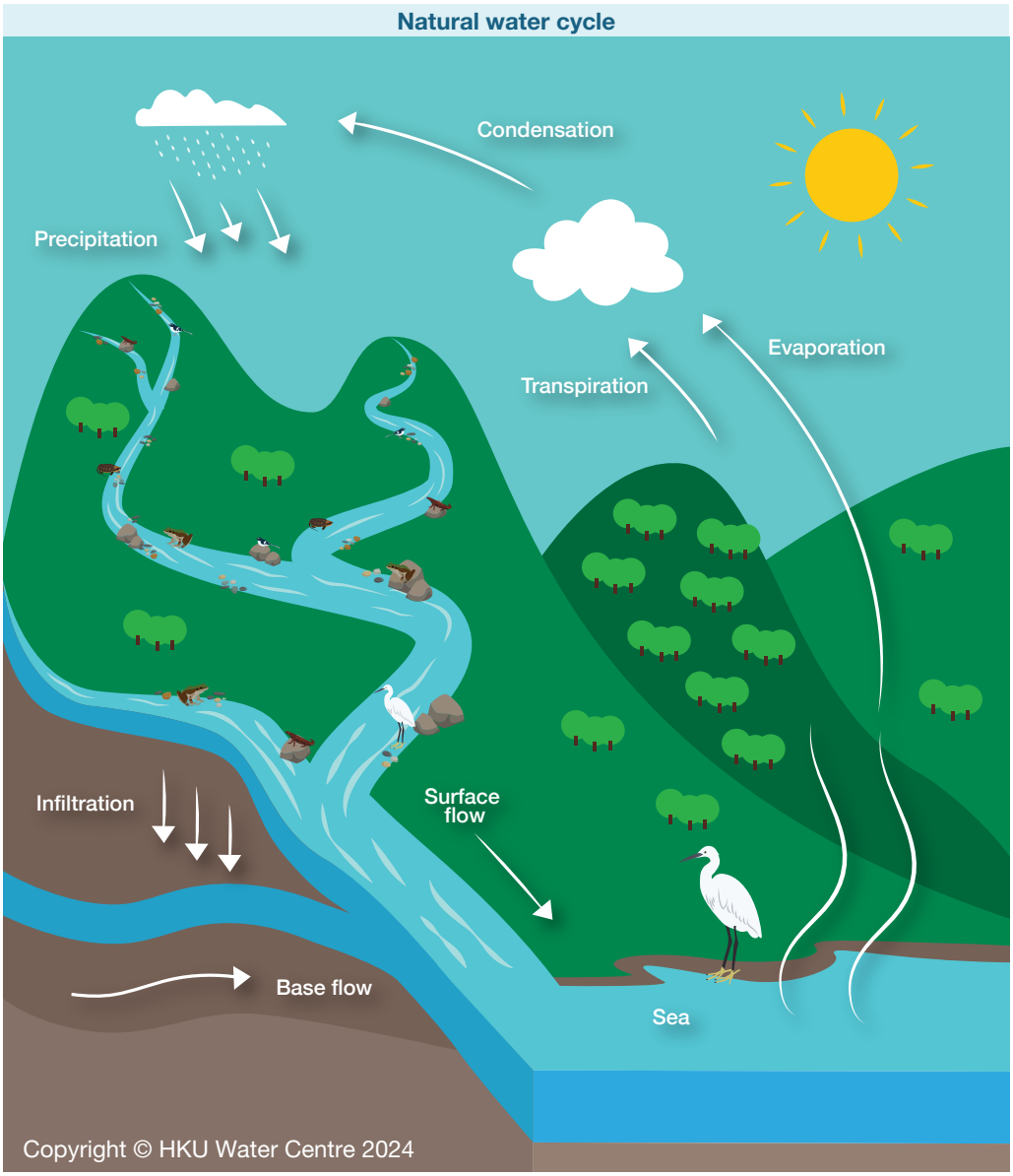
Drainage basin

1.4 Where does rainwater go to?

Rainwater flows over the land surface of a drainage basin as surface runoff, and makes its way to a lake, a river, or an ocean.

Through the processes of infiltration and percolation, rainwater can also travel through the soil to groundwater.

Infiltration is the process by which water on a ground surface is absorbed by soil. Percolation is the process by which water moves through the soil and reaches groundwater.



1.5 How would rainwater affect rivers?

Rainfall directly and indirectly contributes to the flow of rivers.

In a drainage basin, rainfall runs over the land surface as surface runoff or infiltrates the soil, eventually reaching a river.

It can also infiltrate into the ground and become groundwater, where it is taken up by plants or it seeps into streams and rivers as baseflow.

1.6 In what ways is the natural water cycle affected by human activities?

People alter the natural water cycle to extract water for urban development, as well as for agricultural and industrial uses.

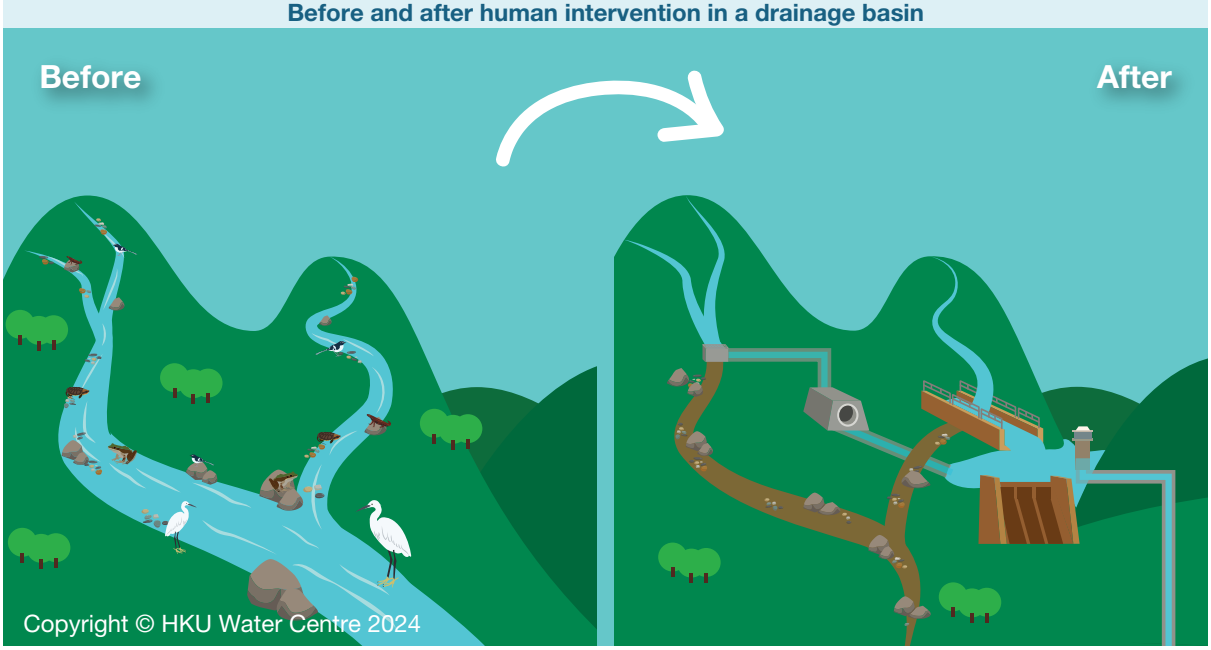
1.7 What have human done to alter drainage basins?

One typical example of human intervention in a drainage basin is the construction of reservoirs to capture freshwater for agricultural, industrial and municipal uses.

A reservoir is formed by constructing a dam across a river valley. After the dam is built, the river is intercepted, and water gradually inundates the valley, forming a reservoir.

To increase freshwater supply, diversion structures—such as weirs, intake structures, and catchwaters—are built to redirect river water into a reservoir.

Before and after human intervention in a drainage basin



1.8 In what ways have reservoir building actions impacted the natural water cycle?

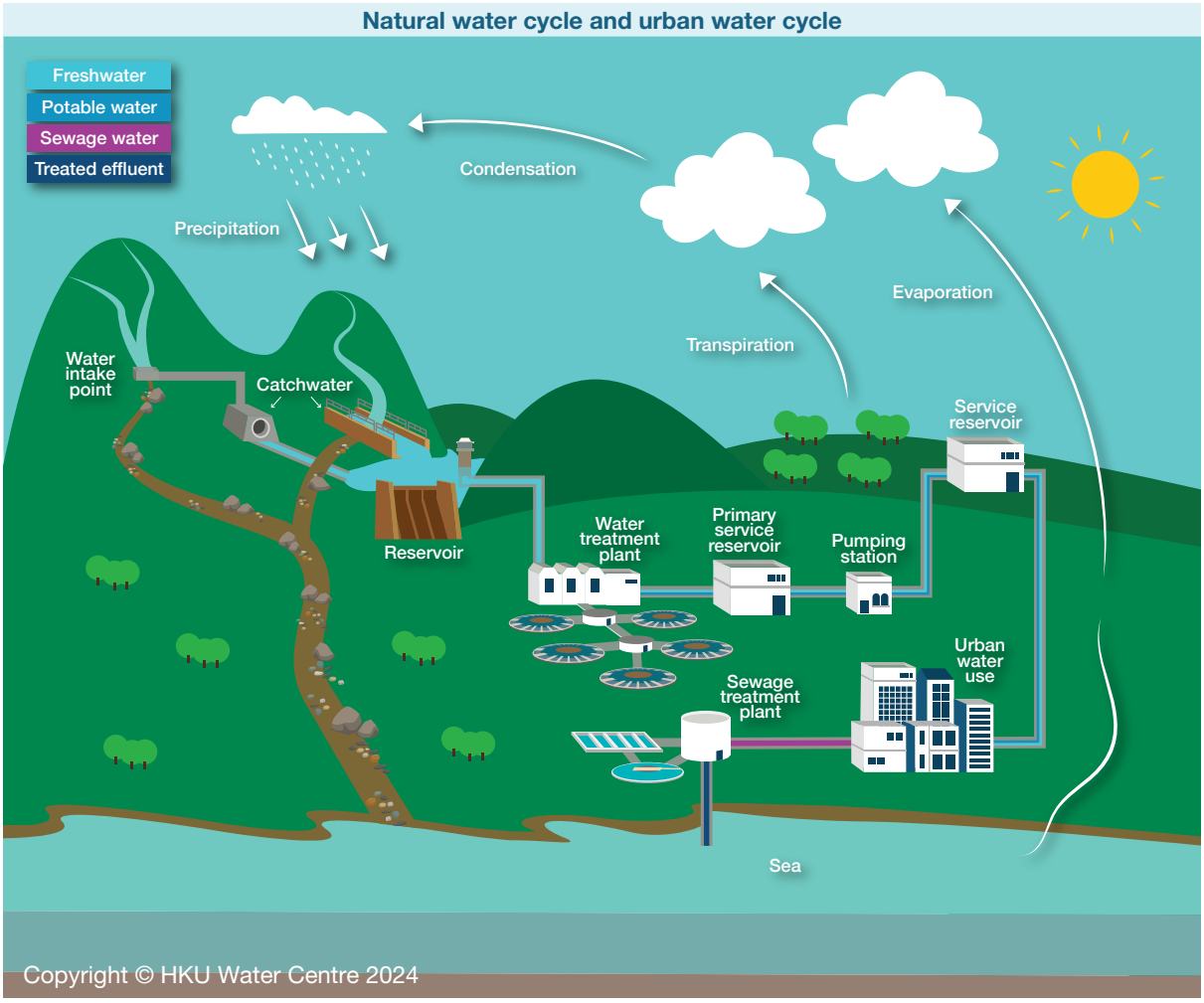
We build reservoirs, and alter the natural flow of rivers with dams and diversion structures constructed across river valleys. Water is stored in reservoirs.

The construction of diversion infrastructure reduces water availability in a river's downstream section or even stops the river flow, adversely impacting the downstream's ecology and related habitats.

Urban water cycle

1.9 What is an urban water cycle?

An urban water cycle refers to a cascading process in which freshwater is managed by people to satisfy their needs in cities. An urban water cycle entails a set of sequential activities: Freshwater collection, treatment, distribution, consumption, wastewater treatment and discharge.



1.10 What is a water gathering ground?

Water gathering grounds are land areas intentionally designated and altered to collect rainwater for human use, often together with the construction of such water infrastructure as reservoirs, water diversion and storage facilities.

In summary, while a drainage basin is a natural land area where water collects and drains to a common outlet like a lake or a river, water gathering grounds are land areas designated to capture rainwater to satisfy human needs.

1.11 What is a water intake point?

One type of water intake point is a man-made structure that akin to a drainage grate designed to intercept a river's flow. When a river crosses such a type of intake point, the intercepted water flows through an underground pipe and drains into a reservoir.

Relationships between water gathering grounds, water intake points, catchwater and reservoir

Relationships between water gathering grounds, open catchwater and reservoir

1.12 What is a catchwater?

A catchwater is a man-made ditch constructed alongside contour lines. The ditch slopes towards a reservoir, allowing river water to naturally flow into that reservoir.

1.13 What happens to rainwater after it has been captured by water gathering grounds?

After rainfall is captured by water gathering grounds, the collected rainwater is channelled into reservoirs for storage, either through water intake points or via catchwater systems.

1.14 How does rainwater become tap water?

Rainwater collected by catchments flows as surface runoff or streamflow. Water intake points would intercept the streamflow and divert the rainwater to reservoirs through conduits.

Water withdrawn by water utilities from reservoirs would undergo treatment processes at water treatment plants before being pumped to service reservoirs. Service reservoirs are temporary storage and distribution hubs. They distribute treated freshwater to buildings located within their service areas, providing utility customers with clean tap water at home.

1.15 Where does wastewater go to?

Wastewater refers to water that has been used in home, factories or businesses, and which carries pollutants. Collected by sewage pipes, wastewater is conveyed to sewage treatment plants, from which, after treatment, it is released into rivers or the ocean.

1.16 What is sustainable water resources management?

To manage freshwater resources sustainably means that we need to make sure that we have sufficient freshwater to meet the needs of people now and the needs of those in the future.

It also means that we should minimise the adverse impacts of human actions on the climate system, ecosystems, and the natural water cycle when we use freshwater to meet our needs.

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