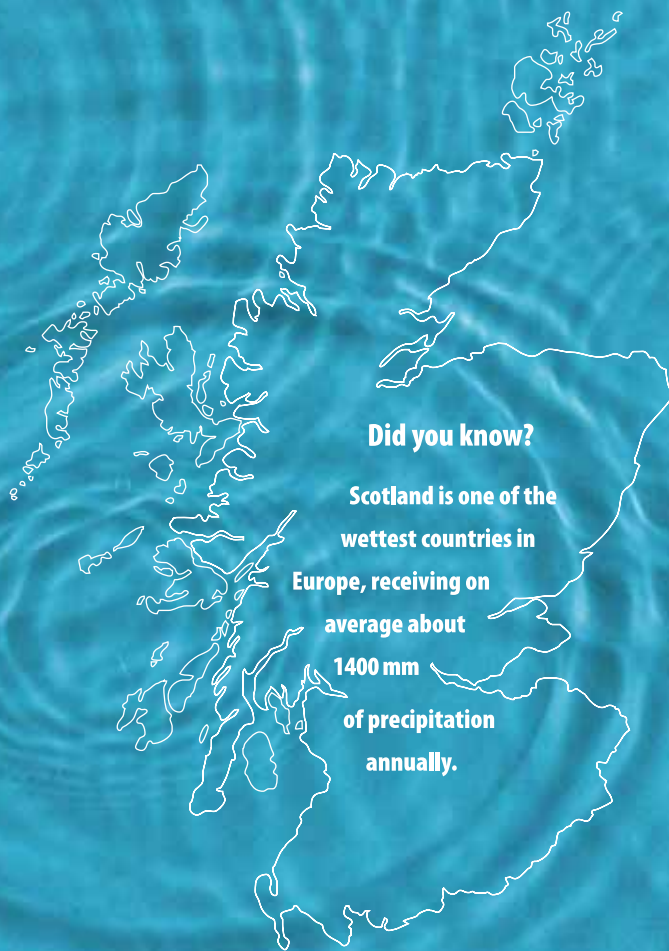



# The Water Cycle



**Did you know?**

**Scotland is one of the wettest countries in Europe, receiving on average about 1400 mm of precipitation annually.**

**The natural system for recycling water works by taking it from the oceans, transporting it to the hills and then flowing back down to the sea.**

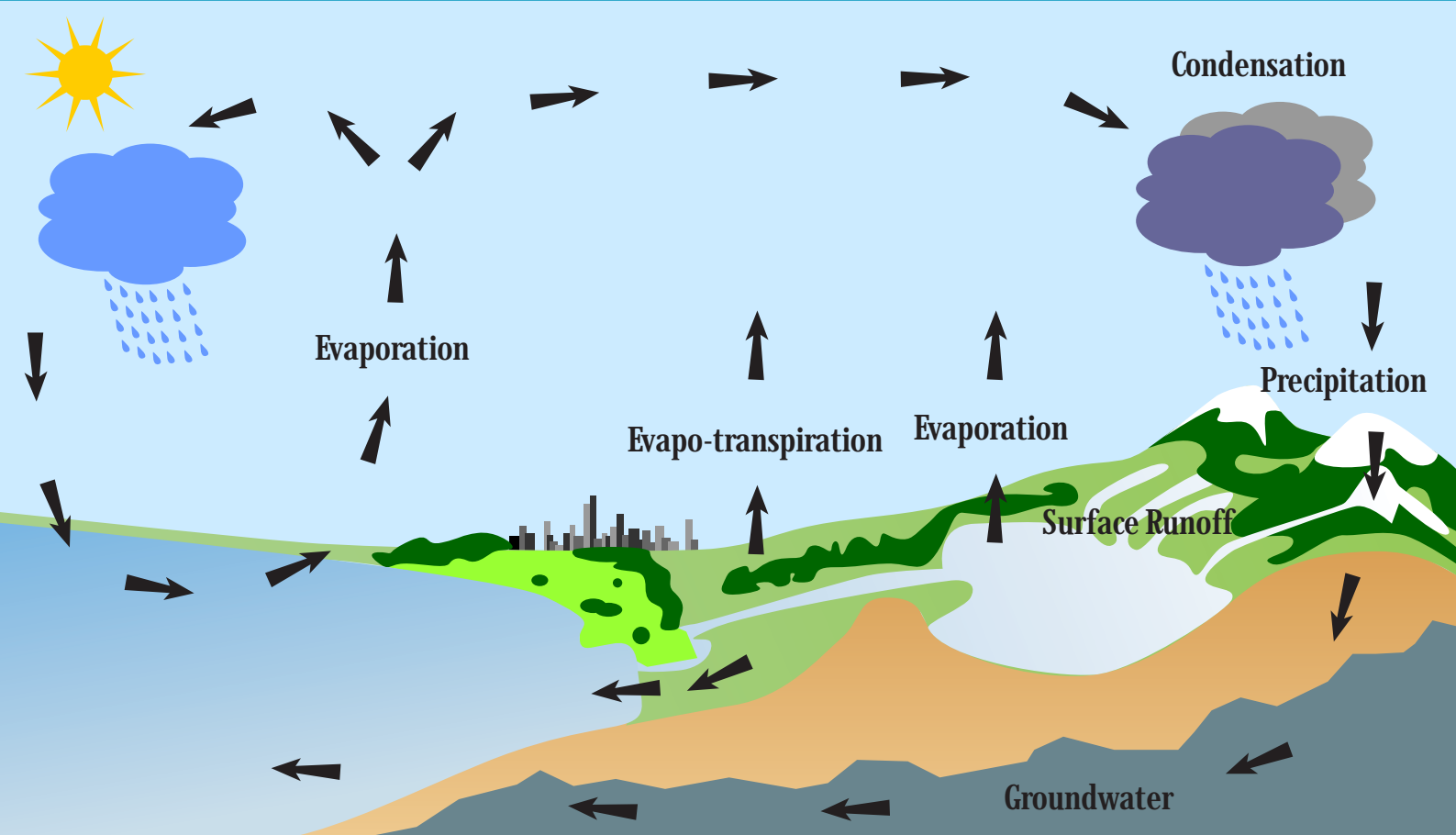
## What is the Water Cycle?

The water that you drink has come from somewhere to reach the tap, and goes somewhere else when you flush the toilet. The natural system for recycling water works by taking it from the oceans, transporting it to the hills and then flowing back down to the sea.

The water cycle begins with evaporation of water from the surface of the oceans and evapo-transpiration from the surface of the land. As moist air rises, it cools and water vapour condenses, forming clouds. Moisture is transported around the globe in clouds until it returns to the surface as precipitation. If precipitation falls on land, it either:

- 1) returns to the atmosphere via evapo-transpiration, or
- 2) flows over or through the soil to rivers and lochs as surface runoff, or
- 3) drains through the soil into the rocks beneath and becomes groundwater

Surface runoff flows into rivers and lochs and is carried back to the oceans, where the cycle begins again. Groundwater flows into rivers and lochs along the way.



### An intimate relationship

A key feature of Scotland's water cycle is the close relationship between precipitation and the soil. Since evaporation accounts for a relatively small part of the cycle here, most of the water that falls from the sky flows either over or through the soils on its way back to the oceans. Understanding soils and how water flows through them is therefore very important.

### How clean is the rain?

Rainfall over Scotland is generally low in pollutants, and levels of certain pollutants, such as sulphur, are falling. However, levels of nitrogen remain a concern. Acidifying pollutants such as sulphur and nitrogen are major drivers of change in aquatic ecosystems, which suffer and adapt in response. If the source of pollution is removed ecosystems may recover. However, populations of some species may not recover completely if pushed too far – a sorry reminder that many of these man-made environmental problems are irreversible. Find out more in... "Acidification and Recovery".

## 1. Water is delivered to the land...

### Upland Environments

Much of the rainfall received in upland environments is carried quickly to rivers as runoff, either over the ground or through the soils. This is because the soils are thin and unable to store much water and the underlying rocks are often impermeable – water cannot flow through them. This means that rivers fill up quickly, and the life within them has to cope with rapidly changing conditions.



Rivers tend to fill up quickly in upland environments

A lot of water flows through the soil in upland environments, picking up organic material on the way. This is an important source of food for aquatic life. Unfortunately a high organic content also turns the water yellow – which, although perfectly palatable, is an unwelcome ingredient when washing your whites! This has proved an expensive problem for the water industry, which spends millions of pounds every year removing the colour from the water.

Rainfall which travels rapidly over the land tends not to have much contact with the underlying rocks, so its chemistry on entering the rivers is relatively unaffected by the geology of the area. Groundwater on the other hand, which can sit around in the rocks for tens of years before gradually seeping into the rivers, often has a chemistry very similar to that of the local rock type. This is most strongly reflected in the chemistry of rivers during the summer, when groundwater is the main input.

### Lowland Environments

Under natural conditions, rivers in lowland settings fill up more slowly than those in upland areas, for a number of reasons, such as:

- Slopes are shallower, soils are deeper and underlying rocks are often permeable. As a result, more rainfall is typically soaked up and stored.
- There is usually less rainfall at lower elevations than in the mountains.
- Rivers are winding, and slow the water down, which can prevent flooding.

However, many rivers in lowland areas have been artificially straightened to improve drainage and maximise agricultural productivity. Without natural floodplains and a winding course, rivers cannot hold as much water, so flooding often occurs in the lower regions of many lowland rivers. As a result, lowland settings can often respond as quickly to rainfall as upland settings.



The natural scenario - a long lost ideal?

We also often see excess fertilisers, such as nitrates and phosphates, being washed into lowland rivers from nearby farmland. This is particularly pronounced in purely lowland rivers where there is no dilution by waters from upland areas. This problem is tackled by implementing various best management practices, which are outlined in “Links Between Land and Water”.

## 2. Water is delivered to the sea...

When water reaches estuaries and coastal areas, it is nearing the end of its journey, soon to begin the cycle again. Everything that happens to the water on its course over and through the landscape affects the quality and quantity of the water when it reaches the sea. It is therefore vital that we deal with problems in water quality or quantity as high up in river systems as possible, in order to avoid transferring problems from one setting to another.