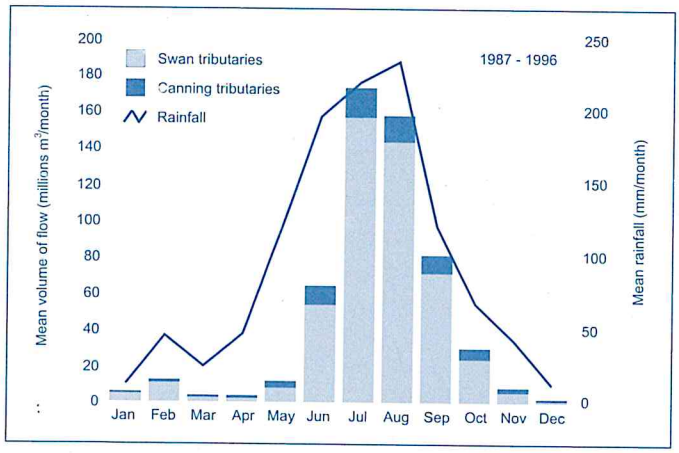
Seasonal changes in the Swan River estuary

In an estuary, fresh water comes from the streams that flow into it from the catchment and meets sea water, which enters as tides. Estuaries undergo constant daily and seasonal changes. There are changes in the volume and quality of water flowing into the estuary; salinity, temperature and oxygen levels change through the year.

Rainfall and salinity

The Swan River estuary is subjected to changes in freshwater flow and salinity. Because of the winter rainfall/summer drought climatic pattern in the south-west of Western Australia, the Swan River usually flows only in winter. This causes great differences in the salinity of the estuary between summer and winter. In winter salinity tends to be much lower because fresh water is flowing into the estuary. This flow is strong enough to prevent sea water moving far into the estuary on the incoming tide, so the upper estuary is fresh throughout winter.



Mean volume of flow and rainfall for the Swan-Canning system (1987-96)

This figure shows average rainfall and river flows into the Swan-Canning system, indicating peak occurrences during the winter and early spring. The flow from the Swan River is approximately 15 times greater than that from the Canning.

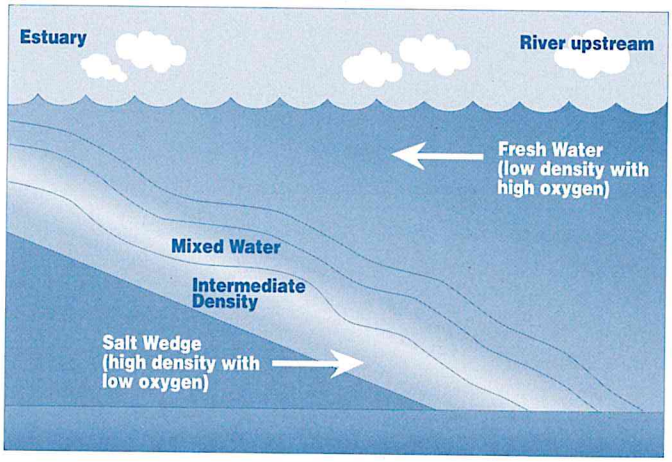
The salt wedge

In early spring, rainfall decreases and the freshwater flow is reduced. Sea water is then moved into the estuary through tides. Because the density of salty sea water is much greater than that of fresh water, the bodies of water do not mix readily, but tend to remain separate. The sea water moves upstream beneath the still-flowing lighter fresh water like a wedge. This process, which results in the layering of fresh water over sea water, creates a 'salt wedge'.

The two bodies of water are gradually mixed by the force of the wind in the open waters of the estuary, and the salinity of surface water increases. As weather conditions become even drier and there is no effective river runoff, this mixed water progresses further upstream. By the end of summer, the whole estuary normally has a salinity level similar to that of the sea.

The estuary's salt wedge can result in deeper bottom waters constituting a separate layer to the better oxygenated surface water. Very little oxygen can diffuse from the air through the surface layer of water and into the deeper waters.

These deeper waters may then become deoxygenated (depleted of oxygen). This is known as anoxia. Millions of invertebrates that live in the mud and sand on the estuary floor are unable to escape and sometimes die as a result of the lack of oxygen.



Salt wedge diagram showing the movement and gradual mixing that occurs as the salt wedge moves up the river.

Water levels

Changing weather conditions affect the estuary's hydrological status. For example, winter storms associated with low pressure systems increase water levels as more sea water enters the estuary. High pressure systems usually associated with calmer weather decrease water levels, forcing water out of the estuary.

Temperature

Water temperatures in the estuary change seasonally, and vary from place to place along the estuary and with the depth of the water. Other factors affecting temperatures are the inflowing water, atmospheric temperatures and the degree of mixing of waters. Temperatures range in winter from about 13 degrees to 16 degrees and in summer from 23 degrees to 26 degrees.

Seasonal changes and algal blooms

Like other living things, most algae need food (nutrients and minerals), warmth and light to grow. Different species need different combinations of conditions to form blooms. The requirements can include nutrient levels, water temperature, salinity levels, light and pH. When conditions are right, the algae multiply rapidly until all the available nutrients are used. The bloom then collapses, decays and recycles its nutrients to the water or sediments. Nutrients stored in the sediment builds up over decades. These nutrients can be released into the water under certain conditions, and recycled to fuel another bloom, often of a different species. Different species of algae may predominate at certain times of the year, so that you might observe an annual cycle of algal growth.

In the Swan River, this cycle is clearly seen in the phytoplankton (microscopic plants). During the winter, the river flow brings in nutrients, sediment and organic matter from the catchment. The river usually becomes fresh as far downstream as Perth Water. There are usually relatively low levels of microscopic algae, mainly diatoms, in the turbid brown flowing waters. In late winter to early spring, the lower reaches of the Swan Canning estuary downstream of the Narrows are never completely flushed out. The estuary retains some of the dense saline water from the previous season and is still brackish to saline in the deepest parts. Frequently in late winter-spring the lower parts of the river experience blooms of chain-forming estuarine diatom species that impart a brownish colour to the water. These common species are harmless.

During spring, when riverflow has reduced, salinity is still low and temperatures and light are increasing, a green bloom of microscopic algae usually occurs in the upper reaches. The river water frequently looks like green cordial. These are harmless species and may bloom for a week or two. By October, the saline water wedge pushes upstream of the Narrows Bridge. There is an increase in estuarine 'flagellate' species dominating blooms upstream of the Causeway. This is partly due to the release of accumulated nutrients from estuary sediment. Typically dinoflagellate 'red tides' occur. Because they are able to swim through the water column, flagellates can suddenly appear as a bright brick-red colour by midday. During the night these organisms can swim down to deeper bottom waters to take up nutrients.

Over summer the lower reaches of the river become clearer and more saline (saltier) and the true marine microscopic algae take over. Some species are potentially toxic but they are fortunately rare.

Any substantial rainfall during summer or autumn will often result in an algal bloom within two weeks. The toxic blue-green bloom in the Swan River in February 2000 was caused by an unseasonal summer storm that caused the river to carry water and nutrients into the Swan from the wheatbelt. The fresh, calm, nutrient-rich conditions suited a species of cyanobacteria (blue green) *Microcystis*, that normally could not grow in the estuary in that part of the year. *Microcystis* only survived for two to three weeks until the summer river flow slowed and the marine conditions returned.

Once winter sets in, the river is flushed out and a new cycle of algae begins.

Further reading: Managing our Rivers- a guide to the nature and management of the streams of south-west Western Australia (Chapter 2: How south-west catchments and river systems work) by Dr Luke Pen, Water and Rivers Commission, 1999..

SWAN RIVER TRUST

WATER AND RIVERS COMMISSION

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