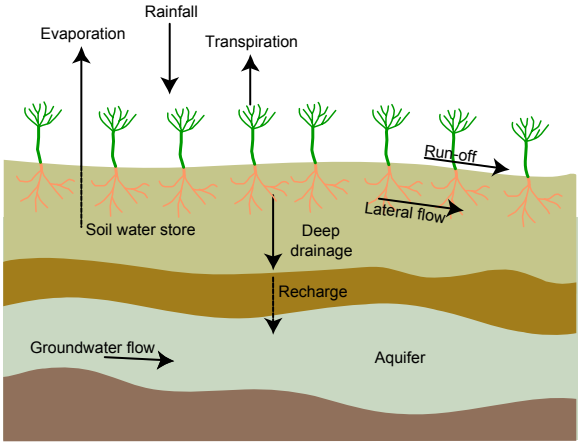
Deep drainage

A problem or an asset?

Deep drainage is the water that 'leaks' below the root zone of plants. It is part of the water balance, which also includes rainfall, run-off, soil water, evaporation and transpiration. Deep drainage is a natural process that leads to the recharge of groundwaters and springs that may flow into creeks and rivers.



The water balance

Why is it important?

Deep drainage represents a loss of water that may otherwise have been available for crop or pasture production. As it moves downwards, it may mobilise salts, nutrients or pesticides.

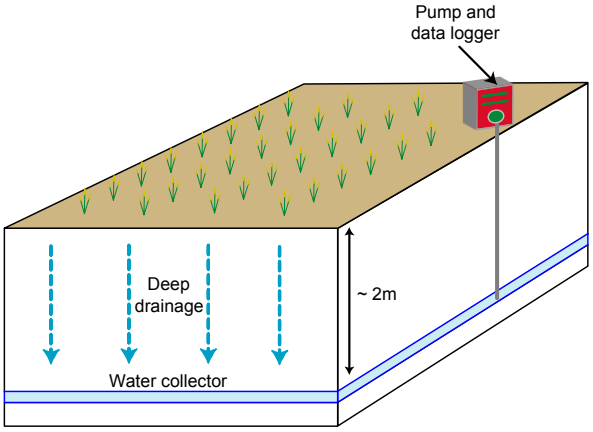
The amount of deep drainage may increase when deep-rooted natural vegetation is replaced by more shallow rooted crops and pastures. This may lead to a rise in groundwater levels and contribute to salinity problems. Spring flows may develop in parts of the landscape and waterlogging may occur.

The rate of movement of water below the surface, either vertically or horizontally, depends on the permeability of soil and rocks and the energy gradient of water. This determines whether the extra water becomes a valuable water resource, or mobilises salts that were previously in equilibrium and not causing any detrimental effects on the environment.

Queensland has traditionally been considered at lower risk of deep drainage than the southern states, due to the majority of annual rainfall coinciding with high evapotranspiration. However, drainage will occur if cumulative rainfall over any period exceeds the amount the soil can hold in the root zone (soil storage capacity). Drainage in summer-dominated rainfall areas is dependent on the rainfall sequence (i.e. when a 'big wet' occurs) and is strongly irregular.

Measuring deep drainage

Deep drainage is measured using a range of techniques. One approach is to directly collect and measure the water leaking out the bottom of a soil profile – this is done using special collectors called lysimeters, buried in the soil.



A field lysimeter for measuring deep drainage

Even in inland areas, rainfall contains salts that have been derived from oceans. These salts include ions such as sodium, magnesium and chloride. They are especially likely to accumulate in clay soils because they have poorer drainage than other soil types. Another way of measuring deep drainage is to determine the movement of the chloride in the soil. Chloride can be used to track water movement in soils as it very soluble, mobile and non-reactive, and so is moved where the water moves.

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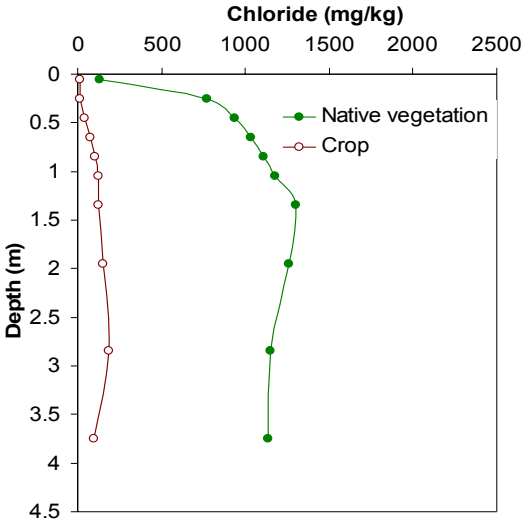
Scientists can compare the amount of chloride in the soils of uncleared areas with adjacent paddocks used for cropping or pastures. This enables them to estimate the amount of deep drainage that has occurred since the land was cleared.



Difference in soil chloride content between native vegetation and cropped land

Modelling deep drainage

There is a need to assess the risk of salinity in many places and under a variety of land uses. Measuring deep drainage with lysimeters or determining changes in chloride levels is expensive and time consuming. An option is to estimate deep drainage using computer models.

Water balance models account for water movement in much the same way a bank keeps a tally of money in an account. The models have been developed over many years to describe the water balance and plant growth for different farming and grazing practices and soil types. Results from many field experiments have been used to test these models. They allow us to make estimates of changes in the water balance for many situations.

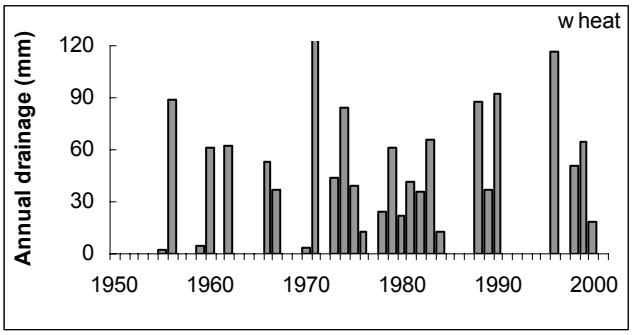
We use this knowledge to predict the consequences of land use change so that we can better manage soil and water for long-term productivity and environmental outcomes.

The results

Research to date suggests that significant amounts of deep drainage can occur in relatively short periods of time, when rainfall or irrigation fully wet a soil. The amount and rate depend on climate, soil type and land use.

On clay soils in southern inland Queensland, drainage under native woodland can average less than 1 mm/yr. Adjacent land cleared for dryland cropping can average about 8 mm/year, but ranges from 2−16 mm/year. In contrast, drainage can be as high as 100−200 mm/year under less efficient forms of irrigation.

Deep drainage occurrences are spasmodic and only occur when the soil is saturated in wet seasons or under irrigation. The graph below shows predicted occurrences of deep drainage. Between 1900 and 2000, deep drainage occurred in 50 years. There can be runs of years with no drainage and then runs of years with drainage.



A problem or an asset?

Deep drainage can be reduced by ensuring as much soil water as possible is converted into pasture or crop yields. This can be achieved with deep-rooted crops, opportunity cropping and paying attention to good crop management.

Many inland cropping soils have naturally high levels of salts that affect plant growth by reducing the amount of water uptake by plant roots. Drainage can improve these soils by leaching salts beyond the root zone, but knowing the fate of the salts is important.

Deep drainage recharges groundwater aquifers and can replace water that may have been extracted for water supplies. However excessive deep drainage may lead to a rise in water tables and lead to salinity problems. It is also possible that deep drainage may increase salt levels in groundwater and also add nutrients and pesticides.

Further information

For more information, check these Department of Natural Resources and Water (NRW) publications:

- Salinity Management handbook (Phone NRW Service Centre 07 3896 3216)
- Other NRW fact sheets in the salinity series
- Fact sheet L40 *Soil limitations to soil water entry soil—Understanding restrictive soil layers*
- enter the words ‘deep drainage’ in the search box at <www.nrw.qld.gov.au>. to obtain other useful references. ■