

# Links Between Land and Water

An aerial photograph showing a vast, plowed agricultural field with deep, parallel furrows that curve gently towards a large body of water in the distance. The sky is a clear, deep blue, and the water reflects the same hue. The foreground shows the texture of the dark brown soil in the furrows.

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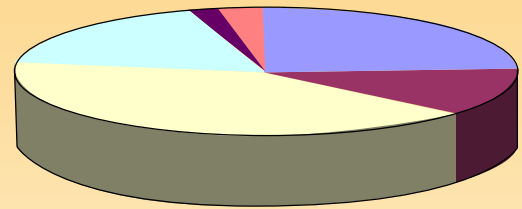
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The main impacts of land use on water quality come from agriculture and forestry. Recreational activities such as deer stalking and walking have a relatively minor role, in terms of transporting soil into water systems.

## Agriculture

Agriculture can have a large effect on water quality both at the surface and in groundwaters.

How land is used in Scotland



-  Cultivated Agricultural Land
-  Semi-Natural Grassland
-  Heathland and Bog
-  Woodland
-  Lochs
-  Built Up



## Do arable crops cause more water contamination than other types of farming?

Arable crops require fields to be ploughed. This involves having periods of bare fields, when soil erosion is greater and more soil is transported into water systems. There are generally two main effects of transporting soil into water courses:

- 1) the physical effect of the soil particle itself
- 2) the biological effect caused by added pollutants that are attached to the soil, such as phosphorus.

Left: Bare fields are more vulnerable to soil erosion

## What is nitrification?

Nitrates are added to arable crops on a regular basis in the form of fertilisers. These can have harmful effects on water if too much fertilizer is added to the land. This is because the nitrates are dissolved in the water and easily transported away from the field. Nitrification occurs when nitrates enter a water course and use up the oxygen needed by plants in the water, causing algae to build up. (See "Nutrient Enrichment of Freshwater").



## What are Nitrate Vulnerable Zones?

In response to concerns about nitrate levels in water, Nitrate Vulnerable Zones have been established across Scotland. These identify areas of land where farmers must adopt certain practices, to ensure that nitrate levels in water stay below a certain legal level. For example, farmers spreading farm waste, such as slurry, in these areas must, by law, keep a precise record of their activities.

## What about pesticides?

Pesticides, fungicides and herbicides are commonly added to crops to kill bugs, control weeds and prevent disease such as mildew. If they are carried by surface or groundwater to water courses however, they can pollute the water and damage the wildlife within it.

## How do livestock affect water quality?

The presence of livestock can also affect the quality of water in an area. Bacteria from manure such as *E. coli*, can make their way into water courses, and are known to cause health problems in humans. Animal waste itself can also reach water courses if spread in the wrong place or at the wrong time of year. It is therefore important that farmers know when and where to spread the waste.

## How do heavy metals contribute to water contamination?

Although some heavy metals are essential for life, others can be highly toxic to aquatic life.



Metals such as copper, found in pig slurry, can make their way into water courses. In extreme cases, high levels of lead in water have caused deformities in fish.

There are many other sources of heavy metal contamination besides agriculture however, such as distilleries, industrial areas and even the ingredients of some pharmaceutical products.

## How can we minimise water contamination from agriculture?

Best management practices are methods which attempt to reduce the movement of pollutants - such as sediments, nutrients and pesticides - from the land into surface or groundwater. They aim to strike a balance between protecting the environment and maximising economic productivity. In farming these methods include:

- Developing buffer strips and riverbank woodland: this practice involves leaving a strip of land next to a water course uncultivated. This is achieved by either leaving it as rough pasture or planting trees. Think of them as giant filtering systems, which trap the sediments and nutrients that are carried in the water running off fields. They also help to diversify the river channel by creating additional habitats for wildlife.
- Encouraging minimal cultivation: arable crop fields are not re-ploughed, but instead have the next crop drilled into them. While this does reduce soil erosion and therefore soil contamination to water courses, the downside is that it tends to lower the quality of soil structure.
- Using contour ploughing: ploughing up and down slopes creates channels which can increase the rate of soil erosion. Contour ploughing encourages farmers to plough following the contours of the land instead.
- Constructing fencing by water courses: fencing which restricts livestock access to water courses is another way of minimising water contamination.

## Forestry

Planted forests can affect the surrounding water courses in different ways during the life of the plantation. Forestry activities that may impact on the soil are both fewer and less frequent than with agriculture. Soils are generally disturbed only when a site is being established, treated or felled, and these events could be separated by intervals from 40 to 80 years.

### How do forests affect the quality of surrounding water courses?

#### Locating a forestry site

Trees consume water as they grow, which means that large forestry plantations may reduce the amount of water available to the rest of the catchment. Once the trees are felled, more water is likely to return to the streams and rivers. These changes to water levels might cause problems if housing developments are not properly designed to cope with the full range of conditions.

#### Establishing a site



Sites were often ploughed before being planted

Ploughing sites to prepare them for tree-planting increases the risk of soil erosion and contaminates nearby water courses. Fortunately, ploughing for forestry is less common than in the past. Badly designed and constructed forest tracks pose another threat to water courses, and can increase the amount of sediment transported to the water. This contamination from sediments damages the flora and fauna of an aquatic system, reducing the light levels entering the water. It also disrupts water treatment works and supplies.

#### Treating a site: Fertilisers and Pesticides

Some forests are treated with fertilisers and pesticides to help the trees grow. These chemicals can pollute water supplies and damage ecosystems in the same way as those from agriculture.

## Felling a site



Felling a site close to water increases the risk of sediment being transported to water systems

Felling a site close to water increases the risk of sediment being transported to water systems. Felling may also cause nitrates to leak from the soil, because they are no longer taken up by trees.

### How can we minimise water contamination from forestry?

In forestry, best management practices aim to achieve a balance between protecting water quality and maximising the production of wood crops. These include:

- Matching species to sites: Selecting tree species to suit the natural conditions of a site reduces the need for fertiliser.
- Constructing buffer strips and riverbank woodland: as with agricultural land use, buffer strips are important in forested areas, protecting water courses from sediments, contaminants and erosion, and also reducing the potential for acidification (See Acidification and Recovery).
- Using non-invasive methods for planting: modern techniques are becoming increasingly less intrusive, and involve roughing up the surface of the soil instead of ploughing. This disturbs the soil less and therefore reduces water contamination.
- Maintaining forest tracks: tracks are maintained on a regular basis to minimise sediment transport.