

# Protecting water from agricultural run-off: an introduction

You may not always see, or be aware of, run-off occurring, but perhaps you sometimes see sandy deposits at the bottom of tramlines or “fans” of sand at the base of slopes? Sand is heavy and may be left behind, but what happens to the lighter components of the soil, the clay, silt and organic matter? This note has been written for farmers and land management advisers to raise awareness of agricultural run-off and the problems it can cause. It also outlines how these problems can be alleviated and provides information on further sources of help and guidance.

## Diffuse water pollution and agriculture

Agriculture can cause diffuse water pollution when rainwater run-off from fields and buildings carries sediment, pesticides, nutrients and faecal contamination into ditches, streams, rivers, ponds and lakes.

Agriculture is a major source of diffuse water pollution because it covers a large area and the pollutants are essential parts of livestock and arable farming. Farming is not the sole cause, but it contributes to approximately 60 per cent of the nitrates, 25 per cent of the phosphorus and 70 per cent of the sediments entering our waters. Farmers who manage their land to reduce run-off, not only reduce water pollution they also conserve one of their most precious resources, the soil.

## The European Union Water Framework Directive

The Water Framework Directive (WFD) is European legislation that requires member states to achieve good ecological status of rivers, lakes and coastal waters designated as ‘water bodies’ under the Directive.

The Directive also brings together a number of other Directives such as those aimed at protecting the quality of drinking water sources, bathing waters and shellfish waters.



Photo 1 Soil erosion from agricultural land

Diffuse pollution from agriculture remains a major obstacle to achieving the objectives of the Water Framework Directive.

The Environment Agency monitors water quality and has identified Priority Areas where water quality is most at risk and those sites where pollution from farmland is the main reason for non-compliance.

Within key WFD Priority Areas, Defra, Natural England and the Environment Agency run the joint Catchment

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Sensitive Farming project to provide training, advice, technical support and capital grants to farmers. Details of the initiative can be seen under *Further information* below.

Diffuse pollution from agriculture is also a major cause of Unfavourable Condition in Sites of Special Scientific Interest (SSSI) and Natura 2000 sites. Effective action to address diffuse pollution from agriculture is critical in sustaining recovery of many nationally and internationally designated sites and ultimately securing Favourable Condition. There is generally good alignment between the distribution of designated sites adversely impacted by diffuse agricultural pollution and the coverage of Catchment Sensitive Farming and WFD Priority Areas.

### Financial reasons to control diffuse water pollution

#### Asset protection

About 2.2 million tonnes of topsoil are lost every year in the UK because of soil erosion and the annual cost of this in lost agricultural production is estimated to be approximately £9 million.

#### Cost reduction

Any pesticides, fertilisers or other agro-chemicals that are washed away represent a significant waste of money for the farmer and poor input management. Precise input management, good soil management and protection of watercourses have significant benefits for farm productivity.

### Other reasons to control diffuse water pollution

#### Environmental damage and reduced biodiversity

Raised concentrations of pollutants such as nitrate and phosphate can have serious effects on the health and biodiversity of our fresh and marine waters and the plants and animals that live in these environments.

Sediments can affect the health of aquatic organisms by smothering plants and river gravels, adding to the loss of diversity of a wide range of plant and animal numbers and species.

A survey carried out by Pond Conservation revealed 80% of the ponds surveyed were degraded and that poor water quality was a major contributing factor to this degradation.

#### Limiting the use of water

Diffuse pollution increases the costs of treating drinking water and can prevent the use of water for recreation, for example where it contains pesticides and / or faecal contamination.

#### Soils and soil carbon

Soils are a particularly significant store of carbon and the erosion of soils speeds up the release of carbon into the atmosphere. This release of carbon contributes to climate change. Climate change is expected to result in more frequent heavy rainfall which in turn will increase the risk of soil erosion.

Carbon is stored in soils as organic matter and this is an extremely important component of agricultural soil. Soil organic matter helps maintain soil structure and stability and retain water and nutrients. Soil organic matter is easily lost and hard to replace. Soils that contain less than 3.5% soil organic matter tend to lose their structure and then are generally not a very good or profitable growing medium.

### Methods to reduce diffuse water pollution

Diffuse pollution can be reduced by slowing the flow of water from farmland into both surface and ground waters. The range of measures includes adopting best management practice, cross compliance and agri-environment land management options. In addition, on some soil types and in areas with significant under-drainage these measures can be used with relatively small engineering works that slow the progress of water to water bodies. These water retention measures can be used within the field and/or within the ditch systems. To be most effective they should be used in conjunction with other land management measures.

Measures can be broken down into three types:

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### Measures that remove the source of pollution

These measures ensure that pollution is not created in the first place, for example by regular soil testing and precise crop management; by careful management and placing of tramlines and by using winter cover crops to prevent soil erosion.

### Measures that slow the pathway of contaminated water

These reduce the flow of water so that pollution does not reach watercourses. It includes adapting land management practices to ensure that any pollutant is not swiftly carried into water courses or high quality standing water habitats. Temporary storage ponds and in-field grass areas are examples of this sort of measure. See TIN099 *Protecting water from agricultural run-off: water retention measures* for more information on these measures.

### Measures that protect the receptor

These are the last line of defence and include land management options that prevent pollutants entering the watercourse. For example by establishing buffer strips adjacent to watercourses. See TIN100 *Protecting water from agricultural run-off: buffer strips* for more information on where to place buffer strips and how to establish and manage them.

## In-field and crop management Tramlines

Defra funded research has shown that up to 80% of run-off from arable land is associated with unvegetated and compacted tramline wheelings. There is on-going research into how best this run-off can be reduced, but measures that reduce run-off from tramlines include:

- Using low ground pressure tyres.
- Leaving tramlines drilled (this maybe possible with GPS guidance).
- Disrupting tramlines with tines to allow water to soak into the soil.
- Building up, or moving, any gateways so they are not the lowest point in the field and thus a pathway for run-off.

- Putting an extra headland tramline on the low side/s of the field that is disconnected from the other tramlines. The area between the two headland tramlines is then effectively a buffer strip to the major part of the field. See figure 1 below for information.

### Other in-field options

Leaving a rougher seed bed after drilling helps water percolate into the soil and reduces run-off, but rolling in after the drill is often desirable. However headlands are often consolidated to a greater degree anyway and a simple measure to lessen the risk of run-off is to leave the lower headland/s and any critical lower areas unrolled. The unrolled areas will improve the percolation rate of water and lessening the risk of run-off.

For other measures to help prevent run-off see *Further information* below.

## Water retention measures

Works include temporary storage ponds, in-ditch wetlands, grassed waterways and seepage barriers. In general it is better to have a series of smaller structures across the farm rather than one large solitary structure. If located and appropriately designed, the series of structures can help reduce water flows and prevent potentially damaging sediment from agricultural land entering watercourses.

### Temporary storage ponds

Temporary storage ponds are excavated or dammed areas within fields that hold surface water flows during high rainfall events. The water can then slowly percolate into soils or be allowed to slowly drain into a watercourse. These ponds can be grassed and managed by grazing or they can be located on one of the field corner/buffer options.

### In-ditch wetlands

In-ditch wetlands are ditches that have been widened and adapted to create suitable conditions for the development of emergent vegetation. They normally have a water control structure to slow the flow of water and allow silt to drop out of suspension. Silt may need to be removed and a system for removing it may be required. However, where ever possible

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sediment should be controlled at source via effective in-field soil and water conservation measures

### Grassed waterways

Grassed waterways are shallow ditches constructed to intercept surface flows during flood events in a way that reduces down-slope flows and subsequent erosion. Water can then be allowed to percolate into the soil or directed into an appropriate site, for example, a temporary storage pond or an area of rough grassland.

### Seepage barriers

Seepage barriers are small dams constructed in a way that allows water to slowly permeate through them. They are normally placed in ditches that only run during high rainfall events. Several seepage barriers may be needed within a ditch depending on the slope and amount of water that they hold. They reduce the speed of water flowing in watercourses and encourage water to percolate into the soil.

## Environmental Stewardship

There are many options within Entry Level Stewardship (ELS) and Higher Level Stewardship (HLS) that are designed to reduce the amount of diffuse water pollution from farmland.

ELS provides payments for *Winter cover crops* and *In-field grass areas* and pays to protect water courses through *Maintenance of watercourse fencing* and buffer strip options. Other ELS options will also help to conserve soils and protect watercourses. To help identify suitable locations for these options detailed advice is available on the Natural England website, see link in *Further information* below.

In addition to the ELS options HLS can support water retention works that help to protect water quality for sites where this is a particular issue, for example, around SSSIs, around ponds and lakes of high water quality or where there are particular risks, such as horticultural crops on light soils.

## HLS priorities for water retention measures



Photo 2 Severe soil erosion after heavy rainfall

### Priority areas

HLS agreements in areas that are in WFD Priority Areas or in catchments affecting SSSIs should be a high priority for water retention engineering works. Many of these areas are likely to be covered by the Catchment Sensitive Farming project. The link to the Catchment Sensitive Farming catchment areas map can be seen in *Further information* below. Natural England Advisers can also use the *Holdings Assessment Toolkit* to identify priority sites.

The appropriate land management practices and options under ES are highly site specific. However sites that may be suitable will be those where there is significant run-off from the land, either over the surface of the soil or through under-drainage.

Many factors influence run-off including land use and the intensity of that use. For example, heavily stocked dairy grassland should be a priority over land used for extensive beef grazing. Listed below are some of the important parameters that influence run-off:

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- Rainfall amount and intensity.
- Infiltration influenced by soil type and management, for example, are the soils compacted?
- Crop types; in particular where there are bare soils over winter, late harvested maize and out wintered animals.
- Catchment area and type, for example, geology, subsoil permeability.
- Field slopes; steepness, length and valley features.
- Connectivity to other watercourses and water bodies. Where the water is coming from and where it is going, both surface run-off and field drainage?

### Priority holdings

Within priority areas the holdings that have one or more of the following should be considered for specific soft engineering measures:

- Sandy and light silty soils.
- Moderate to steeply sloping land.
- High connectivity to water bodies (ie land close to ditches, streams and rivers; where there is a high density of standing water bodies or where underdrainage provides a connection to a water body).
- Farming practices that risk causing agricultural run-off, for example, spring cropping, horticultural crops or intensive livestock.
- Land identified in the Farm Environment Record or Plan as being at *High Risk of Erosion*.

You can get information to identify these from:

- Geographic Information Systems (GIS) (for information on topography, geology, soils, fields, and location of tracks, roadways). See *Further information* below for sources of GIS data.
- SSSI condition assessments (to help identify and indicate if siltation is compromising the conservation objectives of features of interest).

### Priority sites

Where holdings have been identified as a priority, the specific on-farm measures can be

identified in a number of ways and from a range of resources including:

- A soil protection review.
- Any incidents of mud on roads. This can be obtained from the local or highways authorities.
- Flooding events.
- Compaction surveys.
- Relevant information held by the Catchment Sensitive Farming Project.
- Maps of old field boundaries.

Some flow pathways can be complex and the uncertainty of GIS data at farm-scales means the accuracy and limitations of any information should be clarified by a site survey.

### On farm surveys

When carrying out the farm survey the key issues on the farm should be recorded and mapped. This should help identify where it is effective to place small engineering structures.

Key pathways, connections and the direction of water flow should be observed, photographed and **recorded** on a map. The absence/presence and location of any soil erosion features such as sediment fans, rills and gullies should also be recorded.

Flow pathways can most easily be observed during, and immediately after, heavy rainfall. Evidence of soil movement and accumulation can most easily be observed following any significant rainfall event, before the land is cultivated.

The farmer will probably be the best source of information as they are likely to have a good idea of where surface flow paths of run-off occur.

When identifying areas of soil and water movement on the holding focus on:

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- **Large fields with moderate to steep slopes:** Fields with long slopes including neighbouring up slope fields, particularly where there are signs of erosion rills, gullies, sediment fans and areas of deposition in fields. Also check for ponding and areas of relatively poor crop growth.
- **Field boundaries:** Where there are depositions near or in field boundaries.
- **Tracks, roadways, tramlines:** Check for any signs of sediment on adjacent roads.
- **Gateways:** Check for run-off through gateways.
- **Livestock feeding areas:** Particularly poached areas.
- **Identify drainage outlets:** Check these for depositions in ditches, streams ponds and lakes.
- **Identify land drain spacings:** This will help identify the location of possible in-ditch options.

You should also identify the locations of existing ponds, ditches, riparian buffers, hedges, hedge banks and small woodlands so that any new structures can be integrated into these existing structures and features.

All watercourses on the holding should be identified as one of four stages shown in figure 2 below, from river to dry ditch. This will help determine where any in-ditch structures can be placed. No obstructions should be placed in a watercourse where free fish movement is required. Therefore, seepage barriers, in-ditch wetlands, soil bunds and dams are only suitable in 1st and 2nd stage ditches. However, these barriers may affect the movements of eels and rare invertebrates and where these are known to be present in stage 1 and 2 ditches, dams, bunds and barriers should not be used.

See TIN099 for further information on the individual types of soft engineering works and on where to site these measures.

### Further information

The Natural England website provides a wealth of information on Environmental Stewardship, including detailed regional maps which identify local environmental priorities. These maps will

show where the protection of water quality is a particular issue. There is also a guidance leaflet available to help identify where ELS options can be most effectively used.

[www.naturalengland.org.uk/ourwork/farming/funding/es/agents/elsoptions/waterandsoil.aspx](http://www.naturalengland.org.uk/ourwork/farming/funding/es/agents/elsoptions/waterandsoil.aspx)

Natural England Technical Information Notes and other publications are available to download from the Natural England website:

[www.naturalengland.org.uk](http://www.naturalengland.org.uk). In particular see:

- NE230 *Farming for cleaner water and healthier soil*
- TIN099 *Protecting water from agricultural run-off: water retention measures*
- TIN100 *Protecting water from agricultural run-off: buffer strips*
- TIN081 *Illustrated guide to watercourses beside grassland*
- TIN093 *Shelter woods to prevent wind erosion*

For further information contact the Natural England Enquiry Service on 0300 060 0863 or e-mail [enquiries@naturalengland.org.uk](mailto:enquiries@naturalengland.org.uk).

### Thinksoils

Further information on soil management and assessment in relation to diffuse pollution can be found in the *Think Soils* handbook which you can order from the Environment Agency website: [www.environment-agency.gov.uk/business/sectors/soils.aspx](http://www.environment-agency.gov.uk/business/sectors/soils.aspx)

### Geographic Information Systems:

[www.landis.org.uk](http://www.landis.org.uk)

[www.bgs.ac.uk](http://www.bgs.ac.uk)

[www.ordnancesurvey.co.uk](http://www.ordnancesurvey.co.uk)

### ELS training and guidance

Natural England offers training and information to farmers and land managers on ELS and Organic ELS. Farm-based group events and farm-specific one-to-one visits are available free of charge.

This training gives information on applying for ELS, how to choose and locate the right options on your farm and how to effectively manage the options over the agreement period. Call our

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events team to find out what advice is available in your area on 0300 060 1695 or visit:

[www.naturalengland.org.uk/ourwork/farming/landmanagementadvice/events/default.aspx](http://www.naturalengland.org.uk/ourwork/farming/landmanagementadvice/events/default.aspx)

### Catchment Sensitive Farming (CSF)

The Catchment Sensitive Farming catchment areas can be seen at

[www.naturalengland.org.uk/ourwork/farming/csf/default.aspx](http://www.naturalengland.org.uk/ourwork/farming/csf/default.aspx)

CSF Officers (CSFOs) are based around the country and managed by River Basin Co-ordinators. These CSFOs run various activities, tailored to provide the most appropriate training and advice for the farmers in their catchments.

External contractors are employed to provide specialist training and advice, in subjects such as Whole Farm Plans and Soil Management and Testing, to ensure that farmers meet regulations and deliver best practice farm management. A simple capital grant scheme is available to support improvements to farm infrastructure, particularly around the management of dirty water from farmyards.

CSFOs can provide specialist support to HLS advisers on all areas of water pollution and soil management and can help identify areas where ES can effectively deliver resource protection benefits.

See also CSF Business Link site:

[www.businesslink.gov.uk/bdotg/action/detail?itemId=1083648236&type=RESOURCES](http://www.businesslink.gov.uk/bdotg/action/detail?itemId=1083648236&type=RESOURCES)

### Pond conservation

For information on protecting ponds

[www.pondconservation.org.uk/](http://www.pondconservation.org.uk/)

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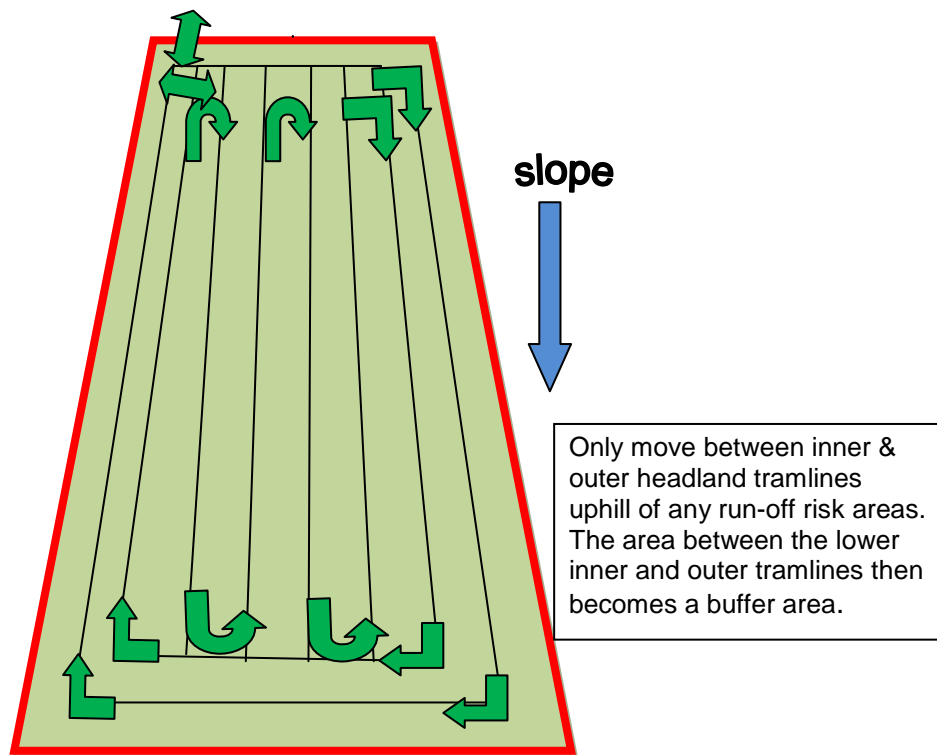


Figure 1 Tramline layout to reduce run-off

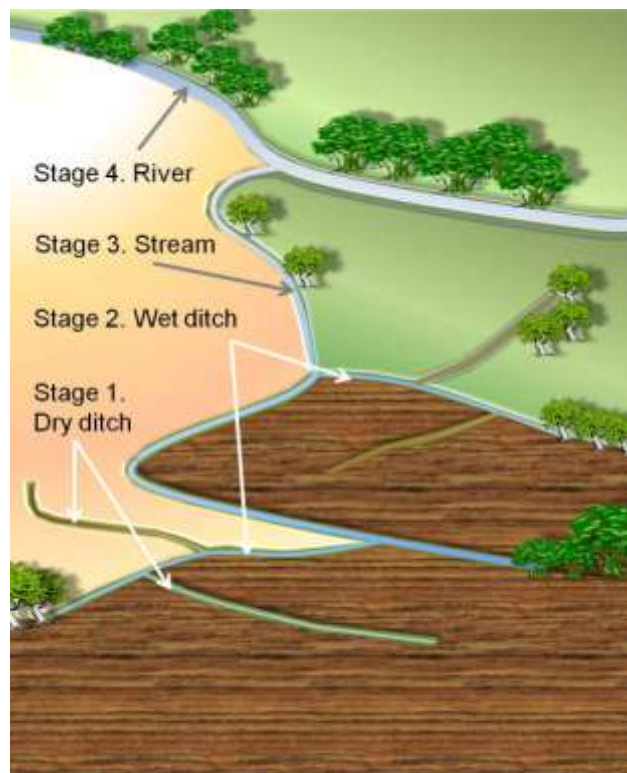


Figure 2 Watercourse stages