Drainage – is it working for you?

Maintenance of existing drainage systems

Many drainage systems put in place in the period of capital grant schemes are still working effectively and with good maintenance they should still be working for at least another 15 – 20 years. The current generation have looked after what has been installed, including the annual maintenance of ditches/sheughs, repairing bank slippage, keeping the outlets of collector drains clear, erecting fences to protect banks and also cleaning out inspection chambers if required. When this work is overlooked and doesn't happen, past investments fail to show rewards and remedial action is needed.

The need for drainage

Why is drainage necessary? The objective of any drainage system is to remove excess water from the soil as quickly as possible to improve productivity. Crop yields are limited due to the adverse effect of excess water in the soil. Air will be lacking at rooting depth and this limits plant respiration and as a result limits plant growth. In prolonged wet periods the plant could eventually die due to the lack of oxygen in the roots. Improved drainage will also aid timely field operations such as cutting silage and spreading manure and will increase the number of possible grazing days annually, plus increase the stocking rate and stock carrying capacity.

Choice of drainage system

The first step to improve drainage is to dig a few soil inspection pits in order to determine the cause of the problem. The type of field drainage system needed will depend on the problem which is either:

- A high ground water table
- An impervious soil (heavy poor drainage clay/silt)
- Springs

Let's look at the different options to alleviate the drainage problems mentioned above:

- Main drains (ditches & sheughs);
- Ground water drainage (conventional drains);
- Shallow drainage (mole drains).

Main drains (ditches & sheughs)

Main drains receive and remove the water from the field drainage system which may be mole drains, deep groundwater drains, collector drains or gravel tunnels. Main drains also receive surface runoff and water close by. The main drain discharges into the stream or river and this level dictates how far the water table can be lowered below that of the land. Cleaning open main drains will lower the water table and should help remove surface water.

Main drains may be in poor condition and the cleanings from them should be taken away or spread evenly so not to hinder the drainage of the surface water in the field.

Some CAFRE BDG members have asked at our BDG events, “Can I pipe the ditches & sheughs?”

There are various reasons why you may want to pipe the main drains, to join smaller fields together allowing more efficient farming, to reduce the costs and hassle involved in maintaining open drains, or maybe for safety reasons as open drains can be dangerous for livestock, people and machinery. Our forefathers dug these main drains for good reason, you may regret closing them in. Best leave them as they are. Surface water collection space is limited on most farms and open drains provide good outlets for installed field drains which will speed up the removal of excess water. They are also an invaluable habitat and corridor for wildlife on the farm.

Ground water drainage (conventional drains)

Cleaning main drains alone may not solve the problem. Conventional drains consisting of pipe and stone may also have to be installed. Digging a soil inspection pit will identify if the soil is permeable and permits water flow and movement into stone drains at that depth providing the fall is at least 1:800.

Conventional drains should be dug out to allow at least 600mm of clean 35-40mm stone above the pipe and the main drain/sheugh must always have a lower outlet than the pipe in the feeder drain. In practice the overall drain depth of 750 – 850mm should suffice with spacing between drains of between 10-15 metres. Where there is a restriction in outlet depth, the drain should still be dug along most of its length, backfilled with stone and place the pipe at the outlet. This is not ideal but there is still drainage to be gained as water will travel up from the permeable layer to the pipe and drain away.

Where a spring is seen, an interceptor drain is needed. Springs are found when the ground water flows through free draining soil with heavy clay soils on top and tries to find a discharge point usually on the side of a hill or on flat land adjacent to a slope. The drain needs to be dug upslope from where the spring is visible on the surface, someone who can divine water flow may be useful here. Dig deep enough to intercept and at least 2 metre wide, fill with clean stone and run a piped drain 850mm deep filled with 35-40mm clean stone into the main drain.

Shallow drainage (mole and gravel tunnels)

In heavy clay soils, water movement can be so slow that the conventional piped drains with wide spacing are not doing the job. Closer spaced shallower drains which loosen the subsoil are required. This method is called mole draining and is used in conjunction with conventional collector drains (Figure 1). The moles are drawn up the slope and over the conventional collector drains.

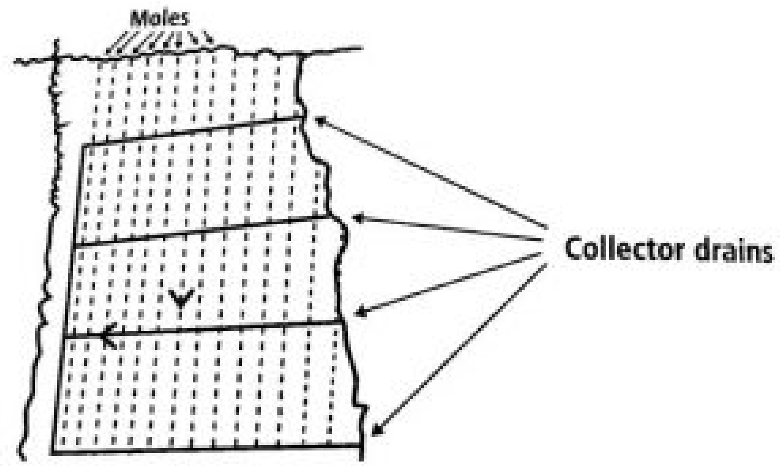

Figure 1: Field diagram showing collector drains

Mole drains need the collector drains to draw off/take the water away quickly to the main open drain/sheugh. These collector drains should be 750-850 mm deep and 30-50 metres apart in a layout that allows the 450-500 mm deep mole drain to connect at an angle to avoid slowing down the water flow and thus sediment build up in the collector drain pipe. On fields with a poor fall, at the furthest point from the main drain the collector drain should still be at least 750mm deep, so an experienced digger driver is needed to achieve a fall in the drain which starts at a higher outlet point than the main drain but deep enough at its furthest point to still provide sufficient drainage. Collector drains need a minimum of a 100mm (4 inch) perforated drain pipe topped with 35-40mm clean stone up to plough depth. For drains less than 300m in length a cheaper 50mm (2 inch) pipe may suffice. Make sure that before pipe or stones go in that the bottom of the drain is level, firm and free from large stones or clods. If the drain is soft at the bottom or cannot be levelled up with a special 4 inch drain shovel (another key piece of machinery!) then it is advisable to put 25-40 mm depth of drainage stone into the drain before the pipe is installed to help level the drain and lift the pipe up out of the wet muddy floor of the drain.

Some have questioned do we need costly pipe in the collector drain? Only in short drains of less than 30m should one even consider not using a pipe. In a stone only drain the water flow is greatly reduced thus drainage reduced considerably. What may block a pipe will block a stone-only drain much quicker. If the collector drain is installed without a pipe, water may fail to be drawn off/ be taken away quickly enough and the entire mole drainage system will eventually fail and prove costly in the long run.

There are two types of mole draining:
– Traditional mole plough
– Gravel tunnelling

The key piece of machinery in this drainage system is the gravel tunnel mole plough, which has a torpedo-like foot which is dragged through the soil with a track machine at 450-500 mm deep and normally 1.5m apart, to form a channel which is filled with 10-15mm stone chips

The mole plough has a torpedo-like foot which is dragged through the soil with a high powered tractor at 450-500 mm deep and normally 1.5m apart, to form a channel in which water can flow into the collector drains which then flows to the main drain (figure 2). Gravel tunnelling uses a similar mole but with the added benefit of filling the channel with 15mm stone chips using a stone cart with a conveyor belt. The advantages with gravel tunnelling over mole plough are:

1. Permanent system
2. Can cope with unstable soils
3. Can cope with large stones in subsoil
4. Can be used on steep slopes
5. Can be drawn up and down hill (moling downhill carries the risk of sediment being washed down blocking the exit of the channel, adding gravel reduces this)
6. Drawn by a low ground pressure track machine so greater flexibility in variable ground conditions.

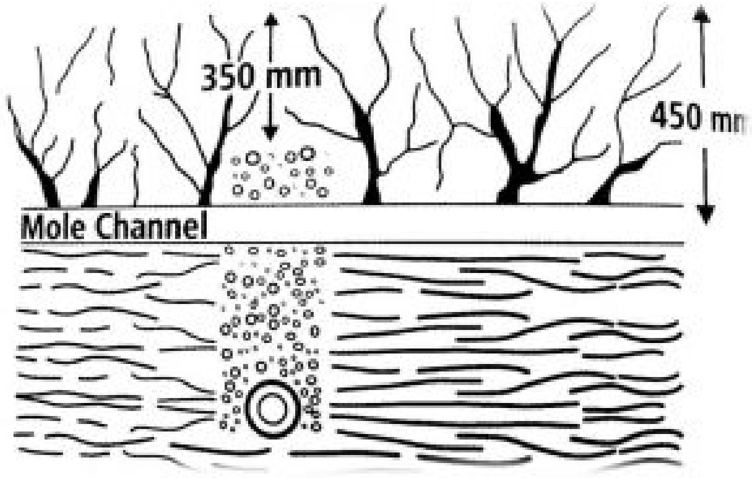

Figure 2: Cross section of collector drain with mole channel running through it.

Fields can be grazed directly after moling or gravel tunnelling. It is good practice not to plough and reseed the area until the following springtime which allows fissures created by moling to stabilise and last for several years

The cost of these projects can be expensive and the return on investment needs to be calculated and can vary greatly between farms. Research has shown that in most cases on suckler to beef farms it is only economically feasible when grass productivity increases by 30%.

Cost assumptions:

Assume a farmer has a one hectare plot to drain which is square in shape, has a gentle slope, good fall and has a main drain running along the entire lower side of the plot, 100m in length:

Table 1: Costs of draining a hectare field

Clean main drain – assume 100m, 50m/hr @ £30/hr	£60
Collector drains – assume 250m, 100mm pipe @ £0.85/m, 65 ton 40mm stone @£11/ton, labour @ £1.30/m	£1252
Gravel tunnelling – 75 ton 15mm stone chips/ha @£13/ton, labour @ £900/ha	£1875
Total Cost	**£3187/ha**

When considering a drainage project, farmers must abide by DAERA cross-compliance rules and environmental scheme regulations.