Farm Drainage

Planning and timing

The first step in farm drainage design is planning for your whole farm because water draining off one part of your farm can flood lower lying areas, or cause serious problems for your neighbours. Drainage can dominate your farm layout. The location of surface drains will influence the location of fences, shelterbelts, laneways and the shape of paddocks. The most satisfactory way of doing this is with an aerial photograph of the farm enlarged to an appropriate scale. The photograph allows you to record the extent of problem areas, where drains are to be installed and estimate distances involved. During winter, a couple of days after a good soaking rain, is the best time to take a closer look at wet areas. You can identify the extent of wet areas and identify soil layers on which a perched water table occurs. Summer and autumn are the best time to install drains. This is when soils are dry and have their greatest bearing capacity for supporting heavy construction machinery. Machines won't become bogged and trench sides smeared. **One of the first things to check is the outfall.** You need to check the level of the outfall in relation to where water needs to be drained from to ensure water will flow off your farm, otherwise drainage can create flooding. Arterial drains are the first drains to install for any farm drainage. These major open drains ensure that the water can get away. If the main waterlogging problem is due to run-on or seepage from off site, interception or pipe drains should be installed first and the effect of these monitored before proceeding further. These should be designed to have adequate capacity, be deep enough to intercept the water flow and at grades and batters which will not erode. A surface drain must have a minimum grade of 30 cm in 100m (0.3%) to ensure that water will flow. Erosion is likely where fall is greater than 1% (1 m in 100 m) for sandy soils, or 5% (5 m in 100 m) for clay soils.

Open trench ditches

These are the first component of a farm drainage system to be installed. This is because they are the means by which water is removed from paddocks whether the ditch is collecting water from a pipe drainage system, acting directly as a land drain to lower the watertable (Figure 1), or intercepting surface or groundwater flow. Ditches are usually installed with an excavator. Ensure there is an outfall for ditches so that there is sufficient gradient on the ditches to keep water flowing. Open ditches have flat bottoms and are not V-shaped, to prevent scouring. A ditch with a bottom width of 40-50 cm requires a gradient of 0.15 - 0.25% (1 in 600 to 1 in 400) to maintain sufficient velocity to prevent weed establishment. Ditches are normally 1 - 2 m deep. Side batter slopes of ditches should be sufficient to prevent the sides collapsing. The batter (vertical : horizontal distance) depends on soil texture. For ditches less than 1.3m deep the batter required are: heavy clay 1:1½; clay or silt loam 1:1; sandy loam 1½:1; sand 2:1. Where unstable soils are present e.g. very fine sand, establish grass on the banks as soon as possible. Severe cases may require lining with stone or protective matting. If spoil is stored near the ditch, gaps must be left at short intervals to allow free surface drainage off the land.

Figure 1. Open arterial ditches lower the water table and remove water from paddocks.

Surface drains

Surface drains (Figure 2) will remove surface water during heavy rainfall but do not provide for through soil drainage.

Figure 2. Surface spoon drains that provide little through soil drainage.

The spoon drain draws water over the soil surface but once this is achieved these drains have very limited effect on lowering the water table. A trench drain by comparison draws water through the soil and results in an overall lowering of the watertable (Figure 3). The objective of installing trench drains is to provide approximately 40 cm of drained soil for plants to grow in.

Pipe Drains

Underground pipe drains can be installed to intercept groundwater flow or to lower the watertable over a wider area. Drains can be laid using clay pipes or plastic Ag-pipe and French drains (where the drain is lined with stones), are sometimes laid. The different pipe types have advantages and disadvantages for ease of handling, performance and cost which should be discussed with your drainage contractor. Pipe drains can be laid using an excavator digger, continuous trencher (ditch-witch) or trenchless drain plough. Tractor mounted backhoes are of sufficient size to excavate trenches for subsurface drains but it is difficult to ensure an even grade on the base of the trench with these machines. Trenchless drain ploughs are large self-propelled tracked vehicles. The narrow slit created by the passage of the machine makes it the most economic means of installing permeable materials above the pipe.

The trench needs to be approximately 0.7 m deep, a perforated ag-pipe of 100 mm diameter laid at the base of the trench, graded blue metal (15-20 mm diameter) covering the pipe and filling the trench to approximately 0.3 m depth, with a final backfill of soil to the surface. Good quality clean gravel is required to prevent clogging up of drains. Consequently the backfill can be a significant component of the overall drainage cost.

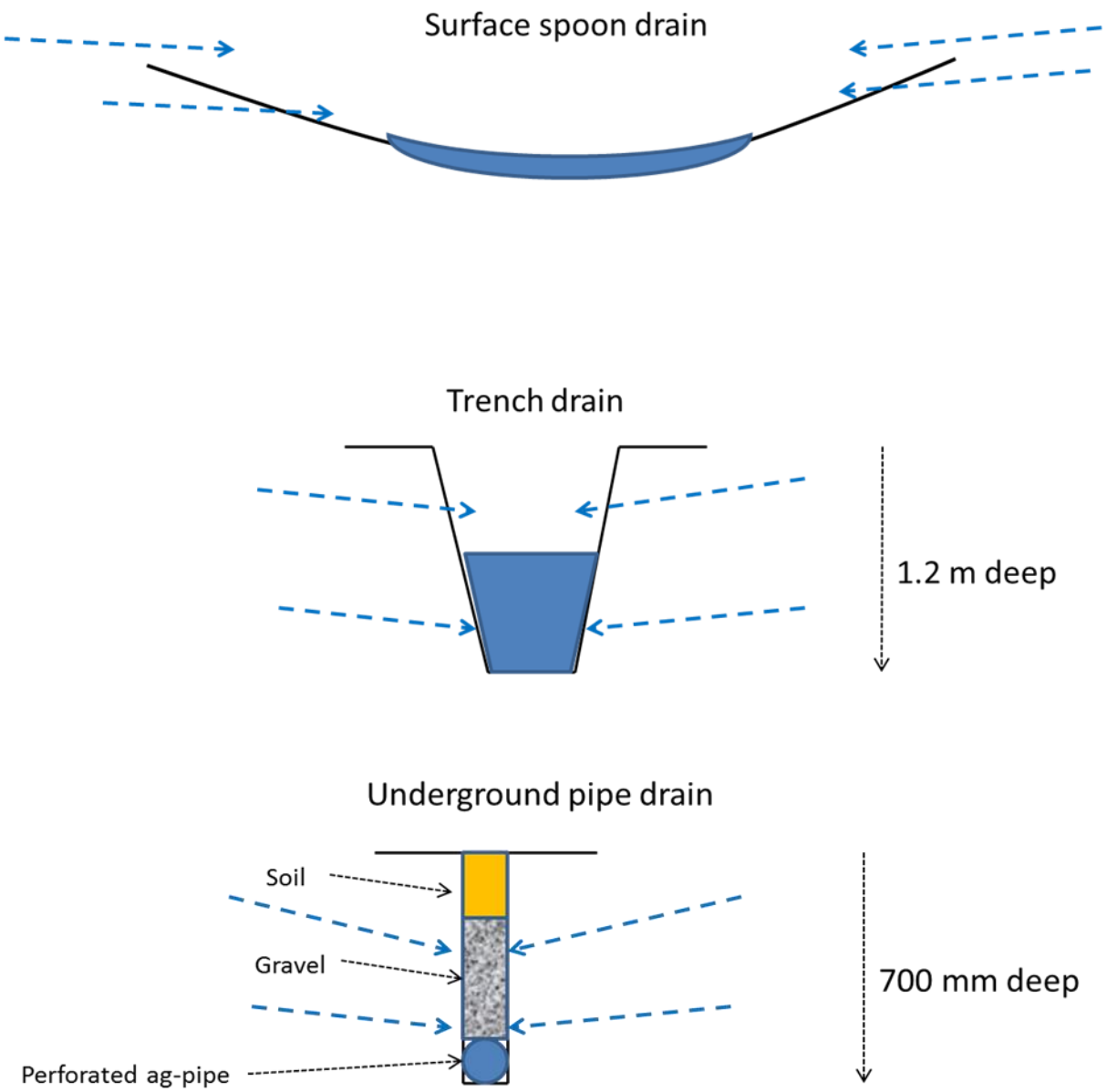

Figure 3. Characteristics of shallow spoon drain , trench drain and underground pipe drain.

Grassed waterways

Grassed waterways promote surface water removal along natural drainage lines and should be used as drainage lines which link up hollows and depressions, particularly on undulating paddocks of duplex soils in the Midlands. Grassed waterways are usually 2.5m wide, of minimum depth (100-200mm) and should run along the natural water pathway. If they are on a side slope, they will need to be deeper and more carefully constructed. Ensure that the base is level and that spoil does not create a levee along the sides of the waterway - it should be spread out across the paddock. They can be made using an excavator, road grader or spinner drainer. A grassed waterway is left unploughed during cropping and should cause minimal disruption to cultivation operations as it is wide and shallow enough to drive across once established.

Hump and hollow drainage

Hump and hollow drainage is where major land surface reshaping creates parallel ridges with even side slope to shallow drains. This form of surface drainage is appropriate when water either perches on the soil surface or winter water tables are at or near the surface and subsoil drainage is limited by restricted outfall. There is a need to either shed water off the surface by creating a slope on the ground, or elevating the soil above the watertable. Hump and hollow drainage (Figure 4) is most appropriate in swamp areas with large flat areas having a regionally high watertable. It is also used on sandy soils with surface water perching. Sandy soils cannot normally be subsurface drained because the pipes become blocked with inflowing sand. Hump and hollow drains only work in conjunction with a good system of arterial drains requiring suitable outfall.

Figure4. Hump and hollow drains are suitable for areas with a high water table.

Hump and hollow drainage can be installed using an excavator with a 3 m wide bucket or a road grader. Drain spacing depends on soil texture with sandy soils requiring 25 m between drains and clay loams and clays requiring 15 – 20 m spacing. A good sequence of operations is if using a road grader is to cultivate in spring' sow a crop of turnips, feed off the crop in February, install humps and hollows with a road grader in March when soils are dry and then sow down new pasture in autumn. If using a wide bucket excavator, cultivate in spring, install humps and hollows with an excavator in spring, sow a crop of turnips, feed off the crop over late summer to gain consolidation and then sow down new pasture in autumn. An excavator can operate when soil conditions are moist to wet but due to losing wheel traction in the wet, a road grader only works efficiently when soils are dry.

Installing hump and hollow drainage should be seen as part of a package of drainage and pasture improvement. It also smooths out depressions left from land clearing. Even with hump and hollow drainage installed you should still take care to prevent pugging and soil compaction by heavy mobs of stock. Maintenance of hump and hollow drains may require rolling the soil surface if cattle have pugged the ground, and the base of the hollows may need to be cleaned out with a spinner drainer every one or two years to keep water flowing.

Maintenance and safety

Drains require regular maintenance including spraying out plant growth in the spring and machine cleaning when the drain becomes clogged with growth or silt. This can often be achieved with a rotary drainer for shallow drains. All arterial ditches should be fenced to exclude stock access. This prevents stock causing collapse of the sides and from damaging end pipes of underground drains. Perhaps the most common soil management problem in relation to drainage is compaction which can prevent water entering the drainage system. Compaction can be caused by heavy machinery operating when soils are wet or grazing with stock in wet weather.

When installing any drainage system it important to be aware of any underground services which might be encountered including telecom cables, water supply pipes and sewerage/effluent disposal pipes. When operating machinery be aware of any electric fences and overhead power lines. Disruption of any of the above services can result in a safety hazard for operators, inconvenience for those relying upon the services and considerable cost for repair. Consent should be obtained for drainage work which can significantly increase the flows of water into a neighbouring property as the work may result in liability claims.