3.6 Standards for land drainage

3.6.1
General – land drainage can be a complex investment requiring a range of designs to solve a number of distinct drainage problems and is unlike most other investments under capital grant schemes in that the completed work is buried in the ground and out of sight.

For these reasons it is essential that the efficiency of the design, the standards of workmanship and quality of materials used are all of a sufficiently high standard at the time of installation.

It is not intended that this section is a complete specification but the minimum standards indicated will provide the basis of sound land drainage work.

It should be borne in mind that poorly designed or poorly executed projects or the use of poor quality materials may cause an investment to fail to meet the capital nature test.

3.6.2 Workmanship standards for ditch Improvements

3.6.2.1
All woody growth which would obstruct the work should be trimmed or grubbed out before the excavations begin. Where branches of trees require to be lopped this should be done with care to avoid damaging the trees. All branches and trimmings should be burnt or carted away so that they do not become mixed with spoil from the ditch.

The removal of bankside vegetation should be the very minimum necessary for the efficient functioning of the ditch.

3.6.2.2
Ditches should be cut to the design dimensions as determined by the depth needed to provide outfall for drains, the gradient and the amount of water to be carried.

The ditch bottom must have an even gradient and the sides need to be sufficiently stable to avoid bank slips in the type of soil forming the banks.

Care is needed to avoid undermining dykes, roads or buildings. Excavated material must be placed at least 600 millimetres from the edge of the ditch and spread in such a way that it does not cause ponding of surface water.

Bank slips must be cleared and rectified and any silt accumulated during excavation should be cleared before the scheme is completed.

3.6.2.3
Ditch banks should be examined for old drains. If functional they should be cleared and provided with satisfactory outlets as described in paragraph 4.6.3.8.

3.6.2.4
Where ditch crossings are required the necessary bridges or culverts should be constructed with adequate dimensions and to a standard which allows them to withstand the weight of vehicles crossing.

The culvert pipes should be suitable for the situation and have positive joints to preserve alignment. The pipe diameters should be sufficient to carry the anticipated flows and in any case not less than 225 millimetres.

Pipes should be set on a firm bed in a recessed trench bottom and aligned to provide an unimpeded continuation of the adjoining ditch. Protective measures may be needed to prevent erosion of the ditch channel at the outflow end of the culvert. Headwalls may be required at both ends of the culvert.

3.6.2.5
Protective fences alongside ditches should be erected at least 450 millimetres back from the edge. The fences should be soundly constructed using good quality adequately protected materials as described in section 4.5.2.

3.6.2.6 In the absence of a piped water supply stock watering points should be constructed in such a way that the animals cannot block the main channel or cause bank collapse.

3.6.2.7
Hill ditching should have a top width of not less than 550 millimetres and the bottom width not less than 150 millimetres with the sides sloped to a stable angle. Hill drains shall be opened with a tracked excavator with "V", or standard, bucket. The provision of a new system of hill drains is no longer eligible.

Excavated material must be placed at least 600 millimetres from the edge of the ditch and spread in such a way that it does not cause ponding of surface water. Bank slips must be cleared and rectified and any silt accumulated during excavation should be cleared before the scheme is completed.

3.6.3 Workmanship standards for under-drainage

3.6.3.1
Attempting land drainage operations with modern heavy tackle when the soil is wet can leave the land in a poorer condition than before, especially on heavy land. If at all possible drainage should be carried out during the summer months when land is in grass, or after early harvest, or through a standing crop early in the growing season.

3.6.3.2
Drain trenches should be cut to design depth, true to line and gradient and the trench bottom should provide a secure seating for the pipes. The minimum depth of cover over any lateral drain should be 600 millimetres and over leader drains 675 millimetres.
When drains are laid in peat the minimum cover should be 900 millimetres to allow for shrinkage. Gradients normally should not be less than one in 400 and sealed pipes are necessary in leader drains at gradients greater than 1 in 60.

3.6.3.3
Pipes should be laid in a true line and gradient on a firm bed free from loose soil and must never be laid on soil backfill or when the trench is in a slurried condition. Clay tiles should be evenly aligned and well butted together to avoid large gaps.

When plastic pipes are used the bottom of the trench should be shaped to support the side walls of the pipes and where the plastic is PVC the pipes should not be laid or backfilled when the temperature is less than five degrees Celsius.

All drain junctions should be made with purpose-made tile or plastic branch pieces. Where possible pipes should be blinded by stone-free earth to avoid damage or displacement during backfilling.

3.6.3.4
With the exceptions of very deep drains on level sites and shallow systems that can be completely disrupted by subsoiling, all old drains encountered during the drain-laying operation

must be positively connected to the new drains by means of purpose-made junctions or by using sufficient amounts of permeable infill to connect the two systems.

When the old drains are deeper than the new system on a sloping site a number of deeper drains are needed to cut and bleed the old system.

3.6.3.5
When draining in peat, running sand, old ditch lines or other unstable conditions, special precautions are needed to maintain drain alignment. A preliminary de-watering system of open channels is of great value in waterlogged peaty soils and the laying of tiles on boards may be essential in deep peats.

Where drains pass through unstable land such as backfilled pipeline trenches or deep ditches, the pipes should be supported on a bridging device of wood, reinforced concrete or steel.

3.6.3.6
Solid pipes or pipes with sealed joints are required near trees and hedges so that roots cannot enter and block the drains.

3.6.3.7
Where the design specifies permeable infill, care should be taken to prevent mixing with earth and the pipes should be covered to design depth. The depth of infill should be sufficient to provide a suitable connection, as appropriate, between the new drains and any old drains, channels created by moling or subsoiling or the plough layer where the subsoil is slowly permeable.

3.6.3.8
A properly constructed outfall is essential where leader drains discharge into an open channel. The last length of the buried pipe and any projecting part of the pipe must be solid and frost-proof and the outfall should be at least 150 millimetres above normal ditch water level wherever possible.

The last two metres of buried pipe must be sealed with well-rammed soil to avoid water flow outside the pipe. Headwalls of cemented stones or bricks or purpose built installations are needed to stabilise the bank and to keep the pipe in position. Drip stones or concrete aprons may be needed to prevent erosion of the channel.

3.6.3.9
At major pipe junctions or at reductions of gradient in leader drains it is advisable to construct inspection chambers with silt traps of satisfactory design.

3.6.3.10
All inlets for the entry of water from an open channel must be provided with a silt trap and grating of satisfactory design.

3.6.3.11
Piping open ditches is an operation requiring careful planning and assessment of likely flow rates. In particular the pipe must be large enough to carry peak flow rates and where open channels discharge into the pipe it must be capable of carrying storm water flows.

All existing drains discharging into the ditch must be located and connected to the new pipe. Special precautions are needed where circumstances demand that water should not leak from the pipe. In the interest of conservation of the countryside, the piping and filling of ditches should be restricted to the minimum amount required for efficient land drainage.

3.6.3.12 Trenches must never be backfilled when the soil is in a slurried condition. Large stones should be removed and the trenches carefully backfilled with excavated material in such a way that the pipes are not damaged or displaced and the fill should be firm but not compacted.

3.6.3.13
Trenchless drainage techniques present difficulties. It is particularly important to make sure that where required a sufficient amount of permeable backfill is installed to provide adequate permeability in the "trench" and the necessary connections between old drains and the new system.

3.6.4
Workmanship standards for soil treatments

3.6.4.1
Mole draining should only be carried out on suitable subsoils, over an efficient under-drainage system and in the right soil moisture conditions. The subsoil requires to be plastic at mole depth to form a stable channel but dry enough above to promote soil fissuring.

These conditions are most likely to occur when the soil is drying out in late spring and early summer.

The equipment used must be capable of drawing a mole channel of circular shape (not less than 75 millimetres diameter) evenly and continuously at the design depth parallel to the general ground surface. The channels should be deep enough to avoid damage by subsequent cultivations and close enough to make sure good drainage usually 1.5 to 2.5 metres apart.

Gradients may range from one in 300, to one in 15. Steeper gradients which may cause erosion of the channel can be avoided by moling diagonally across slopes. All mole channels should be connected to the drains by permeable infill in the drain trenches.

The top level of the permeable backfill should be at least 150 millimetres above base of the mole channel which should be drawn across the line of the collector drains.

3.6.4.2
Subsoiling should be carried out only when the subsoil is dry enough to obtain adequate shattering and fissuring of the soil and over an efficient under-drainage system. Suitable conditions for subsoiling occur in a dry summer or autumn after plant growth has removed a substantial amount of moisture from the subsoil.

The subsoiling should be carried out at the depth needed to burst the compact layer in the subsoil and at intervals of not more than 1.2 metres. When soil conditions are right for maximum effect a high power capability is essential.

3.6.5 Workmanship standards for hill drains

3.6.5.1
Before starting the work serious consideration should be given to the effect the drainage may have on the grazings, the general environment and local waterways. Where necessary consultations should be arranged with interested parties.

3.6.5.2
The channel should have a tapered section with a bottom width of 150 millimetres to 300 millimetres, a top width not less than 550 millimetres, a depth of not less than 350 millimetres and continuously graded to one or both ends of its length. The excavated material should be deposited on the downslope side at least 550 millimetres from the near edge.

The laterals should be connected to the leaders with a clean and undiminished cross-section, hand labour being used where necessary.

The channels should be cut in such a direction that the gradient is sufficient to allow self-cleansing flow velocities in average conditions but in no case so steep that scouring can occur. Lateral drains should be cut across slopes to intercept surface water.

Special care is needed to make sure that main outlet channels are not seriously scoured and eroded.

3.6.6
Quality of materials used

3.6.6.1
All pipes must be suitable for their required drainage function and conform to the appropriate British Standard – BS 1196 for clayware tiles and BS 4962 for plastic piping. Pipes not covered by a British Standard should be of a type approved by the Department.

All pipes under roads and bridges and pipes over 750 millimetres (30") diameter require special consideration, see paragraphs 4.6.2.4 and 4.4.2.

3.6.6.2
Some soils cause the rapid deterioration of concrete pipes and restrictions on their use are necessary. In general, pipes made of high alumina cement are not suitable for field drainage. Pipes made from Portland or sulphate resistant cement may be used as follows:

a) porous pipes can be used only in soils where the pH is more than 6.5 and the sulphate content is less than 0.06 per cent
b) dense concrete pipes can be used in similar conditions or where local experience has shown that they last for a reasonable period

3.6.6.3
Reject asbestos cement pipes may be suitable for use as culverts or for the larger carrier drains. Pipes of this type sometimes fail the stringent tests required for pressure pipes in water and sewerage works. They can be used as field drains only in situations where sealed joints or precise alignments are not essential.

3.6.6.4
Permeable backfill must be clean gravel, stone chips or other approved durable material with no dimensions greater than 50 millimetres or less than six millimetres. Other materials used for land drainage works, usually building materials or fencing materials should be of a standard specified in the appropriate sections above.