SURFACE DRAINAGE

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In this paper it is not intended to suggest a form of drainage alternative to the more orthodox methods of underground drainage. There are, however, certain conditions under which underground drains cannot possibly function and a form of drainage. referred to as surface drainage must be resorted to.

Some of the rain which is precipitated on to the earth's surface percolates down through the soil until it reaches the water-table, the rate of percolation depending on soil type. It is this water which is normally dealt with by orthodox methods of drainage. Some is returned to the atmosphere by evaporation either from the surface of the ground or by way of the transpiration path through plants. This represents a substantial proportion, being somewhere in the vicinity of 30in. per annum. Some of the rain runs off the surface of the higher ground and finds its way to lower areas. The surface drain merely serves to increase the efficiency of this run-off so that there is very much less moisture left to be dealt with by the other methods mentioned.

In other words, instead of relying on the water to percolate down through the soil, it is run quickly off the surface by means of the surface 'drain.

What are the conditions unsuited for tile and mole drainage? Such conditions exist at the present time on the Hauraki Plains and in scores of similar tidal estuarine flats throughout the Dominion. A network of open drains deals adequately with the situation on the freer draining phases of these soil types, but fails to deal satisfactorily with the situation on the heavier clay soils during periods of extended rainfall.

It is a familiar-sight-on-theeHauraki--Plains-to-see puddles of water remaining on the very edge of drain banks for several days, an indication of just how ineffective these drains are, No matter how close these open drains are placed and how well they are maintained, the area between the drains is still too

wet during winter and spring to support the number of cattle the pastures are capable of feeding.' If the land is stocked according to the available feed supply, severe poaching is the inevitable result.

For underground drains to function satisfactorily they must have a constant outlet, not one which varies according to the tide and hence whether a flood gate is open or shut. On the other hand tiles must be placed at a minimum depth of 25in. below the surface of the ground to allow for moles to be drawn across them, making allowances for variations in the surface contour.

Farmers who are familiar with flat areas bordering tidal rivers will know that it is inevitable that the tile outlets would be submerged, during periods of reduced floodgate action unless pumping is' resorted to. This leads to the rapid silting up of any form of underground drain. As soon as water backs up in a tile, mole, or fascine there is an immediate decrease in velocity of flow within the drain with consequent deposition of silt. Considerable areas of the heavy soils of the Hauraki Plains have been tiled in the past, but these silted up very rapidly indeed, persumably because of the fluctuating outlet problem Just described.

Because farmers on the Hauraki Plains and similar areas are unable to get rid of surplus water by drawing it down through the soil, they are left with but one course open to them, and that is to run the water off the land as rapidly as possible. The surface drain-is-designed-to-facilitate-this-process.

To be successful surface drains must be constructed in such a manner that the land between the drains has a definite camber to shed the water. If the intervening land is not cambered up, the surface drains so constructed function merely as inefficient open drains which instead of being confined to the fence lines clutter up a paddock and inhibit the free use of implements. The properly constructed surface drain actually produces an artificial fall from the crests of the lands to the bottom of the furrows of approximately-1-in-18.--Somefall is created in the surface drain itself, although this does not amount to very much, approximately 1 in 250. Even if there is no marked fall in the surface drain, the water gets away quickly enough owing to the flood gradient which is built up.

It will no doubt be claimed by some that the area

devoted to surface drains is very considerable and production from such areas would be reduced accordingly. During dry periods growth in the surface drain can be as good as on the intervening lands. During wet periods loss of grazing area should not amount to more than 10 per cent.

It is significant that during last spring when Plains farms were the wettest for many years one of the few farmers who was able to carry out break grazing was one whose farm was well surface 'drained.

It will also be claimed that the surface furrows are an obstacle when harvest machinery has to be used. If the drains are correctly constructed, it is possible to mow or work the pick-up baler either with or across the drain. Sweeping, however, must be carried out in the direction of the lands.

CONSTRUCTION OF SURFACE, DRAINS

Grading is best carried out where the paddock is already worked down to something approaching a seed-bed. Unless the initial working is carried out early enough,. final work with the grader is made difficult owing to the fact that unrotted turf is dragged to the surface. A frequent although not so desirable 'practice is to. cut the drains while the paddock is still down in pasture.

Surface drains can be constructed at any time of the year providing the ground is firm. If the ground is too wet, the grader shaves off a cheesy mass rather difficult to break up; traction too becomes poor once the first cut is graded off. The drains should be constructed early enough to facilitate preparation and consolidation of a seed-bed for regrassing. In practice this work has been performed mainly in- January and February.

The optimum distance apart for the surface drains is 10yds., and for best results the drains should not exceed 5 to 6 chains in length. If the drains are placed wider apart than 10yds., it becomes difficult to obtain an even camber on the lands without considerably increasing the required number of Cuts with the grader. Obviously it is undesirable to place the drains closer together than is actually necessary: Headland drains should be graded first 10yds. 'from the fences before- the remainder of the drains are constructed at right angles to these. These latter drains should 'be graded in the direction of the fall, if any, but where country is practically dead level it is 'a good plan to

make fall when constructing the furrows by decreasing the cut at the centre of the paddock and increasing the cut at either end.

The best procedure has been found to make two to three cuts with the giant discs before going to work with the grader. This procedure can be repeated if necessary. Two to 3 acres can be graded in one day after the discing has been carried out. When all the furrows have been constructed the headland drains are finally cleaned out with the heel of the grader blade, the spoil being thrown toward the fence. If the construction of the headland drains are left to the last, the rest of the drains would be sealed off at each end by the soil thrown up by the grader. It is essential that no shoulder be left on the edge of the drains so that all classes of implements can be worked with ease. A final touch up with the shovel is usually necessary as soon as there is sufficient water in the furrow to give an idea of levels.

Outlets to the open drains surrounding the paddocks are cut through the headlands after sufficient rain has fallen to indicate the lowest regions. These should be tiled to avoid damage by stock and sufficient of these outlets should be provided to carry away the water satisfactorily.

Once the work of constructing the surface 'drains is complete it is of course necessary to resow the whole area. The degree of success with this operation depends on the seed-bed produced. Where a paddock has been broken up early enough before grading to permit rotting of the turf no difficulty arises. Where the turf has not had sufficient time to rot it will become graded up on to the highest portions of the lands, giving rise to a poor, unconsolidated seed-bed along the ridges. Strike of grass and clover seed on the ridges can be very poor as a result.

If the land is wet enough to require surface draining, difficulty in controlling the 'new grass during the first winter can be anticipated. During a reasonably dry winter this presents no problem, but more often than not conditions become too wet to permit grazing by cattle or even by calves? Under these circumstances sheep have proved to be the only answer. The sheep control buttercup so prevalent in new pastures on meadow soils and will keep both buttercup and ryegrass at a level at which the clover can compete successfully. At the same time, instead of cutting up the paddock as cattle would if they were

used, they actually consolidate the ground and maintain an even surface. To do this job successfully the sheep must be put on in large numbers for short periods to avoid selective grazing. Overgrazing in this manner has proved very much less damaging to the new sward than under-grazing. The value of sheep in the development of the new pasture is stressed, because the money and effort put into surface draining and resowing a paddock are fairly considerable and much of this work can be in vain if subsequent management is not up to standard.

MAINTENANCE

Where the surface drains have been well constructed practically no further maintenance work with the grader is required. In the past rushes have had to be dug in the actual surface drain for a year or two, but after that they have given very little trouble. Experience to date suggests that the spraying of the rushes under the right conditions with 2, 4-D is likely to lighten the task in the future. Other weeds such as buttercup and pennyroyal which can be a problem in the surface drain are also readily controlled with 2, 4-D.

GRADING EQUIPMENT

The road grader is the only satisfactory implement for the construction of surface drains. Old horse graders modified for tractor haulage are used extensively on the Hauraki Plains. Grader ditchers -and tractor-mounted blades have not proved very successful, as they tend to follow the contour of the ground rather than produce an even grade.

Discussion in this paper has been confined to the use of the surface drain 'on meadow soils. It may be that the surface drain has a place in Northland for use on rolling country where the existence of a pan formation close to the surface of the ground precludes the use of more orthodox methods of drainage.

The fact that surface drainage is recommended only where conditions are such that other forms of drainage are impracticable is stressed.