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Land Preparation for Border Irrigation

By B. SWAN, B.Sc. (Agric.), Irrigation Branch, Harvey

The object of border irrigation is to wet the land as evenly as possible by flowing water in long narrow strips between low parallel banks laid down the natural slope. These banks are known as border checks or berms and may vary in spacing from 10 to 30 feet apart.

The main advantage of this system lies in the evenness of watering achieved together with a minimum of wastage.

Under ideal conditions enough water is absorbed by the soil to saturate the root zone of the crop or pasture irrigated.

An uneven slope and variable supply of water will lower the efficiency of the scheme.

LARGE amounts of water may be lost through excess run-off and deep percolation.

Proper preparation of irrigation land can help to minimise these losses. This preparation is done by grading or levelling so that the original ground surface is shaped to allow for a more uniform distribution of water.

In the preparation of land for surface irrigation factors such as soil type, depth of soil, slopes, crops to be grown, and cost must be considered.

On uneven land with shallow soils the amount of grading possible may be limited. It may also be too costly to carry out much grading on very uneven land, even if the soils are deep.

Land with slopes greater than 4 per cent. should be treated with great care, and precautions taken against erosion. These steeper slopes are better watered by the sprinkler system.

PLANNING THE SCHEME

The first step in designing the scheme is to prepare an accurate contour plan of the area. This should be done by somebody skilled in the use of the dumpy level.

The contour plan shows the extent of land preparation needed and is the basis for the design of the layout.

It indicates the fall of the country, the practicability of the scheme, the area of land which can be irrigated from the supply point, the amount of grading necessary and the position of the head channels.
Layout of the border system
and drains. From these details the cost of the scheme can be calculated.

Once the contour plan has been prepared the next step is to determine the positions of head channels and drains.

Land to be irrigated should be at least 6 inches below top water level. The main channels should be placed along the highest parts of the farm commanded by the supply point so that the largest possible area may be irrigated. Failure to do this may lead to future re-planning of the scheme should the irrigable area need to be extended.

The spacing of channels will depend on contours and soil types.

Where slopes are relatively steep and head of water sufficient, channels may be spaced up to 15 chains apart. For normal slopes, 10 chains should be the maximum. On very porous country 5 chains or less may be enough.

The sketch gives a diagrammatic picture of the finished paddock.

**PREPARATION OF LAND FOR GRADING**

Having selected the positions of main channels, the next step is the preparation of the land for grading.

Where land has carried annual pasture it should be heavily grazed in the spring. After unwanted trees and stumps have been removed, the soil should be ploughed to a depth of 5 to 6 inches, preferably in the direction of watering. Friable soil may be left in this condition. If large clods remain, these should be broken down to about 4 inches in diameter by cultivation with disc harrows.

Preparation of old irrigated pasture land is more difficult. Before ploughing, the surface root mat must be broken down; this is best done with a rotary hoe, or by cross cultivation with disc harrows. This loosens and breaks the surface before ploughing. If this cultivation is carried out in spring while the soil is moist, it creates ideal conditions for decomposing the root and plant material before grading.

Ploughing old permanent pasture without cultivation usually produces large root-bound clods which are difficult to handle and break down. In effect the land must be left clean ploughed 5 to 6 inches deep.

Soils of poor structure which break down to a fine powder should be worked as little as possible. Soils broken down to a fine powder are hard to grade.

**GRADING**

Although the preliminary work is done in the spring the actual grading is a summer job and should only be done when the land is dry.
Grading with a D4 bulldozer. This land has been badly prepared. Large clods of soil should be broken down with disc harrows before grading. Land in this condition is expensive to grade.

Grading can be done by a variety of earth moving equipment. Whatever type of machine is used, the final cost and quality of the work will rest largely on the skill of the operator. Where extensive earthmoving over long distances is necessary, a power driven carry-all scoop is most effective.

Smaller scrapers may be used with farm tractors, but while these may move soil as cheaply as larger machines, a great deal more time and effort is needed to get the same results.

Bulldozers are effective for rough grading over short leads but cannot be relied on to produce a finished job. For this a high powered grader such as the Road Patrol is the best machine.

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proven most effective. These machines are capable of shifting large amounts of soil and finishing the work to a good standard. The same machines are ideal for border, drain and channel formation.

For light smoothing of land a wooden float or drag is quite effective, for example, when it is used on a field that has already been graded, or for smoothing after subsequent ploughing or heavy cultivation.

**Furphy Grader**

The Furphy tractor drawn grader is an ideal farm implement. The machine is mounted on wheels and has a centre slung blade either manually or hydraulically operated. It can be pulled by a farm tractor of about 30 h.p. Adjustment of the side plates allows it to be used for check bank formation.
The Furphy grader is cheap to operate but the work is heavy and time consuming. Skill is needed for efficient work and this is not always available on the farm, whereas a full time power grader operator has the necessary experience and skill. Being a light machine, the Furphy tends to ride over hard spots and this can lead to uneven grading.

During grading a plough should be available to loosen the subsoil bared in the process. The work should be constantly checked with a level and a final check made after the job is finished.

Side Slope

On land with little side slope, a uniform grade only in the direction of irrigation should be the aim in grading. On more uneven land this is not always practical, due to the amount of earthmoving involved and the excessive removal of top soil.

To overcome the problem of side slope it is more practical to concentrate firstly on grading only in the direction of watering. When a uniform grade has been achieved, cross fall can be overcome by terracing. In this way the field is divided into strips of convenient widths which are then graded level.

Border irrigation lends itself to this type of land preparation, as light terracing may be done during the formation of the borders.

Two Gradings for Uneven Land

At least two gradings are necessary on uneven land. After heavy filling a period of settling and soil stabilisation is needed before the work can be completed.

During the interval between gradings the land may be cropped before being sown with permanent pasture.

The crop will depend on the farmer’s requirements and locality and may be Sudan grass, Japanese millet or maize in the summer, or oats or potatoes in the winter.

Poor grading leads to ponding and waterlogging with subsequent pasture damage and weed growth.

More labour, time and water are needed to irrigate a badly graded area than a well graded area. A well-graded area virtually waters itself and the operator is needed only to control the supply of water.

Cost of Grading

Depending on conditions, the cost of land grading can vary from £3 to £40 per acre. In our grading operations in 1961-62 the average cost of grading of all types and conditions was £8 8s. 11d. per acre and the variation was from £3 16s. 11d. to £21 14s. per acre.

About 1,750 acres are graded each year in the irrigation areas.

A crop of Japanese millet planted immediately after the first grading. Where filling has been heavy, a final grading is needed before sowing to permanent pasture.
The first watering on newly graded land. The banks have been well formed and the land well graded. Note the even spread of water in the bays.

Cows on irrigated mixed pastures of grasses and clovers.
LAYOUT OF THE SYSTEM

After checking the final grading the layout of the system follows. The land is first divided into bays separated by border checks or berms.

The berms are long narrow parallel banks of soil about 6 inches high when finally consolidated, and 2 ft. 6 in. wide at the base. To facilitate farm operations and transport the berms should not be unduly high but, at the same time must be high enough to hold the water on the bay.

Depending on the side slope, steepness of the land and amount of water available, the width of the bays will vary from 10 ft. to 30 ft. It is unwise to make the bays too wide as this demands a much greater accuracy in grading and makes the control of water more difficult.

As the object is to allow water to advance evenly down the bays, the cross levelling must be accurate. If cross levelling is not accurate the water will run down one side. An accuracy in levelling of 1/2 in. to 1 in. should be the aim. If possible the bays should be re-checked after the berms have been constructed and small irregularities graded out.

The berms can be constructed by angling the blade of the grader or making the Furphy grader into a crowder by removing the blade and adjusting the wings; or by making a home made crowder.

Dimensions for a suitable home made crowder are given in the sketch.

In forming the banks care must be taken not to leave a furrow alongside the bank because water will run down this during irrigation instead of spreading evenly in the bay. Any furrows or depressions left should be smoothed out.

CHANNEL LOCATION AND FORMATION

The location of the head channel is determined from the original contour plan.

It must be large enough to carry the required amount of water and the banks must be high enough to hold water 3 in. to 4 in. above the surface of the land to be irrigated.

A channel 2 ft. to 2 ft. 6 in. wide on the bottom, 9 in. deep, with banks 9 in. above the surface of the land and sides with a slope of 1/4 : 1 and having a fall of about 1/2 in. to 1 in. per chain will meet most requirements.

While grading is in progress all surplus material should be placed on the channel site. This results in a build up of soil along the proposed site, creating an ideal situation for channel excavation.

With steep channel grades water is controlled by a series of checks which retain the water in level sections. A check is required for about each 4 in. fall.

The system enables large quantities of water to be handled safely. It can be used for nearly all crops and except for very porous soils and stiff clays, on all soil types but . . .

To ensure success the grading and layout must be efficient.