SAVE SOIL with GRASS WATERWAYS

W. F. Purnell and B. A. Jones, Jr.
GRASS WATERWAYS are an essential part of most sound farm plans for saving soil and water. Their wide, shallow, sod-lined channels safely dispose of surface water from heavy rains and thus keep it from forming gullies.

Nearly all fields need grass waterways. On many farms the channels formed by surface runoff are farmed in the same way as the rest of the field. Some farmers believe that keeping these natural drainageways “plowed shut” will keep gullies from forming. But the fact is this practice speeds gullying. Furthermore, if the practice is followed for a number of years, much if not all the surface soil for some distance on either side of the drainageways will be plowed into them and washed away. Also, when gullies are allowed to form, tile located under them is often washed out and destroyed (Fig. 1). Grass waterways prevent gullies from forming and protect the tile.

They do not, however, take the place of erosion-control measures on adjoining slopes. Silt in a waterway is evidence that adjacent hillsides are eroding. On gently sloping fields, erosion can be controlled by soil treatment and a rotation that includes at least one or two years of soil-building grasses and

Left unprotected, the tile line on this Iroquois county farm has washed out. When it has been repaired, the gully should be worked in, shaped, and seeded to a permanent waterway. (Fig. 1)
legumes. On more sloping land or where the rotation does not give enough protection, other measures are needed, such as contour strip-cropping, or terraces. Steep slopes are best kept in hay or pasture most of the time.

Wherever terraces are built, grass waterways are needed for outlets. To give the grass time to form a good sod, these waterways should be put in at least a year before the terraces are built. No matter what other measures are used, grass waterways are a valuable and necessary supporting practice.

Grass waterways are easy to build, but a single seeding may not take hold well enough to withstand the effects of running water or unfavorable weather. Farmers replant other crops when they fail — the same persistence is needed with a grass waterway.

**LEAVE ESTABLISHED SOD**

Fields that have been in hay or pasture often have good sod in the draws. Leave sod undisturbed to form wide grass waterways (Fig. 2). Do not plow even a partial stand of grass — it is easier to thicken it with another seeding than to develop a new stand on bare soil.

When this field in Woodford county was plowed out of alfalfa-brome-grass meadow, the owner was wise enough to leave the sod in the draw. With good care he will have an excellent waterway indefinitely. (Fig. 2)
Before you plow a field, mark the outside edges of draws with stakes or with shallow scratch furrows to indicate the part to be left in grass. The furrows will be obliterated as the field is plowed. Without marking, it is hard to see just where to throw out the plow. Stagger the points at which the plow is pulled or dropped on the soil so that a rough edge is made along the waterway. This will keep water from forming a secondary channel along the edge of the sod.

Also when you disk a field, avoid cutting up and destroying any sod that has become established in waterways. This is important. Turning between waterways is better than crossing them. Where crossing is necessary, always straighten or raise the disks.

**PRELIMINARY STEPS**

**Provide a Wide Channel**

One of the first things to consider in establishing a new grass waterway is the shape of the draw. The waterway should, of course, be wide enough and deep enough to carry off the water after the heaviest rain and should be shallow enough for mowing and crossing with farm machinery. A wide, almost flat-bottomed or saucer-shaped ditch, slightly deeper in the center than on the sides, is desirable (Fig. 3, page 6).

When a deep, narrow ditch has formed in part of a drainageway (Fig. 1) or a ditch has meandered badly, the banks will need considerable shaping and straightening. If the ditch is small, regular tillage implements can be used. On larger gullies a grader or dozer is more effective. When you shape the ditch, be careful to avoid leaving ridges that will interfere with mowing the grass.

Waterways built according to the dimensions given on page 5 should be safe for most Illinois cropland. It is a good practice to seed the banks to a line a little above the high-water mark of previous heavy rains. A small waterway can be made easier to mow by building it somewhat wider than would be needed to carry the actual runoff.

To use this table, you need to know the acreage to be drained and the slope of the channel. It is also important to check the map and the note that accompany the table, and
that indicate how the top width should be modified in different areas of the state. In area I, for example, a waterway draining 25 acres and having a slope of 3 feet in 100 (3 percent) should be 25 feet wide at the top and 8 inches deep. In

### SUGGESTED DIMENSIONS FOR SOD WATERWAYS

For Normal Runoff With No Velocities Greater than 5 Feet per Second

<table>
<thead>
<tr>
<th>Slope of channel</th>
<th>Acres drained by waterway&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Width and depth of channel</th>
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<tr>
<td></td>
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<td>5 10 15 20 25 30 35 40 50 60 80 100 150 200</td>
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<tr>
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<td>14 20 20 25 28 30 35 36 40 48 52 55 55 60 90</td>
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<td>D in.</td>
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<tr>
<td>2%</td>
<td>T ft.</td>
<td>14 18 19 22 25 28 32 36 40 45 50 55 60 70 70</td>
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<tr>
<td></td>
<td>D in.</td>
<td>6 8 9 9 9 9 9 9 10 10 11 11 14 15 15 15</td>
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<tr>
<td>3%</td>
<td>T ft.</td>
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<tr>
<td></td>
<td>D in.</td>
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<tr>
<td>4%</td>
<td>T ft.</td>
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<tr>
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<td>T ft.</td>
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<tr>
<td>10%</td>
<td>T ft.</td>
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</tr>
<tr>
<td></td>
<td>D in.</td>
<td>4 5 5 5 5 5 5 5 5 5 5 5 5 5 5</td>
</tr>
</tbody>
</table>

<sup>a</sup>Adapted from Soil Conservation Service Engineering Handbook for the Cornbelt States.

<sup>b</sup>Be sure to consider the entire watershed, including land on other farms.

<sup>c</sup>T = Top width in feet. D = Depth in inches.

**NOTE:** The dimensions in this table apply specifically to that area indicated as "I" on the map. If you live in area II, reduce top widths by 2 feet. For area III, increase top widths by 2 feet.

Cross-section of waterway showing how measurements are taken.
area II the top width should be 23 feet, and in area III, 27 feet. Having the proper dimensions is particularly important when the waterway is to serve as a terrace outlet.

**Make Soil Conditions Favorable**

Waterway seedings need a moist, fine, compact seedbed. Thorough working of the soil with disk and harrow is therefore important. Rolling the soil with a corrugated roller firms the seedbed and makes it less likely to wash before sod is formed. The roller is also an excellent tool for working the seed into the soil. If possible, make the last tillage operation across the waterway.

To establish a resistant turf quickly, the soil must have an abundance of readily available plant food. It is best to test the soil to find out if it needs limestone, phosphate, or potash.

A very good way to supply much of the needed fertility is to apply 8 to 10 tons of manure an acre and work it into the soil as the seedbed is prepared (Fig. 3). Manure, however, is relatively low in phosphorus, and on phosphorus deficient soils, a phosphate fertilizer should also be used. Manure containing straw, disked into the soil, helps to prevent erosion until the grass starts growing. Or a mulch of strawy material, such as clover chaff or soybean straw, may be used to hold the soil and to help seedings "catch."

A liberal application of manure is being spread on this newly graded waterway in Champaign county. Besides supplying fertility, the straw in manure helps to control erosion until the grass is well started. (Fig. 3)
If no manure is available, apply ammonium nitrate at the rate of 100 to 150 pounds an acre, or an equivalent amount of other nitrogen fertilizers. Or if tests show that phosphorus or potassium is lacking, use a complete fertilizer high in nitrogen (such as 8-8-8 or 10-10-10) at the rate of 400 to 800 pounds an acre. Plenty of fertility, especially nitrogen, is needed to give a waterway seeding a quick start toward development of a thick sod. On established waterways, repeat fertilizer applications as needed.

**Use Tile for Underdrainage**

Tile cannot be expected to replace open waterways for carrying away flood water. To carry any appreciable flood runoff, tile must be so large as to make the cost prohibitive. The use of surface inlets is of little help except to carry off small amounts of surface water after the flash runoff is past.

Tile are exceedingly useful, however, in removing excess soil water. Wet draws or adjacent areas often require tiling before satisfactory sod waterways can be established and the area conveniently farmed.

Tile lines placed under waterways often wash out and break. They usually must be repaired before a satisfactory grass waterway can be established. When a new tile line is to be laid along a waterway, laying it at the side of the waterway will reduce the danger of its being washed out.

**SEEDING THE WATERWAY**

**Best Time to Seed**

Ordinary seeding methods, carefully used, are the cheapest means of establishing grass in draws that are bare of vegetation.

A waterway seeding may be made regardless of the crop on the watershed above. But since new seedings are always in danger of being washed out, it is best to make them when the field is in hay, pasture, or small grain. These close-growing crops reduce the amount of runoff water that must be carried in the waterway channel.
Draws which have shown only a slight to moderate tendency to gully may be seeded when the rest of the field is sown to meadow or pasture. Under these circumstances little special preparation may be needed.

Waterways should be seeded early in either spring or fall. Early fall is usually preferred in southern and central Illinois, while spring seeding is more common in the northern part of the state.

Fall seedings are not so likely to be washed out. The soil then is dry and will absorb more water, thus reducing runoff and erosion. Also weed growth is less serious. The cool, moist conditions of fall and early spring enable fall-seeded plants to become better established before the weather becomes hot and dry. Many farmers, however, report success with spring seedings, so choice may depend on the most practical time to prepare the waterway.

**What to Seed**

A tough sod is needed for a waterway (Fig. 4). Grasses are most desirable because of their extensive and fibrous root systems. The deeper-rooted grasses are best.

**Tall fescue** is a hardy grass that makes a good sod. It has been successful in all parts of the state and is definitely superior to other grasses in southern Illinois and on tight soils in other parts of the state. Tall fescue grows best on good soil but if well fertilized will do well on soils of low fertility and on tight soils that drain slowly. It starts quickly and makes a strong growth.

**Bromegrass** is a hardy, aggressive, sod-forming grass that is a favorite in northern and central Illinois. When well established it gives good protection to a waterway channel. It does best on good soils. Only southern strains are recommended for use in this state.

**Timothy and redtop** are two grasses well suited to waterway seedings in all parts of Illinois although they are not as deep-rooted as the other three recommended grasses. Redtop makes a good turf quickly and grows under a wide range of soil and climatic conditions. It does best on good soil and yet
grows fairly well under drouthy conditions, on wet soils, or on soils low in fertility. Timothy, like redtop, is widely adapted, but requires somewhat better soil and does not grow as well on wet soil or during dry weather.

**Reed canary grass** is a long-lived perennial that produces an excellent growth, especially on wet areas. It is useful in waterways that stay wet and marshy during so much of the year that other grasses do not thrive. This kind of waterway has to be prepared and seeded when the soil is dry, usually in the summer. Reed canary grass can be seeded in the same way as other grasses. New seed should be used as old seed does not germinate well. The best method is to take root-stocks from an established stand, chop them, spread them with a manure spreader, and then disk them into the soil.

**Kentucky bluegrass** grows best on fertile soils in central and northern Illinois, where it has been extensively used in waterways. It is not as deep-rooted as the other grasses already mentioned and therefore is not as desirable. Present practice is to omit bluegrass from the seeding mixture. On good soils it will come naturally into stands of other grasses.

**Nurse crop optional.** Seedings made without a companion crop are often completely satisfactory. However, a light seeding of a nurse crop will help to hold the soil until the grasses
get well started. Spring grain seeded in the fall or fall grain seeded in the spring at the rate of $\frac{1}{2}$ to 1 bushel an acre may be used for this purpose. Perennial ryegrass may be used in either season, but the seeding should be light (3 pounds an acre or less) to avoid smothering the other grasses.

Any nurse crop that threatens to compete seriously with the young grasses must be mowed and removed.

Legumes not needed. In a pasture or meadow mixture legumes are included for their ability to gather and supply nitrogen and thus increase the growth of the grasses, as well as for their value as feed. In a waterway, however, the grasses must take hold quickly — there is not time to wait for nitrogen to be supplied by legumes. It is much more important to provide ample plant food at planting time by using manure or other fertilizer than it is to include legumes.

Legumes do not form a sod as do grasses but are stemmy, tend to loosen the soil, and may winterkill, leaving bare spots. Once grasses are established, the moist condition in a waterway plus regular applications of fertilizers will promote ample growth. If not, apply manure or other fertilizer regularly.

Alsike clover will grow on wet soils and is therefore frequently included in seedings for waterways that tend to stay wet for considerable periods.

Use Plenty of Seed

A heavy seeding at a rate two to three times that for ordinary field conditions is necessary to establish a thick stand of plants quickly. The following suggestions are for an acre of waterway:

For general use throughout the state

Tall fescue .................. 20 to 25 pounds
Timothy ...................... 6 to 8 pounds
Redtop ........................ 4 to 6 pounds

For the more-productive soils, well fertilized, especially in northern and central Illinois

Bromegrass .................... 20 to 25 pounds

For wet soils

Reed canary grass............. 15 to 20 pounds
Temporary Seedings

Sometimes a temporary seeding is desirable in order to control erosion until permanent grasses can be established. Temporary seedings are recommended where spring seedings have failed or where seeding is to be delayed until fall.

Corn seeded at the rate of 3 to 4 bushels an acre in May or June will give good temporary protection. The seedlings grow rapidly and protect the soil from serious washing. In late August or early September the corn can be mowed and removed for forage. The regular waterway seeding can then be made in the stubble, which will prevent erosion until the young plants can get started. Care should be taken in making the permanent seeding to preserve the corn stubble to hold the soil until the new grasses take hold. This means that the channel should be shaped before the corn is seeded.

MAINTAINING A SOD WATERWAY

Give Waterway Regular Attention

A grass waterway can’t be kept in good repair without regular attention. This is especially true if it carries a large volume of water or is on a steep slope. Soddng or reseeding small breaks in the sod, fastening down any loosened sod, and sloping back and sodding small overfalls are some of the ways to avoid having to make extensive repairs later. If the grass fails to make a good growth, apply manure or a fertilizer high in nitrogen.

Never use a waterway as a road. The ruts or breaks that will be made in the sod will endanger the waterway. Controlling burrowing rodents such as ground hogs and moles is also important.

Prevent Livestock Damage

If waterways are carefully protected in rotation pastures, cattle and sheep may be grazed on them at seasons when the ground is not soft. But do not allow the animals to cut paths lengthwise of the waterway. Short sections of fence built across the channel at intervals will help to prevent them from
doing this. Hogs should not be allowed in waterways as it is very difficult to prevent them from rooting the grass and making walls.

Gullies in permanent pastures will frequently heal over if livestock are fenced out. "Shingling" them with a light covering of brush is often just as effective as fencing if there are no hogs in the pasture. The shade that the grass receives from the brush encourages its growth. Care should be taken to remove debris and silt that may collect in the brush, smother the sod, and start scouring in the channel.

**Control Silt**

The silting in of the channel is a frequent reason for the failure of an established waterway. When much silting occurs, it means that serious erosion is taking place on the watershed. More control measures, such as a change in rotation, contour planting, strip-cropping, or terracing are needed.

When silt completely fills a waterway, it will be necessary to open a new channel of the desired size and re-establish the grass.

**Use Care in Plowing**

Plowing a field in which a grass waterway has been established requires special care. The plow must of course be lifted when the waterway is crossed. Since a plow moves forward several feet while the bottoms are being lifted, the lift must be tripped an ample distance from the edge of the waterway. The plow should be lifted along the edge of the waterway so as to stagger the furrows. Such slight staggering forms a jagged rather than a smooth edge, and by directing the flow of the water into the waterway tends to prevent the water from forming a channel at the side. In no case leave an open furrow along the edge parallel to the waterway.

Many farmers use short diversion dikes or levees to stop channels from forming at the side of a waterway and to keep the runoff water flowing over the sodded strip (Fig. 5). These short dikes can usually be built with a shovel or scoop. For longer dikes some type of grading equipment is more effective.
The gullies at the side of this waterway were formed when the channel was allowed to silt in. Short diversion dikes or levees will keep the runoff water flowing over the sodded strip, thus preventing the formation of ditches.

(Fig. 5)

Mow Regularly

Heavy sod does not develop under the shade of a rank growth of weeds or of tall grass. Furthermore, a heavy growth of vegetation retards the flow of the water and may cause it to overflow the grassed area. This tall vegetation may also be

It is a good plan to mow for hay in June and then cut the grass as often as necessary the rest of the season. If the grass gets too heavy or too high it will block the free flow of the water.

(Fig. 6)
flattened out by the flowing water and, particularly if soil is deposited on top of it, may smother the grass.

A good practice is to cut the growth in the waterway for hay in June and then to mow it as often as necessary to keep the vegetation under control (Fig. 6). Rake and remove the clippings to prevent drifts that smother the grass.

**AIDS IN ESTABLISHING WATERWAYS**

**Divert Runoff When Possible**

Diverting the runoff from gullies by means of diversion ditches or terraces is often an important first step in establishing sod. This method is especially good for controlling hillside gullies that drain small watersheds. Frequently water draining into a gully can be diverted to another draw or another portion of the slope that is well sodded (Fig. 7).

When building diversion ditches, it is important to locate the ditch with a level, so as to avoid a fall of more than 6 inches per hundred feet. The ditch should be large enough to carry runoff water and should have a well-sodded outlet. After
diversion ditches have been constructed, the gullies below them can be worked in and seeded with much less danger of washouts.

In some places, terraces may be so located as to run the water from several nearby waterways into one central drainageway. Thus only one or two waterways will be needed in an entire field where a large number of small waterways were previously employed. Terraces must be carefully laid out with a surveyor's level and constructed properly for satisfactory performance. For guidance in building terraces, see your farm adviser or soil conservationist.

When several waterways are needed on a field, it is usually best to start work on the smaller lateral waterways first and to leave large central ditches until they can be carefully studied.

The practice of filling gullies with rubbish is never to be recommended. Although the original ditch may for a time appear to be controlled, eventually new ditches will cut out. Later, when a grass waterway is to be shaped and seeded, much hard work is required to remove the rubbish.

**Use Sod When Other Methods Fail**

If the channel is well shaped and if other suggestions already made are followed, a good sod will generally develop without the use of other special measures.

Dams of straw, brush, stakes, and wire usually do more harm than good and therefore are not recommended. They often create holes in the waterway just below the overfall. At best their average life is only a few years; then they must be replaced or erosion will start in the cuts around them.

Good sod cut from established stands of grasses such as reed canary grass, redtop, fescue, or bluegrass is excellent for covering areas where the seeding does not catch readily.

**Sod flumes** are especially useful at abrupt overfalls in a ditch and at gully heads. The overfall or gully head is sloped down to a gentle slope, extending horizontally 4 feet for each foot of height. Sod is then laid over and below the slope to form an apron.

Sod flumes have been used successfully in overfalls as great as 8 to 10 feet when the area drained was comparatively small.
Permanent Dams

To control larger gullies having high overfalls or large watersheds, some type of permanent soil-saving dam of earth, reinforced concrete, or masonry may be needed, usually at the lower end of grass waterways. Since permanent dams are expensive to build and ones that wash out are worse than none at all, they must be built properly. Most landowners find it worth while to obtain the services of an agricultural engineer or soil conservationist to help locate, design, and supervise construction of permanent dams. Such services are available through the office of the county farm adviser or the soil conservation district. Information can also be obtained from the Department of Agricultural Engineering, University of Illinois, Urbana.

This circular replaces Circular 593. These revisions are by W. F. Purnell, Extension Soil Conservationist, and B. A. Jones, Jr., Associate Professor of Agricultural Engineering. Circular 593 was by E. D. Walker, formerly Extension Soil Conservationist, and R. C. Hay, Professor of Agricultural Engineering.