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Erosion Control

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FPHASubject: EROSION CONTROL

The disruption of natural erosion controls during the construction of housing projects, by grading and by the destruction of natural cover, has created erosion problems which seriously affect the operation and management of many projects. The following discussion concerns these problems, with suggested methods of solving them.

The principle factors affecting erosion are:

1. Probability of torrential rainfall.
2. The topography of the land, which includes the degree of slope and the total slope area drained of individual drainage ways, both on the project and contributing areas above.
3. The erodibility of the particular soil type.
4. Vegetative cover either present or established later.

Climatic conditions and the basic soil characteristics, cannot of course be changed. The soil, however, can be made more permeable and fertile. Grades can be changed, and cover can be reestablished. These are the three basic items in erosion control.

Drainage

The project site should be studied from the point of view of overall drainage, in order to determine the causes for erosion. Drainage may come from adjacent holdings, a public highway culvert or the collection of water from a large drainage area on the project which when concentrated in one channel amounts to considerable volume. Some of the most frequent drainage problems, with suggestions for their solution, are as follows:

1. Drainage from adjacent properties should be diverted before crossing the property line. If this is impossible, it should be checked on the project side of the boundary line. This is usually done by a diversion ditch or dike.
2. If public highway drainage is the source of erosion, steps should be taken to have the highway department responsible for the road make corrections to divert the water.
3. Drainage from project roads, ditches and drains are sometimes emptied into inlets or culverts that are either too small or improperly located. These should be corrected to the proper locations and sizes.

4. Large volumes of water and resulting erosion at points of concentration or on embankments is often caused by an accumulation of water from a large drainage area. Run-off from such areas are often controlled by:

- (a) The diversion of water by constructing a diversion ditch or dike above the embankment.
- (b) By grading the drainage area to a diversion ditch or channel.
- (c) By establishing an adequate cover on the drainage area.

Drainage pertaining to embankments and gullies will be discussed later under those headings. Drainage of all types should be provided before cover is established.

COVER

The large open areas of a housing project are usually of two types: (1) play areas and; (2) meadow or field areas. Since playfields will receive concentrated wear, they will require a different treatment than field areas. A satisfactory cover should be established prior to actual use as a playfield.

Playfields

Playfields are often affected by sheet erosion, which is the washing away of the surface materials. If the soil on the area is not in satisfactory condition to grow a permanent cover, it is advisable to sow a green manure crop in the spring and plow it under in the fall. A permanent cover applicable to the region should then be sown. The procedure is as follows:

1. Test soil for pH.
2. Plow disc & harrow, grade as necessary to correctly drain. Apply lime as shown to be required by the pH test.
3. If the soil is poor, apply 500 lbs. of superphosphate per acre. Harrow in.
4. Seed a leguminous green manure crop at the rate of 25 to 30 lbs. of hulled seed per acre.
5. Disc or harrow in.
6. In the fall, double disc the crop under.
7. Approximately two weeks after green manure has been disced, seed to grass, in two directions, and roll in.

Fields or Meadows

Those areas having a field or meadow character should be sown to grass suitable to the region, as discussed later under "Grasses For Cover".

Where the soil is not sufficiently fertile to support grass perennial legumes consisting of sweet clover and Lespedeza should be sown.

The procedure is as follows: 1. Preserve all existing cover, where practical; 2. Follow procedure as outlined under play areas #1, 2, 3 & 4; 3. Seed with a perennial legume; 4. Disc or harrow in; 5. Apply straw or hay, if available, as a surface mulch on the steeper slopes at the rate of 2 to 3 tons per acre.

Embankments

Erosion on embankments is sometimes the result of inadequate cover above the bank. In such a case, it is important that the drainage area above the embankment be planted with a good cover before attempting to treat the bank.

Where necessary and practical, the runoff from the drainage area should be diverted from the embankment by a diversion ditch.

Embankments usually present conditions most difficult for the establishment of cover. Grades should, therefore, be revised, if possible, to the minimum before attempting to establish a cover. The procedure is as follows:

1. Preserve existing cover where practical.
2. Regrade to a minimum slope with a maximum limit of 3 to 1, insofar as possible.
3. Fill in gullies.
4. Follow procedure as outlined under playfields #1, 2 & 3.
5. Harrow or rake in.
6. Seed with a perennial legume.
7. Apply a mulch of straw or hay at the rate of 2 or 3 tons per acre.

Plantings of seedling trees, cheap hardy shrubs, or fast-growing vines may be the most economical method of establishing a cover.

Sod flumes may be necessary to carry water from the crest of an embankment to the base where diversion ditch outlets are not available. The construction of sod flumes are discussed under the following heading.

GULLIES AND DIVERSION DITCHES

Complete gully control, like the control of bank erosion, includes proper treatment of the drainage area as well as the gully itself. If the control treatment is applied only to the gully, it is likely that all control efforts are being directed at the result, and the cause neglected. It is important, therefore, that the drainage area be planted with a good cover before attempting to treat the gully.

Diversion Ditches

Where necessary and practical, run-off should be temporarily diverted from a gully head before control measures are attempted within the gully. This applies to gullies of all sizes, except those having a very small drainage area, say of less than an acre.

Diversion ditches are particularly adapted to areas above gullies already covered with trees or grass, as they are not likely to receive silt loads from the drainage area. Ditches should be made large enough to carry all the run-off that will be discharged from the contributing drainage area during the periods of maximum run-off and should be wide, shallow and have mild grades to produce the lowest velocity possible. Deep ditches and steep grades invite erosion. Shallow earth channels, not having a vegetative cover should have grades not exceeding one percent. Where a permanent plant cover is to be maintained in the channel, 2 or 3 percent grades may be used.

The diversion ditch should be set back from the head of the gully a minimum distance of approximately three times the height of the gully overfall. If well protected natural outlet locations can be found, no special outlet revegetation or construction will be necessary. If none are available, it is necessary to take certain precautions to spread the concentrated run-off over vegetative areas to natural outlets or into an outlet drainage way already established.

If funds are available, sodding the ditches makes a more satisfactory job, preventing any possibility of erosion. Where ditch alignment changes, or at the confluence of ditches, sodding is a necessity.

Size of Ditches

1. The settled depth of the ditch should be seldom less than 18 inches. A minimum cross section area of 7.5 square feet is suggested for drainage areas up to 5 or 6 acres.

2. Drainage areas up to 10 acres require a channel depth of 24 inches and a minimum cross section of 24 square feet.

Flumes

Often it is impossible to carry water to an appropriate outlet by diversion ditches or to carry water down steep grades or overfalls to a base grade. Steep grades upon which flumes are usually constructed produce high discharge velocities, and care must be exercised to provide necessary apron and grade protection below the structure. Spill flumes are the most economical to build and may be used successfully to control overfalls in gullies with heads less than ten feet and drainage areas less than 25 acres.

The overfall to be sodded must be cut back to a slope flat enough to make possible the establishment and maintenance of a permanent plant cover. Generally a 4 to 1 slope should be about the steepest. To avoid destructive velocities, a width at least 15 inches per acre of watershed is desirable, and a minimum depth flow should seldom exceed 12 inches. Steeper grades, however, will require concrete, stone, or wooden flumes. The economy of choosing the type of flume will depend on the material available and the permanency of the project. A wooden flume should be the most practical for a temporary project and will convey water adequately from one level to another during the establishment of cover on the embankment. The capacity should be adequate to handle the maximum flow anticipated. An apron should be constructed at the base of the flume, the length of which should not be less than the total height from the spillway crest to the apron floor. The gully channel for some distance below the flume should be on a stable grade.

Check Dams

Check dams constructed of wood, masonry and woven wire have often been used in gullies to stop erosion. Where they are the only corrective measures used, they are usually unsatisfactory. Check dams of these types should only be used in gullies that have had the major portion of drainage diverted to diversion ditches. The check dams then serve to act primarily as obstructions to hold silt and the precipitation occurring on the immediate area. If used, low dams are desirable, placed at frequent intervals to cut down on the velocity of water and to store up the silt. The total amount of soil collected by these dams is relatively small, but they hold enough to promote growth of some vegetation, which in turn forms a barrier that collects more soil. Dams should be constructed far enough into the bottom and sides of the gully to prevent wash-out underneath or around the ends of the checks.

They should also have sufficient spillway capacity to convey run-off at the maximum rate that can be expected during the life of the structure. An apron will generally be necessary to protect the structure from undermining action of the run-off as it is discharged from the spillway.

Shrub Checks

In small or medium sized gullies, it is often possible to construct checks consisting of shrubs planted across the flow line of the gully in double or triple rows. The shrubs should be planted 4 or 5 inches apart in rows and in shallow trenches. Each row of plants should be staggered in relation to the adjacent row, sometimes protected by a row of stakes. Stakes are placed about 1 foot down the channel from the shrubs so that the plants will benefit from the silt collected by the stakes. Shrub checks should be closely spaced if they are to be effective and should only be used in gullies that have a mild grade.

SUGGESTED COVER PLANTS AND PLANT MATERIALS

Vegetation for Gullies

Plants will always come naturally on protected areas in a location where vegetation will grow. This is usually very slow as it is hard for vegetation to get a foothold because of freezing, thawing and washing. Conditions can be helped by mulching the area with boughs, straw, hay or leaves. Very steep slopes should be graded off to a 3 to 1 slope, if possible. The extreme maximum grade would be a 1 to 1 slope - Vegetation cannot get established on a grade greater than that. The establishment of natural vegetation, however, may be a lengthy process. Where such vegetation does not appear able to cope with existing erosion, it may be necessary to consider ways and means of establishing vegetation artificially.

The following list is illustrative of the type of material generally used for this purpose and should not be considered as complete for any particular locality.

Suggested Cover Plant Materials

Vines

1. *Lonicera japonica* (hall's honeysuckle)
2. *Pueraria thunbergiana* (kudzu vine)

Shrubs

1. *Rhus* in variety except poison sumac.
2. *Symphoricarpos* in variety (Snowberry, Coralberry).
3. *Cornus stolonifera* (Red-osier)
4. *Prunus virginiana* (choke cherry)

Trees

1. Robinia pseudoacacia (Black Locust)
2. Catalpa
3. Pine in variety
4. Salix (willow) in variety for wet locations.

Kinds growing near the project are most likely to survive. Seedling or "whip" sizes are usually satisfactory for bank planting.

The spacing of plants will depend on local conditions, but 6 feet apart in each direction is the maximum spacing ordinarily recommended for erosion control. Spacing of 3 x 3 and 4 x 4 feet are better, especially for shrubs in gullies.

As gullied areas usually have poor soil, it is important that good planting stock be used. Hardy, thrifty plants have a much better chance of establishing themselves under such adverse conditions. The use of fertilizer in planting aids in insuring survival and growth.

Whether trees, shrubs or perennial grasses are used on gullies, soil will be more satisfactorily retained and growth encouraged if the gully is mulched with hay, straw or grass at a rate of 2 to 3 tons per acre.

Legumes

1. Legumes for the north: Alfalfa, 30 lbs. per acre, sweet clover, 15 lbs. per acre. A combination of 10 lbs. inoculated sweet clover and 15 lbs. of Korean Lespedeza is recommended for green manuring or as a permanent cover. Seed in early spring.

2. Legumes for the south: Lespedeza sericea, seeded at the rate of 15 to 20 lbs. of scarified and inoculated seed per acre. For best results, seed in April.

Kudzu vine is a very good plant to use on gully banks. In general, Kudzu is not well adapted to the black belt section of Alabama and Mississippi, but in the coastal and Piedmont Plains it does well.

Grasses For Cover

Southern Grasses

Carpet grass (Axonopus compressus). Coastal plains soils from southern Virginia to Texas and inland to Arkansas and northern Alabama. (Seed 10 lbs. per acre). Grows well when mixed with Lespedeza.

Bermuda grass (*Cynodon dactylon*). Extends northward as far as Maryland, Kansas and the warmer valleys of Washington and Oregon. Plant stolons or seed (seed 20-30 lbs. per acre).

Western Grasses

The following grasses may be used in pure stands or in mixtures with alfalfa or sweet clover, in the more humid areas.

Broom grass (*Bromus inermis*) Extends western Oregon and Washington, Montana, North Dakota, Idaho, Wyoming, South Dakota, Nebraska, Colorado, and northern New Mexico, (Seed 30 to 40 lbs. per acre).

Crested wheat grass (*Agropyron cristatum*) and western wheat grass (*Agropyron Smithii*) for extreme drought areas. Extends eastern Washington, Montana, Western North Dakota, Wyoming, Western South Dakota (25 to 30 lbs. per acre).

Eastern Grasses

North of Washington and west to Minnesota, Iowa and Missouri, mixture of the following: (Seed 30 lbs. per acre).
1. 40% Canada Blue; 2. 10% Kentucky Blue; 3. 30% Red Top;
4. 15% Italian Rye; 5. 5% White Clover.

Maintenance of Erosion Controls

An important, and frequently neglected practice, in the control of erosion is systematic inspection, repair and maintenance. Too often erosion controls are installed and then neglected until they become so badly damaged that they are no longer effective. When this happens, practically all expenditures and efforts have been wasted. Installations for control of gullies should be inspected periodically, especially after heavy rains to determine if they are functioning or need repairs. This is particularly true of vegetative controls during the period when vegetation is becoming established. Attention given to minor adjustments or repairs often determine whether or not the vegetation will successfully control erosion.

Consultation

The many problems involved in erosion control, such as soil fertility, amount of run-off on a given drainage area and the size of diversion ditches required, make it advisable to consult with someone experienced and technically qualified. It is suggested that project managers consult with the nearest Soil Conservation Service field office or county agent in order to obtain qualified assistance.

References

A number of publications on erosion control and cover can be obtained from the United States Department of Agriculture. These publications are as follows:

1. Legumes in Soil Conservation Practices, Leaflet #163.
2. Soil-Repleting, Soil Conservation and
Soil Building Crops, " #165.
3. Kudzu-A Forage Crop For the Southeast, " # 91.
4. Native and Adapted Grasses for Conserva-
tion of Soil and Moisture in the Great
Plains and Western States, Farmers Bulletin #1812.
5. Prevention and Control of
Gullies, " " #1813.
6. The Annual Lespedezas as Forage
and Soil-conserving Crops, " " #1814.
7. Lespedeza Culture and
Utilization, " " #1852.

Addendum

On page -- Bermuda and Carpet Grass is recommended for use in the south. Attention is called to Food Production Order No. 6, dated January 20, 1943, which restricts the sale of all seed of these grasses to use on Army, Navy, Marine or Coast Guard projects.

Planting of these grasses can, of course, still be accomplished by the use of vegetative methods, such as sprigging or spot sodding. Should the use of this method be determined as not feasible, and seeding be desirable, it will be necessary to substitute other grasses. The following are suggested: Perennial or Italian Rye grass; sweet or burr clover and lespedeza.