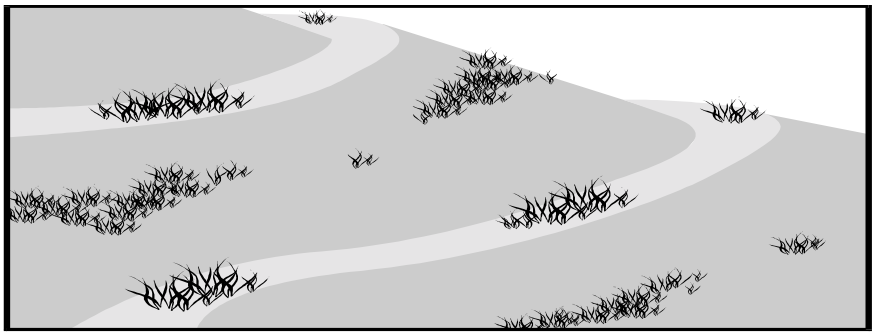
ACTIVITY: Terracing

TCP – 11



Targeted Constituents				
● Significant Benefit	◗ Partial Benefit	○ Low or Unknown Benefit		
● Sediment	○ Heavy Metals	○ Floatable Materials	○ Oxygen Demanding Substances	
○ Nutrients	○ Toxic Materials	○ Oil & Grease	○ Bacteria & Viruses	○ Construction Wastes

Implementation Requirements				
● High	◗ Medium	○ Low		
○ Capital Costs	○ O & M Costs	○ Maintenance	● Suitability for Slopes >5%	○ Training

Description

Terracing creates small but widespread areas for establishing vegetation that reduces runoff velocity, increases infiltration, and provides small depressions for trapping sediment, thereby reducing sediment from leaving the site. This management practice is likely to create a significant reduction in sediment.

Suitable Applications

- Any cleared area prior to temporary or permanent seeding and planting.
- Required for cleared, erodible slopes steeper than 3:1 (H:V) and higher than 5 feet (1.5 m) prior to seeding and planting.
- Graded areas with smooth, hard surfaces.
- Where length of slopes needs to be shortened by terracing. Note, terracing is usually permanent, and should be designed under the direction of and approved by a licensed professional civil engineer based on site conditions. Terraces must be designed with adequate drainage and stabilized outlets.
- Terracing can be enhanced by surface roughening as explained in TCP-06.

Application Methods

Slope roughening/terracing is performed in several ways:

- Stair-step grading.
- Grooving.
- Furrowing.
- Tracking.
- Rough grading.

- No grading.

Installation/ Application Criteria

Graded areas with smooth, hard surfaces give a false impression of "finished grading" and a job well done. It is difficult to establish vegetation on such surfaces due to reduced water infiltration and the potential for erosion. Rough slope surfaces with uneven soil and rocks left in place may appear unattractive or unfinished at first, but they encourage water infiltration, speed the establishment of vegetation, and decrease runoff velocity. Rough, loose soil surfaces give lime, fertilizer, and seed some natural coverage. Niches in the surface provide microclimates which generally provide a more favorable moisture level that aids seed germination.

There are different methods for achieving a roughened soil surface on a slope, and the selection of an appropriate method depends upon the type of slope. Roughening methods include stair-step grading, grooving, and tracking. Factors to be considered in choosing a method are slope steepness, mowing requirements, and whether the slope is formed by cutting or filling.

1. Disturbed areas which will not require mowing may be stair-step graded, grooved, or left rough after filling.

2. Graded areas steeper than 3:1 (H:V) should be stair-stepped with benches (See figure TCP-11-3). The stair-stepping will help vegetation become attached and also trap soil eroded from the slopes above. Stair-step grading is particularly appropriate in soils containing large amounts of soft rock. Each "step" catches material which sloughs from above, and provides a level site where vegetation can become established. Stairs should be wide enough to work with standard earth moving equipment.

3. Make the vertical cut distance less than the horizontal distance, and slightly slope the horizontal position of the step in towards the slope.

4. Do not make individual vertical cuts more than 24 in. (600 mm) high in soft materials or more than 3 ft. (1 m) high in rocky materials.

5. Groove the slope using machinery to create a series of ridges and depressions that run across the slope and on the contour.

Fill Slope Roughening

- Place fill slopes with a gradient steeper than 3:1 (H:V) in lifts not to exceed 8 in. (200 mm), and make sure each lift is properly compacted.

- Ensure that the face of the slope consists of loose, uncompacted fill 4 in. (100 mm) to 6 in. (150 mm). This is not to be confused with proper compaction necessary for slope stabilization.

- Use grooving or tracking to roughen the face of the slopes, if necessary.

- Apply seed, fertilizer, and mulch and then track or crimp in the mulch. See TCP-07, 08: Temporary Seeding and Mulching.

- Do not blade or scrape the final slope face.

Cuts, Fills, and Graded Areas

- Slopes that will be maintained by mowing should be no steeper than 3:1 (H:V).
- To roughen these areas, create shallow grooves by normal tilling, disking, harrowing, or use a mechanical seeder. Make the final pass of any such tillage on the contour.
- Make grooves formed by such implements close together, less than 10 in. (250 mm), and not less than 1 in. (25 mm) deep.
- Excessive roughness is undesirable where mowing is planned.

Maintenance

Periodically check the seeded or planted slopes for rills and washes, particularly after significant storm events greater than 0.5 in. (12 mm). Fill these areas slightly above the original grade, then reseed and mulch as soon as possible.

- Inspect roughened slopes weekly and after rainfall for excessive erosion.

Limitations

- Roughening may increase grading costs and result in sloughing in certain soil types.
- Stair-step grading may not be practical for sandy soils, very steep, or shallow slopes.
- Roughening alone as a temporary erosion prevention measure is of limited effectiveness in intense rainfall events. If roughening effects are washed away in a heavy storm, the surface will have to be re-roughened and new seed and mulch applied.

Primary References

California Storm Water Best Management Practice Handbooks, CDM et.al. for the California SWQTF, 1993.

Caltrans Storm Water Quality Handbooks, CDM et.al. for the California Department of Transportation, 1997.

Subordinate References

Best Management Practices and Erosion Control Manual for Construction Sites, Flood Control District of Maricopa County, Arizona, September 1992.

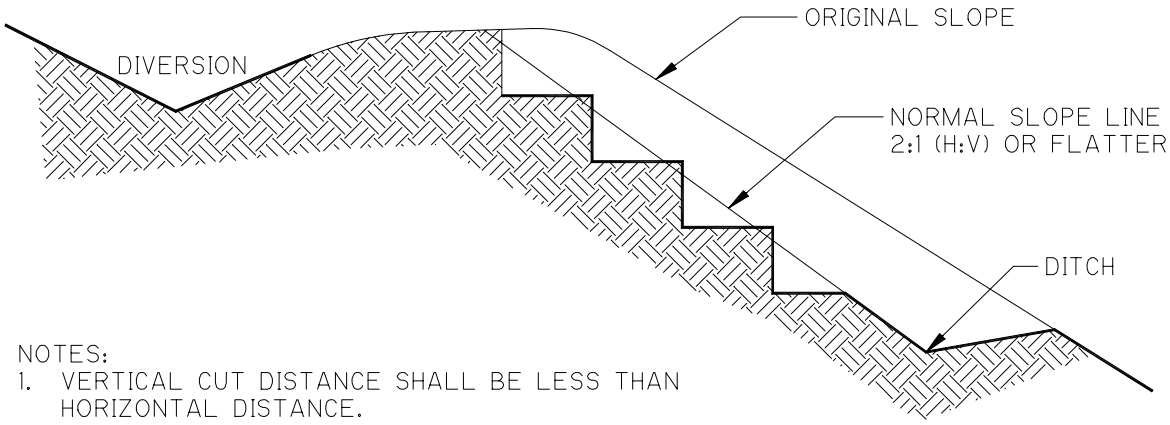
Handbook of Steel, Drainage & Highway Construction, American Iron and Steel Institute, 1983.

Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group Working Paper, USEPA, April, 1992.

Stormwater Management Water for the Puget Sound Basin, Washington State Department of Ecology, The Technical Manual – February 1992, Publication #91-75.

Inspection Checklist

- Are furrows at least 6-inches (15.2 cm) deep?
- Are furrows spaced no more than 50-feet (15.2 m) apart?
- What are the groove slopes in serrated slopes?
- Are stepped slopes cut so that the horizontal distance is greater than the vertical?
- Are stepped or terraced slopes cut so that the steps drain in on themselves?



NOTES:
1. VERTICAL CUT DISTANCE SHALL BE LESS THAN HORIZONTAL DISTANCE.
2. VERTICAL CUT SHALL NOT EXCEED 24″ (600 mm) IN SOFT MATERIAL AND 3′ (1 m) IN ROCKY MATERIAL.

STEPPED SLOPE

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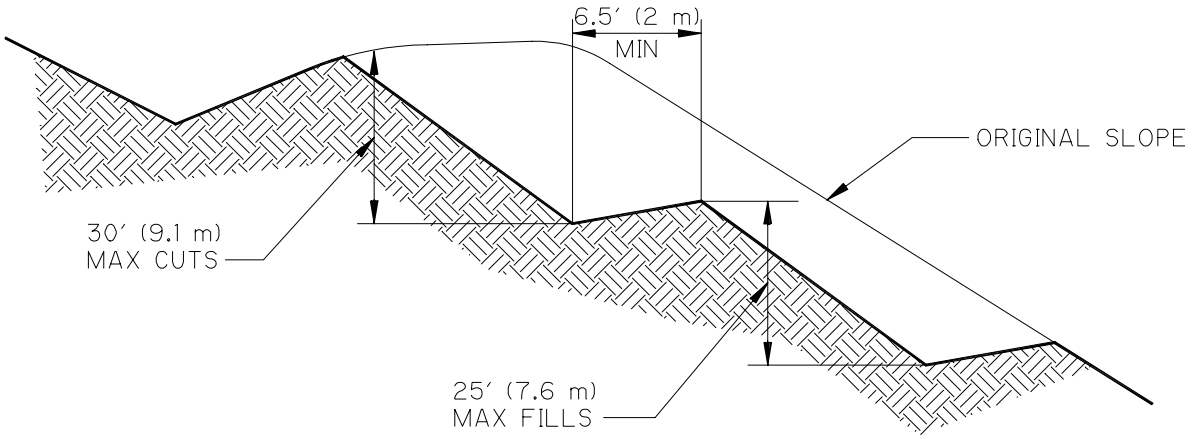

TERRACED SLOPE

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Figure TCP-11-1
Stepped and Terraced Slope Construction