Fact sheet 2 Slope stabilisation and stability of cuts and fills

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The objectives of river bank cuts and fills

1 to create a stable surface to minimise bank erosion and loss of productive land;

2 to balance material between the cut and fill;

3 to remain stable over time;

4 to not be a source of sediment and;

5 to minimize long-term costs.

Any activities undertaken in a watercourse, including placing fill and excavating on a river bank associated with stabilisation and rehabilitation works, are regulated under the Water Act 2000 and Water Regulation 2002, and may require a riverine protection permit. General exclusions apply as outlined in "Guideline – Activities in a watercourse, lake or spring carried out by a landholder". Any disturbance of remnant vegetation is covered by the Vegetation Management Act 1999 and may need a management plan to be assessed under the Sustainable Planning Act 2009. Any permits required for works on a site are to be applied for and approved prior to commencement of works.

Proper long term stabilization of stream banks, along roadways and access tracks on banks, and drainage ways will significantly reduce if not prevent costly maintenance, and will contribute significantly to the reduction and prevention of considerable amounts of sediment delivery into streams and waterways.

Before any works on a river bank, the site is to be assessed by a suitably qualified person for stability, access, ability/feasibility of the site to be stabilised, and dimension of works. A site plan will outline the site to be stabilised and any conditions.

Ideally, both cut and fill slopes should be constructed so that they can be vegetated. Ideally, fills should be constructed with a 2:1 or flatter slope to promote growth of vegetation and slope stability. Terraces or benches are desirable on large fill slopes to break up the flow of surface water.

Slope failures, or bank slips, typically occur where a slope is steep (>25^{o}), where fill material is not compacted, or where cuts in natural soils encounter groundwater or zones of weak material.

When failures do occur, the slide area should be stabilized by removing the slide material, flattening the slope, adding drainage where appropriate, or using structures, as discussed below. Designs are typically site specific and may require input from geotechnical engineers, engineering geologists, soils scientists or equivalent.

In most excavation and embankment work, relatively flat slopes, good compaction, and adding needed drainage will typically eliminate routine instability problems. Once a failure has occurred, the most appropriate stabilization measure will depend on site-specific conditions such as the size of the slide, soil type, road use, alignment constraints, and the cause of the failure. Vegetation threating the stability of a site is to be removed as indicated in the site plan.

A range of common slope stabilization options appropriate for low-volume bank stabilisation batters are listed below (delete items if not applicable to the site):

1 Use balanced cut and fill construction in most terrain to minimize earthwork;

2 Construct cut slopes in most soils using a cut slope ratio of 2:1 to 3:1 (horizontal: vertical) in coarse granular and unconsolidated soils, in wet areas, and in soft or clay-rich soils. Use these relatively flat cut slopes to promote growth of vegetation;

3 Construct fills with a fill slope ratio of 2:1 or flatter fill slope ratio will promote vegetative growth. For clay-rich, unstable or dispersive soils or in high rainfall areas (>1500 mm), a 3:1 fill slope is desirable;

4 Where long-term examples are available, use local experience, as well as ideally materials testing and analysis, to determine the stable cut slope angle in a particular soil type;

5 Direct concentrated surface water (runoff) away from cut and fill slopes;

6 Dispose of unsuitable or excess excavation material in locations that will not cause water quality degradation or other resource damage or interfere with farm or infrastructure operations;

7 Remove debris before fills to enable even compaction of the fill;

8 Debris may be placed on the lower bank and keyed into the bank to provide improved bank stability as assessed by a suitably qualified person and as indicated on the site plan;

9 Compact fill slopes in sensitive areas or when the fill is constructed with erosive or weak soils. Use specific compaction procedures, such as wheel rolling, layer placement of the fill (with 15 to 30 cm lifts), or use specific compaction equipment when available. The whole area of fill is to be compacted;

10 Compact fill and cut slopes to remain in a relatively “rough” state to reduce surface run-off and increase water infiltration;

11 All wheel tracks, tine or other equipment marks to be on the contour to reduce surface run-off or concentration of run-off. Vertical tracking (up & down slope) with a dozer will also enhance infiltration;

12 Slope grades should be straight and true without humps, bellies, dips or ridges. This will reduce concentration of runoff on slopes and promote sheet flow which is less erosive and enhances infiltration of water needed for plant growth.

13 Remove organic surface material for topdressing once cut and fill compacted. Slopes to be seeded should be no steeper than 2 horizontal to 1 vertical (2:1) and should be covered with a minimum of 2 inches of topsoil. Finish grading should always follow top soil placement;

14 Construct a toe bench before the fill is placed over the native unconsolidated collapsed soil to prevent a “sliver fill” failure at the contact of the native soil and fill. Once a fill failure occurs on a steep slope, a retaining structure or reinforced fill is typically needed for repairs;

15 Use physical and biotechnical slope stabilization measures such as retaining structures, buttresses, brush layering, and drainage, as needed to achieve stable slopes. Retaining structures may be loose rock, gabions, reinforced concrete, piles, crib;

16 Consider mulching graded and finished areas before a rain event if seeding cannot be performed;

17 Seed bare areas as soon as possible after disturbance, preferably as soon as a significant area is graded and finished and before the next rain event;

18 Fertilize and lime the area as needed based on soil condition and disc or rake it into the soil surface to a depth of 0.05-0.1 m, or apply by hand at planting time, whichever is appropriate.