Contour Banks

EROSION AND SEDIMENT CONTROL GUIDELINES

Technical Note No. 17

Description

A contour bank is a compacted ridge of soil, constructed across the slope, used to intercept runoff within a paddock to reduce velocity and redirect the water into a stabilised receiving area. Contour banks are also called graded banks.

Application and function

Banks of different shapes and heights are used depending on the situation and the diversion requirement.

Contour banks are primarily used in broad acre horticultural or agricultural farming developments and are used to reduce runoff velocity (especially where long slopes are present) and catchment size. Depending on catchment size, multiple banks may be required.

Banks are constructed at a set grade off the contour (ie. across the slope), at regular intervals and are usually broad-based 'roll-over' in shape to enable trafficability.

Limitations

Large earth moving machinery (such as a grader or bulldozer) is required to construct contour banks. Depending on the type and number of banks required, construction times can be lengthy and suitable soil moisture is an important consideration. Construction of multiple banks can be costly, and seasonal maintenance may be necessary depending on land use (e.g. horticultural crops and pivot irrigation).

Advantages

Material for the construction of contour banks is obtained on site. Contour banks are permanent structures and if maintained will last many years, especially in low traffic areas (eg. improved pasture). Depending on land use, bank construction need not detract from the total area under cultivation and will not impede pivot irrigation.

Alternatives

Retention of native vegetation buffers (unstocked and maintained) containing suitable groundcover, at similar intervals to those calculated for bank spacing, can be a cheaper option than the installation of contour banks.

Construction

Planning is essential prior to construction. First survey the paddock to obtain elevation / contour data and use attached methodology to calculate the required bank spacing and sizes. Ensure bank location is accurately pegged in the field (taking into account suitable discharge points) prior to commencing construction.

WARNING: Incorrect or poor construction can cause gully erosion.

Cut and push lines are ripped across the area at a grade of 0.2%. A shallow channel should be cut along this line (depth depending on calculations) and excavated material dumped on the down slope side of the channel and then compacted and smoothed out to form a bank with even batters (no greater than 1(vertical):4(horizontal)) and a level or gently rounded top. Allow for compaction of the material which is usually one third of the initial bank height. The bank should direct runoff into an area with suitable groundcover where velocity will further be reduced, sediment filtered and water is able to infiltrate (preferably an area of undisturbed native vegetation). A level sill should be constructed at the end of each bank to spread the water back to sheet flow.

A level sill is a shallow excavation at the end of a bank, allowing water to flow out evenly along the length of the sill, thereby avoiding concentrated flows. There should be NO disturbance to the ground surface down slope of the sill outlet.

When constructing multiple banks it may be necessary to stagger the exit points to avoid concentrated release of runoff. For example, the bank at the top of the slope would extend a greater distance into undisturbed vegetation than the bank at the bottom of the slope. Alternatively, every second bank might deliver water to the opposite side of the paddock.

Maintenance

Depending on land use, banks are likely to require seasonal maintenance works. All banks and outlets should be inspected regularly, in particular before and during the wet season. Banks under horticultural cropping are likely to require more frequent maintenance than banks under pasture.

Contour banks should not pond water after rain and the outlet should not be eroding. Sediment loads reaching level sills should not be excessive and scouring between banks should not occur. If encountered, additional banks may need to be constructed between existing banks, or the bank grade reduced.

Contact details

For further information contact the Land Management Unit in your region. Additional Technical Notes and Erosion and Sediment Control Guidelines are available on the website: www.nt.gov.au/nreta/naturalresources/

Land Management Unit, Natural Resources Division

Darwin:	Tel (08) 8999 4478 Level 3 Goyder Centre, Palmerston
Katherine:	Tel (08) 8973 8838 32 Giles Street
Alice Springs:	Tel (08) 8951 9208 Level 1, Alice Plaza, Todd Mall

Contour bank design methodology

NOTE: The following methodology is based on calculations suitable for erodible arable crop land which has been cleared. Bank spacing may be increased for less intensive land uses (such as pastures with a high level of groundcover). Under the correct conditions, double spacing may be acceptable.

STEP 1 – calculate bank spacing

Spacing = (90/√% slope)

Spacing = …m

NOTE: Depending on intended land use, double spacing may be sufficient. (Eg. Double spacing may be sufficient for pasture, tree crops or forestry, however horticultural activities will require single spacing).

Step 2 – Calculate catchment area

Catchment area refers to the cleared area up-slope of an individual contour bank. For example, a paddock with three contour banks will have three separate catchment areas.

Area = length x width

A = …ha

Step 3 – Calculate the time of concentration

Time of concentration is the maximum time taken by water to travel from the catchment boundary to the catchment outlet point.

(i) Calculate the maximum flow distance (ie. the distance from the furthest point at the top of the catchment, across the paddock, to the bank, along the bank and to the level sill).

Flow Length = …m

(ii) Determine the maximum permissible velocity from Table 1 based on the risk of soil erodibility.

Velocity = …ms^{-1}

Table 1. Maximum permissible velocities for bare soil

Soil Erodibility	Maximum Permissible Velocity($m\ s^{-1}$)
Extreme	0.30
Very High	0.35
High	0.45
Moderate	0.55
Low	0.60

NOTE: Soil erodibility is a measure of the susceptibility of individual soil particles to detachment and transport by rainfall and runoff. Soil texture is the principal component affecting soil erodibility, but structure, organic matter, permeability, slope, length of slope, rainfall intensity, level of disturbance, cover and management practice also contribute.
For example, in the Katherine Region a Kandosol (i.e. loamy soil) on <0.5% slope might be classed as having 'Low' erodibility, while a Tenosol (i.e. sandy soil) on 3% slope might be classed as having a 'Very High' erodibility risk.

(iii) Determine the Time of Concentration

Time of Concentration = Flow Length / Velocity

TOC = [Length (m) / Velocity (ms^{-1})] / 60min

TOC = … min

(iv) Determine the Rainfall Intensity from the Graph 1 for 1 in 10 years (ie. the middle line).

Graph 1. Rainfall Intensity for Katherine Region (Bureau of Meteorology)

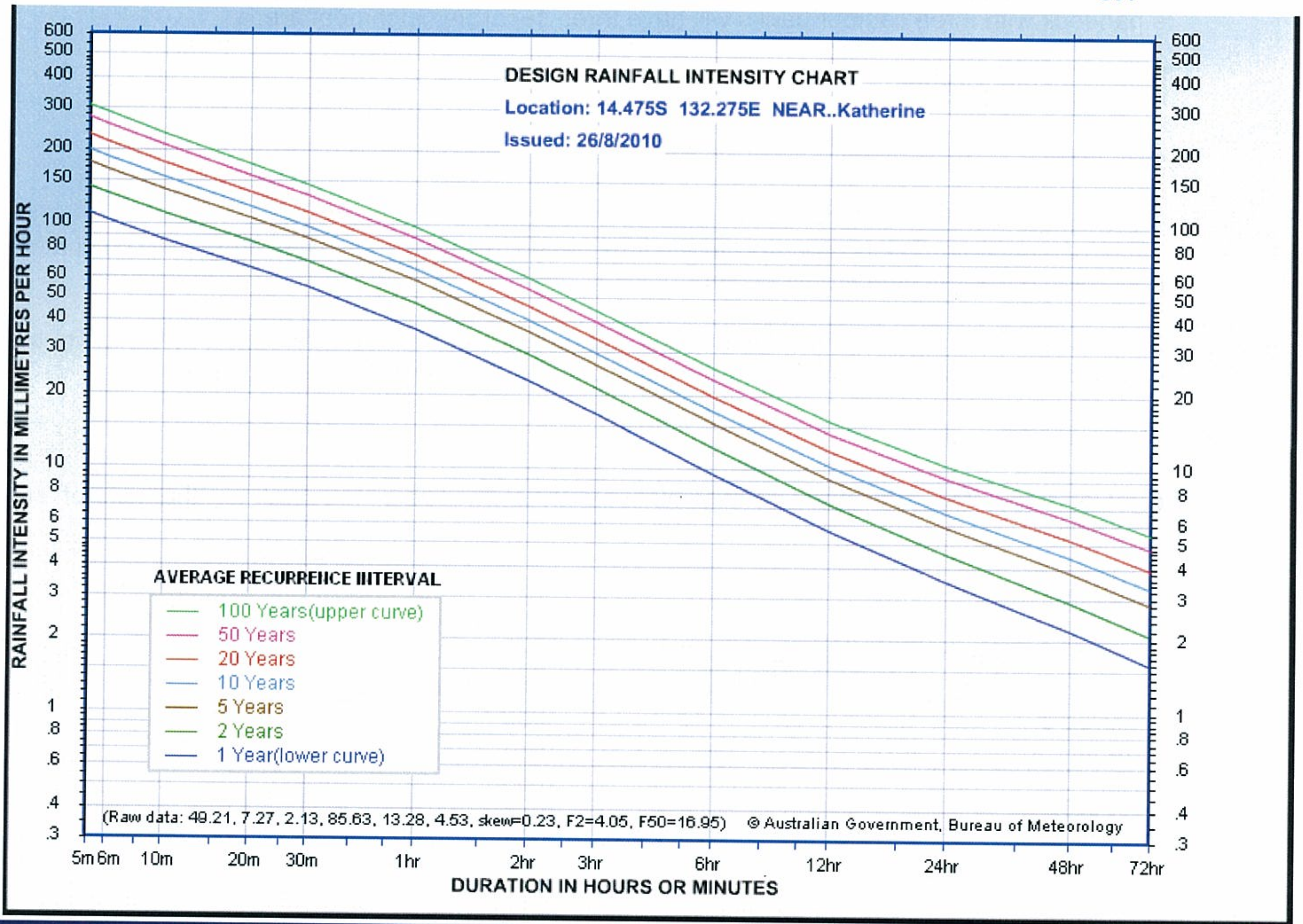


Table 2. Runoff Coefficients *(Conservation Commission NT, 1990)*

Treatment	Coefficient
No till (single spacing)	0.6
No till (double spacing)	0.8
Conventional (single spacing)	0.8
Conventional (double spacing)	0.9
Minimum till (single spacing)	0.7
Improved pasture	0.7
Native woodland (ungrazed & undisturbed)	0.2

Table 3. Catchment Area Correction Factors *(Conservation Commission NT, 1990)*

Area (ha)	Correction Factor
100	0.91
200	0.86
300	0.83
400	0.81
500	0.79

STEP 4 – determine bank dimensions

(i) Calculate the channel cross-sectional area

$A_{cs} = Q / v$

A_{cs} = … $m^3 s^{-1}$ / … $m s^{-1}$

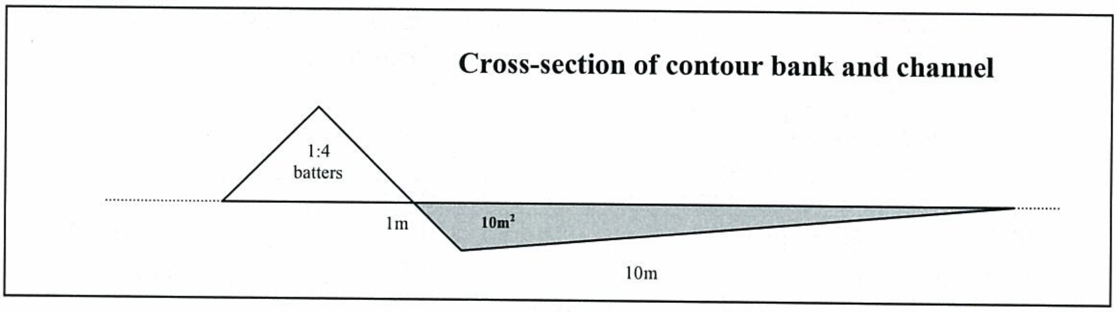
A_{cs} = … m^2

Where

A_{cs} = area of channel cross-section
Q = peak discharge (from Step 3v)
V = velocity of runoff (from Step 3ii)

(ii) Design bank using cross-section area

For example: If cross-sectional area of channel needs to be $10m^2$, this is the amount of soil which needs to be pushed up ($1m \times 10m = 10m^2$). The depth and base width of the channel can be altered as required / suitable (e.g. $0.5m \times 20m = 10m^2$). Note however, that banks will settle and compact in height over time (post-construction) and therefore this will need to be accounted for (i.e. it may be necessary to build them higher). **Batters should be no steeper than 1(v):4(h)**. NOTE: It is preferable for banks to be broad-based roll-over, especially for pivot irrigation.



Step 5 – plot banks

Plot the banks on a map with appropriate scale (before surveying and pegging in the field).

Contour banks should be separated as per spacing calculated in Step 1 and be plotted at a **grade of 0.2%** off the contour. For example, every 100m along the contour, the bank should be distanced an additional 0.2m down-slope of the contour line:

Distance along contour (m)	0	100	200	300
Separation distance between contour line & bank (m)	0	0.2	0.4	0.6

NOTE: At the discharge point, banks should extend into uncleared, stable native vegetation and a **level sill** should be constructed, so that runoff dissipates gently, instead of being concentrated and causing scouring.

Further Information

Refer to NRETAS *Fact Sheet – Erosion and Sediment Control Plans: Model.*