

A Field Guide to Assessing
Australia's Tropical
Riparian Zones

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www.landmanager.org.au

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TROPICAL SAVANNAS CRC
Cooperative Research Centre for Tropical Savannas Management



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All photos and diagrams, except when noted otherwise, are by Ian Dixon and Michael Douglas.

Online information

Score sheets to accompany this booklet and a workbook to perform data calculations can be downloaded at the Tropical Savannas CRC website: www.savanna.cdu.edu.au/publications/lwa_trarc_guide.html

You can also download score sheets for your region from the CRC's Land Manager website: www.landmanager.org.au (go to Wetlands and Waterways in your region, then Management or Monitoring).

As research continues, versions of score/data sheets suited for different tropical regions will be available.



Australian Government



Government of
Western
Australia



RANGELANDS
NRM Co-ordinating Group



Department of
Environment and Conservation

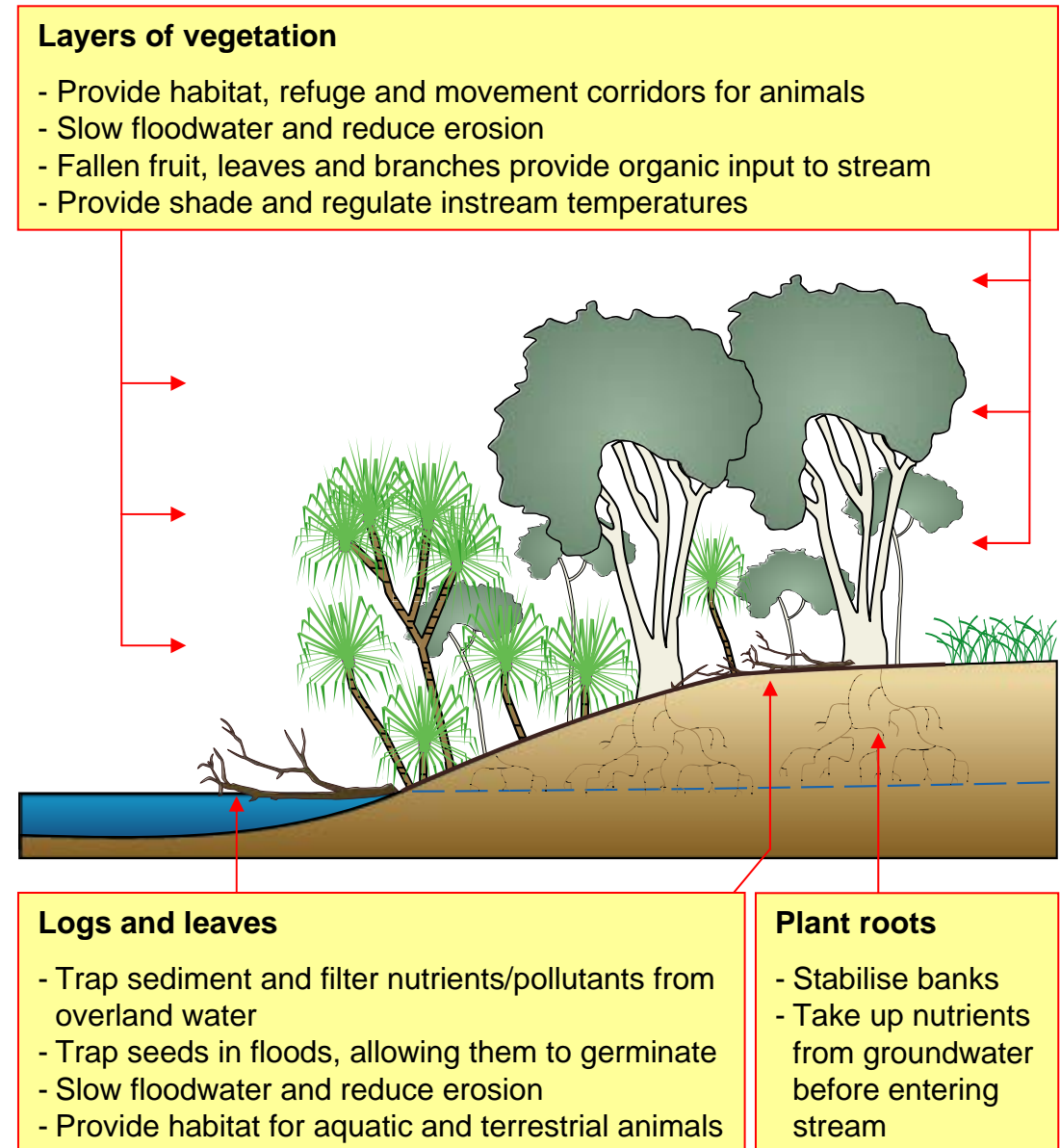


Australian Government
Land & Water Australia

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Why are riparian zones important?

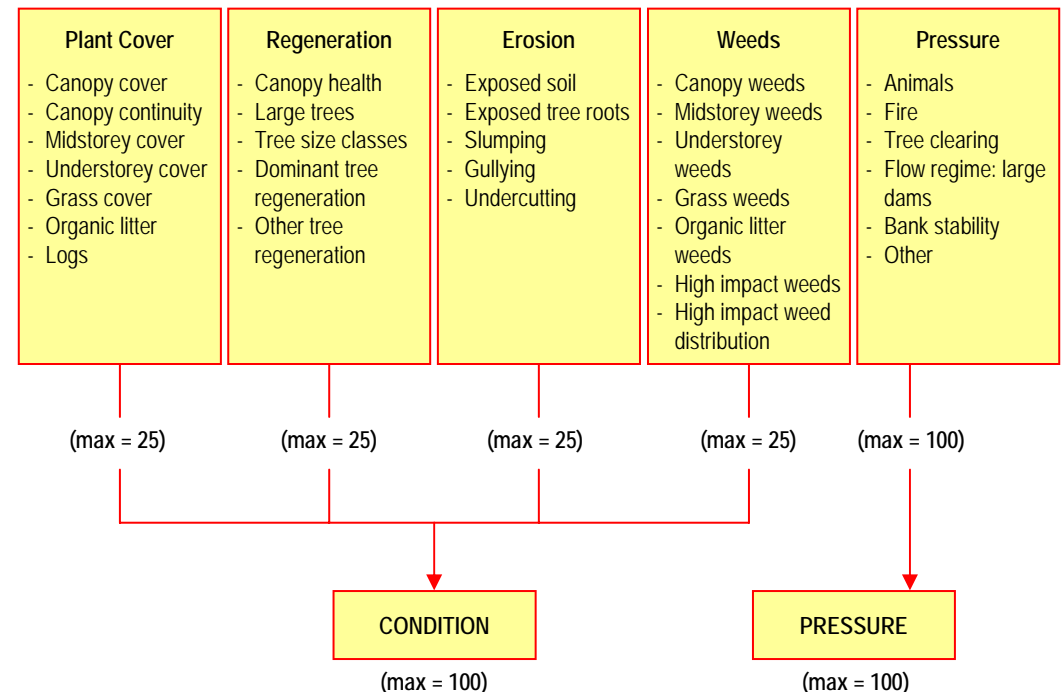
Riparian zones are the green-belts alongside creeks and rivers. They perform many roles in the landscape. We can identify some simple features that can be easily measured using the methods described in this booklet. The illustration below summarises these features and the roles they perform.



- This booklet describes a field-based method to quickly assess riparian condition at small scales, i.e. sections of creeks and rivers that are less than 10 km long. Larger scale assessment, such as 100 km of river, require different methods, such as remote sensing from planes or satellites.
- This method is specifically designed for a 100 m length of river bank, called a *transect*, and can be repeated several times within an area with the same management regime.
- The more assessments that are made, the more accurate the overall assessment of condition will be. The number of transects you choose will depend on time, cost and access.
- Assessments can be repeated over time to monitor changes in condition. The timeframe between these assessments will need to be trialled. A starting point would be at two to five year intervals.
- The method described in this booklet is named the Tropical Rapid Appraisal of Riparian Condition (TRARC) and has been trialled and modified for the Ord catchment (WA), Top End (NT), Burdekin Catchment (Qld) and sections of the Gilbert and Mitchell catchments (Qld). The general procedure for each region is the same, but requires different Score Sheets for use in the field.



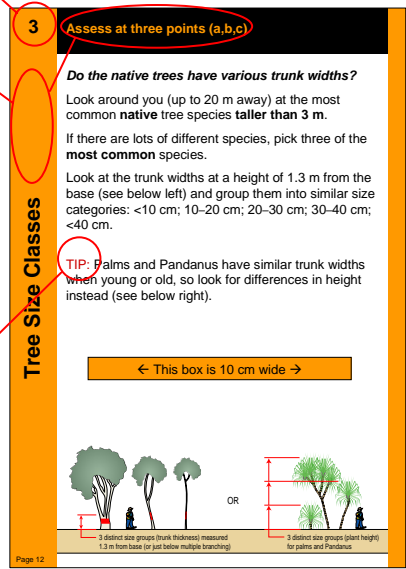
- The Tropical Rapid Appraisal of Riparian Condition (TRARC) is a user-friendly assessment and monitoring tool designed for northern Australia's land and water managers.
- The TRARC is a visual assessment of the riparian zone immediately adjacent to creeks and rivers. It is not designed for floodplains or wetlands.
- The entire assessment is a visual measurement of features (*indicators*) in and around the riparian zone that indicate good or poor condition. It also identifies threats or pressures to the riparian zone. Each indicator is given a score between 1 and 5.
- Indicators are grouped into five categories (*sub-indices*) that can be analysed individually or combined to give an overall score (*index*) for the study area.
- These five categories and their indicators are listed below.



The number in the corner of the following instructional pages refers to the number on the score sheet (see example at bottom of page).

- The edge of each page is colour coded.
- Orange pages are assessed at Points 'a', 'b' and 'c' (see next page).
 - Green pages are assessed along the 100 m transect (see next page).
- The header also gives this information.

Text marked with **TIP** provides helpful hints and answers common questions.



Example Score Sheet

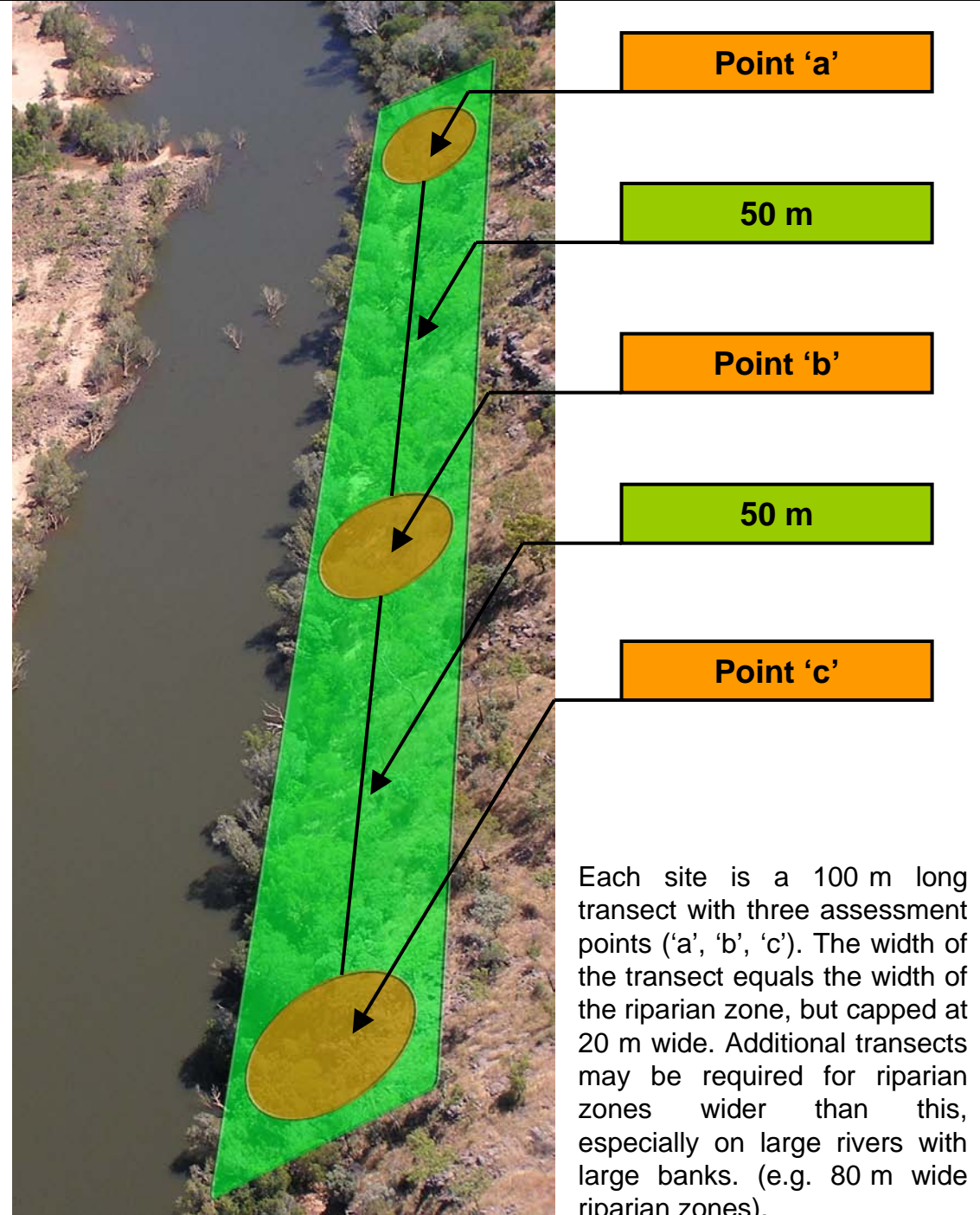
To undertake this assessment you will need to use a score sheet. Score sheets are not included in this booklet. They can be downloaded at the web sites listed on Page 3, *Online information*.

Item number that matches the number in the top corner of each instructional page (see example above).

Circle the most appropriate score.

In this example Point 'a' has 2 size groups; Point 'b' has 3 or more size groups; and Point 'c' has no canopy.

TREE SIZE CLASSES	Point		
	A	B	C
Variation in trunk width/height of dominant native trees >3 m tall. Look around area (approx. 20 m up and down the transect). Do not include weeds. Size groups: <10 cm, 10-20 cm, 20-30 cm, 30-40cm, >40 cm			
No canopy, few trees or all same size group	1	1	1
2 distinct size groups	3	3	3
3+ distinct size groups	5	5	5



How much cover is provided by the leaves and branches of the canopy plants?

Look above you at trees and shrubs **taller than 5 m**.

Include **weeds and native** plants.



0–5%



50–75%



5–25%



75–100%



25–50%

How healthy do the native canopy plants look?

Look around you (up to 20 m away) at **native** trees and shrubs **taller than 5 m**.

Do not include **weeds**.

TIP: Select score that represents the majority of these plants.

TIP: Do not score deciduous plants as unhealthy just because they have lost their leaves.



Assess at three points (a,b,c)

Do the native trees have various trunk widths?

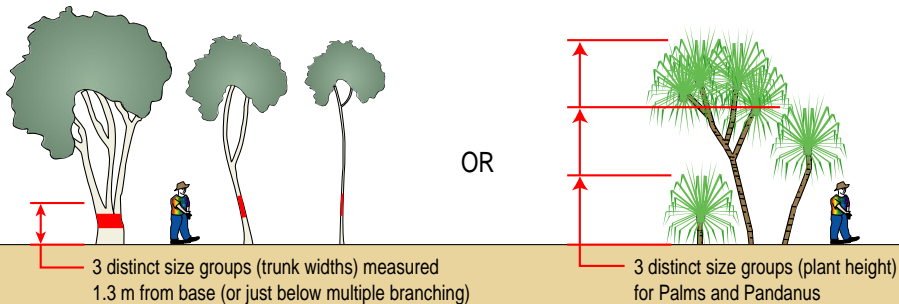
Look around you (up to 20 m away) at the most common **native** tree species **taller than 3 m**.

If there are lots of different species, pick three of the **most common** species.

Look at the trunk widths at a height of 1.3 m from the base (see below left) and group them into similar size categories: <10 cm; 10–20 cm; 20–30 cm; 30–40 cm; >40 cm.

TIP: Palms and Pandanus have similar trunk widths when young or old, so look for differences in height instead (see below right).

← This box is 10 cm wide →



Assess at three points (a,b,c)

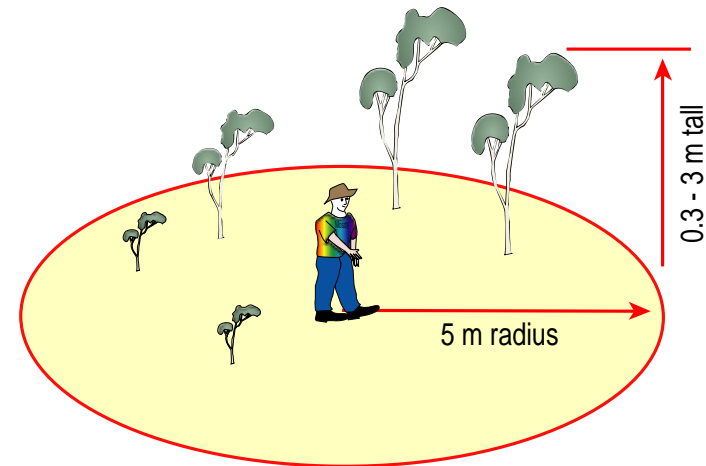
How many young plants are there?

Look around you (up to 5 m away) for young **native** tree species **between 0.3 m and 3 m** in height (see image below). Include regrowth sprouting from fallen trees.

Dominant Tree Regeneration: Only include the same species as *Tree Size Classes* (Page 12).

Other Tree Regeneration: Include other tree species not recorded above (i.e. non-dominant species).

TIP: Look carefully, some small trees may be hidden by tall grass.



How much cover is provided by the leaves and branches of:

- 1) Midstorey plants (1.5 – 5 m tall)?
- 2) Understorey plants (<1.5 m tall)?
- 3) Grass (any height)?
- 4) Organic litter (leaves & sticks <10 cm thick)?

Look around you (approx. 5 x 5 m square).

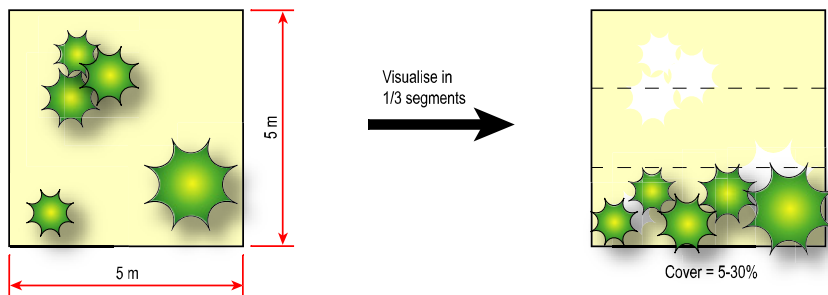
Imagine you are looking down into this square from above (see image below).

Include **weeds and native** plants.

TIP: Visualise groupings of plants in quarters or thirds of the square to help estimate percentage cover (see image below).

TIP: Overlapping may occur, so the combined cover of all plants may be greater than 100%.

TIP: Complete this assessment at the same time as *Weed Cover* (Page 15) and *Exposed Soil* (Page 16).



What proportion of the plants are weed species for:

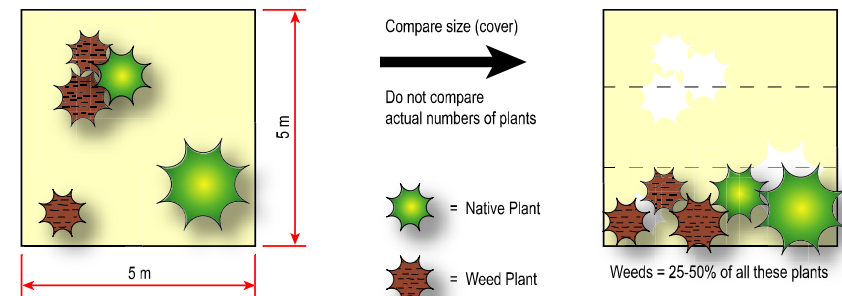
- 1) Midstorey plants (1.5 – 5 m tall)?
- 2) Understorey plants (<1.5 m tall)?
- 3) Grass (any height)?
- 4) Organic litter (leaves & sticks <10 cm thick)?

Use the same plants and 5 x 5 m square as for *Plant Cover* (Page 14).

Identify which plants are weeds and which plants are native species. Ignore canopy weeds at this stage because they are assessed later (along the whole transect).

TIP: Do not compare the actual number of plants. Compare their cover (see image below).

TIP: Complete this assessment at the same time as *Plant Cover* (Page 14) and *Exposed Soil* (Page 16).



Assess at three points (a,b,c)

How much exposed soil can you see?

Use the same 5 x 5 m square as for Plant Cover (Page 14).

Ignore all plants, roots, leaves, logs and large rock formations.

TIP: Include sand, dirt, pebbles, rocks and ash.

TIP: Three examples are given below.



0-5% exposed soil



30-60% exposed soil



80-100% exposed soil

Assess at three points (a,b,c)

What is the:

- 1) Maximum size of the bank sediment?
- 2) Dominant size of the bank sediment?

Look at the sediment (soil) from the top to the bottom of the river bank.

Sediment includes silt, sand, gravel, pebbles, cobbles, boulders and bedrock.



TIP: If the ground is completely covered with vegetation and leaves, scrape off the plant material to expose the soil to see the sediment size.



Maximum bank sediment size



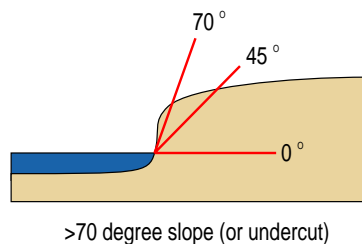
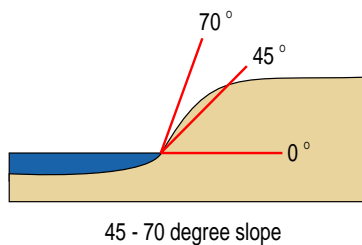
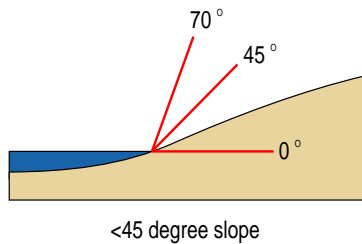
Dominant bank sediment size

How steep is the bank?

Look at the slope from the top of the bank to the bottom (near water level), (see image below).

If the bank has multiple benches (steps) only assess the portion of the bank that your transect is in.

TIP: For comparison, a staircase is usually less than 45 degrees.

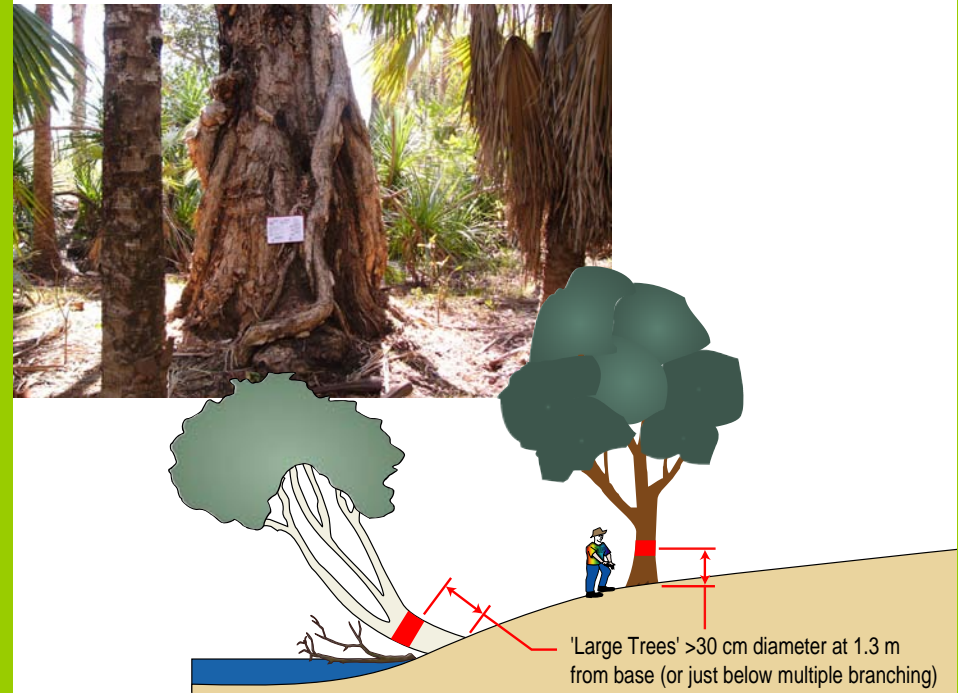
**How many large trees are there?**

Only include **living native tree** species with a trunk width greater than **30 cm** (when measured 1.3 m from the base, or just below multiple branching), (see image below).

TIP: This booklet is approx. 30 cm wide when open.

TIP: Keep a written tally on the score sheet.

TIP: Old Palm and Pandanus trees may have narrow trunks. Instead, include them if they are taller than 10 m.



How many 'logs' and 'large logs' are there?

Look at all fallen branches or trees on the ground that are thicker than 10 cm (see image below).

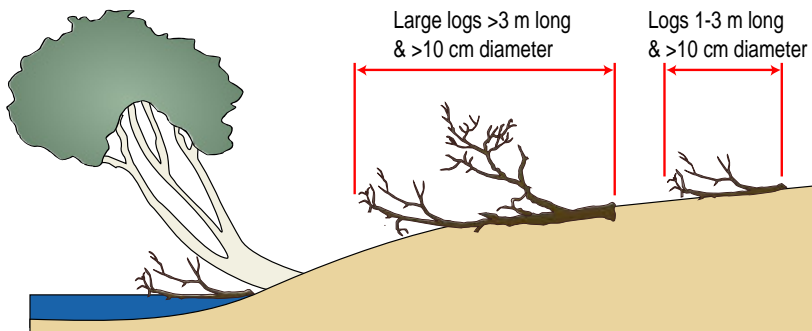
Logs are between 1 and 3 m in length.

Large logs are longer than 3 m.

TIP: Keep a written tally on the score sheet.

TIP: Pick the highest score for logs or large logs.

← This box is 10 cm wide →

**How many high impact weed species are there?**

Look for the high impact weed species listed on the score sheet.

Tick the boxes if the species occurs, even if there is only one individual plant.

TIP: You may also wish to take notes of weed species that occur outside the transect for future reference (but do not score them).

TIP: Use the following photos (Pages 22–29) as a guide to identifying some of the most common high impact weeds. However, the weed list for your region may vary slightly. Species names may also vary between States.

TIP: Plant form may vary with age and between regions. If unsure, take photos and/or a sample to show an expert. Be careful not to spread their seeds!

See weed photos on Pages 22–29.



Andropogon gayanus (gamba grass)



Calotropis procera (rubber bush)

Photo: NT Weeds Management Branch



Photos: Dick Pasfield

Azadirachta indica (neem)



Photo: John Dawe

Cenchrus ciliaris (buffel grass)



Calopogonium mucunoides (calopo)



Centrosema molle (centro)



Cryptostegia grandiflora (rubber vine)



Photo: John Dowse



Jatropha gossypifolia (bellyache bush)



Photos: Tania Paul



Hyptis suaveolens (hyptis)



Lantana camara (lantana)

Photo: John Dowse



Hymenachne amplexicaulis (olive hymenachne)



Leucaena leucocephala (coffee bush)





Macroptilium atropurpureum (siratro)



Parkinsonia aculeata (parkinsonia)



Megathrysus (Panicum) maximus (guinea grass)



Passiflora foetida (wild passion fruit)



Mimosa pigra (mimosa, giant sensitive plant)



Pennisetum sp. (mission grass)



Ricinus communis (castor oil plant)



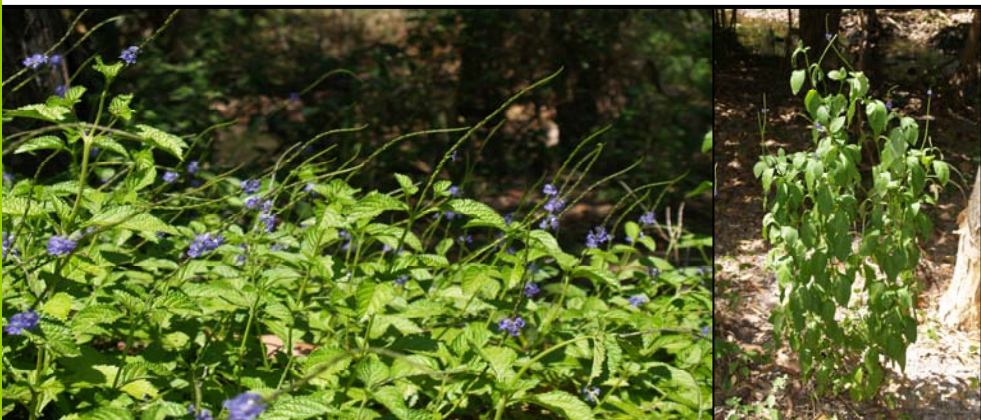
Urochloa (Brachiaria) mutica (para grass)



Senna alata (candle bush)



Xanthium strumarium (noogoora burr)



Stachytarpheta spp. (snakeweed)



Ziziphus mauritiana (chinee apple)

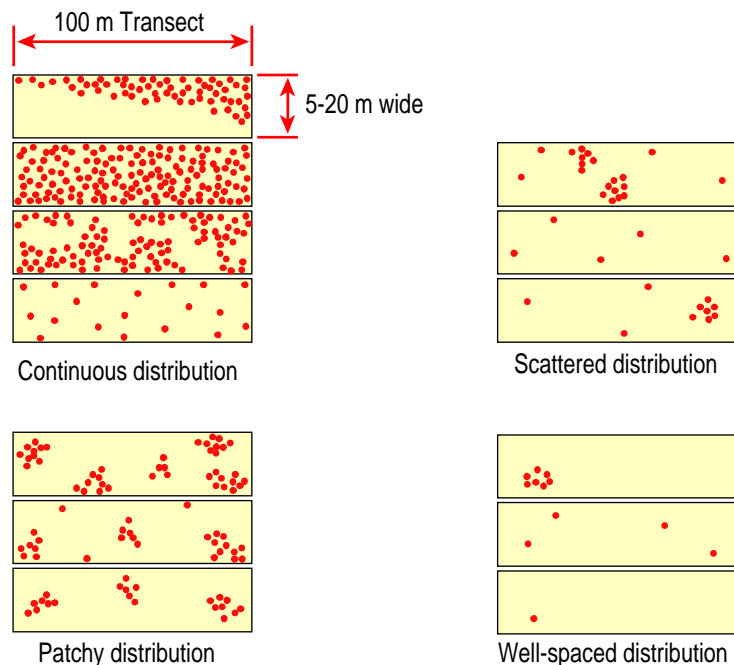
Photos: John Dowe (left, middle); NT Weeds Management Branch (right)

What is the distribution pattern of high impact weeds?

Look at the location of high impact weeds in the transect. These must be the same species as recorded for *High Impact Weeds* (Pages 21–29).

Are there only a couple of weeds scattered around, or are there large patches of them? Use the examples below to select the pattern that best matches your transect.

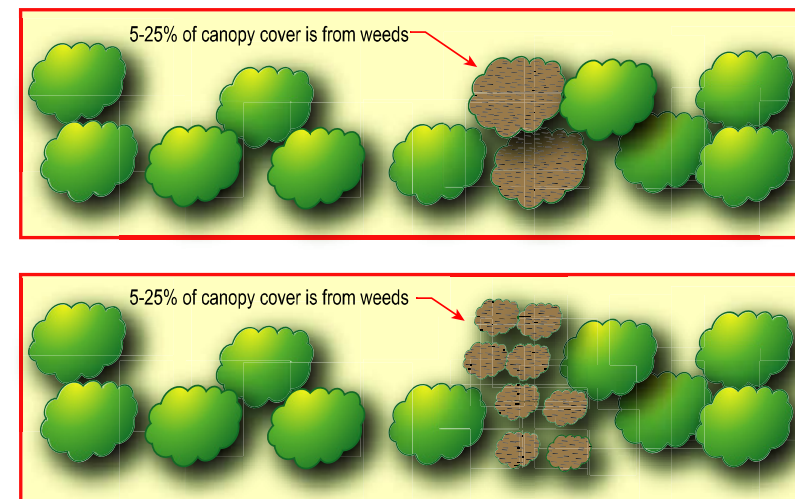
TIP: Include the entire community of high impact weeds in the overall distribution pattern, regardless of how many of each species there are.



What proportion of the canopy plants are weed species?

Include all canopy trees and shrubs taller than 5 m.

TIP: Do not compare actual number of plants, but compare the cover or area they occupy within the canopy community. In the images below, both examples have 5–25% canopy weeds. Even though the bottom image has four times the number of individual weed plants than the top image, they both have the same combined cover.

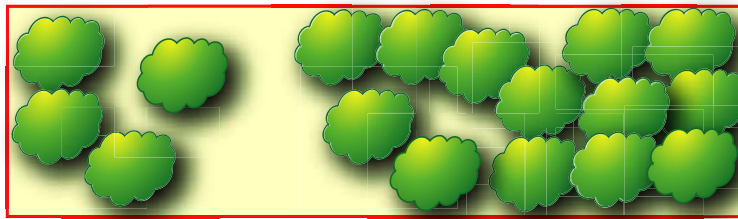


How much of the river bank has a continuous canopy along its length?

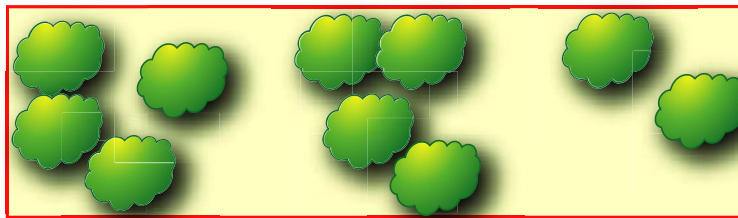
Including both weed and native plant species, look at how continuous the canopy cover is along the transect.

A break in the continuity must be at least 5 m between tree crowns and span the entire width of the transect (see images below).

TIP: One tree missing within a wide riparian zone is not counted as a break in the canopy continuity because the break must span the entire width of the riparian zone.



90-100% Canopy continuity



50-90% Canopy continuity

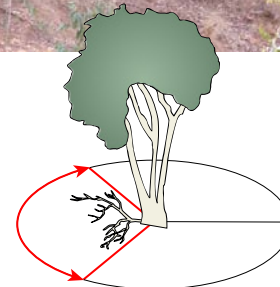
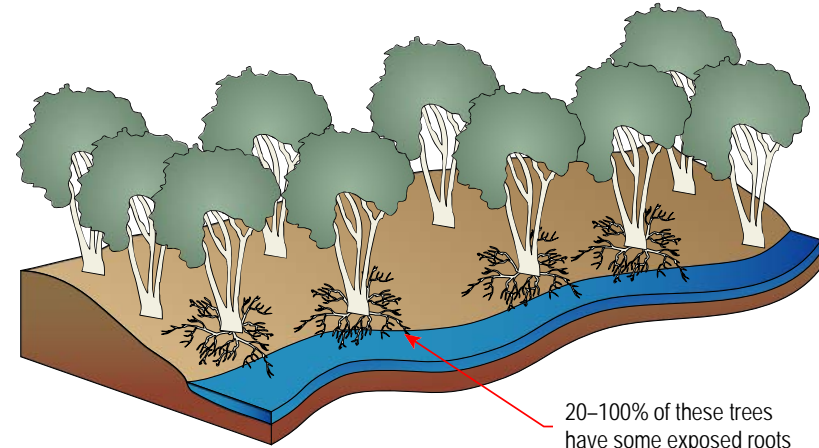


<50% Canopy continuity

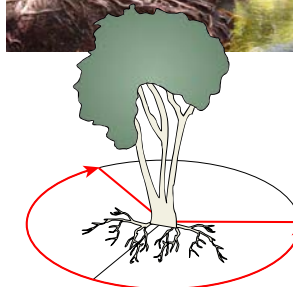
To what extent have the tree roots been exposed due to erosion?

First estimate the proportion of trees that have exposed roots due to erosion (see top image). Only include roots thicker than 20 mm. Do not include natural aerial roots (e.g. Pandanus and Figs).

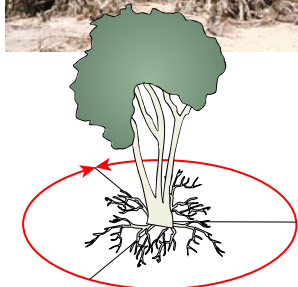
Then estimate the average area around these trees that have exposed roots (see bottom images).



<1/3 circumference



1/3-2/3 circumference



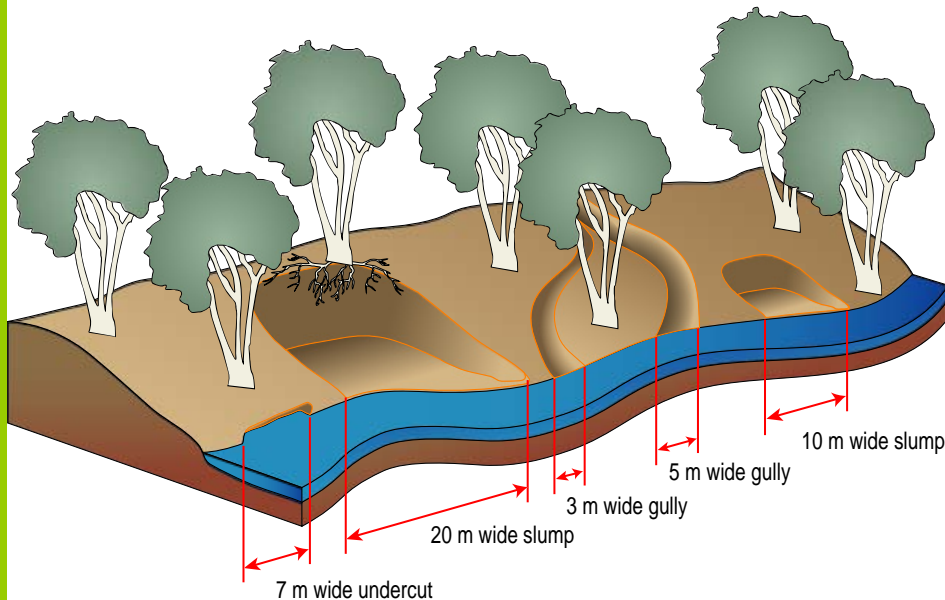
>2/3 circumference

What is the combined width of slumping, gullying and undercutting?

There are three erosion assessments to make:

- 1) **Slumping:** where the bank has collapsed under its own weight.
- 2) **Gullying:** eroded drainage lines that flow into the stream. They are not stabilised by vegetation.
- 3) **Undercutting:** areas washed away under the vegetation, leaving an overhanging section.

TIP: In the example below, the combined width of slumping is 30 m, gullying is 8 m and undercutting is 7 m.



What is the extent of damage due to managed and unmanaged animals?

There are two animal assessments to make:

- 1) **Managed animals:** disturbance caused by farmed animals on a managed property, such as cattle.
- 2) **Unmanaged animals:** disturbance caused by wild (feral or native) animals on any property, such as pigs, buffalo, donkeys, horses, wild cattle, wallabies, etc.

Disturbance includes tree ringbarking, vegetation trampling, grazing, wallowing, soil compaction and track formation.

Record whether fences are present and/or effective.

TIP: Tracks and scats can help you identify the type of animal causing damage.



How long has it been since a fire and how much was burnt?

First estimate how long it has been since the riparian zone has been burnt: this year, last year or more than two years ago (see **TIPS**).

Then estimate the extent of fire impact: major, moderate or minor.

Major impact: the canopy was burnt and the fire reached the channel edge.

Moderate impact: the tree trunks have burn marks but the fire did not burn the canopy or reach the channel edge.

Minor impact: only the edge of the riparian zone was burnt (i.e. edge furthest from the channel), or there was a small spot fire.

TIP: If there is dead grass at the base of living grass, especially long-lived (perennial) grasses, then it probably hasn't been burnt for at least one year (one fire season).

TIP: If the older trees have burn marks but the younger trees do not, then the fire must have occurred before the young plants grew.

TIP: After a few years, burn marks on tree trunks start to rub off because of floods or new growth.

Canopy fire

Old burn marks

Recent fire to channel edge

Burnt young plant



Is the Clearing Width greater than the Riparian Width?

Four features must be assessed to complete this component.

- 1) Stream Order:** This is the size of the stream (1st, 2nd, 3rd, 4th order etc). A 1st order stream is a small creek. When it joins another 1st order stream it becomes a 2nd order stream. Stream order only increases when two streams of identical order meet.

TIP: Use the most detailed maps you can access. If unsure of the Stream Order, select the generic options: 'Drainage lines', 'Creeks' or 'Rivers'.

- 2) Riparian Width (RW):** This is measured from the channel edge to where there is a distinct change in vegetation type and landform. For this assessment it does not include the floodplain.

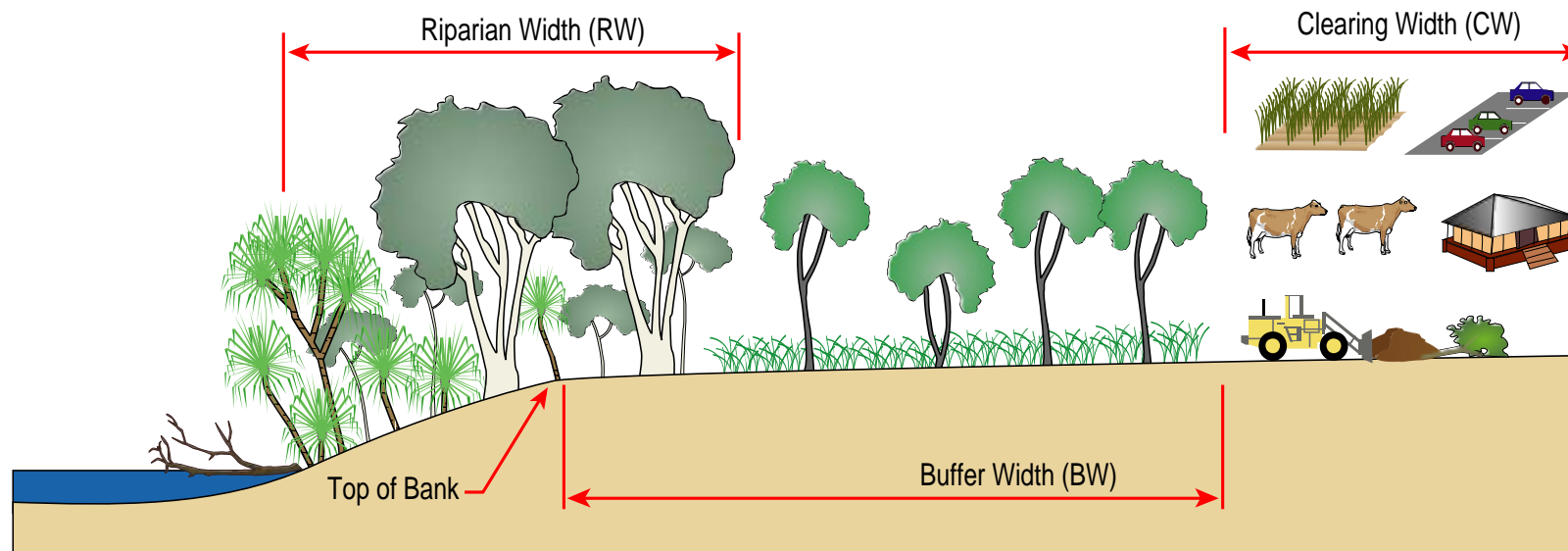
TIP: The RW may extend past the top of the bank (see image below). Include the width of the tree crowns.

- 3) Buffer Width (BW):** This is uncleared land measured from the top of the bank to where any mass tree clearing begins.

TIP: The BW may be a combination of riparian zone, floodplain and savanna.

- 4) Clearing Width (CW):** This is where large amounts of native trees have been removed for any reason (e.g. grazing, horticulture, urban development).

TIP: Do not include native tree regrowth. The clearing must be maintained by machinery or grazing.



Have large dams had an effect on the vegetation's ability to regenerate?

Is there a large dam upstream (any distance) that is used for drinking water, power generation, irrigation or recreation? Do not include small dams or causeways (see *Instream Structures*, Page 41).

Large dams may reduce the size and number of floods downstream.

Riparian vegetation that rely on these floods may not regenerate successfully high up the banks or away from the channel.

Look for riparian tree regeneration high up the banks.



Photo: Sean Lawrie



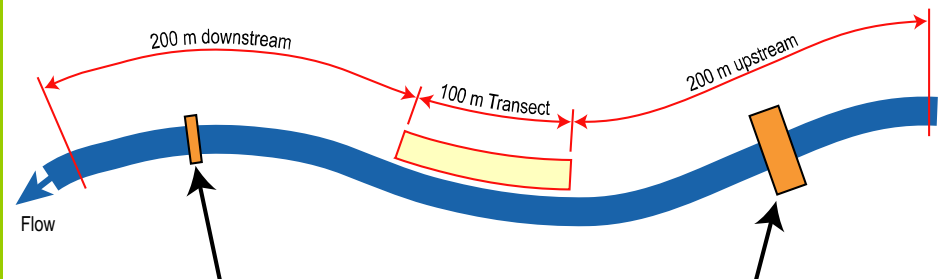
How many human-made structures are present?

Instream structures are human-made constructions such as bridges, culverts, weirs and small dams.

These structures can alter the localised flow of the stream and cause frequent erosion events.

Include all instream structures within 200 m upstream and downstream of the transect (see image below).

TIP: Do not include 4WD crossings or minor obstacles that do not appear to alter the stream flow.



How much impact have other structures or activities had?

Include any other disturbances to the transect that have NOT been assessed yet.

This has no limitations, but could include things like 4WD tracks or crossings, boat ramps, pumps, pipes, gauging stations, camp sites, footpaths, roads, walking tracks, recreation access (e.g. fishing sites and swimming holes), sand mining, slashed grass and residential/urban development.

Estimate the proportion of the transect that has been directly disturbed by other features.



Entering the data into a computer

- To assist in analysing the data collected in the field, it is highly recommended that you download a spreadsheet from the Tropical Savannas CRC website, or the Land Managers website:
www.savanna.cdu.edu.au/publications/lwa_trarc_guide.html
www.landmanager.org.au (go to Wetlands and Waterways in your region, then Management or Monitoring)
- There are unique calculations for each version of the score sheets. For example, if you use the score sheets designed for the Ord Catchment, then you must download the spreadsheet for the Ord Catchment.
- The spreadsheet is in Microsoft Excel format and is set up to automatically perform all calculations. All you have to do is enter the numbers you have circled on the score sheet.
- If you have many sites, you will need to copy the template spreadsheet into new worksheets (see example on [Pages 46–47](#)).



What are the calculations?

- All the indicators that are assessed in the field are grouped into categories (*sub-indices*), as presented on [Page 7](#). The scores for these indicators are summed together within their respective sub-index (Plant Cover, Regeneration, Erosion and Weeds). This summed score is then converted to a new score that lies between 0–25. The new scores can then be summed to give an overall Condition score of 0–100, where a higher score implies better condition. In addition to this, the indicators grouped in the Pressure category are summed and converted to a score of 0–100, where a higher score implies greater pressure (or threats).



Further information

- For a full description of the calculations please read pages 26–27 of Dixon, I., Douglas, M., Dowe, J. & Burrows, D. (2006) Tropical Rapid Appraisal of Riparian Condition: Version 1 (for use in tropical savannas). *River Management Technical Guideline No. 7*. Canberra, Land & Water Australia. ISSN 1445-3924.
- Free hardcopies are available from the Tropical Savannas CRC or can be downloaded at www.landmanager.org.au (go to Wetlands and Waterways in your region, then Management or Monitoring) or www.savanna.cdu.edu.au/publications/lwa_trarc_guide.html

Example Data Spreadsheet

Site number is automatically generated from the name of the worksheet (see tabs below).

Index scores are calculated automatically.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ															
1	date	4/9/06																																													
2	stream name	Deep Creek																																													
3	site number	Site (3)																																													
4	bank (left/right)	right																																													
5	assessors names	ID/BH																																													
6		A	B	C	Ave																																										
7	Channel width	12	30	20	21																																										
8	riparian width	5	5	15	8																																										
9	photo numbers	56-67		photo order	c-a																																										
10		canopy cover	canopy health	tree size classes	dominant tree regeneration	other tree regeneration	midstorey cover	midstorey weeds	understorey cover	understorey weeds	grass cover	grass weeds	organic litter	organic litter weeds	exposed soil	maximum bank sediment size	dominant bank sediment size	bank stability: bank slope	large trees	logs	high impact weeds	high impact weed distribution	canopy weeds	canopy continuity	exposed tree roots	slumping	gulying	undercutting	animals: managed	animals: unmanaged	fire	tree clearing	flow regime: large dams	bank stability: instream structures	other	animals	bank stability	Plant Cover	Regeneration	Erosion	Weeds	Pressure	Condition				
11	Point A	2	5	5	3	3	1	3	3	5	2	4	2	4	3	1	1	5																													
12	Point B	4	5	5	1	5	5	4	1	3	1	4	3	4	4	1	4	1																													
13	Point C	4	5	5	1	3	1	1	1	2	3	5	2	4	3	4	5	3																													
14	Average	3	5	5	2	4	2	3	2	3	2	4	2	4	3	2	3	3	4	4	2	1	5	3	4	1	4	3	1	2	1	1	1	2	2	2	2	2	3	8	18	13	14	13	52		
15																																															
16																																															
17																																															
18																																															
19	Point A	Deg	Min	Sec	High impact weed species																																										
20	Lat	18	12	1.8	<input type="checkbox"/> <i>Andropogon gayanus</i> (gamba grass) <input type="checkbox"/> <i>Azadirachta indica</i> (neem) <input type="checkbox"/> <i>Calotropis procera</i> (rubber bush) <input type="checkbox"/> <i>Calopogonium mucunoides</i> (calopo) <input type="checkbox"/> <i>Centrosema molle</i> (centro) <input checked="" type="checkbox"/> <i>Cryptostegia grandiflora</i> (rubber vine) <input type="checkbox"/> <i>Hymenachne amplexicaulis</i> (olive hymenachne) <input checked="" type="checkbox"/> <i>Hyptis suaveolens</i> (hyptis) <input type="checkbox"/> <i>Ipomoea quamoclit</i> (morning glory) <input checked="" type="checkbox"/> <i>Lantana camara</i> (lantana) <input type="checkbox"/> <i>Leucaena leucocephala</i> (coffee bush) <input type="checkbox"/> <i>Macroptilium atropurpureum</i> (siratro) <input type="checkbox"/> <i>Mimosa pigra</i> (mimosa, giant sensitive plant)																																										
21	Long	144	1	14.2																																											
22																																															
23																																															
24	Point C	Deg	Min	Sec																																											
25	Lat	18	11	58.5																																											
26	Long	144	1	13.8																																											
27																																															
28																																															
29	UTM zone	52K																																													
30	GPS datum	WGS 84																																													
31																																															
32																																															

Only enter data in these cells.

Average scores are calculated automatically.

Indicators that are assessed at three Points (a, b, c).

Indicators that are assessed along the entire transect.

These two indicators are calculated automatically.

4WD tracks
Pumps
Boat ramp
Picnic area
1 Recreation use
1 Camp fires
Walking track
Camp site
Garden waste dumping

Template sheet. Copy this sheet for each site and rename.

Name each sheet by their Site Number.

Use the number '1' to indicate presence of species. This is useful for compiling summary data on a Master Sheet (not included).

Additional information. Use the number '1' to indicate presence.