Riparian Forest and Ground Cover Levels

in South East Queensland Catchments

Queensland Government

Prepared by: Remote Sensing Centre, Science and Technology Division, Department of Environment and Science

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Introduction

Why monitor riparian vegetation

Riparian forest and ground cover is the vegetation beside waterways which can help reduce pollutant flow to the waterways and stabilise the stream bank. Areas which are non-forested and have very low ground cover levels may be areas of concern for soil and nutrient loss to the stream (Hubble et al, 2010, Lyons et al. 2000, McMahon et al, 2017, Simon and Collison 2002). Maintaining and enhancing riparian forests and ground cover in riparian areas is therefore important to minimise impacts on water quality in South East Queensland catchments (Croke et al, 2017)

Reporting riparian vegetation extent

For reporting, we define and map the riparian area as any area within 50 metres of a (mapped) stream, or riverine/lacustrine wetland. In this report, we separate riparian vegetation into two components, riparian forest and riparian ground cover. We used data derived from Sentinel 2 satellite imagery to estimate riparian forest cover and ground cover levels, as well as data from the Statewide Landcover and Trees Study (SLATS) (DES, 2018) https://www.qld.gov.au/environment/land/management/mapping/statewide-monitoring/slats, and the Queensland Ground Cover Monitoring Program, https://www.qld.gov.au/environment/land/management/mapping/statewide-monitoring/groundcover. For those areas defined and mapped as the riparian area, we report on:

- the present extent of riparian forest and the estimated area remaining of the pre-European extent of riparian forest
- the amount of forest loss in recent history and up to 2017
- the level of ground cover in non-forested riparian areas
- the proportion of endangered and of concern regional ecosystems

Project Area

The South East Queensland region consists of 14 subcatchments from the Noosa River catchment in the north to the Nerang / Gold Coast catchment in the south (Figure 1). It includes the western catchments of the Upper Brisbane River, Lockyer Creek and Bremer River.

Methods

Monitoring and reporting of riparian vegetation extent (and cover) is made up of three key components:

1. Defining and mapping riparian areas.
2. Mapping riparian woody vegetation extent and measuring changes to this extent over time.
3. Estimating riparian ground cover.

Defining and mapping riparian areas

Riparian areas range from small headwater creeks to major rivers. Many studies have shown the benefits of using GIS and remote sensing to analyse vegetation within a range of specified distances to a stream (Goetz, 2006; Yang, 2007, Apan et al., 2002). For the purposes of this report, we defined riparian areas using a 50m buffer zone applied to a combination of topographic drainage line data for streams of order 1 or higher, and riverine or lacustrine wetlands (Figure 2), as mapped by the Queensland Wetlands Program (Environmental Protection Agency, 2005). As this is a new dataset, results in this report will not be directly comparable with previous reports. Estuarine areas were excluded from the analysis.

Figure 1 - Location of South East Queensland catchments

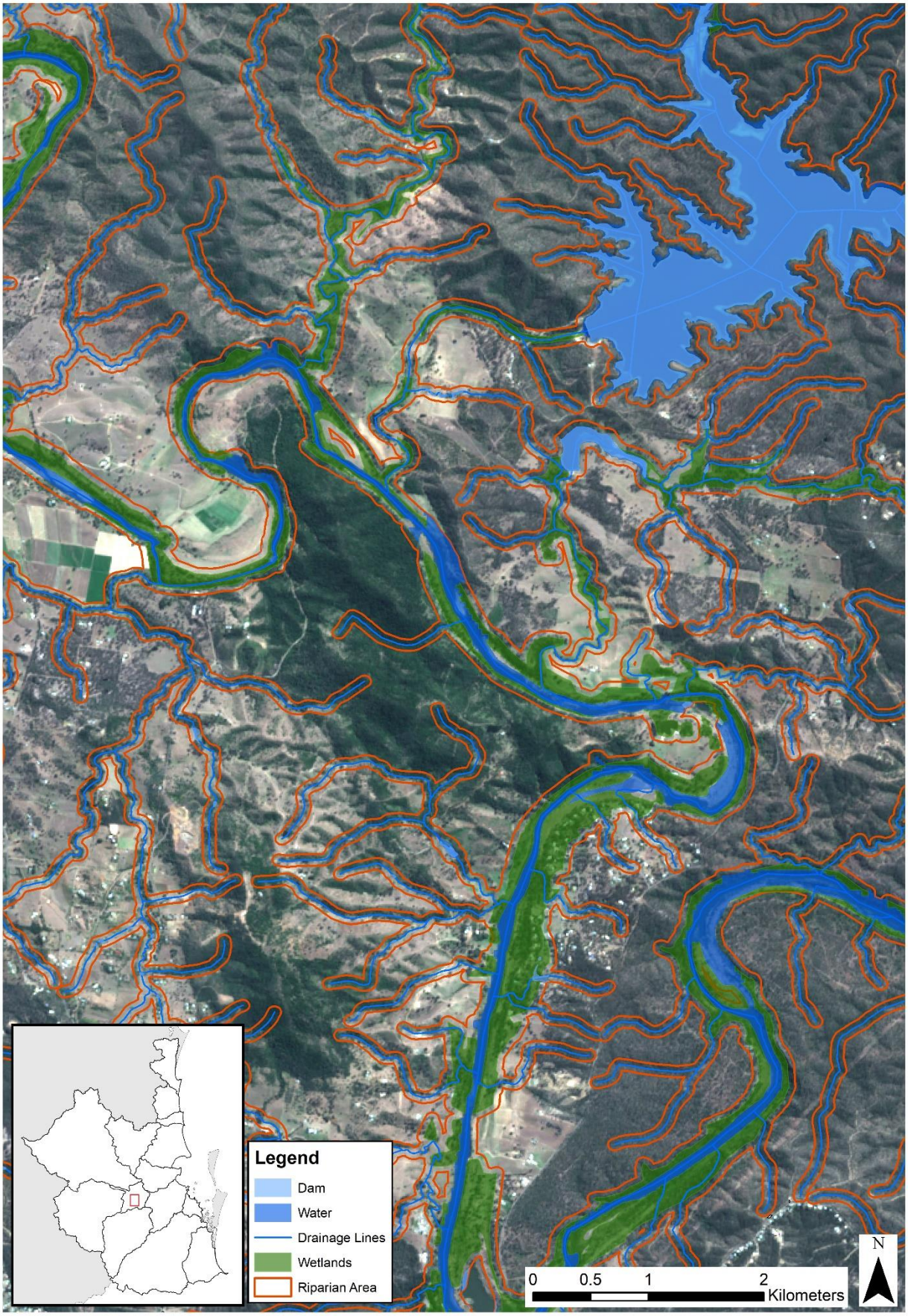

Figure 2 - Example of riparian area mapping

Mapping riparian woody vegetation extent

The extent of riparian woody vegetation was mapped using Sentinel-2 Multi-Spectral Instrument (MSI) satellite imagery, which has been pre-processed to standardised surface reflectance, following Flood, 2017. Previously, riparian vegetation was mapped using Landsat satellite imagery. The 30m spatial resolution of Landsat has some limitations and uncertainty for reporting on riparian vegetation. In particular, there can be considerable uncertainty about riparian woody vegetation, as these areas are often very narrow (i.e. < 30m), fragmented as a result of historical clearing, and intermixed with non-woody vegetation that remains persistently green due to the proximity to water. For this report, the riparian woody vegetation extent has been revised to a spatial resolution of 10m (using Sentinel 2 data) which is more appropriate for riparian areas. It is important to note that this change in spatial resolution will mean that there will be scale differences between current reporting and previous eras therefore comparisons with previous reporting are not appropriate.

An index of woody vegetation, known as Foliage Projective Cover (FPC) was applied to the Sentinel-2 satellite imagery to predict areas of woody vegetation cover within the riparian area. The FPC index was recently re-calibrated using several thousand new field measurements obtained across Australia but generally the method still follows that described in Armston et al., 2009 and Kitchen et al., 2010. After inspection of high resolution imagery in South East Queensland, an FPC threshold of 16 % was selected to distinguish areas of woody vegetation from non-woody vegetation. This is a different threshold than that used previously (11%), but reflects the generally wetter, greener conditions present in South East Queensland compared to the state as a whole. Some areas of cropping within the riparian area were misclassified as woody vegetation using this threshold. We conducted an additional analysis to help remove these cropping areas. We examined multi-temporal statistics of fractional cover (Guerschman et al., 2015, Scarth et al., 2010) applied to Sentinel 2 seasonal composites (Flood, 2013) between 2015 and 2018. Visual inspection of areas with a large range in greenness showed these locations corresponded well with cropped areas, and we removed them from the woody classification. Ancillary data on wetlands, dams and waterbodies was also used to refine the woody classification. Vegetated swamps were removed from the woody classification, and assessed as ground cover. Waterbodies, including dams and natural water bodies, were classified as 'no data'. Small areas of undetected cloud may cause woody areas to be classified as non-woody, but visual inspection indicated this problem was of limited extent.

As FPC is calculated separately for each era, the woody proportions can differ due to misclassification and therefore the FPC data should not be directly compared to quantify changes in extent. Instead, loss of woody vegetation was assessed using the SLATS Landsat-based data, as discussed in the next section below.

Measuring changes to riparian extent over time

Historical and recent losses of riparian vegetation are analysed using woody vegetation clearing data from the SLATS and ‘pre-development’ forest data. Due to the historical time-series required for this component of the reporting, these analyses rely on the use of SLATS Landsat-based data, which has an archive extending to the late-1980’s (for Landsat’s 5, 7 and 8). Some scale/resolution differences may reduce the precision and accuracy of some of the reporting statistics derived from this component, particularly when comparing losses mapped by SLATS using Landsat imagery with current woody vegetation extent mapped using Sentinel-2 imagery. The recent losses relate only to anthropogenic clearing, and do not include vegetation loss from natural events such as storms and drought stress. This distinction is determined through the SLATS classification process (for further details see Queensland Department of Environment and Science, 2018).

The pre-clearing woody vegetation areas are defined as areas assessed as woody (forests, woodlands and tall shrublands) before European settlement. These data are derived from pre-clearing Regional Ecosystem mapping (Accad et al., 2001).

Riparian woody vegetation loss in extent is reported for two time periods for the South East Queensland catchments:

- Pre-clearing baseline to 2016-2017, to provide an approximate estimate of the extent of modification to riparian woody vegetation in each of the regions; and
- From 1988 to 2016-2017, for historical woody vegetation clearing summaries.

Estimating riparian ground cover

For riparian areas with up to 16 % FPC (ie classed as non-woody), we estimated ground cover for the late dry season (July - August 2017) for the current reporting year. Ground cover monitoring is included to recognise the importance of having some level of vegetation cover in riparian areas to help minimise erosion, particularly where woody vegetation is not present to stabilise the soil. Ground cover reporting in riparian areas is based on Sentinel-2 seasonal fractional cover data derived using the method described by Flood (2017). The Sentinel-2 fractional cover

product is not specifically a ground cover product, and does contain woody vegetation. However, as its use is restricted to non-forested areas it is suitable for the purposes of assessing ground cover. Three classes of ground cover were used for reporting – 0-30%, 30-70% and over 70% ground cover. Very low ground cover can indicate degraded areas, such as gullies. It may also be present naturally in areas containing sandbars, sand dunes and rocky streams.

Endangered and of concern regional ecosystems

We analysed the regional ecosystem status (Accad 2001) of remnant vegetation within the riparian area, and report the proportion of each catchment's riparian area which is endangered or of concern.

Results

Riparian Extent

Approximately 531,000 hectares were mapped as riparian areas in South East Queensland which represents approximately 23 % of the total catchment area (Figure 3). The Upper Brisbane, Lockyer, Logan Albert and Bremer catchments have the largest riparian areas.

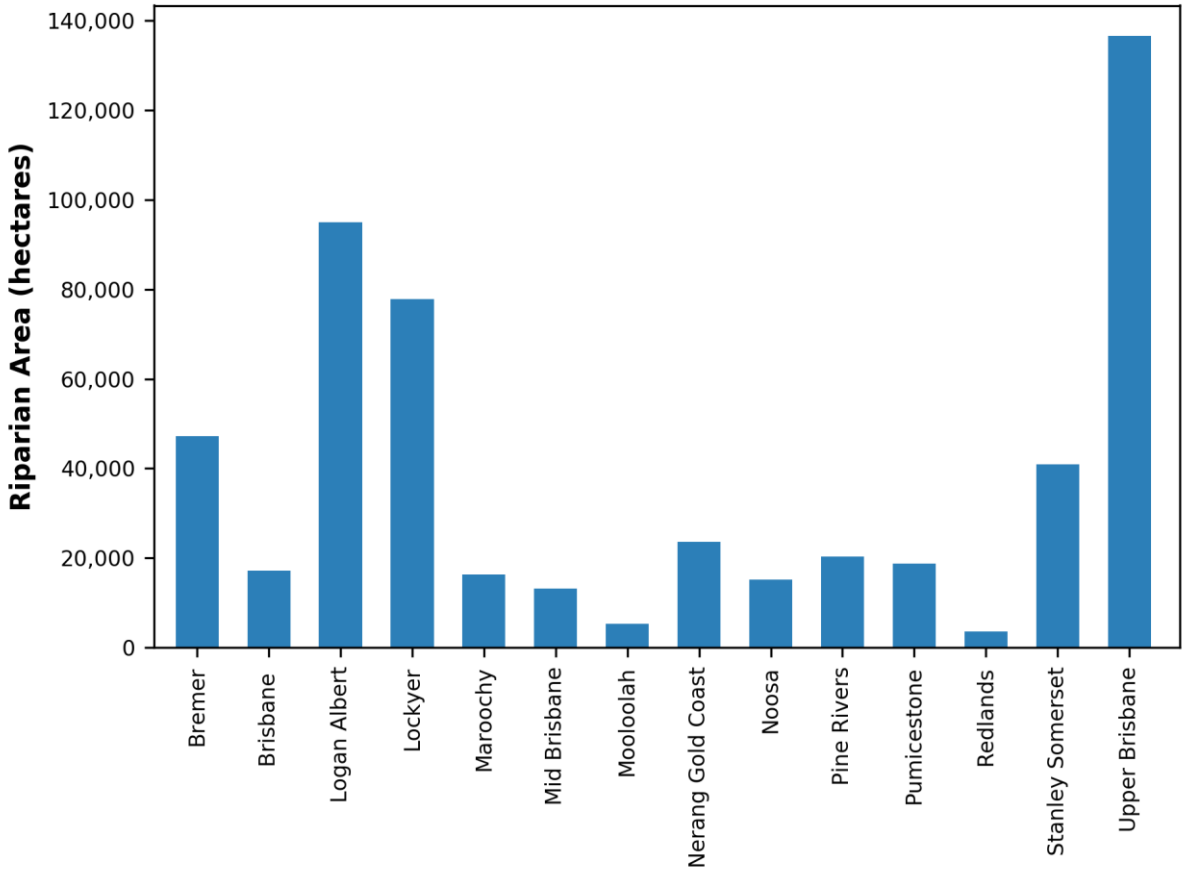

Figure 3: Number of hectares mapped as riparian areas within South East Queensland catchments

Changes in extent of riparian vegetation

Extent of modification to riparian forests since European settlement

The historical loss of riparian forest until 1988 for South East Queensland was estimated to be 42% (225,000 hectares) of the pre-European extent. The greatest estimated historical loss has occurred in the Bremer (58%; 27,300 hectares) followed by the Upper Brisbane catchment (56%; 77,000 hectares).The catchments with the least amount of historical loss are Pumicestone (0.5%; 100 hectares) and Noosa (14%; 2000 hectares). Pumicestone has large recent changes due to forestry.

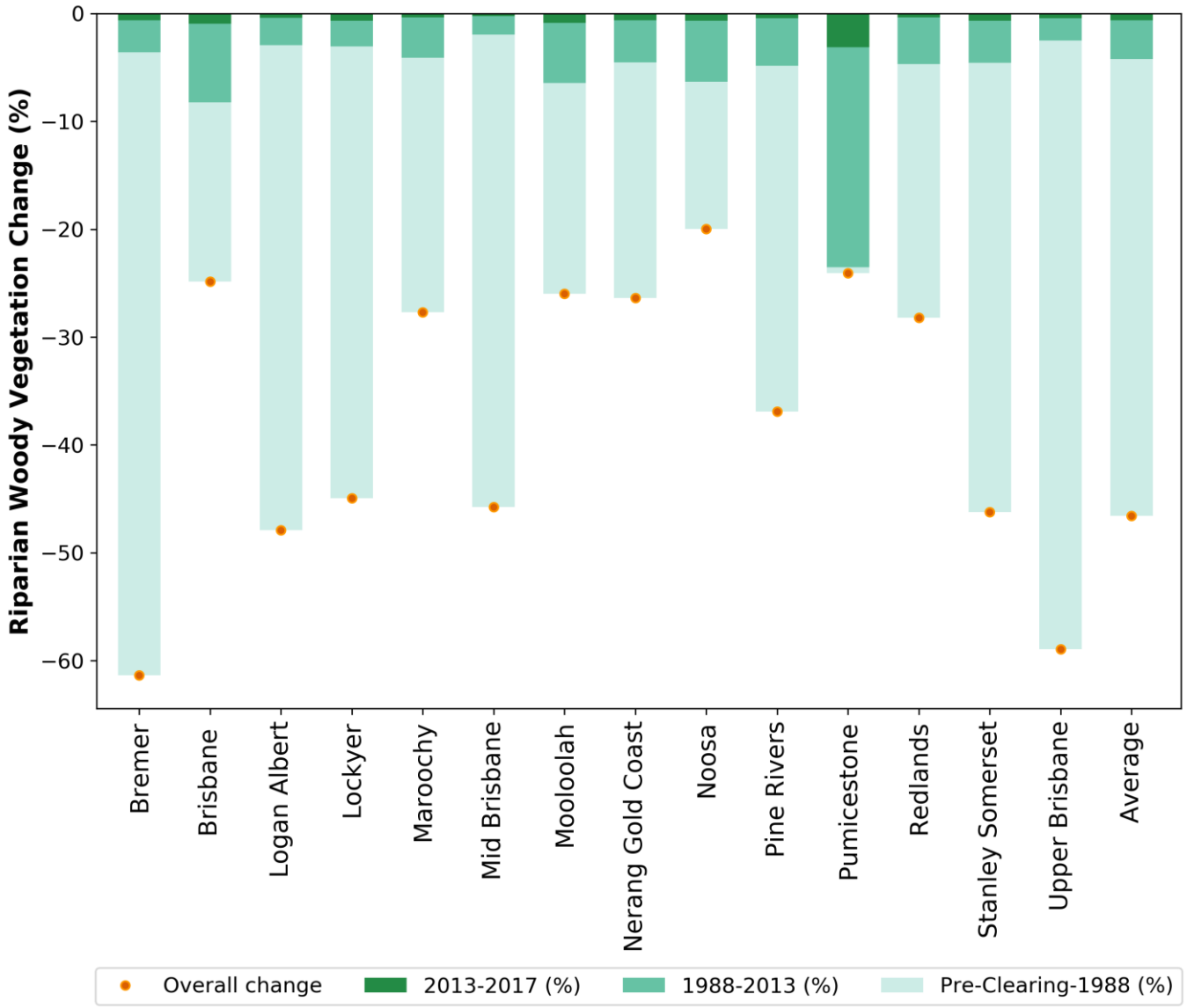

Figure 4: Proportion of riparian forest loss in South East Queensland catchments since pre-European settlement

Historical loss of riparian vegetation

Recent riparian vegetation loss in South East Queensland has generally fluctuated around a mean of 770 hectares (0.15%) per year, between 1988 and 2017, with a recent slightly higher mean of 830 hectares (0.16%) per year for the 2013-2017 period (Figures 5 and 6). For 1988-2017 period, the Pumicestone catchment had this highest proportion of riparian vegetation loss.

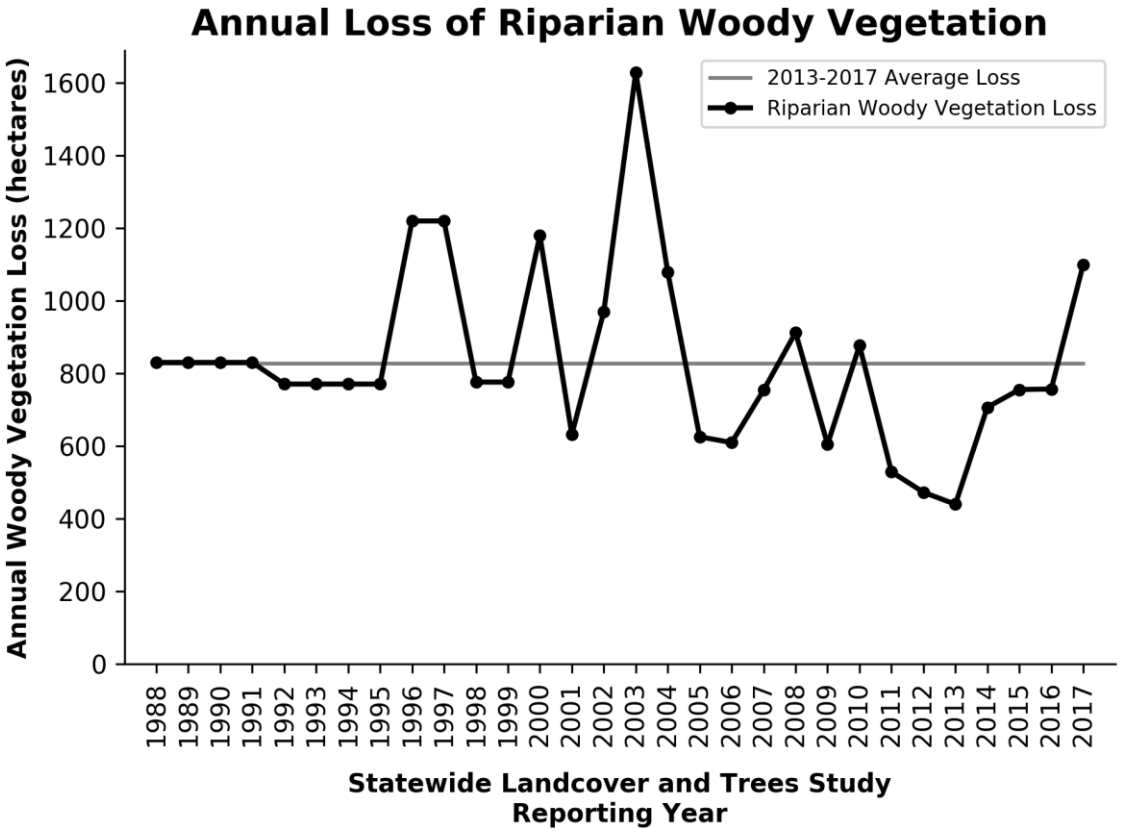

Figure 4: Annual loss (ha) of riparian woody vegetation in South East Queensland catchments

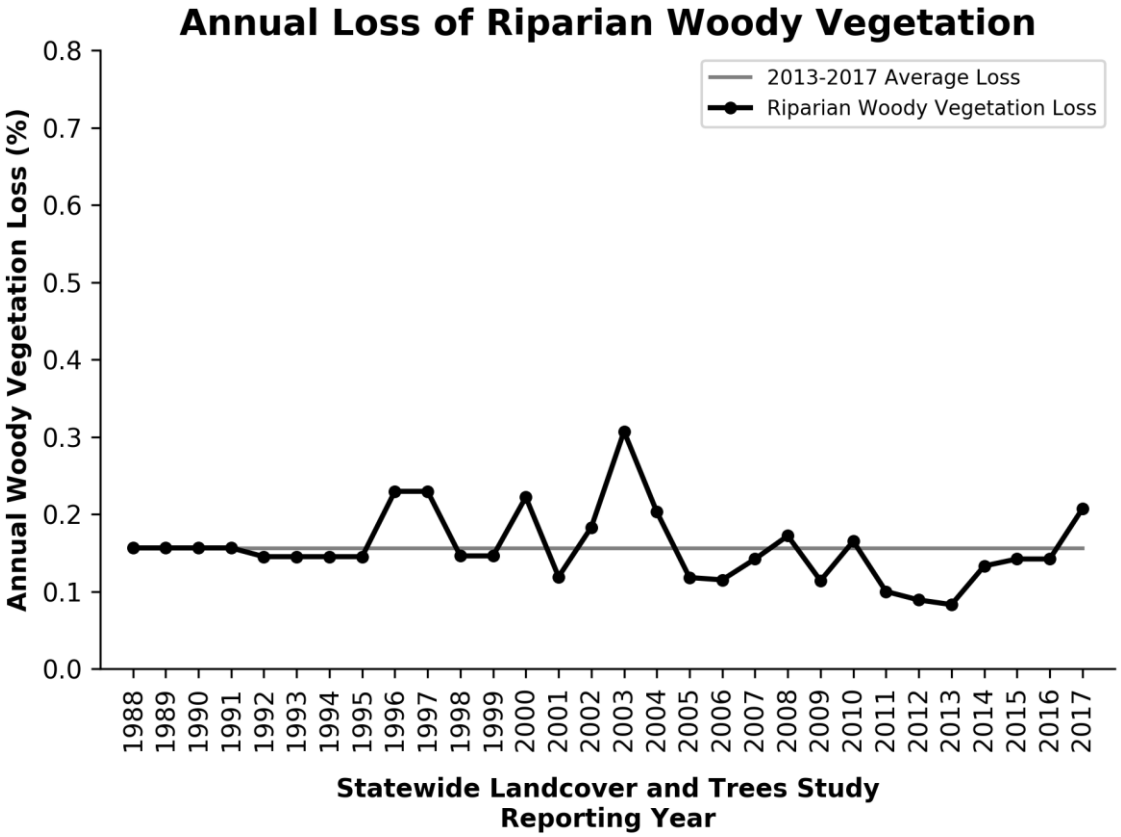

Figure 6: Annual loss (%) of riparian woody vegetation in South East Queensland catchments

Proportions of riparian forest and ground cover

In 2017, approximately 53.4% (283,800 hectares) of the riparian area of South East Queensland catchments were forested. Non-forested areas where the ground cover was less than 70% accounted for 0.5% (2900 hectares) of the total riparian area. Non-forested areas which have less than 30% ground cover were 0.01% (40 hectares) of the total riparian area (**Error! Reference source not found.**). Importantly, those catchments which have historically had greater development and therefore have a low proportion of forested areas (e.g. Bremer, Lockyer, Logan Albert, Upper Brisbane and Stanley Somerset) all have relatively large proportions of their non-forested areas with greater than 70% ground cover, indicating that there is at least some vegetation cover in these areas which could help reduce runoff and erosion. The 'Missing Data' category includes dams and other waterbodies, as well as areas obscured by cloud in the data products derived from satellite imagery.

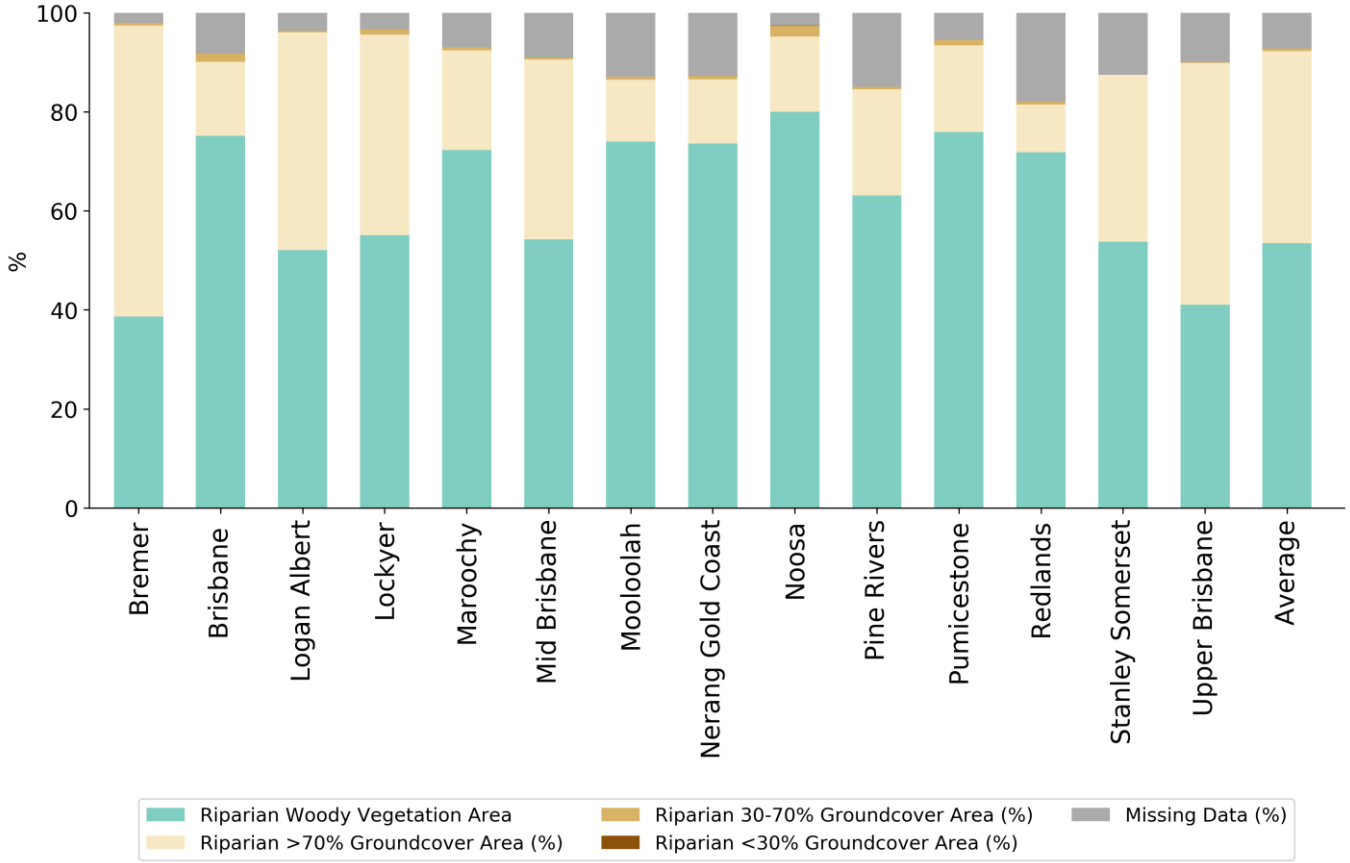

Figure 7: Proportions of riparian vegetation in South East Queensland catchments

Regional Ecosystems

In South East Queensland catchments, 3% (16,300 ha) of riparian areas were classified as endangered and 11.8% (62,900 ha) as of concern regional ecosystems (Figure 8). The Noosa catchment has the highest proportion of endangered (8.0%) and of concern (25.2%) regional ecosystems. The Mid Brisbane catchment has the lowest proportion of endangered (1.4%) and of concern (2.4%) regional ecosystems.

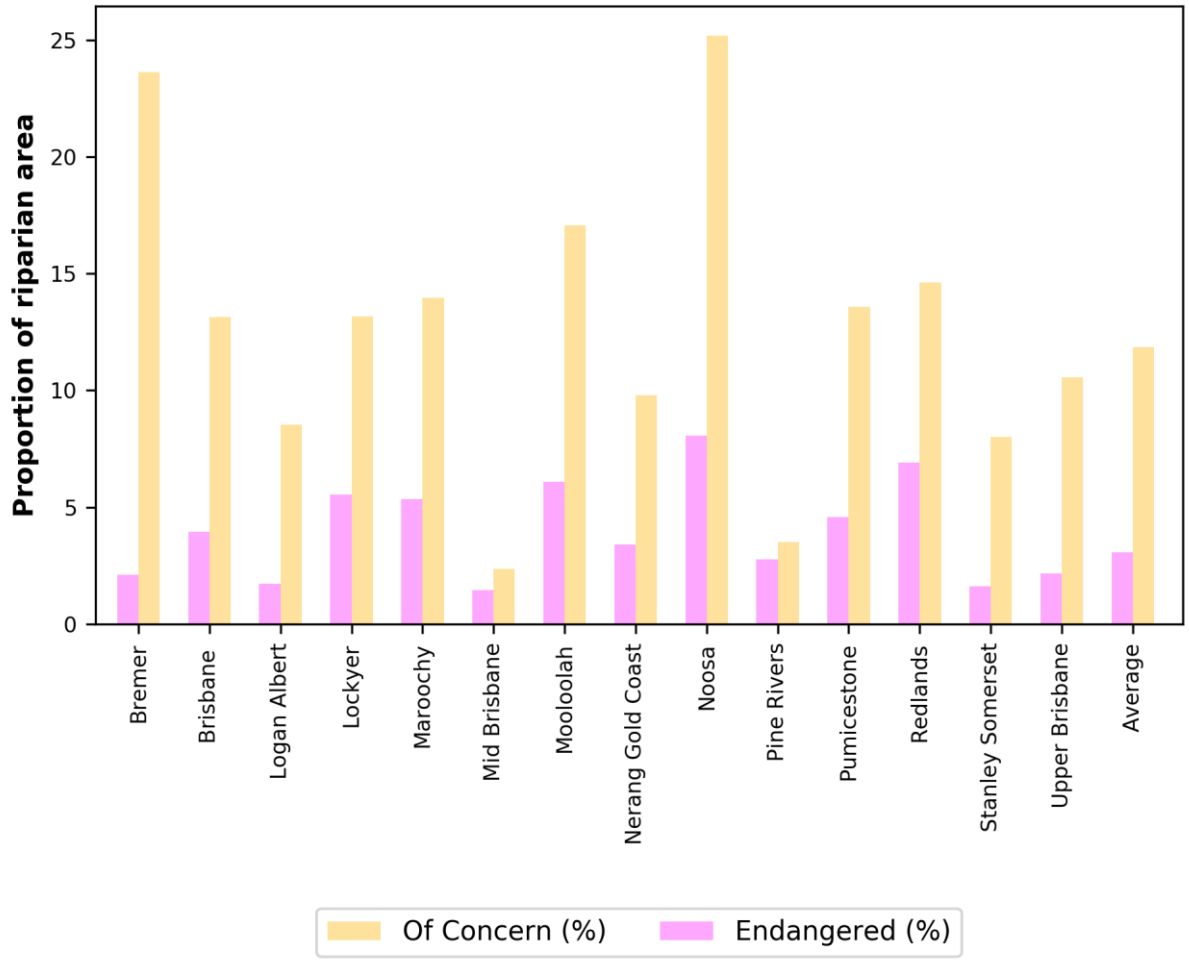

Figure 8: Proportions of riparian regional ecosystems that are Endangered or Of Concern in South East Queensland catchments

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