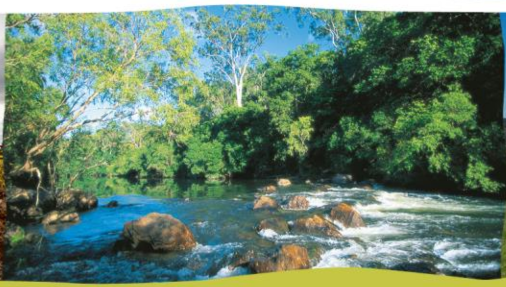
Results


Great Barrier Reef
Report Card 2015

Australian Government

Queensland Government

Great Barrier Reef Report Card 2015 Results

Prepared by the Australian and Queensland governments.

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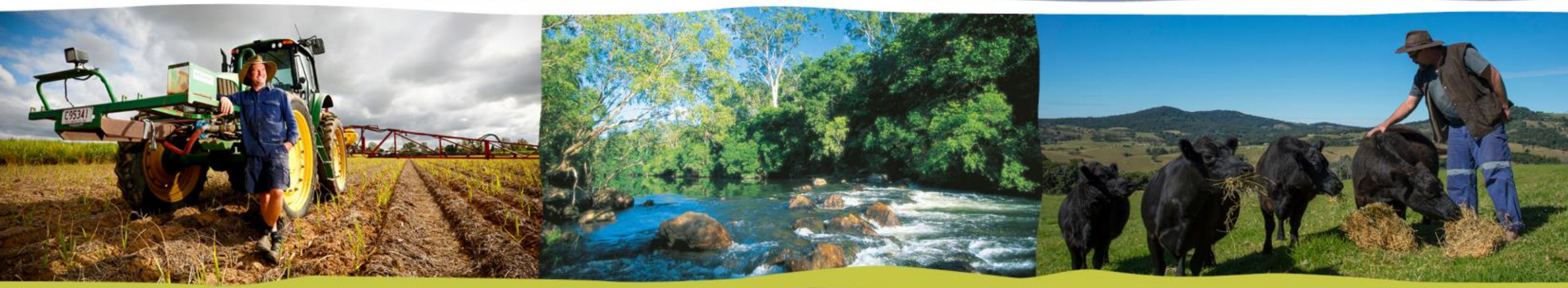
Management practice results



Great Barrier Reef

Report Card 2015

Australian Government

Queensland Government

Management practice results

The updated management practice target in the Reef Water Quality Protection Plan 2013 is:
90 per cent of sugar cane, horticulture, cropping and grazing lands are managed using best management practice systems (soil, nutrient and pesticides) in priority areas by 2018.

Landholders manage complex farming systems made up of many diverse individual management practices. The target acknowledges that the largest water quality benefits will be realised through use of management systems that include adoption and integration of a number of critical management practices.

Best management practices in this context are defined in Reef Water Quality Protection Plan water quality risk frameworks for each major agricultural industry. These frameworks identify the management practices with greatest potential influence on off-farm water quality, and articulate a reasonable best practice level which can be expected to result in a moderate-low water quality risk. The levels described for each practice, where relevant, are:

- High risk (superseded or outdated practices)
- Moderate risk (a minimum standard)
- Moderate-low risk (best practice)
- Low risk (innovative practices expected to result in further water quality benefits, but where commercial feasibility is not well understood)

The Great Barrier Report Card 2015 (reef report card) estimates the area of land managed using best management practice systems (low and moderate-low risk levels) as at June 2015.

Drivers of reported adoption

It is important to acknowledge how challenging the achievement of a best management practice system is for many landholders. To varying degrees, each component practice requires new knowledge and skills, and in some cases considerable direct investment in farm equipment and infrastructure.

For those management improvements that are relatively simple to implement and present little perceived production risk, adoption can be fostered through awareness activities and modest extension efforts. The provision of financial incentives can greatly assist landholders to implement these changes rapidly. For example, incentives provided over the previous seven years have enabled more rapid adoption of:

- GPS guidance systems, more targeted herbicide application practices, and improved levels of irrigation water recycling in the sugarcane industry
- fencing to manage cattle access to stream banks in the grazing industry
- the installation of erosion control structures like contour banks in the grains industry
- the installation of fertigation systems in bananas and other horticultural crops.

This type of program has been a feature of Reef Water Quality Protection Plan investments to date. However in recent years (from 2013) the investment mix has been changing to reflect more challenging adoption issues – those that require new knowledge and skills, and sometimes trialling new practices, before landholders have sufficient confidence to invest in implementing the change across the farm.

Both Queensland and Australian government investments have increased the emphasis upon capacity building extension to landholders through:

- Industry Best Management Practice (BMP) programs, which support individual landholders in assessing their own management and comparing it with commonly accepted industry standards (this clarifies where management improvements may be warranted and beneficial)
- technical extension services to support the industry BMP programs (where landholders identify potential improvements, accessing professional opinion and advice is often necessary to act on opportunities for improvement)
- delivering training for certain technical issues
- in-field demonstrations of improved practices in practical situations
- working with landholder groups to develop local understanding of how new practices best fit into their farming systems
- support for on-farm research for farmers to trial practices that are new for them and working out if the risks associated with adoption are acceptable.

This report describes adoption progress based on the degree of management improvement reported through the Australian Government's incentive program (Reef Programme). These are mainly management changes that have been more rapidly implemented due to a level of fiscal subsidy and technical support.

There are many other ongoing programs that are engaging with landholders, and some of these are occurring on a much larger scale (summarised in the Management Practice Methods chapter). This process of engagement and follow-up interactions to enhance knowledge and skills is not included in the Great Barrier Reef Report Card 2015 estimates of best management system adoption, or in modelling conducted to estimate pollutant load reductions. These are the outcomes expected from these programs, but learning new knowledge and skills takes time, and implementing new practices in farming systems with long production cycles (such as sugarcane and beef cattle) is not immediate.

These programs are expected to report on the extent of implemented farm management improvements for the next Great Barrier Report Card (the 2015-16 year):

- Queensland Government extension programs in the grazing and sugarcane industries
- industry BMP programs (sugarcane, grazing, grains)
- novel market-based instrument projects in the sugarcane industry in the Wet Tropics and Burdekin regions funded by Reef Trust and implemented between 2014 and 2016
- relevant system repair projects funded through the Australian Government's Reef Programme and implemented between 2014 and 2016.

How progress is reported

The metrics used to describe progress toward best management practice systems refer to the degree of adoption of practices relating to major pollutant categories. The category scores are averaged to provide an overall score for each industry.

For sugarcane, horticulture and grains, metrics refer to the adoption of practices that minimise the loss of soil, nutrients and pesticides (pesticides not reported in bananas). For the grazing industry, metrics refer to the adoption of practices that minimise soil loss through pastures (hillslope), streambank and gully erosion processes.

For sugarcane and horticulture, there is a coaster metric describing progress toward best management practice systems. The relative size of the outer wedge indicates the potential influence of the practice on water quality.

For all industries, there is a bar graph displaying the area managed from low risk (innovative practices) to high risk (superseded practices).

Paddock to Reef program modelling of estimated mean annual pollutant load reductions is based on estimated changes to these farm management practice systems, with off-farm water quality impacts decreasing as management systems progress from high risk towards low risk.

Scoring

Grade	Status	Criteria for June 2015	Colour
A	Very good	90-100%	Dark green
B	Good	68-89%	Light green
C	Moderate	46-67%	Yellow
D	Poor	23-45%	Orange
E	Very poor	0-22%	Red

Factors affecting agricultural industries in 2014-15

Changing management practice can be a long and complex process that requires new or expanded knowledge and skills, and sometimes significant capital investment. The capacity to afford such an investment is typically closely related to climatic and market forces beyond the landholder's control. Recent challenges for landholders are briefly summarised below.

Sugarcane

The 2014 sugarcane harvest produced yields that were at or slightly above 10 year averages (approximately 102 per cent of the 10 year average, excluding the Mossman and Tablelands districts). Sugar prices were modest (although somewhat offset through marketing opportunities associated with the weaker Australian dollar) meaning farms were generally operating on low profitability.

Fertiliser prices were generally at the higher end of the recent 'normal' range (at around $650 per tonne of urea), but do not appear to have had a significant influence on rates of product applied.

Most districts received relatively dry and trouble free harvesting conditions which meant that a relatively high proportion of growers were able to plant legume crop rotations, particularly in the Wet Tropics. These dry conditions also meant that there was relatively low risk of pesticides moving off-farm. The other side of dry conditions is that irrigation requirements increased, at a time when electricity prices were escalating. This was particularly relevant for growers in the Mary, Burnett, Burdekin, Proserpine and upper Barron River districts. Relatively low rainfall experienced during 2014-15 meant that yields in most production areas were forecast to be reduced for the 2015 crush.

Horticulture
Severe Tropical Cyclone Marcia caused heavy crop and infrastructure losses to horticulture growers in the area around Yeppoon, Rockhampton, Biloela and Gladstone in February 2015 with very destructive winds and flooding.

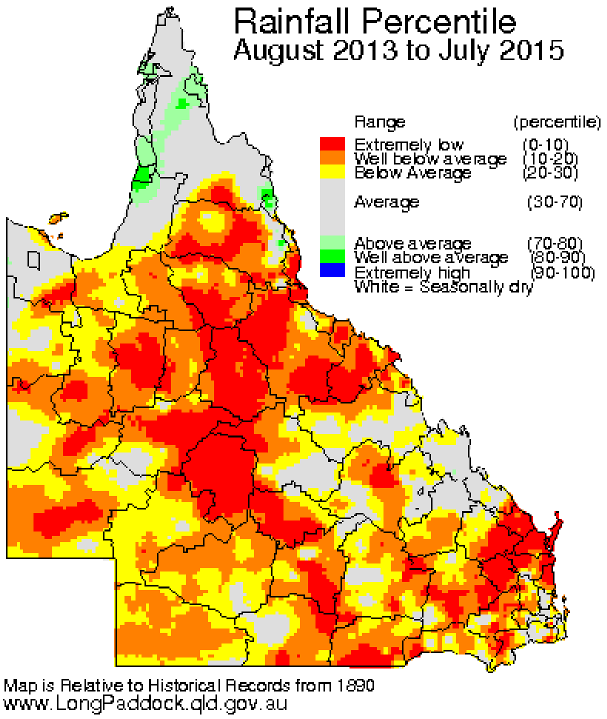
For other major production areas the 2014-15 year generally produced good growing conditions and typical market prices for commodities. The value of production of most horticultural commodities in the Great Barrier Reef catchments was at or above that achieved in recent years.

Grains
The 2014 winter crop in the Burnett catchment was depressed due to ongoing dry conditions. The summer crop however benefited from the good lead-up rains during November to January and the widespread rain resulting from Tropical Cyclone Marcia's rain depression in late February 2015.

The larger grain growing areas in the Fitzroy and western Burdekin catchments experienced very similar winter crop conditions. Significant areas of wheat and chickpeas were planted into marginal conditions and with little in-crop rain, yields were generally well below average. A moderate area was planted to summer crops, predominantly grain sorghum, mung beans and maize. Much of this area received applications of residual herbicides although limited follow up rainfall meant that the risk of off-farm movement of herbicides was low.

Tropical Cyclone Marcia severely impacted grain growers in the area between Rockhampton and Biloela. Extremely intense rainfall caused loss of crops and infrastructure and severe soil erosion.

Grazing
Drought conditions through much of Queensland have limited the ability of graziers to afford and implement farm management improvements. Most of Queensland was drought-declared by July 2015, with large portions of the Great Barrier Reef catchments receiving well below average rainfall for the two years between 2013 and 2015. Driest areas included the majority of the Burdekin, Burnett, and Mary catchments, and large parts of the Dawson, Nogoa and Comet river catchments in the Fitzroy region.



Great Barrier Reef-wide

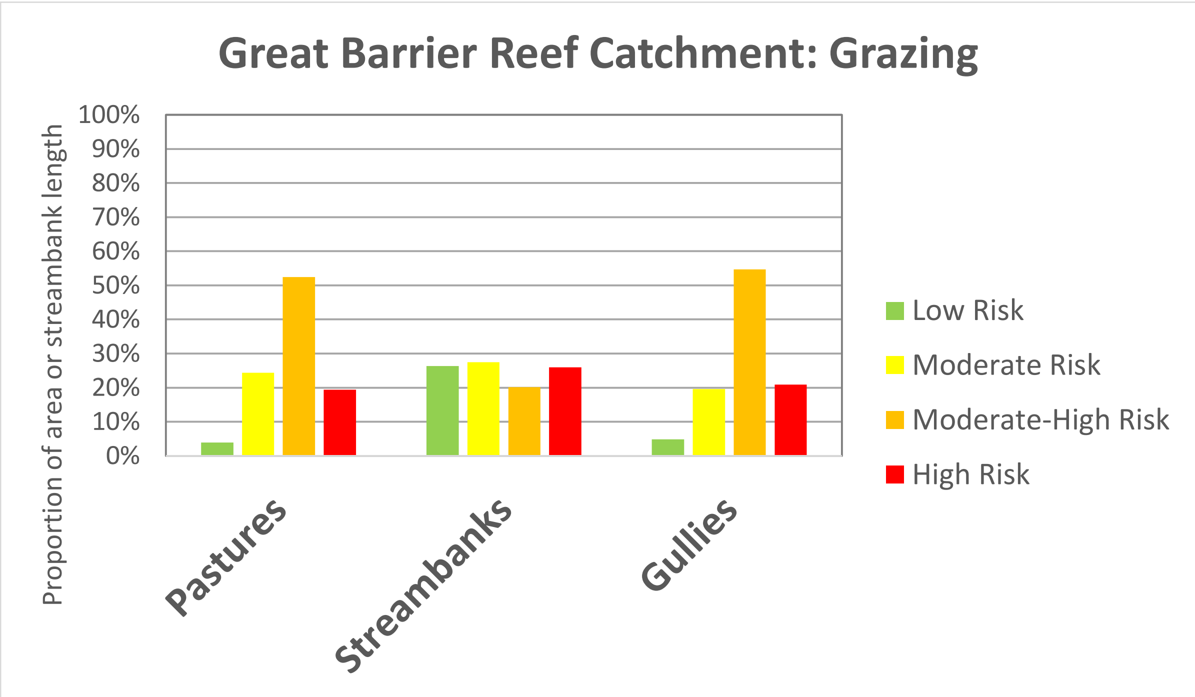
Grazing

D
36%

Target: 90 per cent of grazing lands are managed using best management practice systems by 2018.

Poor progress: By June 2015, approximately 28 per cent of grazing land was managed under best management practice systems related to erosion from pastures (8.8 million hectares), 54 per cent for practices relating to streambank erosion (60,000 kilometres of streambanks) and 25 per cent for practices relating to gully erosion (7.6 million hectares).

Erosion Source	Area managed using best management practice systems
	2014-15
Pastures	**28%**
Streambanks	**54%**
Gullies	**25%**



There are approximately 8545 graziers managing 31.1 million hectares of land and over 100,000 kilometres of streambanks across the Great Barrier Reef catchment.

The Australian Government's Reef Programme directly funded on-farm infrastructure improvements related to best practice adoption on 254 farms covering over 558,000 hectares, and 652 kilometres of streambanks during the 2014-15 year.

The Grazing BMP program, a partnership involving the Fitzroy Basin Association, AgForce and the Queensland Government, worked with 402 individual grazing businesses during 2014-15. These businesses, managing over 4.2 million hectares, completed BMP modules on soil health and grazing land management which were directly relevant to runoff and soil loss. In addition, the Grazing BMP program conducted activities aimed at enhancing knowledge and skills of graziers on the ground with over 2500 participants. There are no soil erosion reductions associated with this engagement in this report. This should not be taken as an indication that the program does not foster improved land management practices. It is acknowledged that the Grazing BMP program is a highly effective and efficient means of engaging with large numbers of land managers; however the impacts of this engagement and capacity building effort in terms of reduced risk of erosion on farms, will require time and evidence to verify.

Queensland Government extension programs supported the implementation of the Grazing BMP program in the Fitzroy and Burdekin regions. These extension teams focused their efforts with graziers in priority areas and those of a larger commercial scale. During 2014-15 the extension programs engaged with 215 individual businesses managing over seven million hectares of grazing land and one million livestock. Follow-up participant surveys by a professional independent evaluator in May 2015 indicated that 78 per cent of graziers (n=49) had improved their knowledge and skills, and implemented some kind of a management practice improvement, some of which have direct and/or indirect links to reducing the risk of soil erosion. Again, this report adopts a conservative approach to attributing soil erosion and water quality benefits and there are no sediment reductions attributed to this engagement at this stage. This is expected to change as the impacts become apparent and the spatial extent of management improvements can be described.

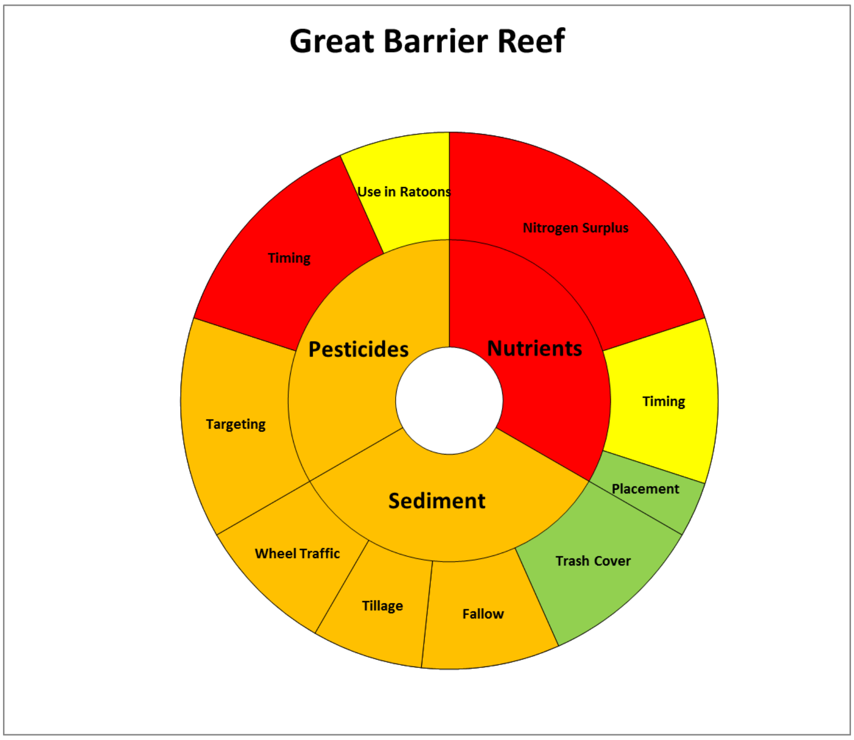
Sugarcane

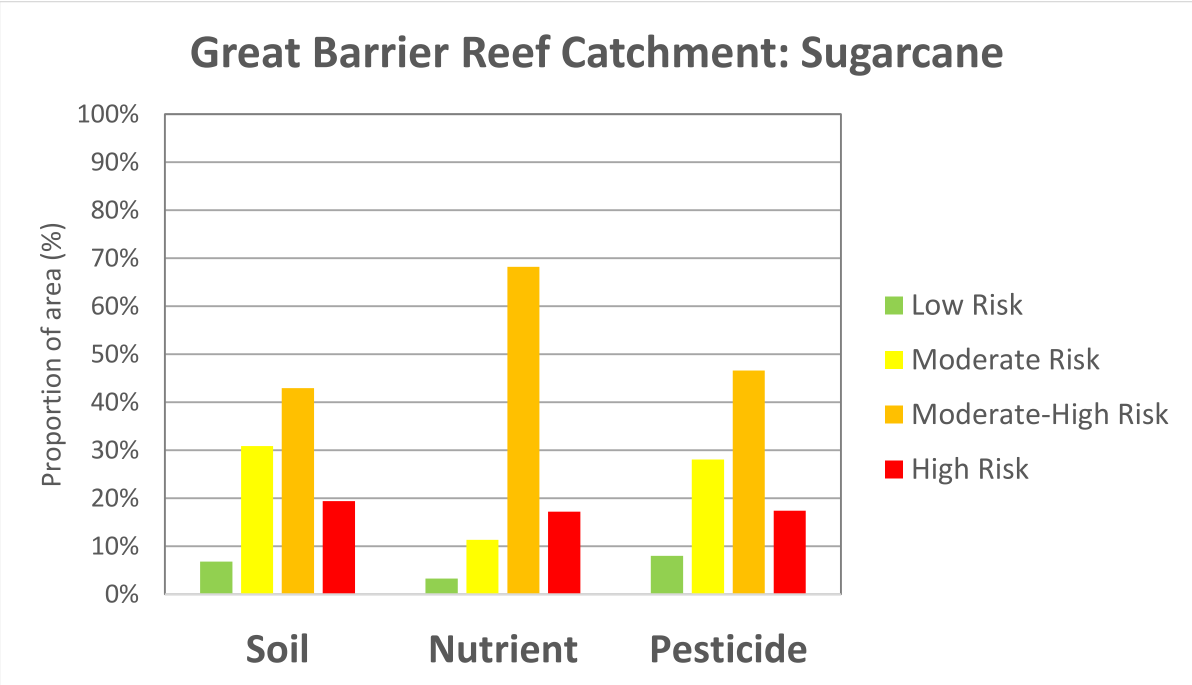
D
23%

Target: 90 per cent of sugarcane lands are managed using best management practice systems by 2018.

Poor progress: By June 2015, best management practice systems were used on approximately 32 per cent of sugarcane land for pesticides (139,000 hectares), 16 per cent for nutrients (69,000 hectares) and 23 per cent for soil (101,000 hectares). There are approximately 3777 sugarcane growers managing 400,000 hectares of land used for sugarcane production across the Great Barrier Reef catchment.

Pollutant	Area managed using best management practice systems
	2014-15
Sediment	**23%**
Nutrients	**16%**
Pesticides	**32%**





The major reported influencers of farm management change modelled for this Great Barrier Reef Report Card during the 2014-15 year were through regional natural resource management organisations facilitating the provision of financial incentives and extension support through the Australian Government's Reef Programme. The adoption of improved farm management practices with varying degrees of water quality benefits was reported for 307 individual farms managing 66,447 hectares of sugarcane.

The Smartcane BMP program is an initiative of CANEGROWERS Ltd, supported by the Queensland Government. Smartcane BMP supports growers in conducting assessments of their own farm management practices in relation to a range of industry standards. This allows identification of priorities for potential management improvements by growers, and the support needs (e.g. follow-up technical support) necessary for industry and governments to foster those improvements. Up to July 2015 the Smartcane BMP program engaged directly with 836 growers (managing 152,895 hectares of sugarcane) in the Great Barrier Reef catchments. As this process of engagement and capacity building evolves and the spatial extent of change can be described, future Great Barrier Reef Report Cards will aim to estimate the impacts of improvements in farm management practice on water quality.

Both the Australian and Queensland governments also invested in extension services in priority sugarcane growing regions, often in support of either or both the Smartcane BMP and the Reef Programme's fiscal incentives. Whilst it has been difficult to describe the exact nature and full spatial extent of farm management improvements influenced by this work, there is evidence of its value in the sugarcane sector. For example, during the 2014-15 year, Queensland Government extension officers (Department of Agriculture and Fisheries) engaged with over 600 growers (managing approximately 113,000 hectares) across the Great Barrier Reef catchments. These activities were designed to support the acquisition of new knowledge and skills amongst sugarcane farmers and their advisors. These capacity building efforts have proven to be valuable; independent, anonymous surveying of grower participants (n=119) by a professional evaluator in June 2015 indicated 99 per cent believed their knowledge and skills had been enhanced, with 57 per cent linking their involvement with some degree of management practice change.

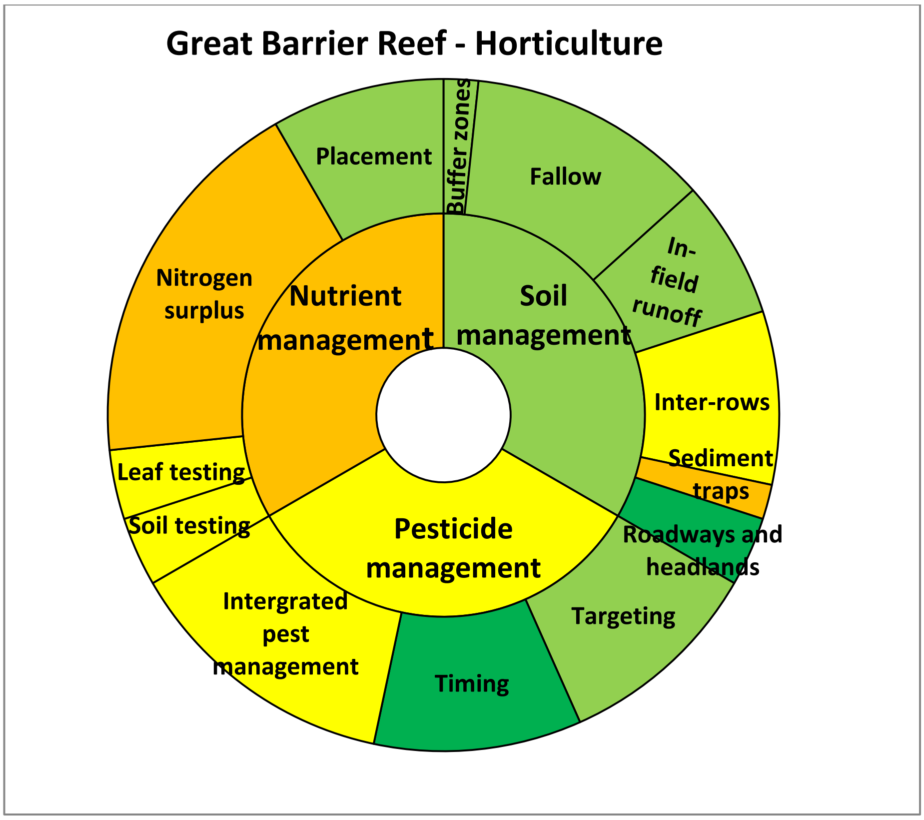
Horticulture

C
47%

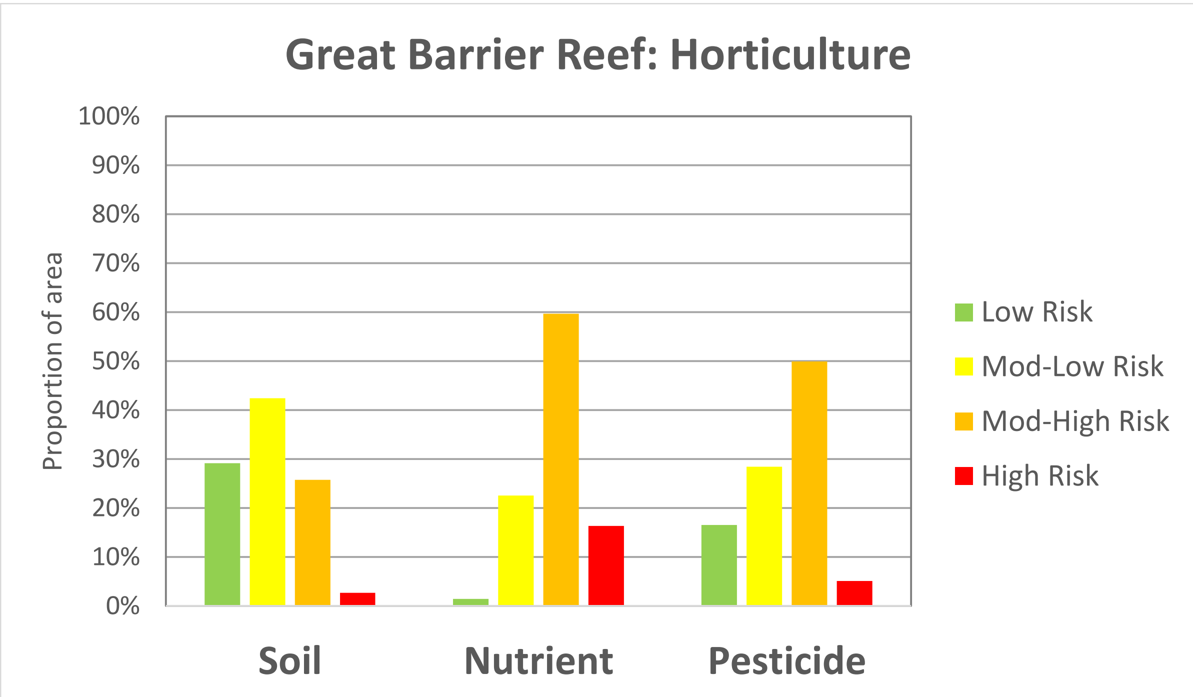
Target: 90 per cent of horticulture lands are managed using best management practice systems by 2018.

Moderate progress: By June 2015, best management practice systems were used on approximately 45 per cent of horticultural land for pesticides (39,000 hectares), 24 per cent for nutrients (21,000 hectares) and 72 per cent for soil (62,000 hectares)**.** There are approximately 970 horticulture producers farming 86,000 hectares of land in the Great Barrier Reef catchment.

Pollutant	Area managed using best management practice systems
	2014-15
Sediment	**72%**
Nutrients	**24%**
Pesticides	**45%**



The major identified driver of change in the horticulture industry during 2014-15 was the Australian Government's Reef Programme, delivered by regional Natural Resource Management organisations and Growcom, and impacting 59 farms and 6475 hectares of crop area.



Cape York

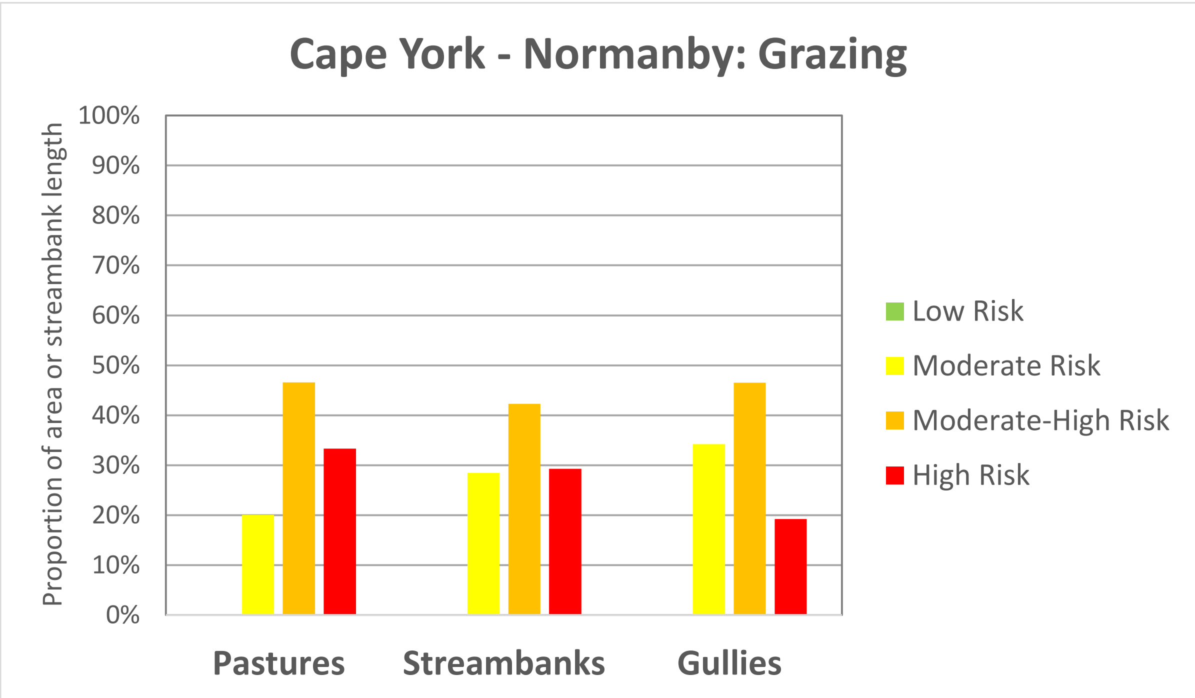
Grazing

D
28%

Target: 90 per cent of grazing lands are managed using best management practice systems by 2018.

Poor progress: Management practice adoption efforts in the Cape York region have focused upon the Normanby River catchment. There are approximately 48 graziers managing 2.16 million hectares of land in the Normanby River catchment. As at June 2015, approximately 20 per cent of grazing land was managed using best management practice systems relating to pasture (hillslope) erosion (434,000 hectares), 28 per cent for practices related to streambank erosion (2944 kilometres of streambank), and 34 per cent for practices related to gully erosion (740,000 hectares).

Erosion Source	Area managed using best management practice systems
	2014-15
Pastures	**20%**
Streambanks	**28%**
Gullies	**34%**



Cape York Natural Resource Management facilitated funding through the Australian Government's Reef Programme to improve management of 53,000 hectares on six grazing properties. Work on these sites involved fencing and providing off-stream water to exclude livestock from streambanks and other degraded areas, as well as some erosion prevention associated with station roads and tracks.

Wet Tropics

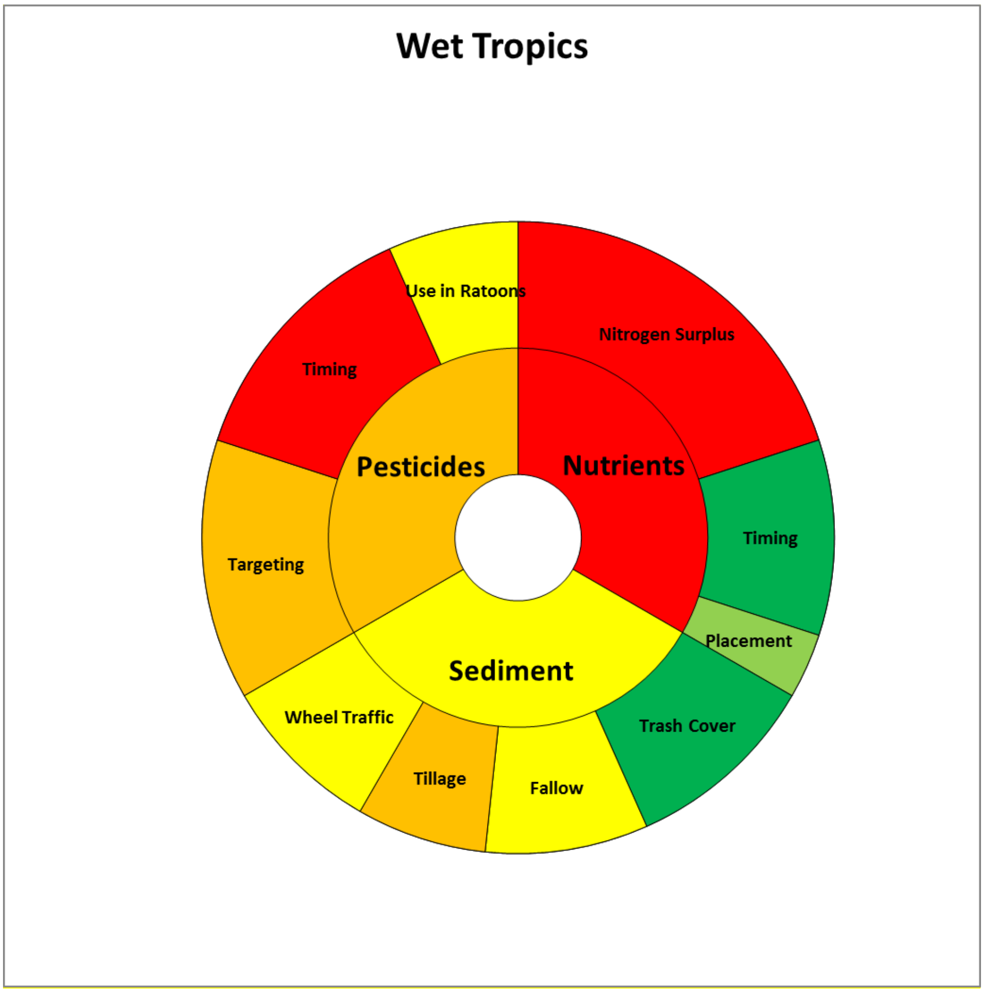
Sugarcane

D
27%

Target: 90 per cent of sugarcane lands are managed using best management practice systems by 2018.

Poor progress: As at June 2015, best management practice systems were used on approximately 24 per cent of sugarcane growing land for pesticides (33,000 hectares), 10 per cent for nutrients (13,000 hectares) and 46 per cent for soil (63,000 hectares). There are approximately 1343 growers managing 136,000 hectares of sugarcane in the Wet Tropics region.

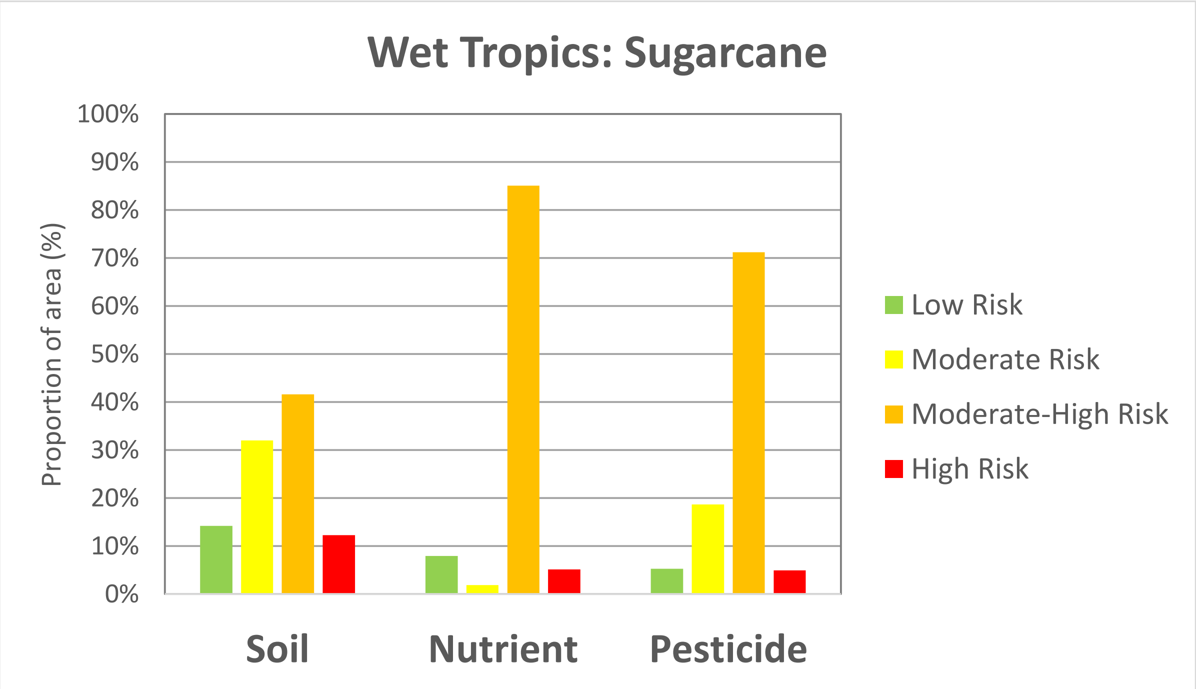
Pollutant	Area managed under best management practice systems 2014-15
Sediment	**46%**
Nutrients	**10%**
Pesticides	**24%**



Adoption of improved management practices occurred largely through the Australian Government's Reef Programme, facilitated in the Wet Tropics by Terrain Natural Resource management (Terrain NRM). Terrain NRM worked directly with 74 sugarcane growers (managing 19,307 hectares of sugarcane) in implementing on-farm changes with financial incentives that supported the purchase or modification of farm equipment, including:

- 10 farms (1231 hectares) applying fertiliser below the soil surface instead of on top of the surface
- 15 farms (5098 hectares) implementing GPS guidance for various field operations
- seven farms completing laser levelling work to improve farm drainage over 1465 hectares
- nine farms completing modifications or installation of improved farm drainage on 1613 hectares
- 22 farms purchasing or modifying equipment to enable directed and/or shielded herbicide spraying (which can significantly reduce the volume of residual herbicide applied) over 5915 hectares
- eight farms purchased or modified equipment enabling reduced levels of tillage over 2320 hectares
- three farms purchased or modified planting equipment suitable for growing legume break-crops in sugarcane land (1195 hectares)
- 26 of these growers also completed Weed Management Plans (6860 hectares) and 29 growers completed Nutrient Management Plans (8207 hectares); these planning tools aim to minimise the risk of off-farm movement of pesticides and nutrients.

The Smartcane BMP program supports sugarcane growers in completing self-assessments of their own farm management practices against a range of industry standards. This allows growers to identify and prioritise areas for potential management improvement. As at July 2015 the Smartcane BMP program had directly engaged with 392 businesses in the Wet Tropics region, representing 74,697 hectares of sugarcane. Future Great Barrier Reef Report Cards will aim to describe any management improvements resulting from this ongoing engagement and follow-up support.



Grazing

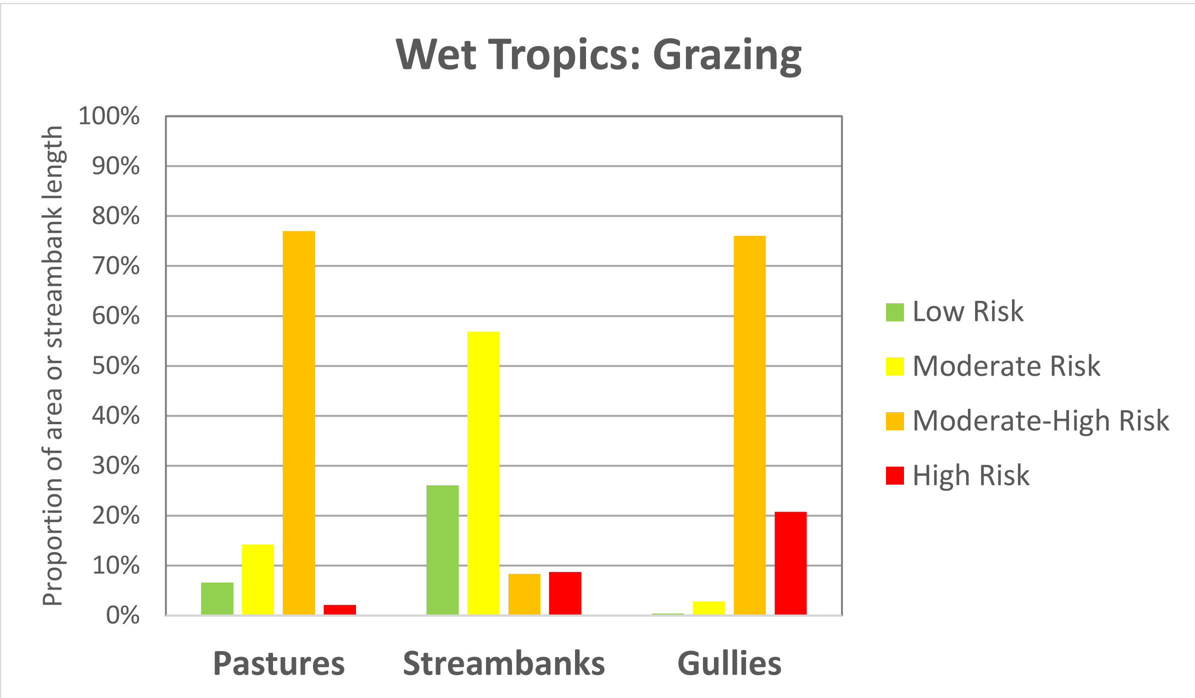
D 35%

Target: 90 per cent of grazing lands are managed using best management practice systems by 2018.

Poor progress: There were no discrete management practice change investments targeting water quality improvements in the grazing industry in the Wet Tropics region during 2014-15. As at June 2015 approximately 21 per cent of grazing land was under best management practice systems relating to pasture (hillslope) erosion (145,000 hectares), 82 per cent for practices related to streambank erosion (5800 kilometres of streambank) and three per cent for practices related to gully erosion (23,000 hectares).

There are approximately 935 graziers managing 698,000 hectares of land in the Wet Tropics region. A large proportion of this grazing land is rangelands in the upper catchment of the Herbert River, where a relatively small number of larger holdings strongly influence the management adoption benchmarks.

Erosion Source	Area managed under best management practice systems
	2014-15
Pastures	**21%**
Streambanks	**82%**
Gullies	**3%**



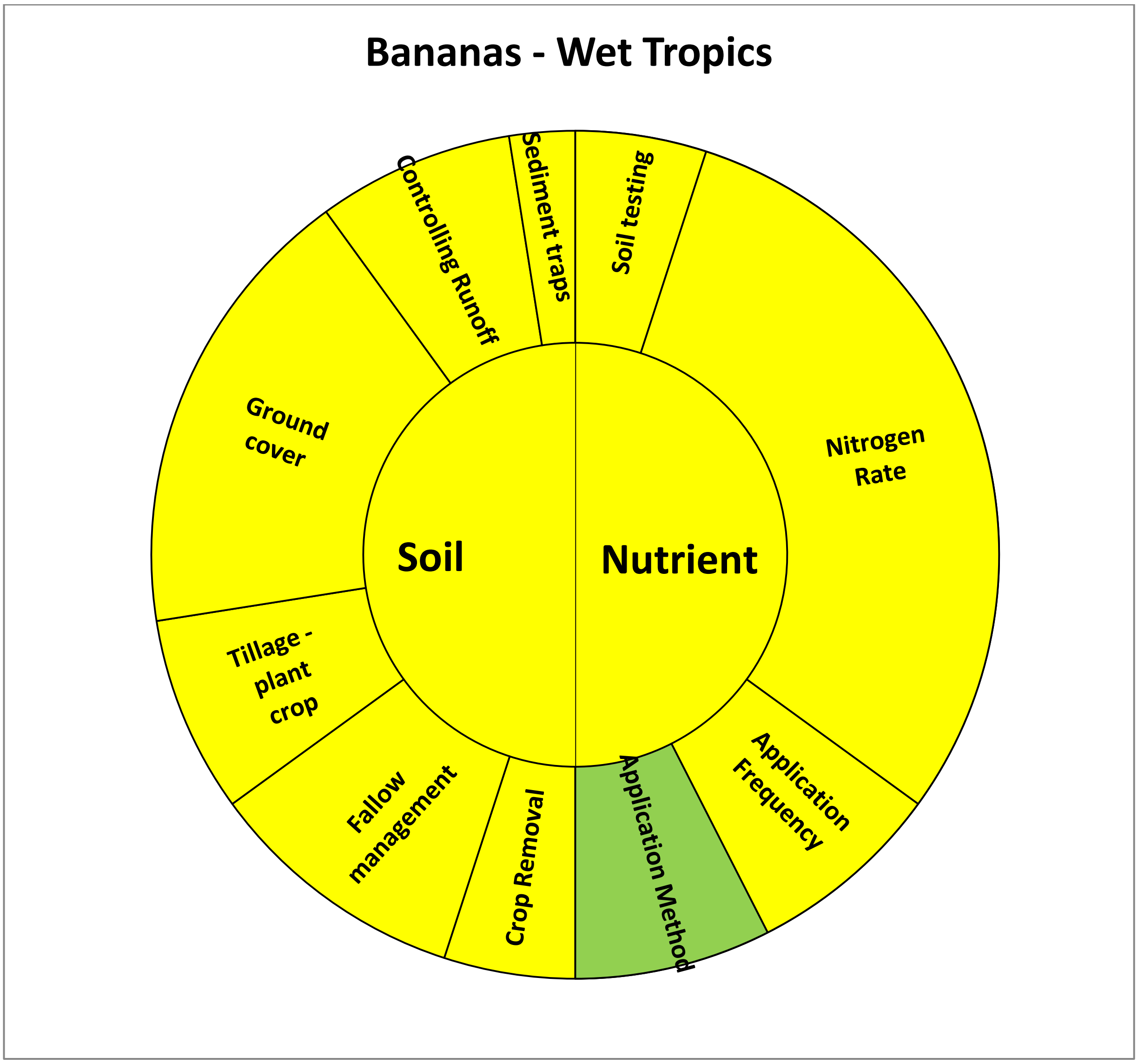
Bananas

C
56%

Target: 90 per cent of banana farming lands are managed using best management practice systems by 2018.

Moderate progress: By June 2015, approximately 56 per cent of banana farming land was managed under best management practice systems for nutrients (6950 hectares) and 57 per cent for soil (7100 hectares). Pesticide management systems are not reported due to the relatively low level of use of residual herbicides and insecticides with high potential ecological toxicity.

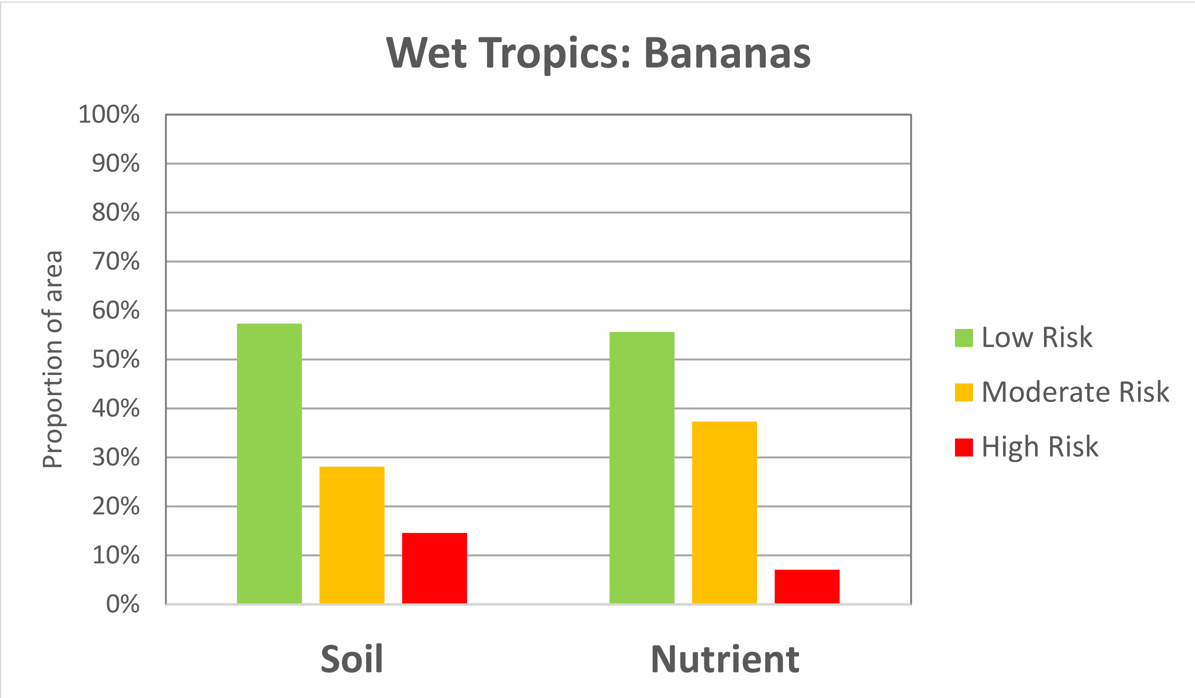
Pollutant	Area managed under best management practice systems
	2014-15
Sediment	**57%**
Nutrients	**56%**



There are approximately 260 growers managing 11,000 hectares of bananas in the Wet Tropics region.

The main source of identified farm management practice change in 2014-15 was the Australian Government's Reef Programme, facilitated by Terrain NRM in collaboration with the Australian Banana Growers Association. This program directly funded farm equipment and infrastructure improvements, including:

- six farms implemented measures to reduce the risk of soil erosion over 483 hectares
- five farms installed automated fertigation systems over 695 hectares, which can significantly reduce risks of nutrient loss associated with nitrogen surplus
- four farms made improvements to their irrigation application methods and/or irrigation scheduling over 68 hectares.



Burdekin

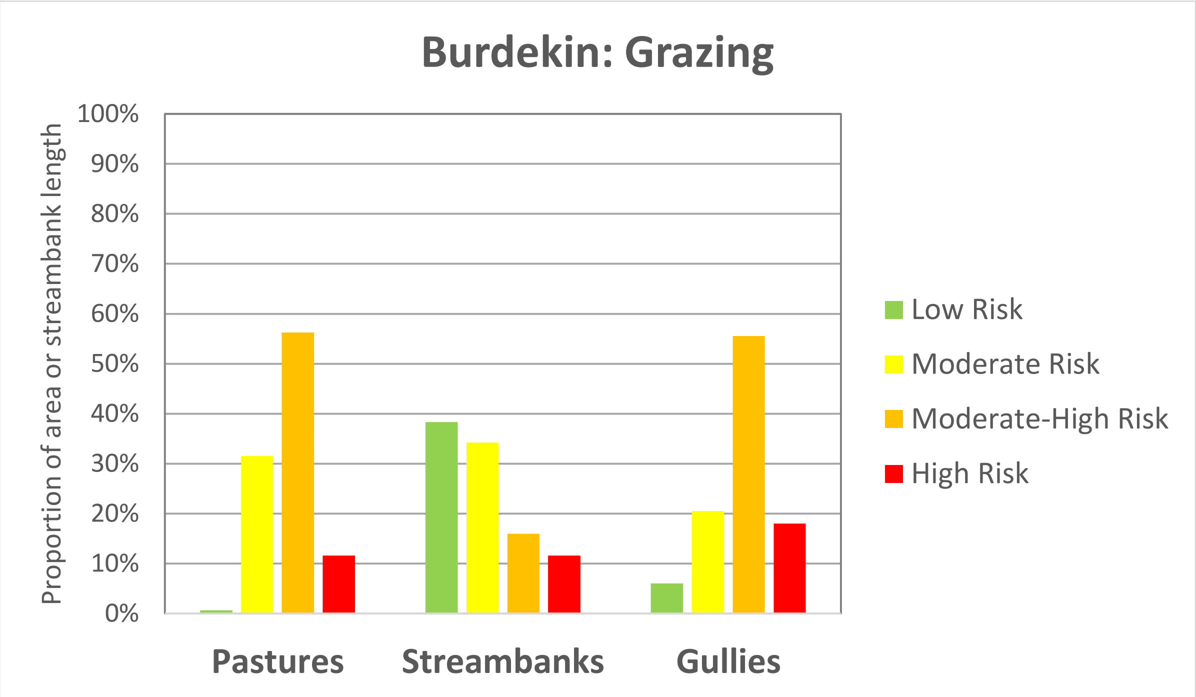
Grazing

D
44%

Target: 90 per cent of grazing lands are managed using best management practice systems by 2018.

Poor progress: By June 2015, approximately 32 per cent of grazing land was under best management practices relating to pasture (hillslope) erosion (4 million hectares), 73 per cent for practices related to streambank erosion (27,000 kilometres of streambanks) and 26 per cent for practices related to gully erosion (3.3 million hectares).

Erosion Source	Area managed under best management practice systems
	2014-15
Pastures	**32%**
Streambanks	**73%**
Gullies	**26%**



There are approximately 983 graziers managing 12.4 million hectares of land and 37,000 kilometres of streambanks in the Burdekin region.

NQ Dry Tropics Natural Resource Management (NQ Dry Tropics NRM), through the Australian Government's Reef Programme, directly assisted 125 graziers implement improved farm management on over 467,000 hectares of grazing land and 97 kilometres of streambanks.

The Grazing BMP program, in combination with Queensland Government extension support engaged with 235 individual grazing businesses that collectively managed 7.7 million hectares of grazing land during 2014-15. These programs enable graziers to assess their management practices and to acquire the knowledge and skills necessary to adopt improved practices. Many of these grazing businesses have begun to implement management changes; as these changes become apparent the impacts will be estimated in future Great Barrier Reef Report Cards.

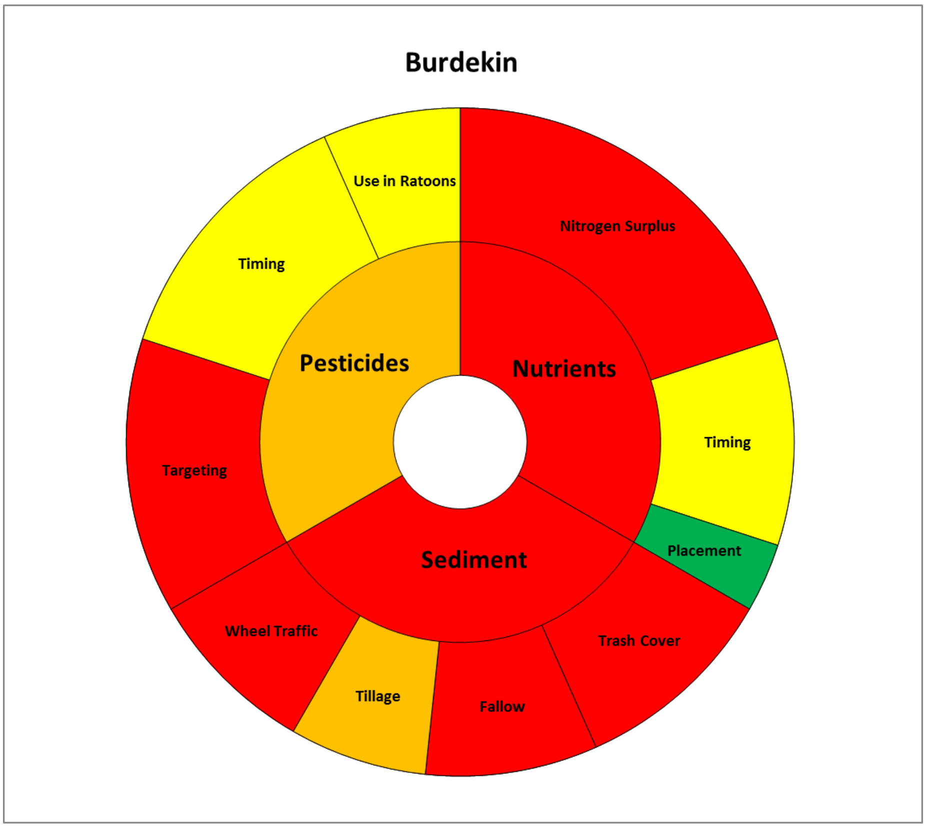
Sugarcane

E
22%

Target: 90 per cent of sugarcane lands are managed using best management practice systems by 2018.

Very poor progress: By June 2015, approximately 36 per cent of sugarcane land was managed using best management practice systems for practices relating to pesticides (30,000 hectares), 14 per cent for nutrients (11,000 hectares) and 17 per cent for soil (14,000 hectares).

Pollutant	Area managed under best management practice systems
	2014-15
Sediment	**17%**
Nutrients	**14%**
Pesticides	**36%**

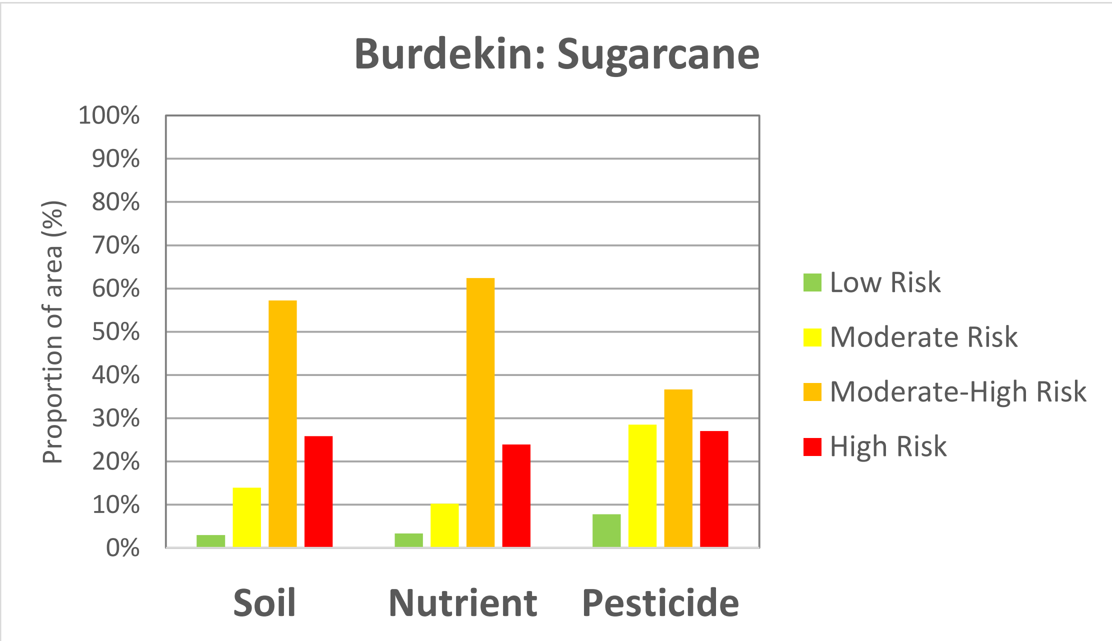


There are approximately 556 growers managing 83,000 hectares of sugarcane in the Burdekin region.

Adoption of improved management practices occurred largely through the Australian Government's Reef Programme, facilitated in the Burdekin region by NQ Dry Tropics NRM. NQ Dry Tropics NRM worked directly with 121 sugarcane growers (managing 26,959 hectares of sugarcane) in implementing on-farm changes with financial incentives that supported the purchase or modification of farm equipment and infrastructure, including:

- 48 farms implementing or improving irrigation tail water capture and recycling
- eight farms implementing more efficient irrigation practices on 455 hectares
- 23 farms acquiring equipment to enable variable rate control of fertilisers and/or herbicides
- two farms implementing green cane trash blanketing on 443 hectares
- 18 farms moving to directed and/or shielded spraying, which can greatly reduce the volume of residual herbicide applied
- two farms moving to controlled machinery traffic systems over 1016 hectares.

The Smartcane BMP program engaged with 91 growers in the Burdekin region (managing 21,738 hectares of sugarcane) up to July 2015. These growers were supported in completing self-assessments of their own farm management practices against a range of industry standards, with a view to identifying priorities for potential improvement. Future Great Barrier Reef Report Cards will aim to describe the impacts of these management changes as they are reported.



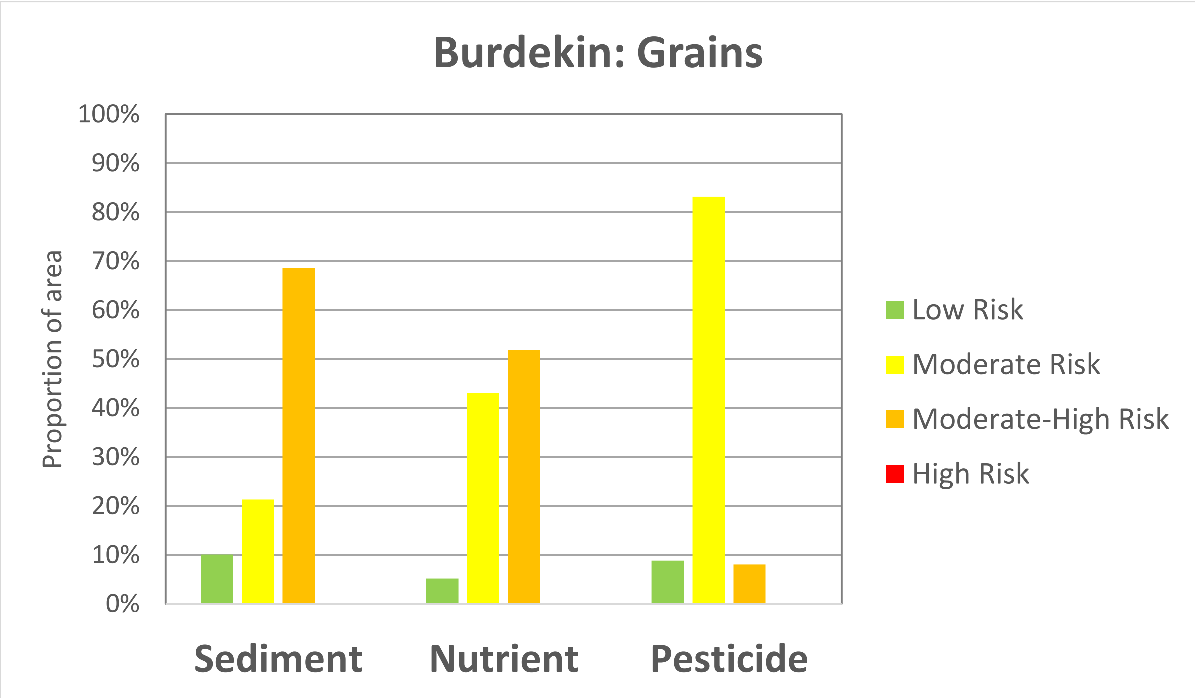
Grains

C
57%

Target: 90 per cent of grain farming land is managed using best management practice systems by 2018.

Moderate progress: By June 2015, best management systems were used on approximately 92 per cent of grain farming land for pesticides (113,000 hectares), 48 per cent for nutrients (59,000 hectares) and 31 per cent for soil (39,000 hectares).

Pollutant	Area managed under best management practice systems
	2014-15
Sediment	**31%**
Nutrients	**48%**
Pesticides	**92%**



There are approximately 44 growers managing 123,000 hectares under grain crops in the Burdekin region. Potential farm management improvements were identified through the Grains BMP program and linked with financial incentives (through the Australian Government's Reef Programme) facilitated by NQ Dry Tropics NRM. Innovative practices for reducing the risk of soil erosion were implemented across 5497 hectares, mainly in the form of highly accurate GPS guidance systems to enable more precise control of inputs and reduced tillage. Innovative practices for herbicide application were also implemented on 1516 hectares.

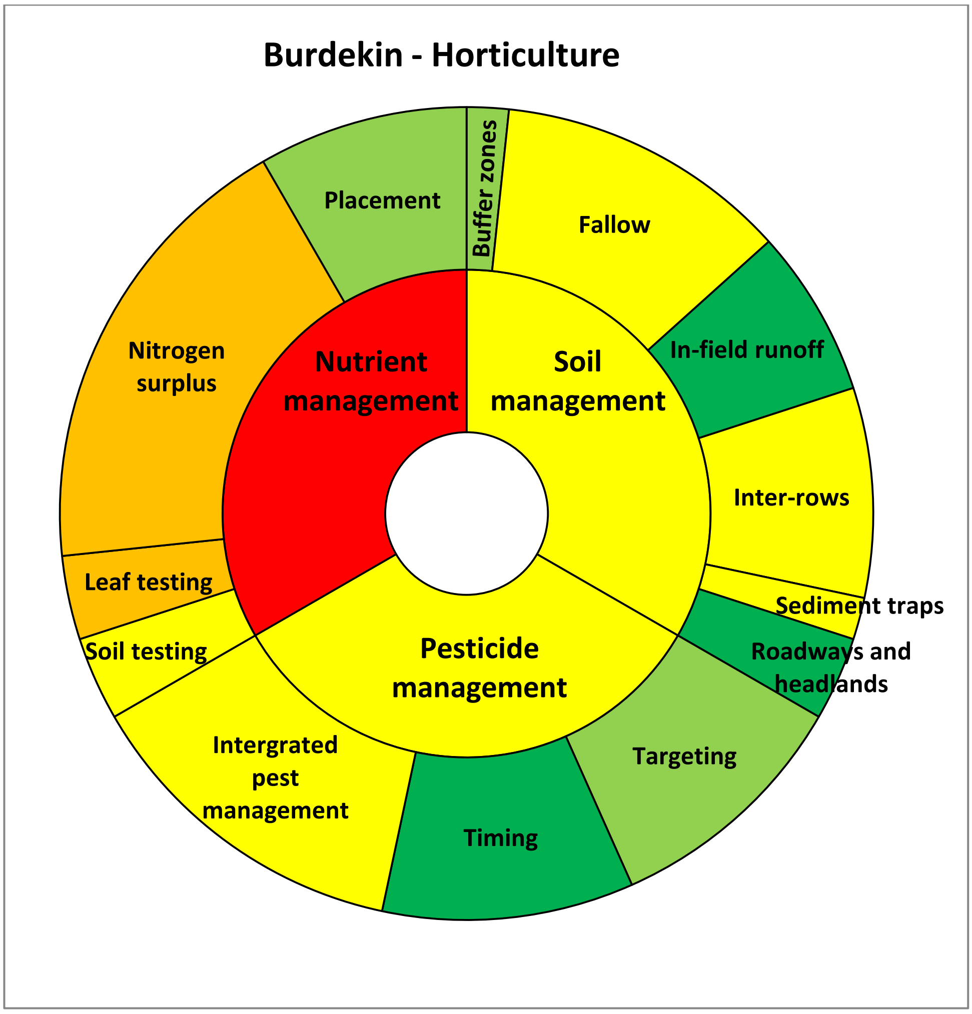
Horticulture

C
48%

Target: 90 per cent of horticulture lands are managed using best management practice systems by 2018.

Moderate progress: By June 2015, best management practice systems were used on approximately 60 per cent of horticultural land for pesticides (15,000 hectares), 19 per cent for nutrients (4700 hectares) and 67 per cent for soil (17,000 hectares).

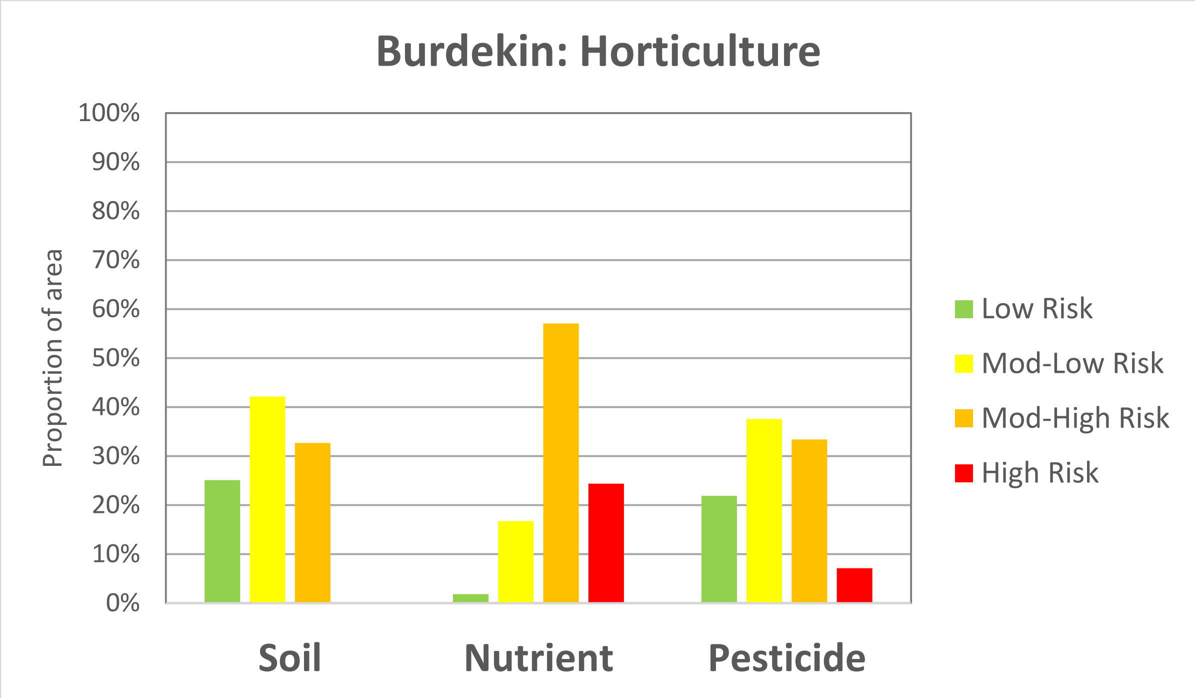
Pollutant	Area managed under best management practice systems
	2014-15
Sediment	**67%**
Nutrients	**19%**
Pesticides	**60%**



There are approximately 200 horticulture producers farming 25,000 hectares of land in the Burdekin region.

A total of 38 horticulture producers in the Burdekin region improved management practices over 4352 hectares during 2014-15, with the assistance of NQ Dry Tropics NRM and financial incentives through the Australian Government's Reef Programme, including:

- 13 farms reduced the risk of soil erosion through reducing tillage in-crop and/or increasing cover in fallow periods, and through the installation of sediment traps
- five farms improved the efficiency of pesticide applications over 1384 hectares
- 12 farms improved irrigation method and/or efficiency over 445 hectares
- five farms installed fertigation systems covering 543 hectares, which can significantly reduce the risk of nutrient losses through drainage and runoff.



Burdekin: Horticulture
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Proportion of area
Soil
Nutrient
Pesticide
Low Risk
Mod-Low Risk
Mod-High Risk
High Risk

Mackay Whitsunday

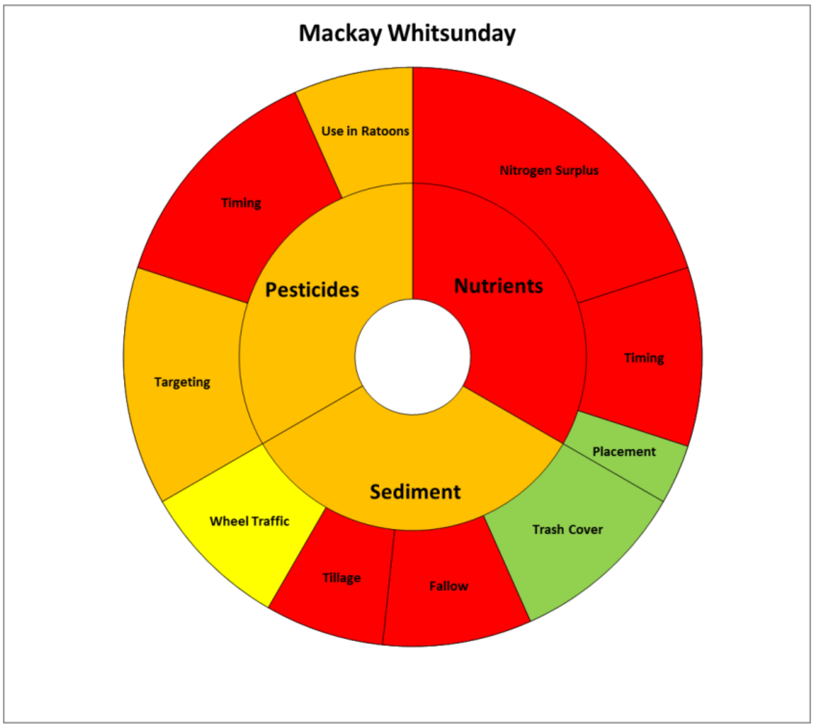
Sugarcane

D
34%

Target: 90 per cent of sugarcane lands are managed using best management practice systems by 2018.

Poor progress: As at June 2015, approximately 41 per cent of sugarcane farming land was managed using best management for practices relating to pesticides (55,000 hectares), 21 per cent for nutrients (28,000 hectares) and 41 per cent for soil (56,000 hectares).

Pollutant	Area managed under best management practice systems
	2014-15
Sediment	**41%**
Nutrients	**21%**
Pesticides	**41%**

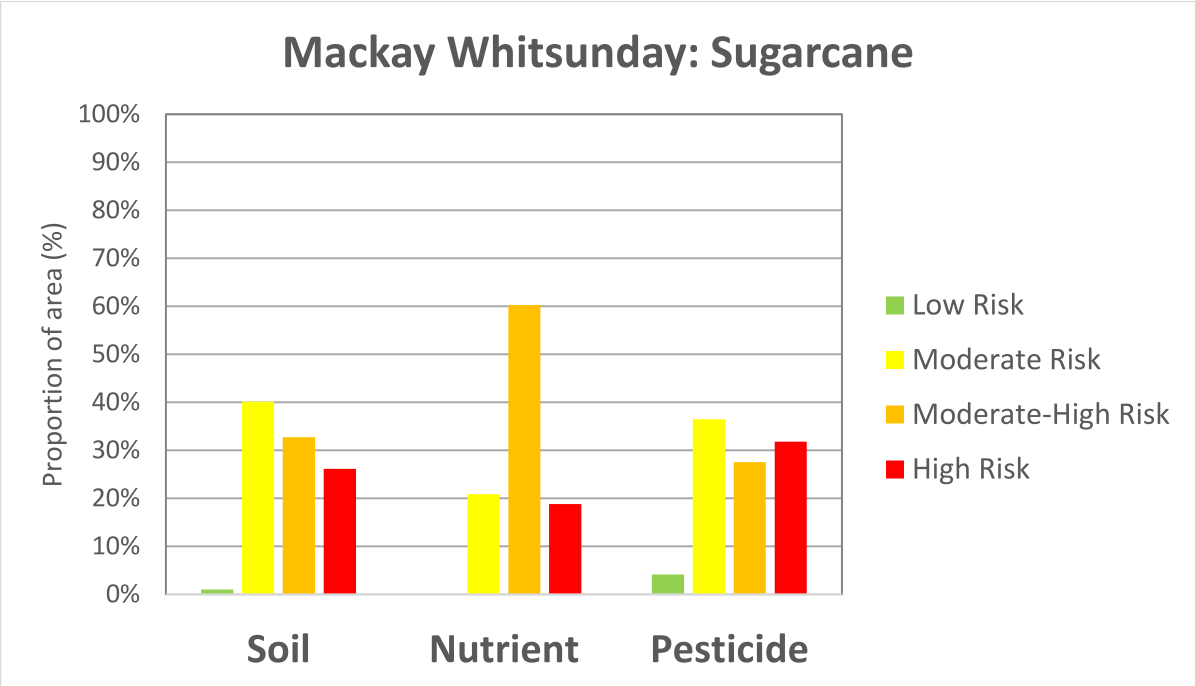


There are 1380 growers managing 136,000 hectares of land in the Mackay Whitsunday region.

Reef Catchments Natural Resource Management (Reef Catchments NRM), through the Australian Government's Reef Programme, facilitated management practice improvements with 79 sugarcane growers over 17,000 hectares. These farm management changes resulted from a mix of 1:1 extension and agronomic support and some financial incentives for taking on best practice or innovative practices. Management changes included:

- 58 growers undertaking nutrient management planning on a block by block basis (12,589 hectares) to inform the most efficient nitrogen fertiliser rates. Planning also included electrical conductivity mapping to understand soil variability and constraints. This work is expected to result in quite significant reduction in nitrogen surplus in future sugarcane crops
- 24 of these growers benefited from incentive funding to modify or acquire equipment to implement best practice or innovative fertiliser application methods
- 59 growers also completed block by block pesticide management plans to inform the most efficient and lowest risk use of herbicides. 29 of these growers also took advantage of financial incentives for equipment allowing best practice or innovative application of herbicides
- seven growers implemented more efficient and lower risk irrigation management systems over 855 hectares
- improved soil management practices were implemented by 15 growers over 3528 hectares. These growers generally adopted best practice or innovative controlled machinery traffic systems, including the use of GPS guidance on cane harvesters.

The Smartcane BMP program engaged with 260 growers in the Mackay Whitsunday region (managing 44,294 hectares of sugarcane) up to July 2015. These growers were supported in completing self-assessments of their own farm management practices against a range of industry standards, with a view to identifying priorities for potential improvement. Future Great Barrier Reef Report Cards will aim to describe the impacts of these management changes as they are reported.



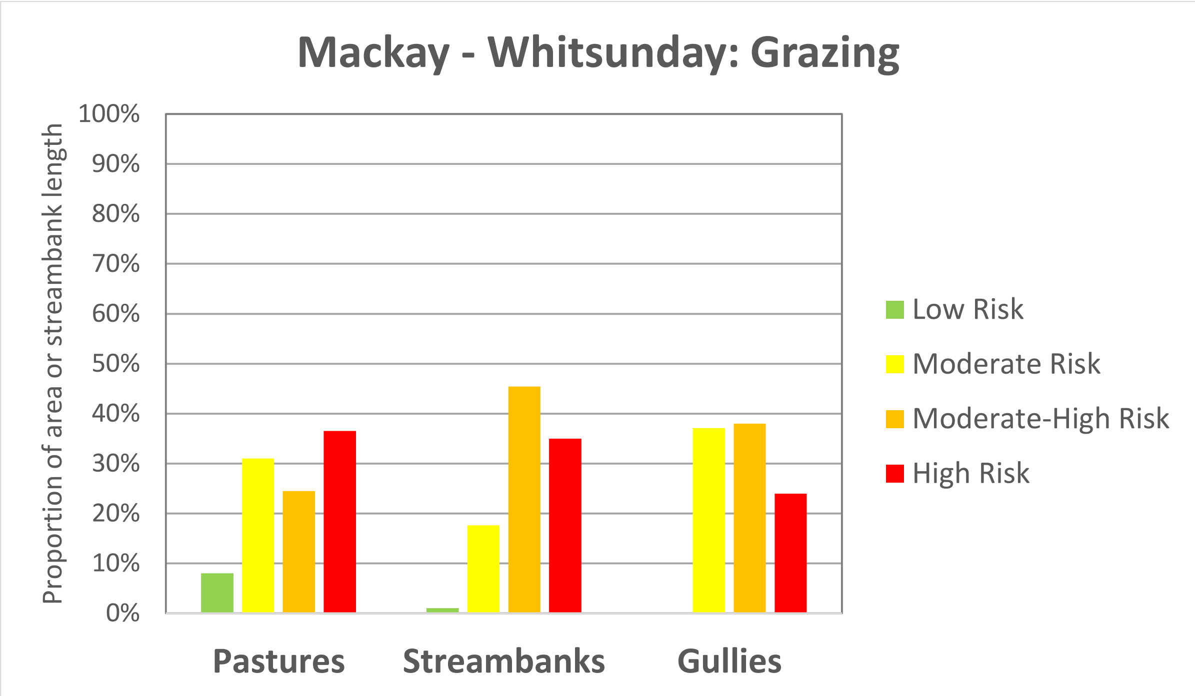
Grazing

D
32%

Target: 90 per cent of grazing lands are managed using best management practice systems by 2018.

Poor progress: By June 2015, approximately 39 per cent of grazing land was managed using best management practice systems for practices related to surface (hillslope) erosion (119,000 hectares), 19 per cent for practices relating to streambank erosion (434 kilometres of streambank) and 37 per cent for practices relating to gully erosion (113,000 hectares).

Erosion Source	Area managed under best management practice systems 2014-15
Pastures	**39%**
Streambanks	**19%**
Gullies	**37%**



There are approximately 416 graziers managing 304,000 hectares of land and 2300 kilometres of streambanks in the Mackay Whitsunday region.

A total of 24 graziers in the Mackay Whitsunday region improved their grazing land management practices on 1376 hectares of land and 18 kilometres of streambanks with the assistance of Reef Catchments NRM and the Australian Government's Reef Programme. The majority of these sites involved fencing to enable exclusion of cattle from streams and the provision of off-stream watering points. Three sites also included revegetation activities on 18 hectares of land adjacent to streams.

Fitzroy

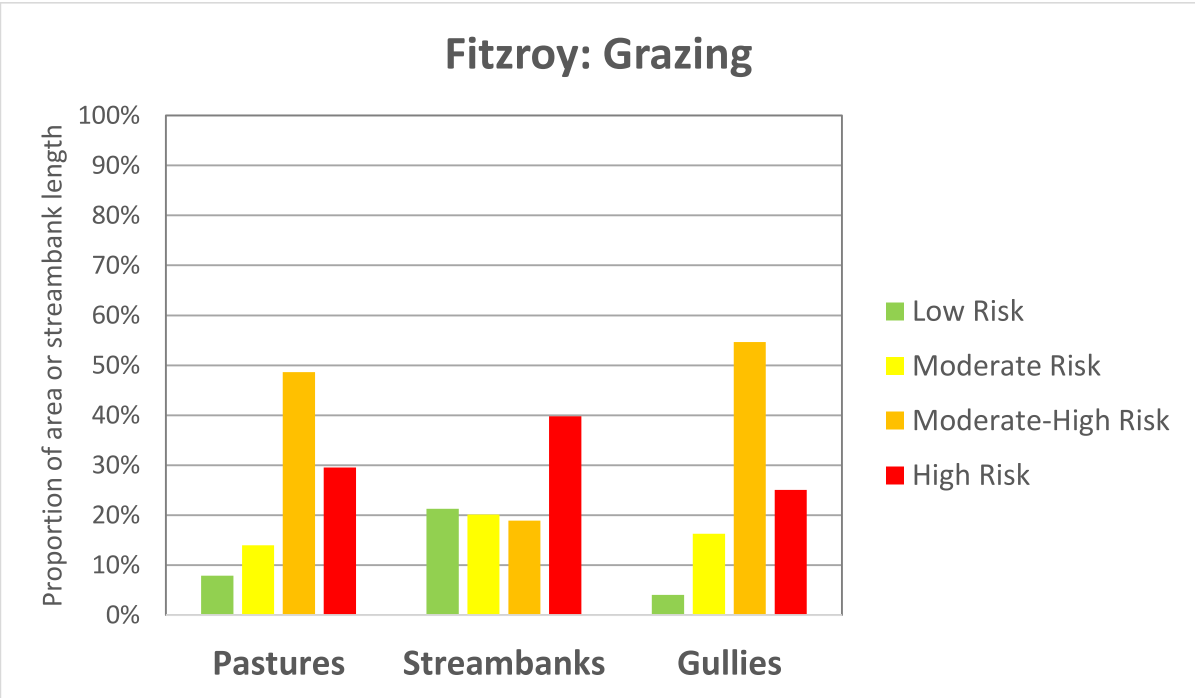
Grazing

D
28%

Target: 90 per cent of grazing lands are managed using best management practice systems by 2018.

Poor progress: By June 2015, approximately 22 per cent of grazing land was under best management practices for practices relating to surface (hillslope) erosion from pastures (1.4 million hectares), 41 per cent for practices relating to streambank erosion (16,000 km of streambank) and 20 per cent for practices relating to gully erosion (1.3 million hectares).

Erosion Source	Area managed under best practice management systems 2014-15
Pastures	**22%**
Streambanks	**41%**
Gullies	**20%**



There are approximately 3666 graziers managing 12.7 million hectares of land and 39,000 kilometres of streambanks in the Fitzroy region.

Adoption of improved management practices occurred with 52 graziers through collaboration with the Fitzroy Basin Association (funded through the Australian Government's Reef Programme), which co-funded management improvements on over 32,000 hectares of predominantly river frontages and 399 kilometres of streambanks.

The Grazing BMP program and associated Queensland Government extension support worked with 233 graziers managing 1.7 million hectares of grazing land to assess farm management practices and identify potential actions to improve as an early step in the process of adoption. With ongoing support it is expected that graziers will be able to acquire new knowledge and skills which will drive management practice changes on farms. Future Great Barrier Reef Report Cards will aim to estimate the impacts of such changes as they become apparent and the spatial extent can be described.

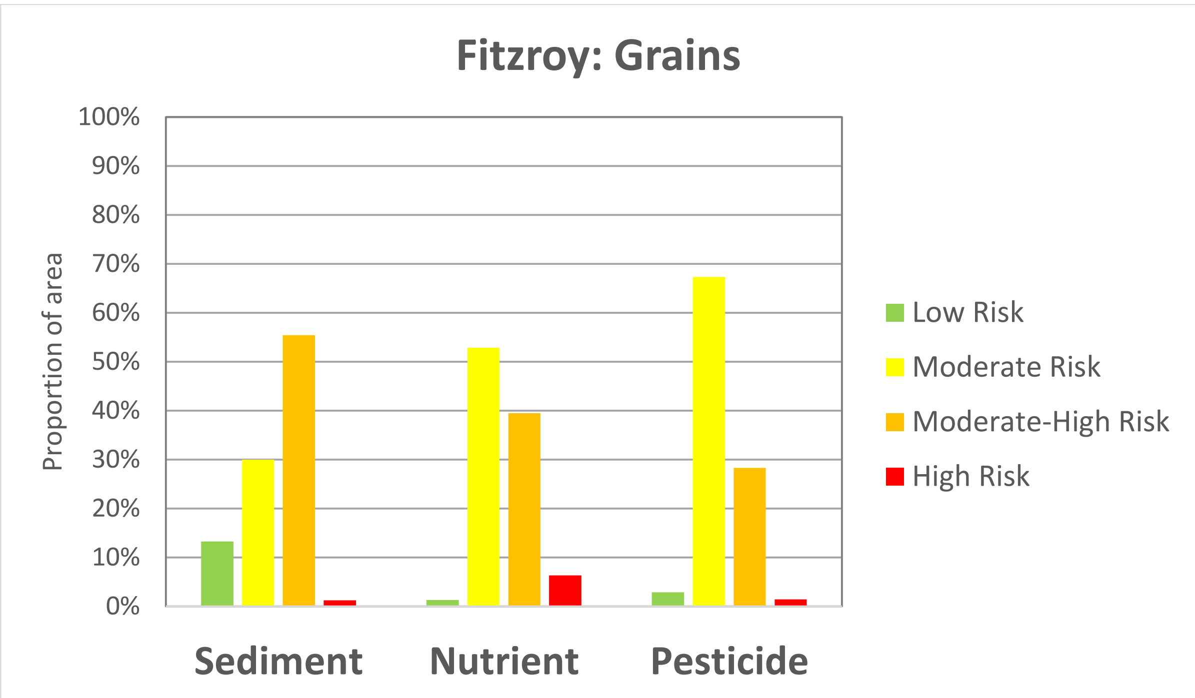
Grains

C
56%

Target: 90 per cent of grain farming land is managed using best management practice systems by 2018.

Moderate progress: By June 2015, best management systems were used on approximately 70 per cent of grain growing land for pesticides (643,000 hectares), 54 per cent for nutrients (495,000 hectares) and 43 per cent for soil (396,000 hectares).

Pollutant	Area managed under best management practice systems **2014-15**
Sediment	**43%**
Nutrients	**54%**
Pesticides	**70%**



There are approximately 600 grain growers managing up to about 914,000 hectares of land in the Fitzroy region. The amount of land under grain production can vary considerably over time due to some land alternating between grain production and pastures for beef cattle.

A total of 27 grain growers implemented best practice improvements on 22,033 hectares of land through working directly with the Grains BMP program and the Australian Government's Reef Programme, facilitated by the Fitzroy Basin Association, including:

- 16 landholders installed contour banks on over 3581 hectares of land. Contour banks are a critical element of best practice systems for minimising soil erosion from cropped lands
- five grain growers modified machinery to enable implementation of zero tillage across 3577 hectares
- three growers adopted innovative controlled traffic farming systems across 6172 hectares.

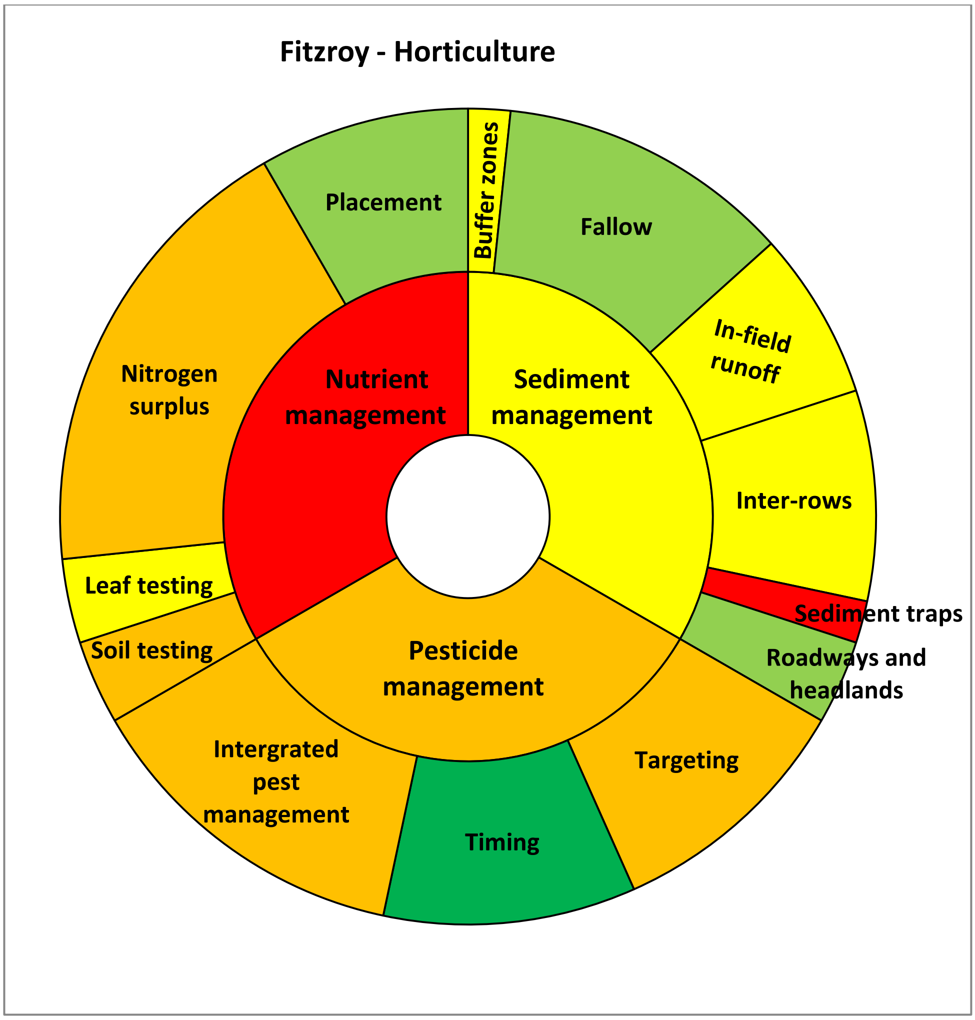
Horticulture

D
31%

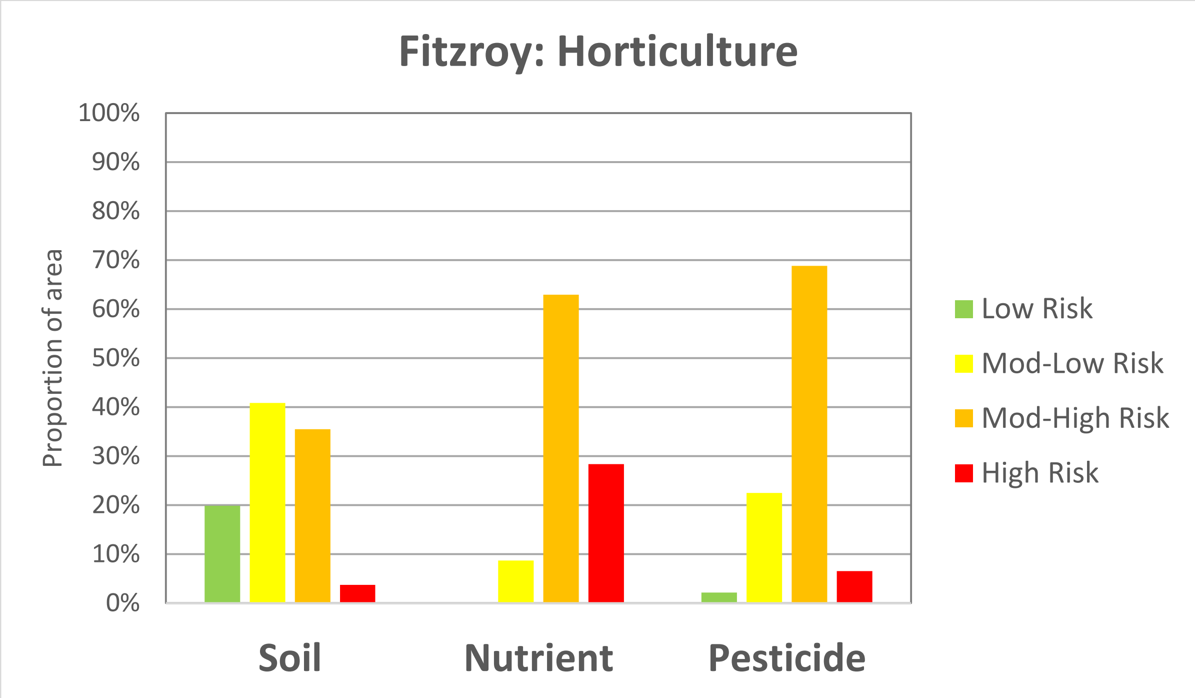
Target: 90 per cent of horticulture lands are managed using best management practice systems by 2018.

Poor progress: By June 2015, best management practice systems were used by approximately 25 per cent of horticulture growers for pesticides (2000 hectares), nine per cent for nutrients (700 hectares) and 61 per cent for soil (5000 hectares).

Pollutant	Area managed under best management practice systems
	2014-15
Sediment	**61%**
Nutrients	**9%**
Pesticides	**25%**



There are approximately 100 horticulture producers farming 7700 hectares of land in the Fitzroy region. The Fitzroy Basin Association facilitated, through the Australian Government's Reef Programme, financial incentives for farm management improvements on six farms and 258 hectares of horticultural land during 2014-15. These farm management improvements involved changes to more efficient irrigation scheduling and practices to increase ground cover around crop rows.


Fitzroy: Horticulture
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Proportion of area
Soil
Nutrient
Pesticide
Low Risk
Mod-Low Risk
Mod-High Risk
High Risk

Burnett Mary

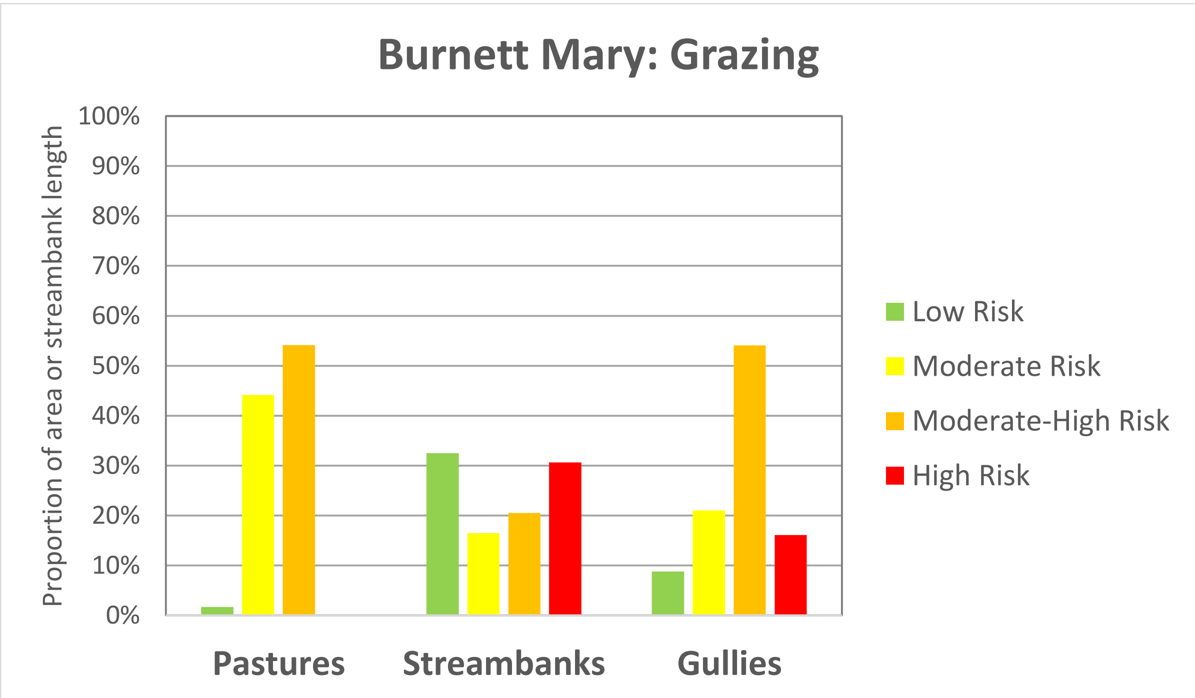
Grazing

D
42%

Target: 90 per cent of grazing lands are managed using best management practice systems by 2018.

Poor progress: By June 2015, approximately 46 per cent of grazing land was under best management practice systems for practices relating to surface (hillslope) erosion from pastures (1.3 million hectares), 49 per cent for practices relating to streambank erosion (6900 kilometres of streambank) and 30 per cent for practices relating to gully erosion (427,000 hectares).

Erosion Source	Area managed under best management practice systems
	2014-15
Pastures	**46%**
Streambanks	**49%**
Gullies	**30%**



There are approximately 2495 graziers managing 28,618 square kilometres (2.66 million hectares) of land in the Burnett Mary region (including approximately 14,078 kilometres of mapped streambanks). Adoption of improved management practice occurred with 47 graziers and 6645 hectares of grazing lands through collaboration with the Burnett Mary Regional Group and financial incentives provided by the Australian Government's Reef Programme. The majority of these projects involved limiting livestock access through fencing to a total of 31 kilometres of stream frontages.

The Grazing BMP program and associated Queensland Government extension support worked with 77 grazing businesses, collectively managing over 240,000 hectares of grazed lands. As in the Burdekin and Fitzroy regions, these graziers assessed their own management with a view to identifying areas where new knowledge and skills may be beneficial. Great Barrier Reef Report Cards in future years will describe the water quality impacts of farm management changes influenced by this process.

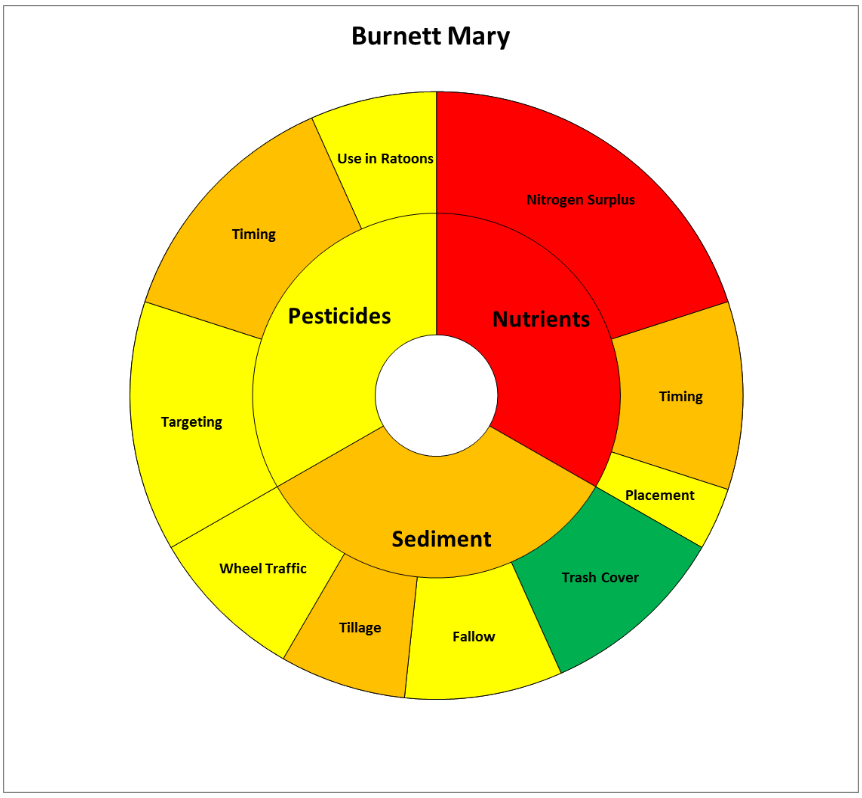
Sugarcane

D
33%

Target: 90 per cent of sugarcane lands are managed using best management practice systems by 2018.

Poor progress: As at June 2015, approximately 48 per cent of sugarcane land was managed using best management systems for practices relating to pesticides (41,000 hectares), 13 per cent for nutrients (11,000 hectares) and 39 per cent for soil (33,000 hectares).

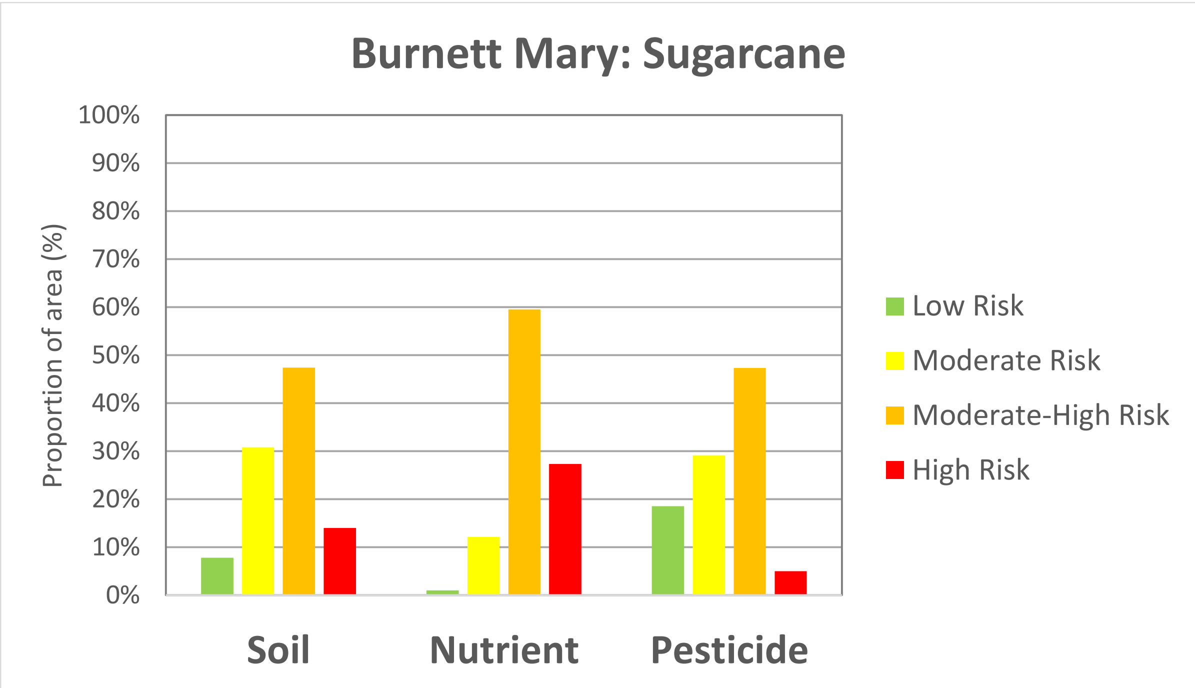
Pollutant	Area managed under best management practice systems **2014-15**
Sediment	**39%**
Nutrients	**13%**
Pesticides	**48%**



There are approximately 498 growers managing 86,000 hectares of land in the Burnett Mary region. A total of 33 sugarcane growers adopted improved practices on 3243 hectares of land through collaboration with the Burnett Mary Regional Group and accessing financial incentives through the Australian Government's Reef Programme, including:

- seventeen growers moved to more efficient irrigation practices on 641 hectares of sugarcane land
- three growers (149 hectares) improved herbicide application risk through purchase of equipment enabling the use of knockdown herbicides instead of relying upon residual herbicides
- six growers reduced the risk of soil erosion on 1242 hectares through implementing reduced tillage, controlled machinery traffic and installation of a sediment trap.

The Smartcane BMP program worked worth 93 growers (12,166 hectares of sugarcane) in the Burnett Mary region up to July 2015. These growers completed self-assessments of their farm management practices in relation to a range of industry standards, with a view to identifying priorities for future improvement. Future report cards will aim to describe the impacts of management changes stemming from this engagement, as they are realised.



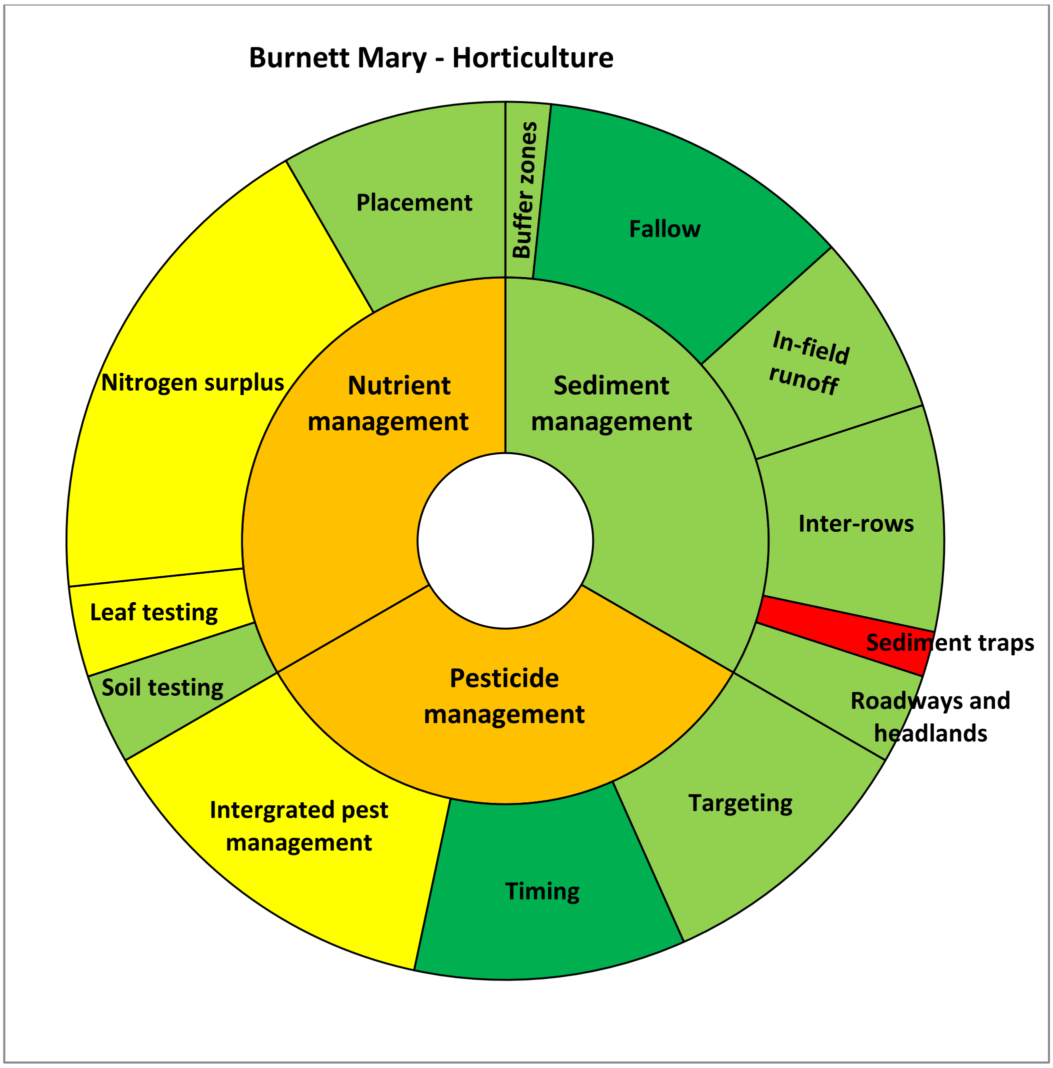
Horticulture

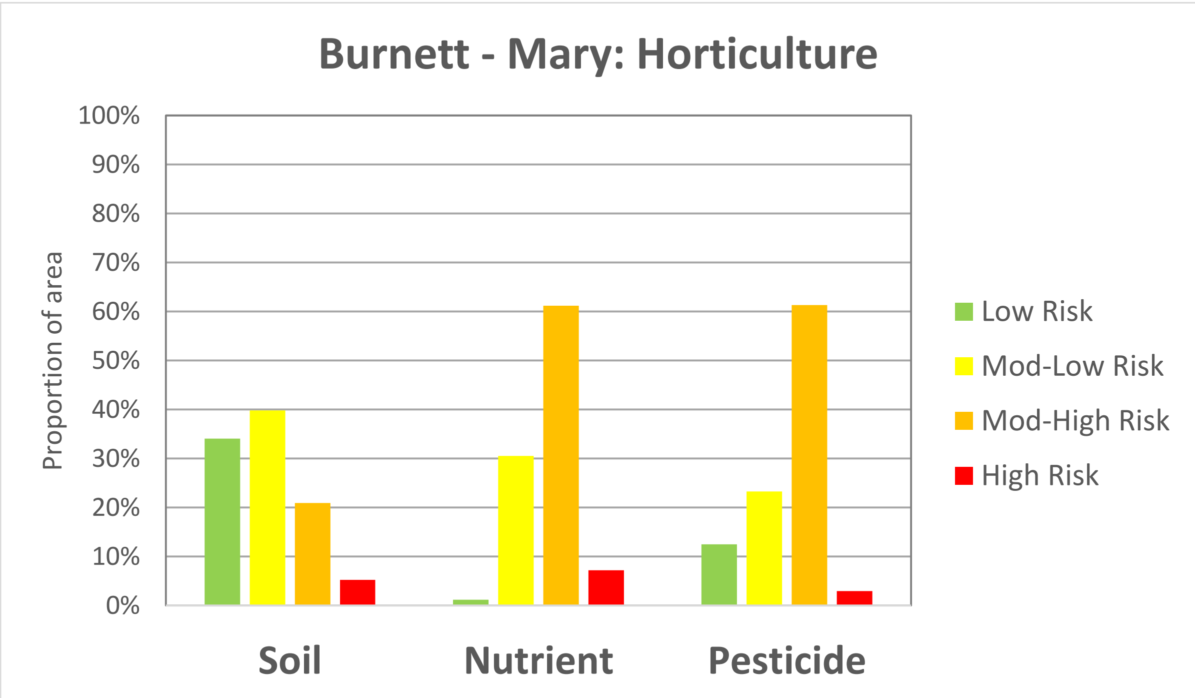
C
47%

Target: 90 per cent of horticulture lands are managed using best management practice systems by 2018.

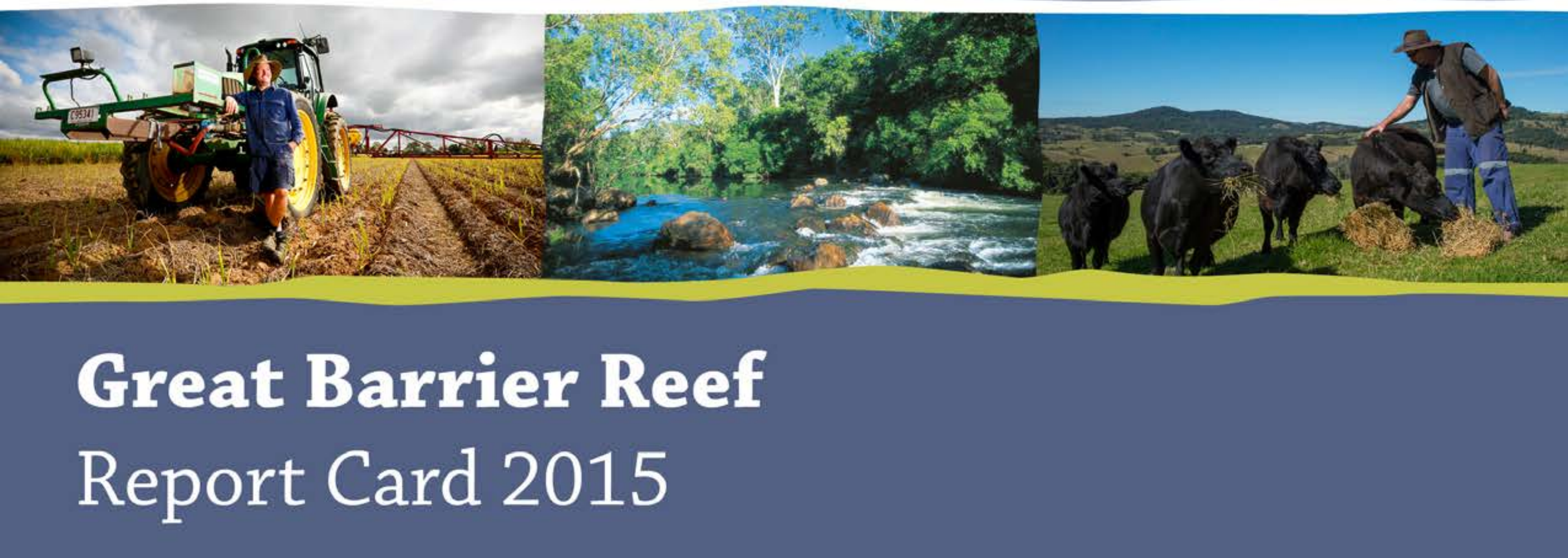
Moderate progress: As at June 2015, best management practice systems were in place on approximately 36 per cent of horticulture land for pesticides (8000 hectares), 32 per cent for nutrients (7000 hectares) and 74 per cent for soil (17,000 hectares). There are approximately 280 horticulture producers farming around 23,000 hectares of land in the Burnett Mary region. The area under horticulture in this region can vary considerably on an annual basis due to rotations between sugarcane and annual vegetable crops.

Pollutant	Area managed under best management practice systems
	2014-15
Sediment	74%
Nutrients	32%
Pesticides	36%


Burnett Mary - Horticulture
Placement
Buffer zones
Fallow
In-field runoff
Nitrogen surplus
Nutrient management
Sediment management
Inter-rows
Leaf testing
Sediment traps
Soil testing
Pesticide management
Roadways and headlands
Intergrated pest management
Targeting
Timing


Burnett - Mary: Horticulture
Proportion of area
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Soil
Nutrient
Pesticide
Low Risk
Mod-Low Risk
Mod-High Risk
High Risk

Ground cover results



Great Barrier Reef

Report Card 2015

Australian Government

Queensland Government

Ground cover results

The ground cover target in the Reef Water Quality Protection Plan 2013 is:
Minimum 70 per cent late dry season ground cover on grazing lands by 2018.

Mean late dry season ground cover in 2014-15 for the Great Barrier Reef region grazing lands was above the target at 77 per cent. Mean annual rainfall in 2015 was above the 28 year mean for the Fitzroy, Burnett Mary and Cape York regions, and below the mean for the Burdekin, Mackay Whitsunday and Wet Tropics regions.

Large parts of western Queensland were drought-declared during mid to late 2013, 2014 and 2015 and this includes large areas of the Burdekin and Fitzroy regions. El Niño patterns continued in 2015 leading to generally drier conditions across the grazing lands of the Great Barrier Reef region which contributed to reductions in mean ground cover levels, although the localised effects may have been more pronounced for some areas.

The 2015 mean annual rainfall has also been affected in this reporting period by the large volume of rainfall accompanying Tropical Cyclone Marcia in February 2015. This explains why even though large parts of the Fitzroy catchment were drought-declared for some of the reporting period, the mean annual rainfall is above the mean for 2015.

Scoring

Grade	**Status**	**Criteria for June 2015**	**Colour**
A	Very good	Greater than 70% average groundcover	Dark Green
B	Good	Between 50-69% average groundcover	Light Green
C	Moderate	Between 40-49% average groundcover	Yellow
D	Poor	Between 30-39% average groundcover	Orange
E	Very poor	Less than 30% groundcover	Red

Great Barrier Reef-wide

A
77%

Target: 70 per cent late dry season ground cover by 2018.

Very good: Late dry season mean ground cover across the grazing lands was 77 per cent, above the Reef Water Quality Protection Plan target of 70 per cent. The 28 year mean ground cover was 79 per cent.

Approximately 73 per cent of the total land area of the Great Barrier Reef region is reported here as grazing lands.

All reporting regions except for the Burdekin had mean ground cover levels above the target ranging from 80 per cent (Fitzroy) to 89 per cent (Burnett Mary) in 2015. The Burdekin region fell just below the target, at 69 per cent. The area of the reporting region below the 70 per cent target was 28 per cent in 2015, compared to 23 per cent over the 28 year period (Table 1).

Table 1: Ground cover results for the Great Barrier Reef catchment and regions

Region	28 year mean ground cover (%)	2015 mean ground cover (%)	Area with less than 70% ground cover averaged over past 28 years (%)	Area with less than 70% ground cover in 2015 (%)
Cape York	85	84	13	14
Wet Tropics	87	88	7	5
Burdekin	75	69	33	48
Mackay Whitsunday	89	88	5	6
Fitzroy	79	80	20	17
Burnett Mary	86	89	7	2
Total Great Barrier Reef	79	77	23	28

The ground cover distribution for the Great Barrier Reef region provides a visual representation of the results (Figure 1). The proportion of the region with less than 70 per cent cover is shaded blue and labelled (28 per cent). The distribution of the long-term mean ground cover levels is displayed as the dashed line, and the 2015 distribution of ground cover levels is the solid line. The median of the long-term mean and 2015 cover are presented (vertical lines), with the actual median value in 2015 (80 per cent) shown in red at the base of the line.

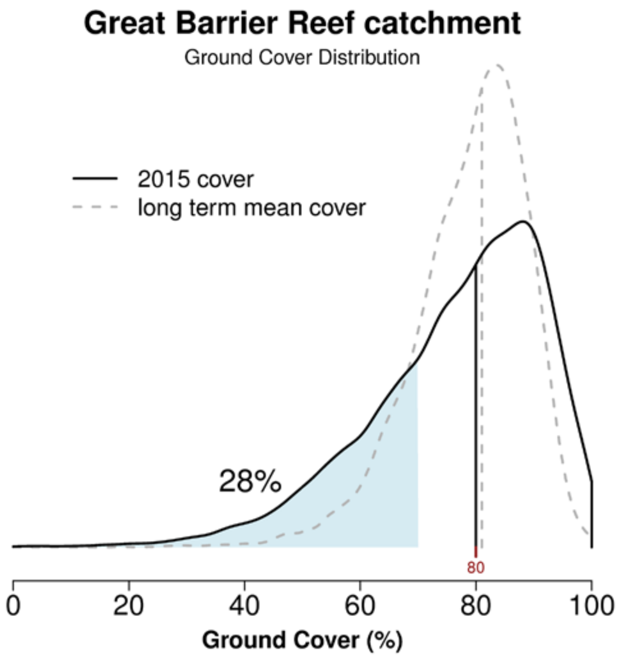


Figure 1: Great Barrier Reef catchment ground cover distribution.

Ground cover changes over time

The mean ground cover across the Great Barrier Reef region has been declining over the past five years, from 92 per cent in 2010 to 77 per cent in 2015. The very high rainfall of 2010 and 2011 resulted in a very high proportion of the region being above 70 per cent ground cover, and the subsequent drier years has resulted in a decrease in mean ground cover. Historically, the years with the lowest ground cover were 1987 to 1988, 1994, 2004 and 2006. During these years, mean ground cover for the region was just over 70 per cent and the percentage of area with mean ground cover below 70 per cent was in the range of 37 to 41 per cent (Figures 2 and 3). These years had low annual rainfall in preceding years.

Mean annual rainfall in 2015 was above the 28 year mean for the Fitzroy, Burnett Mary and Cape York regions, and below the mean for the Burdekin, Mackay Whitsunday and Wet Tropics regions. Large parts of western Queensland were drought-declared during mid-late 2013, 2014 and 2015 and this includes large areas of the Burdekin and Fitzroy regions. El Niño patterns continued in 2015 leading to generally drier conditions across the grazing lands of the Great Barrier Reef region which contributed to reductions in mean ground cover levels, although the localised effects may have been more pronounced for some areas.

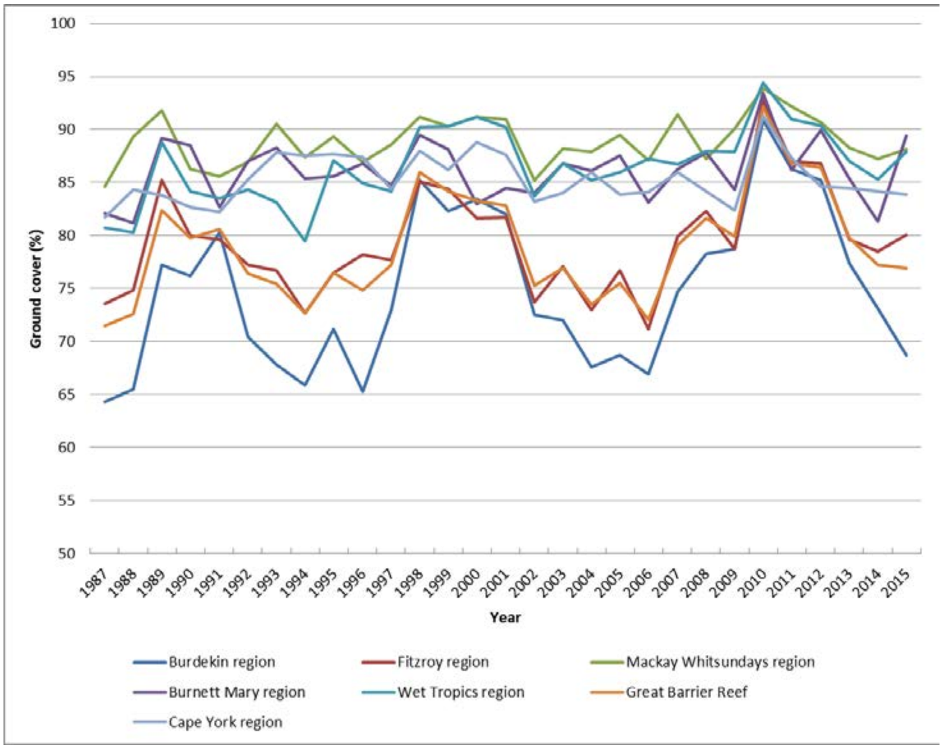


Figure 2: Great Barrier Reef regions - mean late dry season ground cover. Note the scale on the y-axis is between 50 per cent and 100 per cent ground cover.

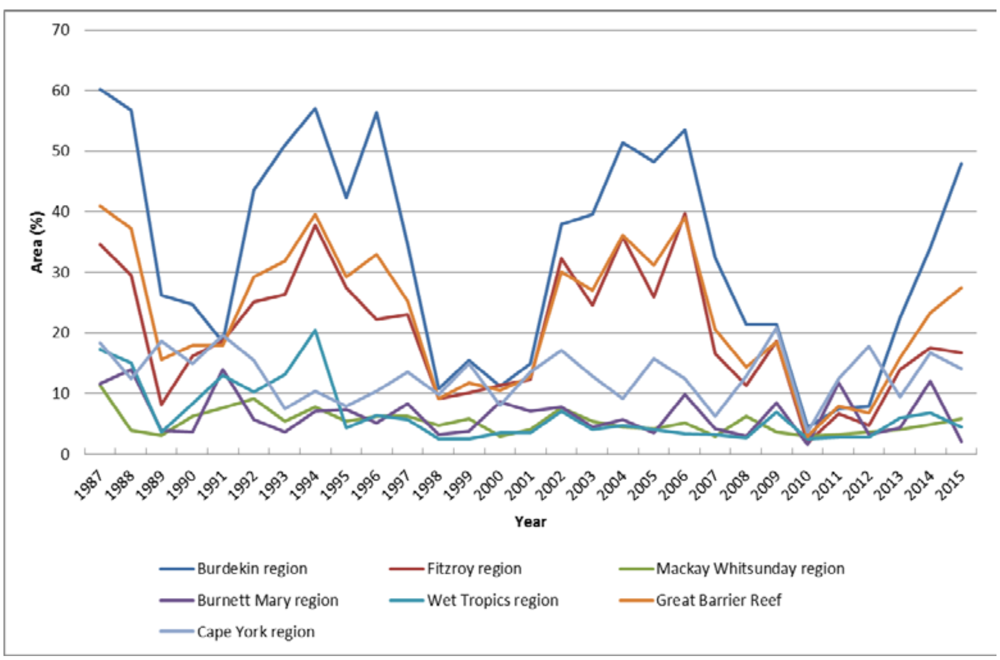


Figure 3: Great Barrier Reef regions - percentage area with ground cover below 70 per cent for the years 1987 to 2015.

Regions with generally high average annual rainfall have consistently high levels of ground cover. For example, the Mackay Whitsunday, Wet Tropics, Burnett Mary and Cape York regions had mean ground cover greater than or equal to 85 per cent over the 28 year period.

In addition, the area with mean ground cover below 70 per cent for these regions has been less than 22 per cent for the entire monitoring period. In comparison, regions with lower, more variable annual rainfall (e.g. Fitzroy and Burdekin) show greater fluctuations in ground cover over time. In these regions, mean ground cover declines in drier years, increasing the area which is below the 70 per cent ground cover target.

It is interesting to note that in these regions, in general, a prolonged time lag follows the end of a wet period before the region has larger areas of lower ground cover, as reserves of ground cover diminish and are not replaced by new growth due to the lack of rainfall. However, the ground cover returns to higher levels comparatively quickly following significant rainfall at the end of a dry period. These lags and the response time after rainfall can be influenced by a range of factors including stocking rates during wet and dry periods, localised climate effects, soil type, land condition and pasture composition.

Mean rainfall for 2015 in the Great Barrier Reef region was 863 millimetres, 48 millimetres above the long- term mean of 815 millimetres. The preceding year was below the mean with 715 millimetres (Figure 4).

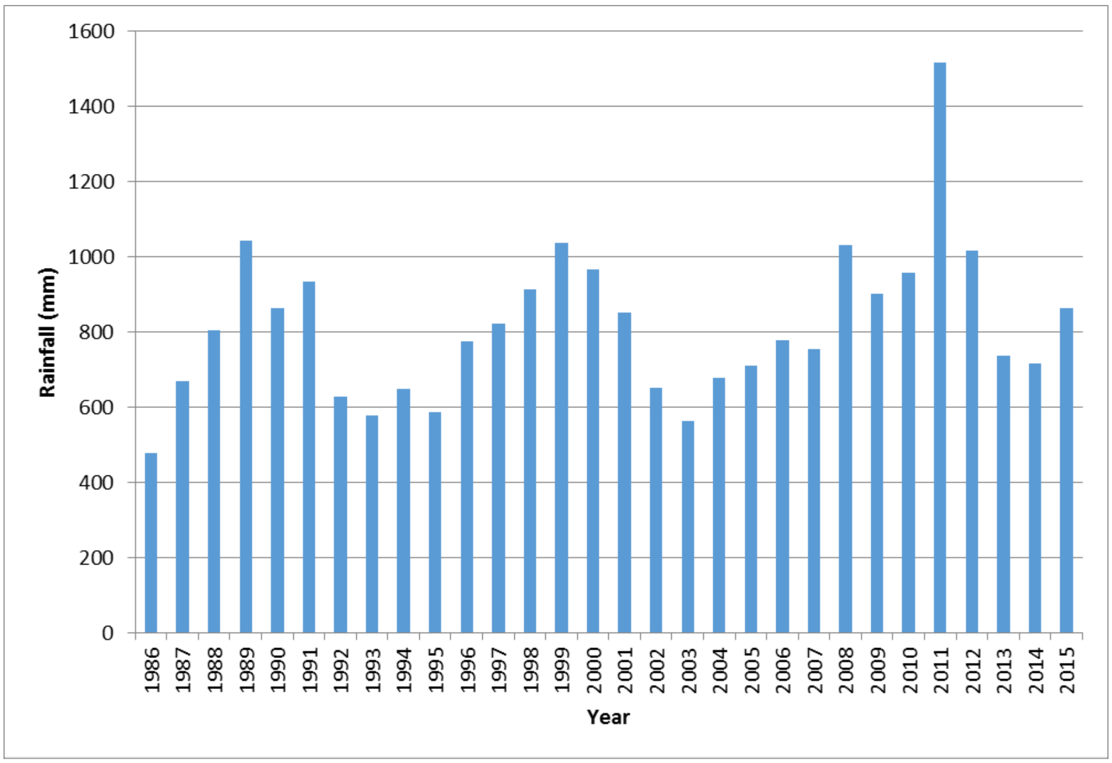


Figure 4: Mean annual rainfall for Great Barrier Reef catchment for the years 1986 to 2015. Note that a year is from September to September to align with late dry season reporting.

Although ground cover is above the target for most of the regions (except the Burdekin region), sediment loads are still affected by localised sources such as overgrazed patches, and erosion features such as gullies, scalds and unstable streambanks.

Ground cover in the regions

The percentage of ground cover for each of the regions is shown in Figure 5.

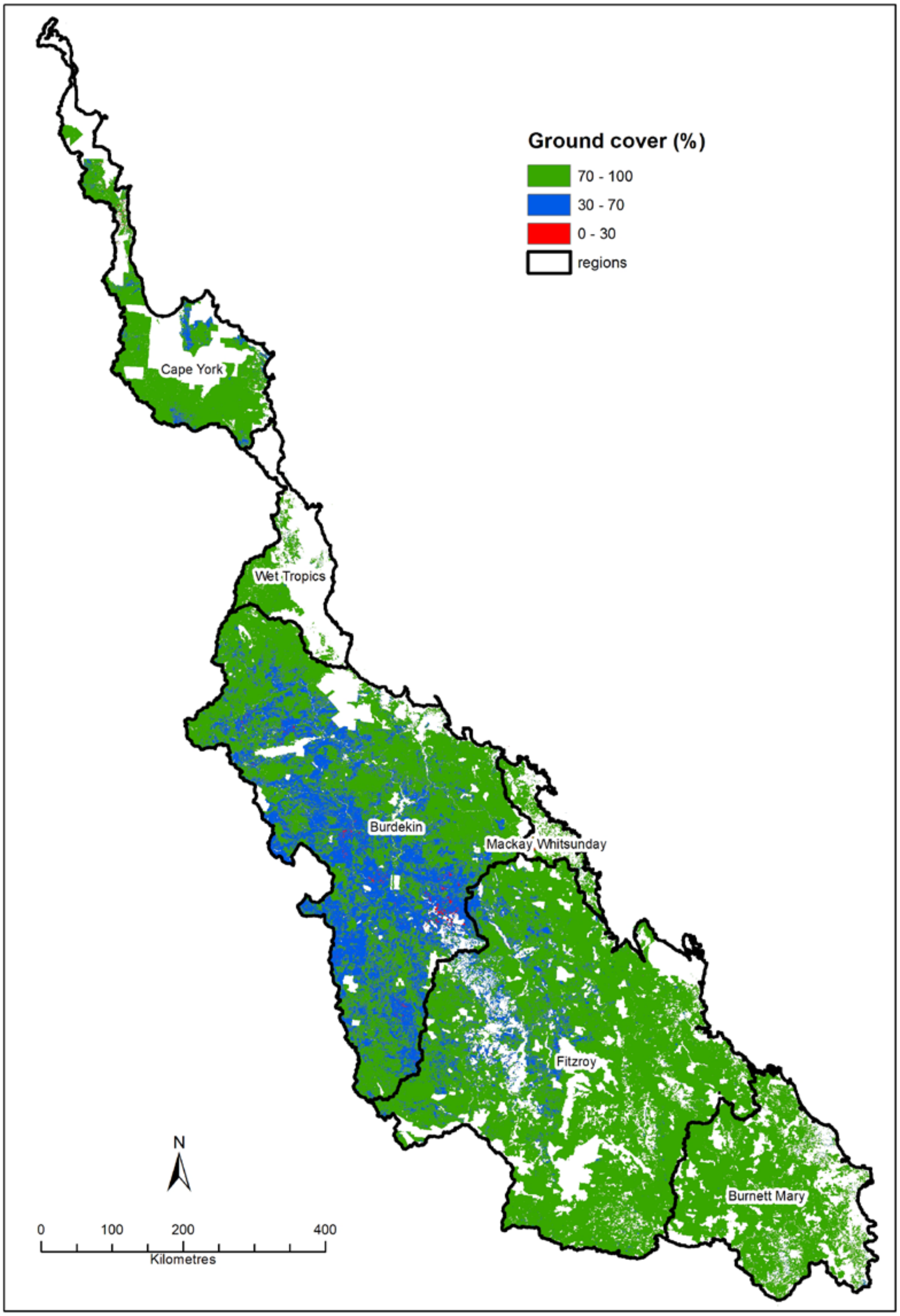


Figure 5: Late dry season ground cover levels for the Great Barrier Reef region grazing lands.

The map of ground cover deciles (Figure 6) shows the spring 2015 ground cover in comparison to the long-term ground cover (1988 – 2012 baseline) for the spring season for the reporting

regions. Red on the map indicates where ground cover is in the lowest deciles (i.e. the lowest level of ground cover that location has experienced relative to the baseline) while blue shows locations where ground cover is at the highest levels (or deciles) it has been relative to the baseline period. This map can be used as a guide to indicate areas of concern or improvement, or conversely, those areas that had good ground cover levels in 2015.

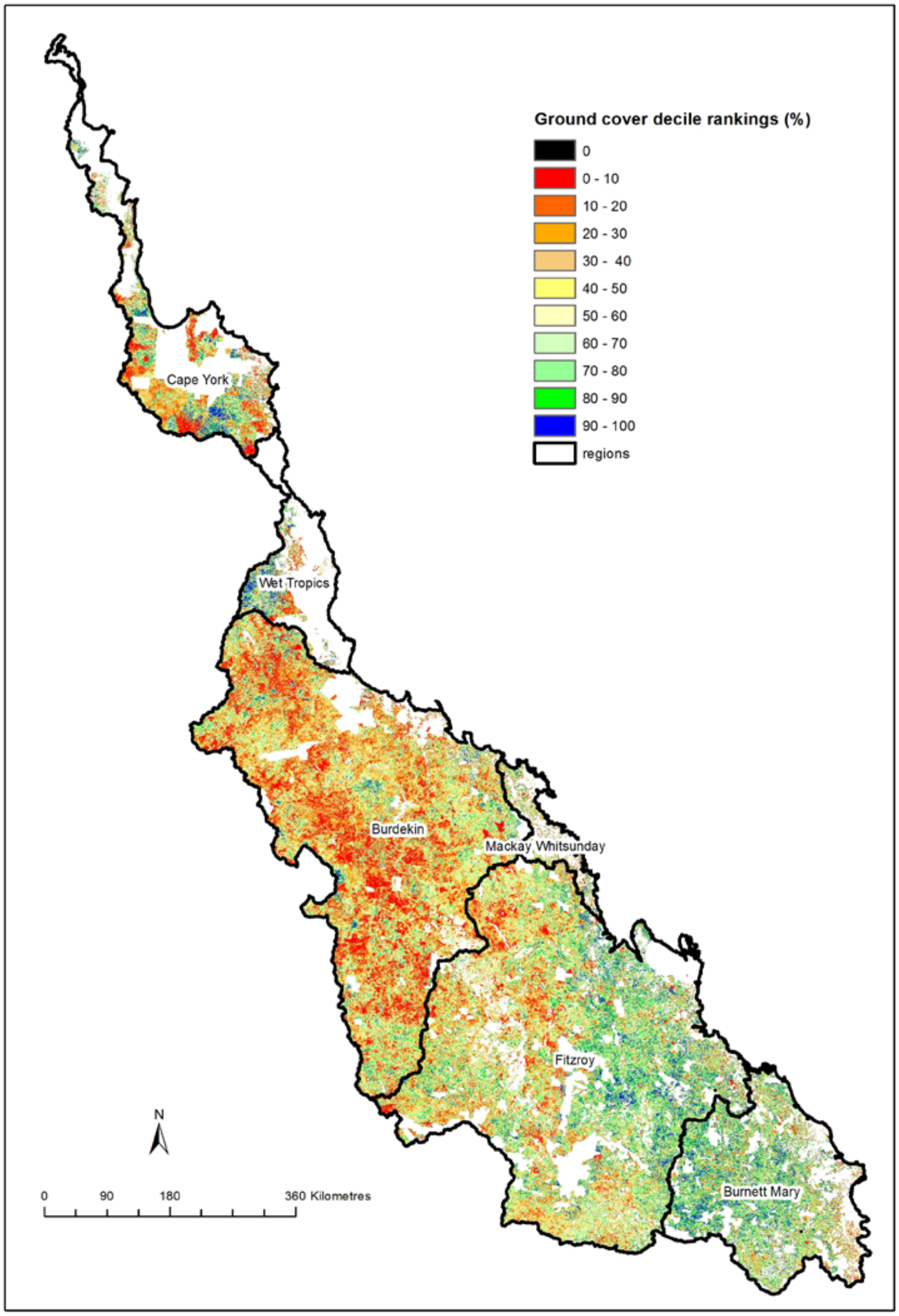


Figure 6: Great Barrier Reef catchments ground cover decile rankings. This map shows spring 2015 ground cover in comparison to the long-term cover (1988 – 2012 baseline) for the same season. The lowest decile (red) indicates where ground cover was at the lowest level relative to the baseline period, and the highest decile (blue) indicates where ground cover was at the highest level relative to the baseline period.

Figure 6 shows that large parts of the Burdekin region, parts of the northern and central Fitzroy, and patches of the Wet Tropics and Cape York regions had very low cover compared to long-term levels of ground cover in those areas. Very high ground cover (compared to the long term levels) is observed for 2015 in parts of the Burnett Mary, eastern Fitzroy, southern Cape York and patches of the Wet Tropics regions.

An overview of each of the regions is provided below.

Cape York

A
84%

Target: 70 per cent late dry season ground cover by 2018.

Very good: Late dry season mean ground cover across grazing lands was 84 per cent.

Table 2: Ground cover results for the Cape York region and catchments

Region	28 year mean ground cover (%)	2015 mean ground cover (%)	Area with less than 70% ground cover averaged over past 28 years (%)	Area with less than 70% ground cover in 2015 (%)
Olive-Pascoe	85	87	15	13
Lockhart	85	83	16	16
Normanby	86	84	12	13
Jeannie	82	78	22	29
Endeavour	86	84	12	8
Stewart	86	85	16	16
Cape York region (excluding Jacky Jacky catchment)	85	84	13	14

The ground cover distribution for Cape York provides a visual representation of the results (Figure 7). The proportion of the region with less than 70 per cent cover is shaded blue and labelled (14 per cent). The distribution of the long-term mean ground cover levels is displayed as the dashed line, and the 2015 distribution of ground cover levels is the solid line. The median of the long-term mean and 2015 cover are presented (vertical lines), with the actual median value in 2015 (87 per cent) shown in red at the base of the line.

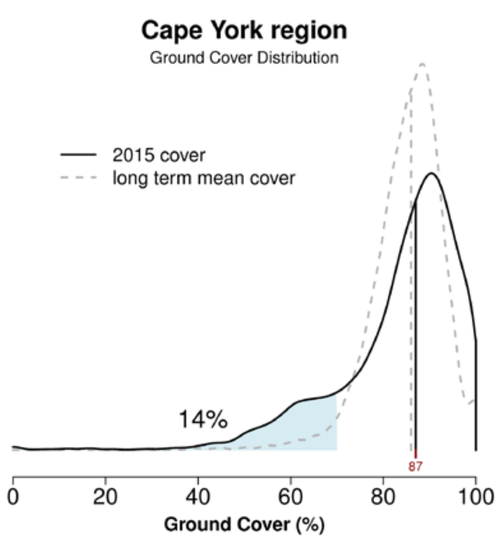


Figure 7: Cape York ground cover distribution.

The percentage of ground cover for the Cape York region and catchments is shown in Figure 8.

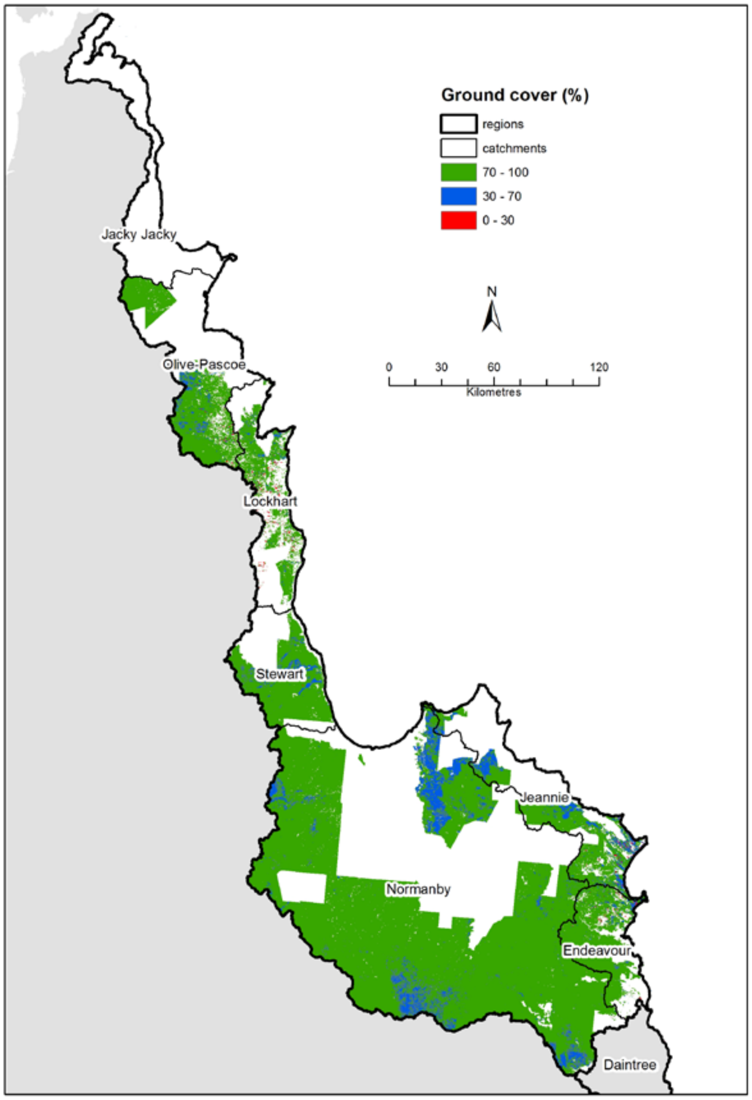


Figure 8: Late dry season ground cover levels for the Cape York region grazing lands.

The Cape York region had mean ground cover of 84 per cent in 2015 and consistently high mean ground cover from 1987 to 2015 with a 28 year mean ground cover level of 85 per cent. The proportion of grazing lands under the Reef Water Quality Protection Plan target of 70 per cent ground cover was 14 per cent in 2015, and 13 per cent for the 28 year period (Table 2 and Figure 7).

This proportion did fluctuate quite considerably over time though, particularly for individual catchments. For example, the area below the 70 per cent target in the Jeannie catchment was 14 per cent in 1990, and 44 per cent in 1991. In this instance a large fire was found to have occurred during 1991, causing significant loss of ground cover at the time of monitoring. The decline in mean ground cover and increase in area under 70 per cent for 2014 in the Endeavour catchment was also due to fire. Fire scars were also evident in some areas of the Cape York region in 2015.

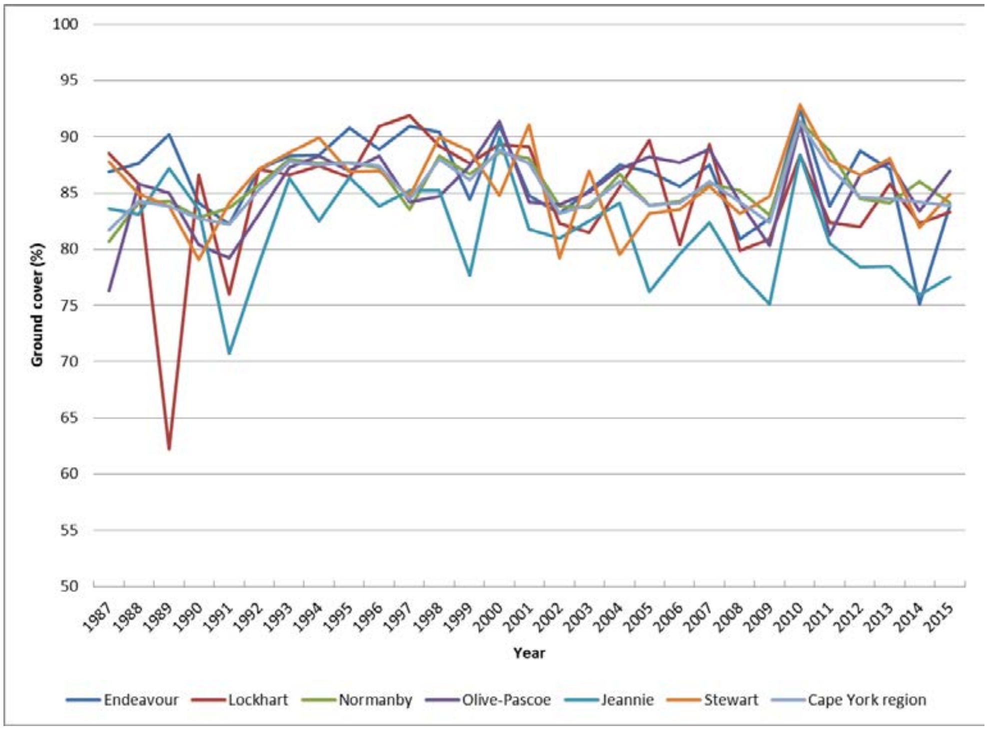


Figure 9: Cape York region and catchments - mean late dry season ground cover. Note the scale on the y-axis is between 50 per cent and 100 per cent ground cover.

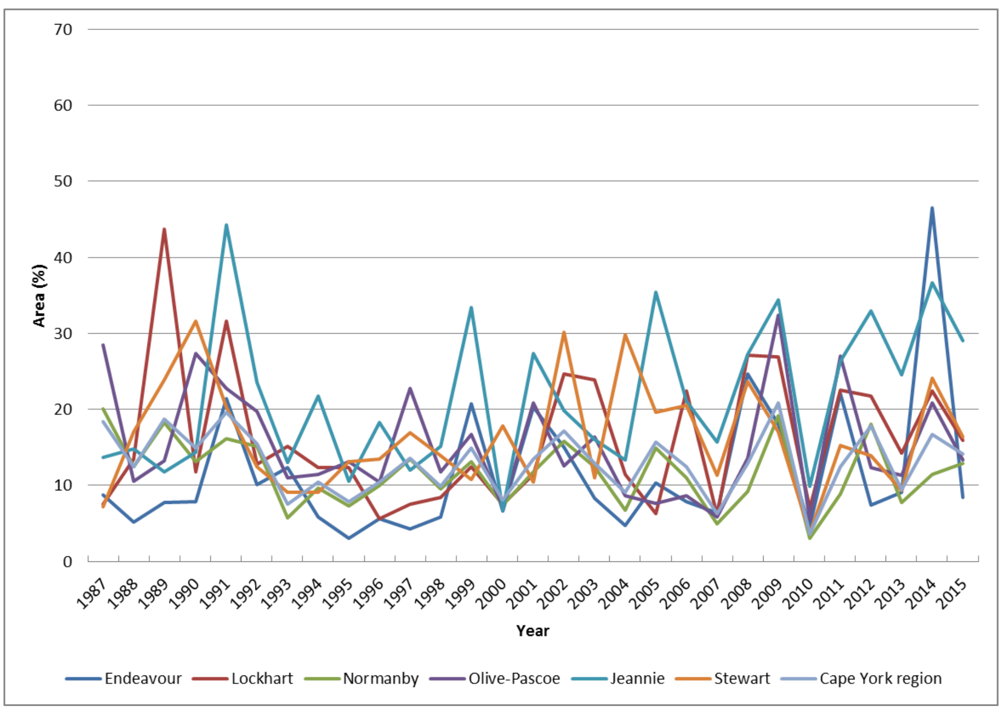


Figure 10: Cape York region and catchments - percentage area with ground cover below 70 per cent for the years 1987 to 2015.

The map of ground cover deciles (Figure 11) shows the spring 2015 ground cover in comparison to the long-term ground cover (1988 – 2012 baseline) for the spring season. Red on the map indicates where ground cover is in the lowest deciles (i.e. the lowest level of ground cover that location has experienced relative to the baseline) while blue shows locations where ground

cover is at the highest levels (or deciles) it has been relative to the baseline period. This map can be used as a guide to indicate areas of concern or improvement, or conversely, those areas that had good ground cover levels in 2015. Some of the large areas of red in the Normanby and Endeavour catchments are the result of fires that occurred in 2014 and 2015.

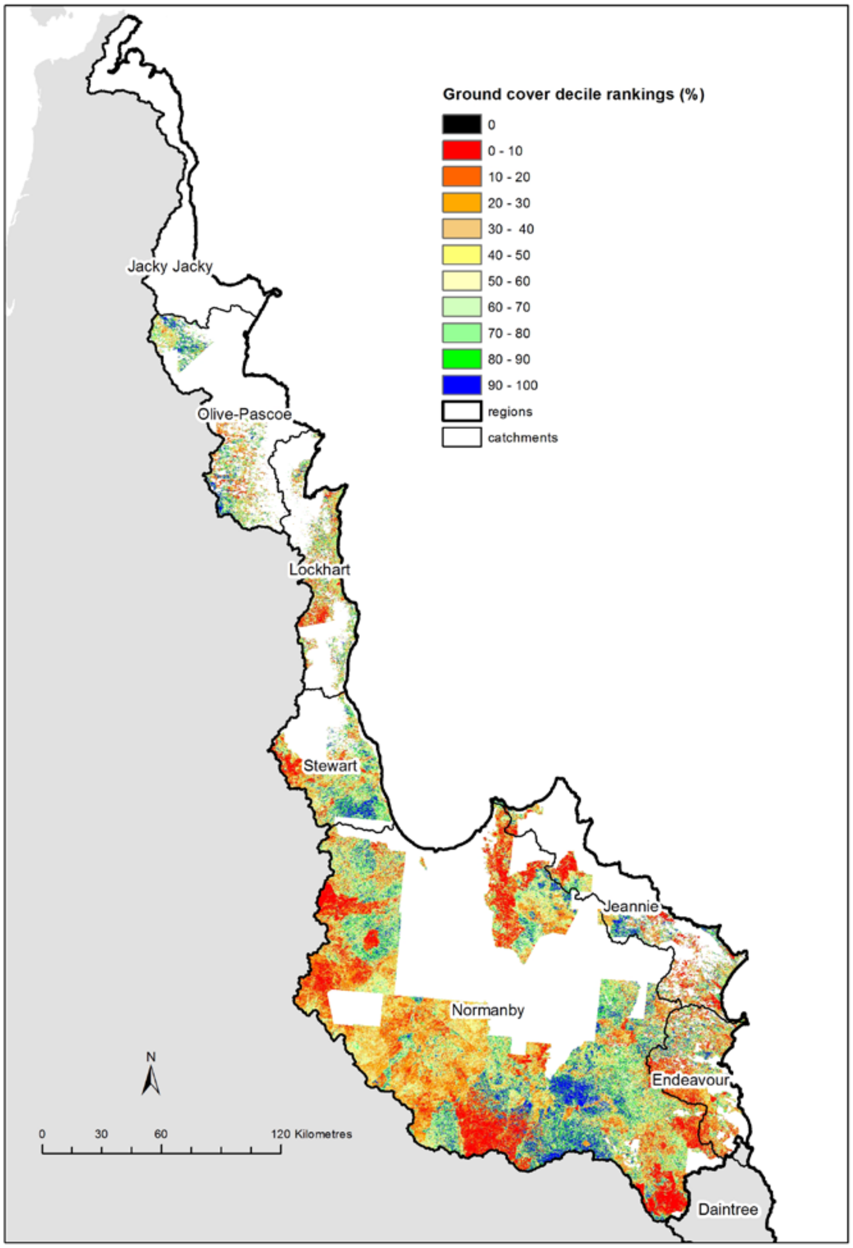


Figure 11: Cape York region ground cover decile rankings. This map shows spring 2015 ground cover in comparison to the long-term cover (1988 – 2012 baseline) for the same season. The lowest decile (red) indicates where ground cover was at the lowest level relative to the baseline period, and the highest decile (blue) indicates where ground cover was at the highest level relative to the baseline period.

The Cape York region is the third wettest of the areas reported (1282 millimetres mean annual rainfall). The preceding rainfall in 2014 was above the mean at 1546 millimetres, and rainfall was also above the mean in 2015 (1396 millimetres) (Figure 12).

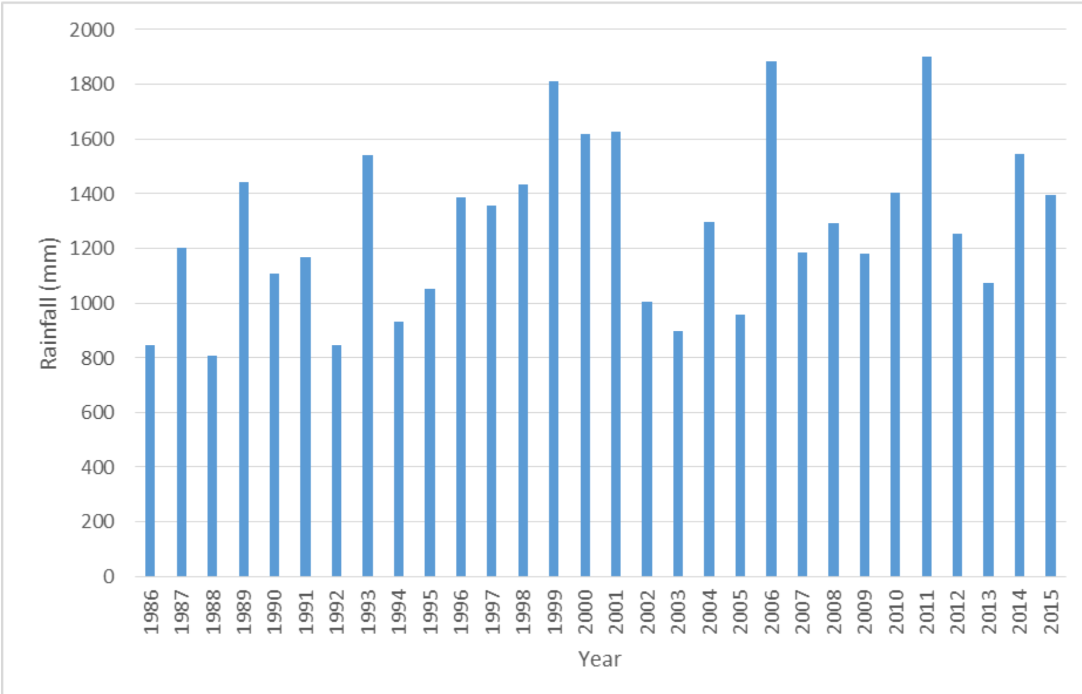


Figure 12: Mean annual rainfall for Cape York region for the years 1986 to 2015. Note that a year is from September to September to align with late dry season reporting.

Wet Tropics

A
88%

Target: 70 per cent late dry season ground cover by 2018.

Very good: Late dry season mean ground cover across grazing lands was 88 per cent.

Table 3: Ground cover results for the Wet Tropics region and catchments

Region	28 year mean ground cover (%)	2015 mean ground cover (%)	Area with less than 70% ground cover averaged over past 28 years (%)	Area with less than 70% ground cover in 2015 (%)
Herbert	87	89	6	3
Johnstone	79	78	20	16
Barron	86	85	9	11
Wet Tropics region (excluding Jacky Jacky catchment)	87	88	7	5

The ground cover distribution for the Wet Tropics provides a visual representation of the results (Figure 13). The proportion of the region with less than 70 per cent cover is shaded blue and labelled (five per cent). The distribution of the long-term mean ground cover levels is displayed as the dashed line, and the 2015 distribution of ground cover levels is the solid line. The median of the long-term mean and 2015 cover are presented (vertical lines), with the actual median value in 2015 (90 per cent) shown in red at the base of the line.

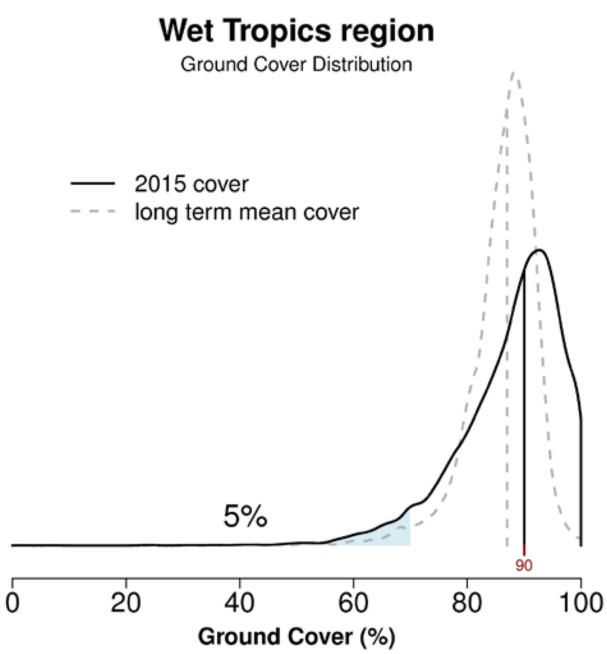


Figure 13: Wet Tropics ground cover distribution.

The percentage of ground cover for the Wet Tropics region and catchments is shown in Figure 14.

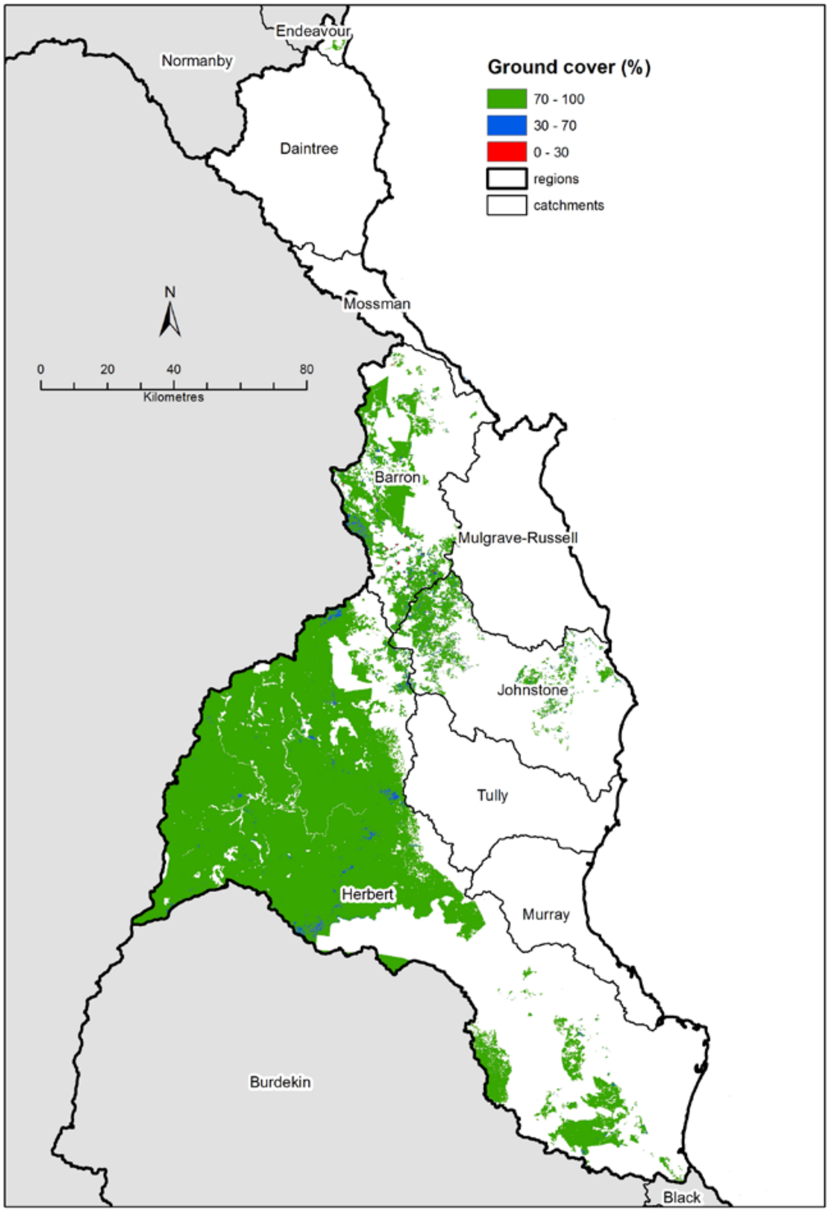


Figure 14: Late dry season ground cover levels for the Wet Tropics region grazing lands.

The Wet Tropics region had mean ground cover of 88 per cent in 2015 and consistently high mean ground cover from 1987 to 2015 with a mean ground cover level of 87 per cent. The minimum mean ground cover for the monitoring period was 80 per cent in 1994. The proportion of grazing lands under the Reef Water Quality Protection Plan target of 70 per cent ground cover was also consistently low for the Wet Tropics region with a mean of five per cent for 2015 and seven per cent over the 28 year period (Table 3 and Figure 13). Only the grazing lands of the Herbert, Barron and Johnstone catchments were reported on in this region as the other catchments in the Wet Tropics had less than 10 per cent reportable area.

When assessing individual catchments, the Herbert and Barron catchments are well above the target for the 28 year mean and 2015 results, however, the Johnstone catchment tends to fluctuate more, with the lowest mean ground cover recorded in 2014 at 67 per cent and the highest recorded in 1998 and 2001 at 84 per cent. Ground cover for the Johnstone catchment was 78 per cent in 2015.

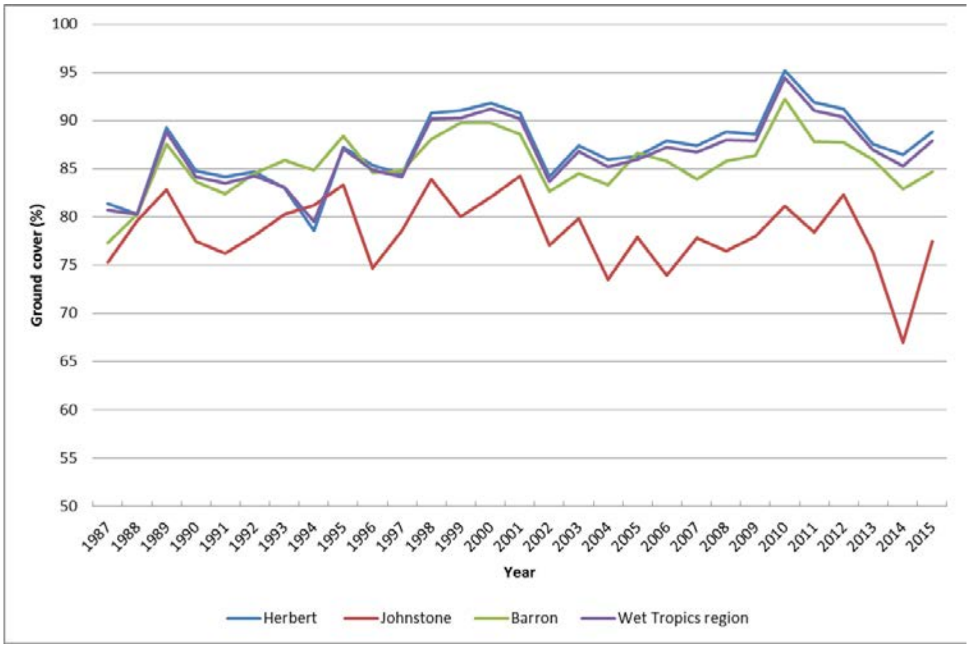


Figure 15: Wet Tropics region and catchments - mean late dry season ground cover. Note the scale on the y-axis is between 50 per cent and 100 per cent ground cover.

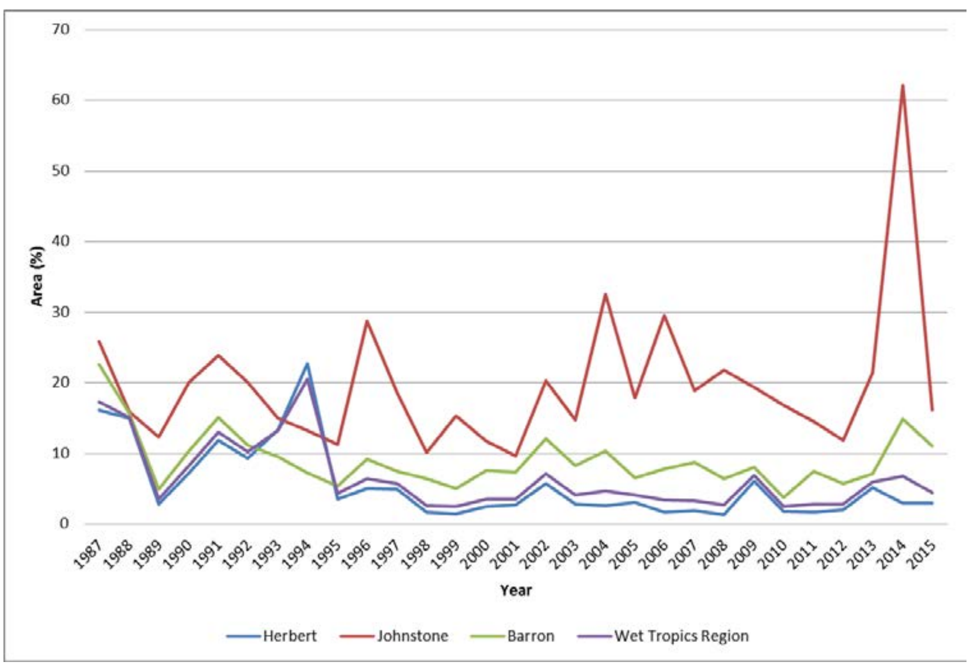


Figure 16: Wet Tropics region and catchments - percentage area with ground cover below 70 per cent for the years 1987 to 2015.

The map of ground cover deciles (Figure 17) shows the spring 2015 ground cover in comparison to the long-term ground cover (1988 – 2012 baseline) for the spring season. Only the Herbert, Barron and Johnstone catchments were reported on as the other catchments in the Wet Tropics had less than 10 per cent assessable area. Red on the map indicates where ground cover is in the lowest deciles (i.e. the lowest level of ground cover that location has experienced relative to the baseline) while blue shows locations where ground cover is at the highest levels (or deciles) it has been relative to the baseline period. This map can be used as a guide to indicate areas of concern or improvement, or conversely, those areas that had good ground cover levels in 2015.

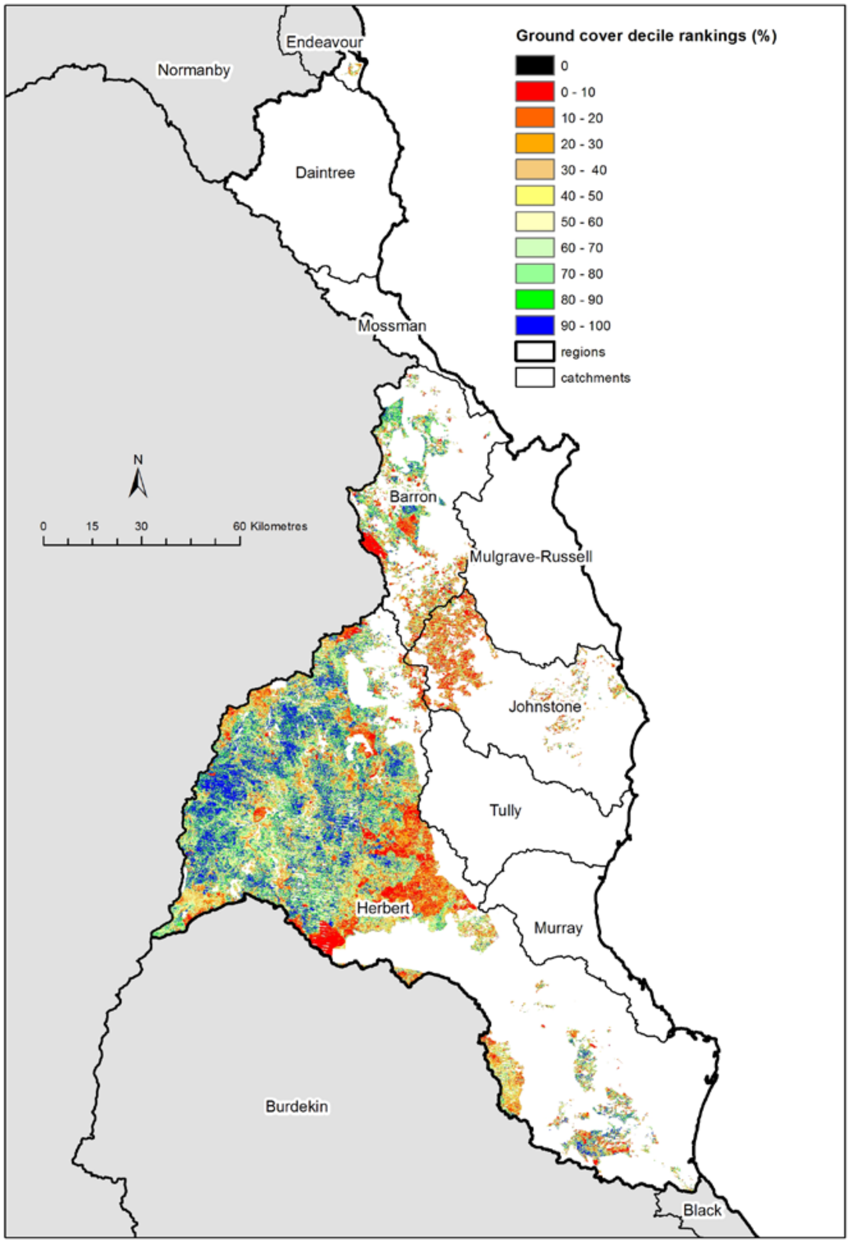


Figure 17: Wet Tropics region ground cover decile rankings. This map shows spring 2015 ground cover in comparison to the long-term cover (1988 – 2012 baseline) for the same season. The lowest decile (red) indicates where ground cover was at the lowest level relative to the baseline period, and the highest decile (blue) indicates where ground cover was at the highest level relative to the baseline period.

The Wet Tropics region is the wettest of the areas reported (1901 millimetres mean annual rainfall). The preceding rainfall in 2014 was above the mean at 2034 millimetres, and below the mean in 2015 (1676 millimetres) (Figure 18).

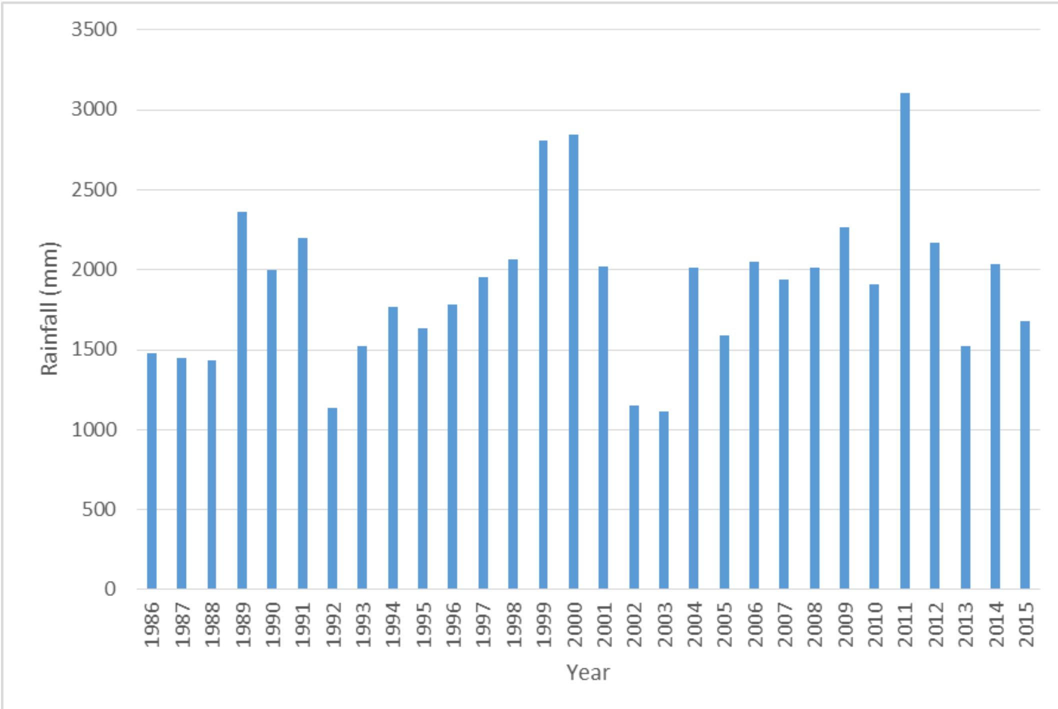


Figure 18: Mean annual rainfall for Wet Tropics region for the years 1986 to 2015. Note that a year is from September to September to align with late dry season reporting.

Burdekin

B
69%

Target: 70 per cent late dry season ground cover by 2018.

Good: Late dry season mean ground cover across grazing lands was 69 per cent.

Table 4: Ground cover results for the Burdekin region and catchments

Region	28 year mean ground cover (%)	2015 mean ground cover (%)	Area with less than 70% ground cover averaged over past 28 years (%)	Area with less than 70% ground cover in 2015 (%)
Black	87	84	10	15
Burdekin	74	68	34	50
Don	84	83	12	10
Haughton	82	76	17	26
Ross	83	79	15	19
Burdekin region	75	69	33	48

The ground cover distribution for Burdekin provides a visual representation of the results (Figure 19). The proportion of the region with less than 70 per cent cover is shaded blue and labelled (48 per cent). The distribution of the long-term mean ground cover levels is displayed as the dashed line, and the 2015 distribution of ground cover levels is the solid line. The median of the long-term mean and 2015 cover are presented (vertical lines), with the actual median value in 2015 (70 per cent) shown in red at the base of the line.

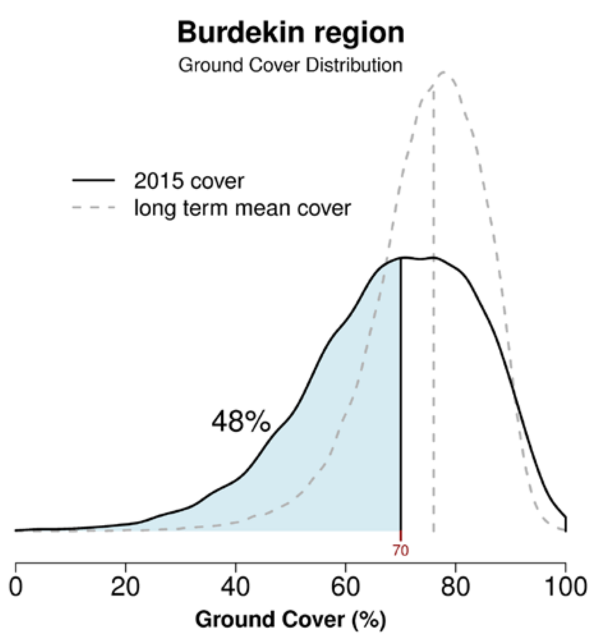


Figure 19: Burdekin ground cover distribution.

The percentage of ground cover for the Burdekin region and catchments is shown in Figure 20.

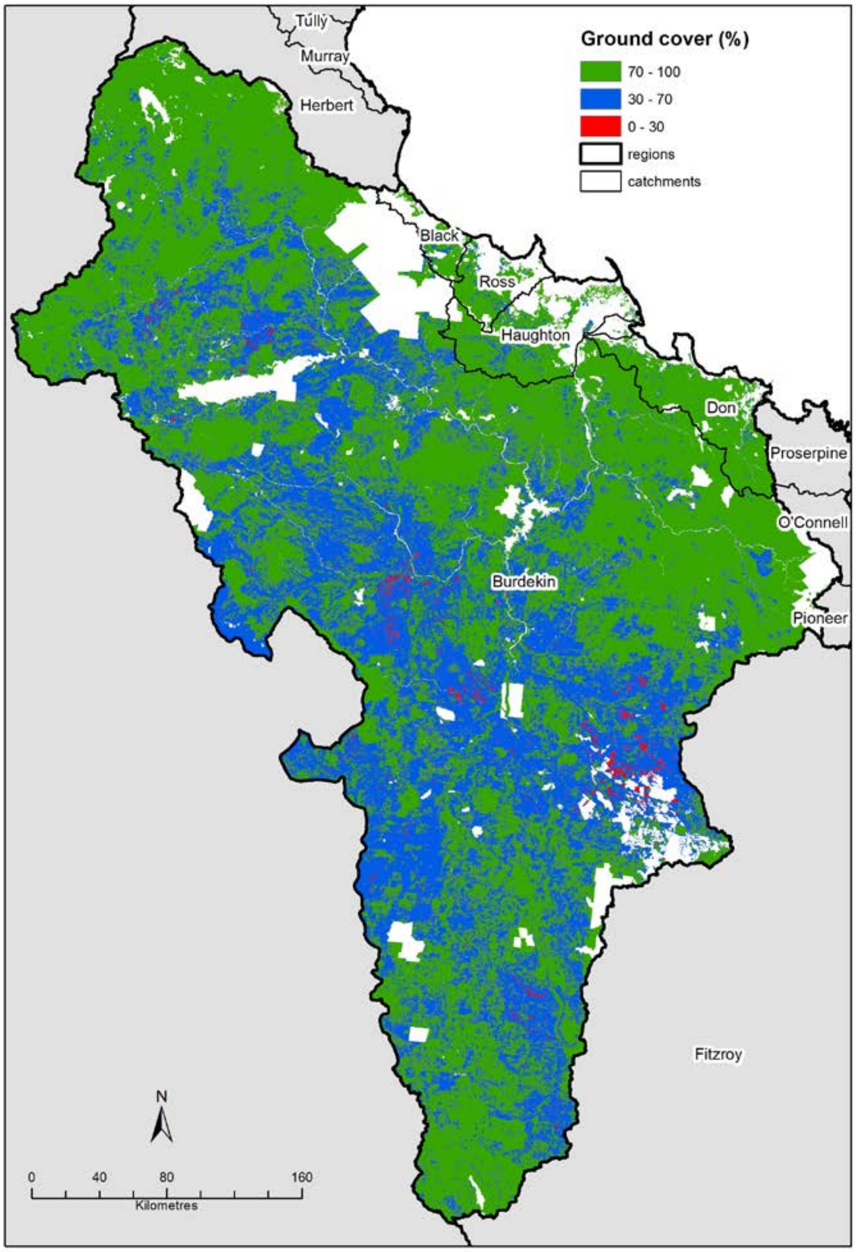


Figure 20: Late dry season ground cover levels for the Burdekin region grazing lands.

The mean ground cover for the Burdekin region in 2015 was just below the Reef Water Quality Protection Plan target at 69 per cent and the 28 year mean ground cover was 75 per cent. Ground cover levels in the Burdekin region fluctuate significantly over time, for example, in 1988 the mean late dry season ground cover was 66 per cent, while the following year it was 77 per cent. The proportion of grazing lands under the Reef Water Quality Protection Plan target of 70 per cent ground cover was 48 per cent in 2015, and 33 per cent for the 28 year period (Table 4 and Figure 19). Increases in the area with less than 70 per cent ground cover correspond to low mean late dry season ground cover and below average annual rainfall.

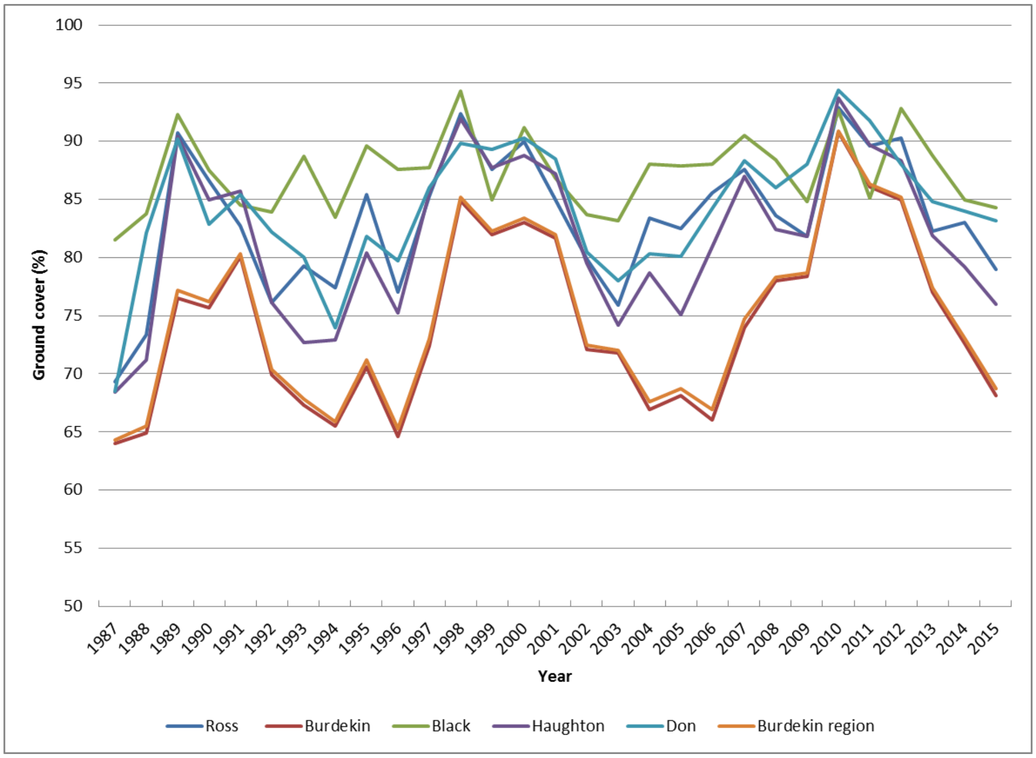


Figure 21: Burdekin region and catchments - mean late dry season ground cover. Note the scale on the y-axis is between 50 per cent and 100 per cent ground cover.

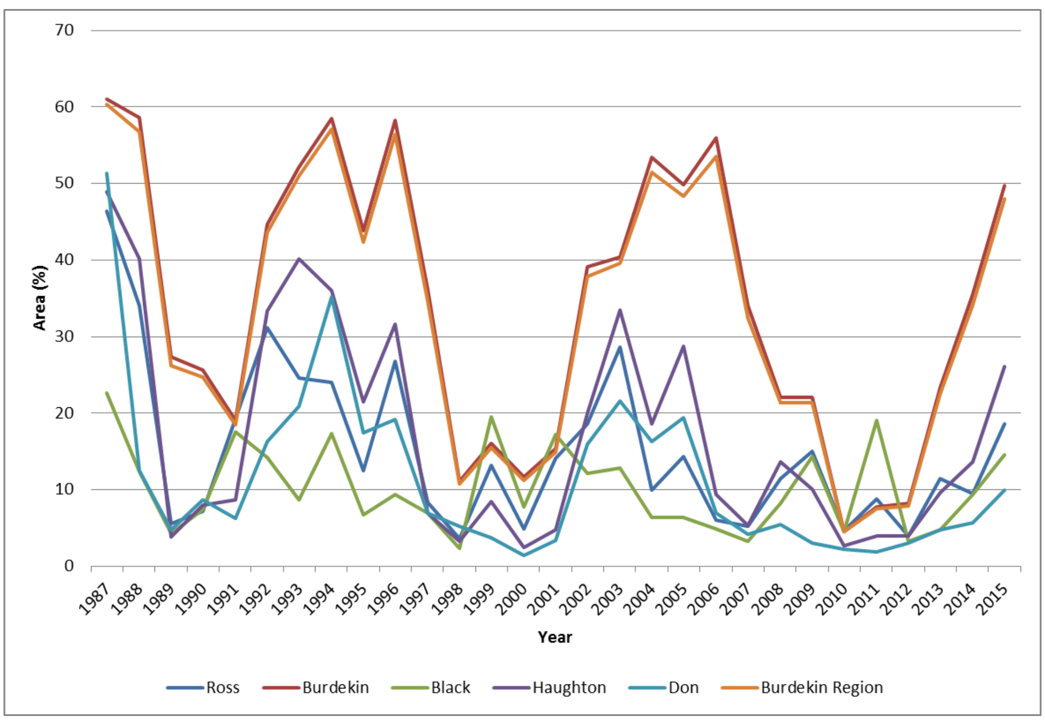


Figure 22: Burdekin region and catchments - percentage area with ground cover below 70 per cent for the years 1987 to 2015.

The map of ground cover deciles (Figure 23) shows the spring 2015 ground cover in comparison to the long-term ground cover (1988 – 2012 baseline) for the spring season for the reporting regions. Red on the map indicates where ground cover is in the lowest deciles (i.e. the lowest level of ground cover that location has experienced relative to the baseline) while blue shows locations where ground cover is at the highest levels (or deciles) it has been relative to the baseline period. This map can be used as a guide to indicate areas of concern or improvement, or conversely, those areas that had good ground cover levels in 2015.

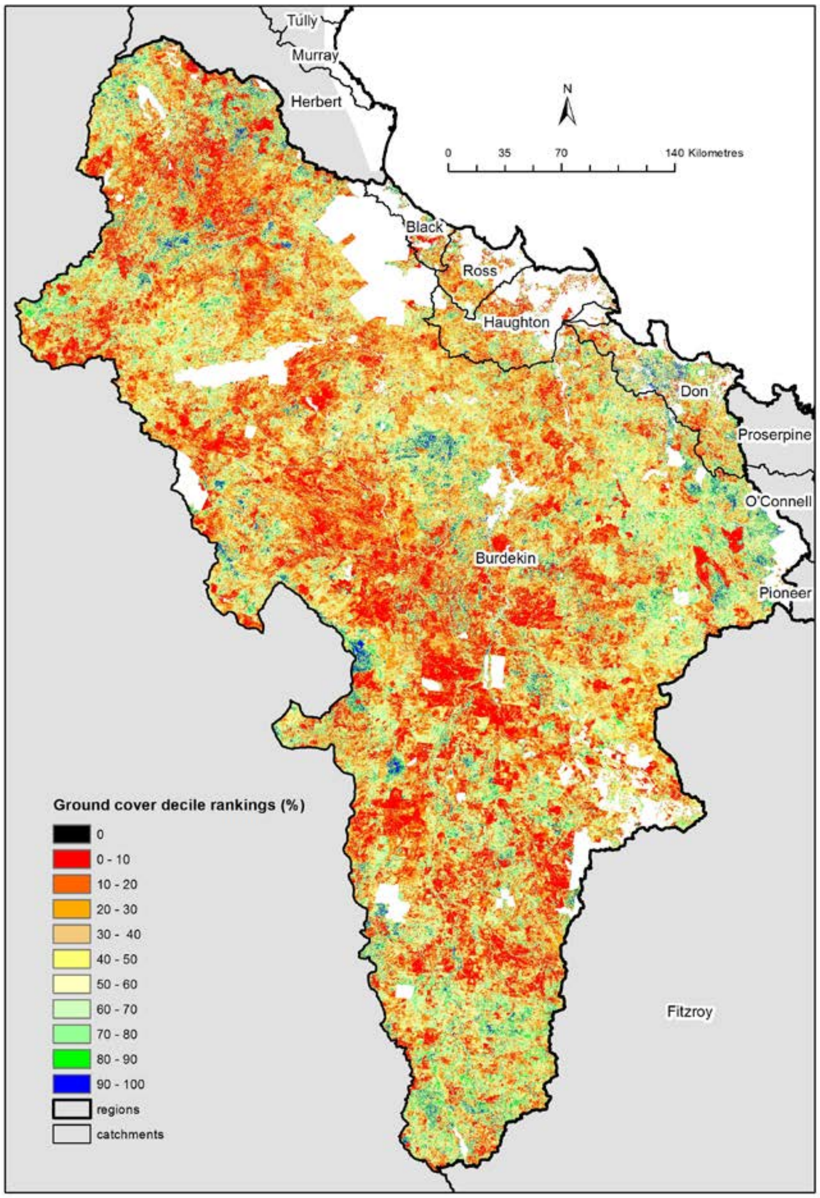


Figure 23: Burdekin region ground cover decile rankings. This map shows spring 2015 ground cover in comparison to the long-term cover (1988 – 2012 baseline) for the same season. The lowest decile (red) indicates where ground cover was at the lowest level relative to the baseline period, and the highest decile (blue) indicates where ground cover was at the highest level relative to the baseline period.

The Burdekin region is the driest of the regions reported (643 millimetres mean annual rainfall). The preceding rainfall in 2014 was below the mean at 513 millimetres and rainfall was also below the mean in 2015 at 487 millimetres (Figure 24).

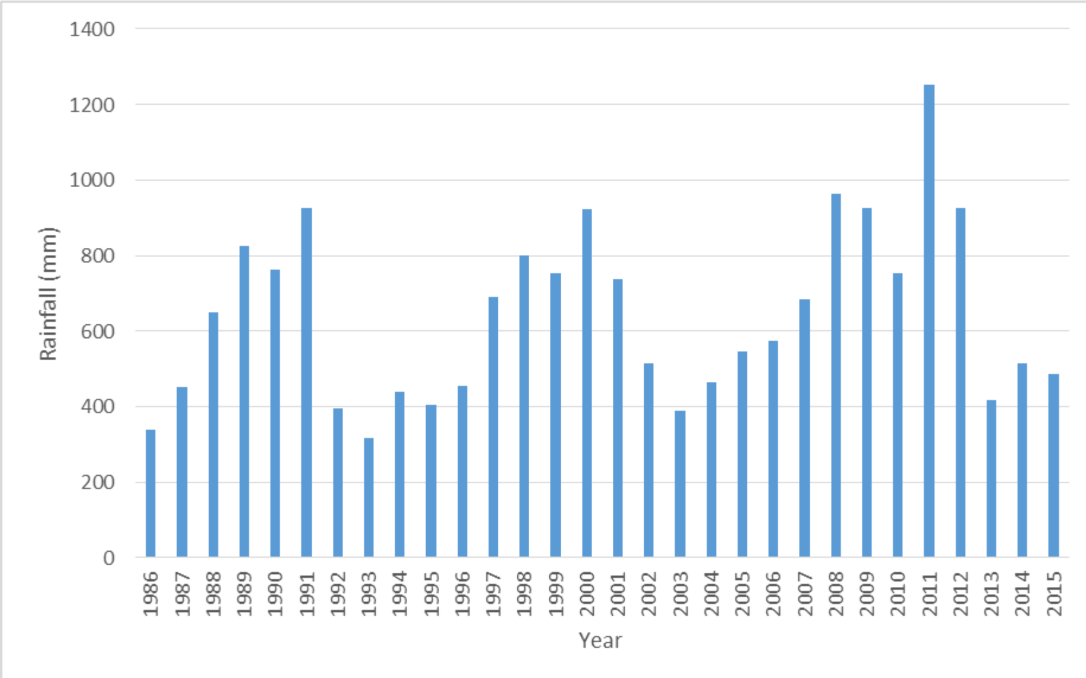


Figure 24: Mean annual rainfall for Burdekin region for the years 1986 to 2015. Note that a year is from September to September to align with late dry season reporting.

Mackay Whitsunday

A
88%

Target: 70 per cent late dry season ground cover by 2018.

Very good: Late dry season mean ground cover across grazing lands was 88 per cent.

Table 5: Ground cover results for the Mackay Whitsunday Region and catchments

Region	28 year mean ground cover (%)	2015 mean ground cover (%)	Area with less than 70% ground cover averaged over past 28 years (%)	Area with less than 70% ground cover in 2015 (%)
O'Connell	90	90	4	4
Pioneer	91	91	4	4
Plane Creek	89	87	6	10
Proserpine	87	87	7	5
Mackay Whitsunday region	89	88	5	6

The ground cover distribution for the Mackay Whitsunday region provides a visual representation of the results (Figure 25). The proportion of the region with less than 70 per cent cover is shaded blue and labelled (six per cent). The distribution of the long-term mean ground cover levels is displayed as the dashed line, and the 2015 distribution of ground cover levels is the solid line. The median of the long-term mean and 2015 cover are presented (vertical lines), with the actual median value in 2015 (91 per cent) shown in red at the base of the line.

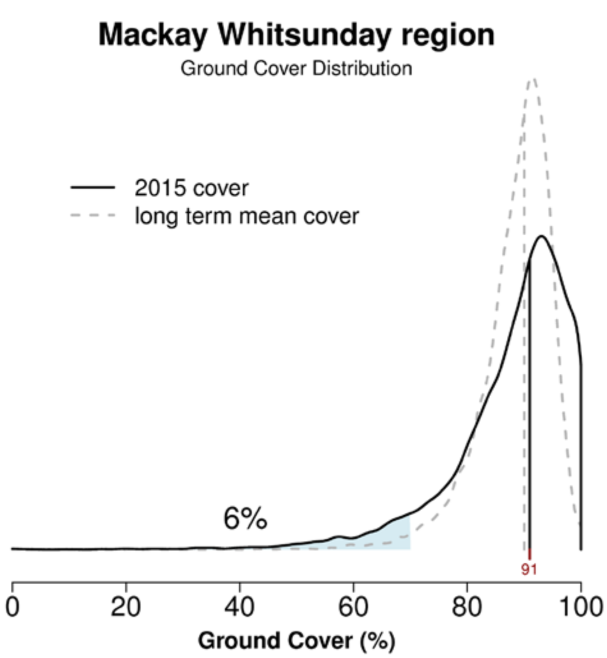


Figure 25: Mackay Whitsunday ground cover distribution.

The percentage of ground cover for the Mackay Whitsunday region and catchments is shown in Figure 26.

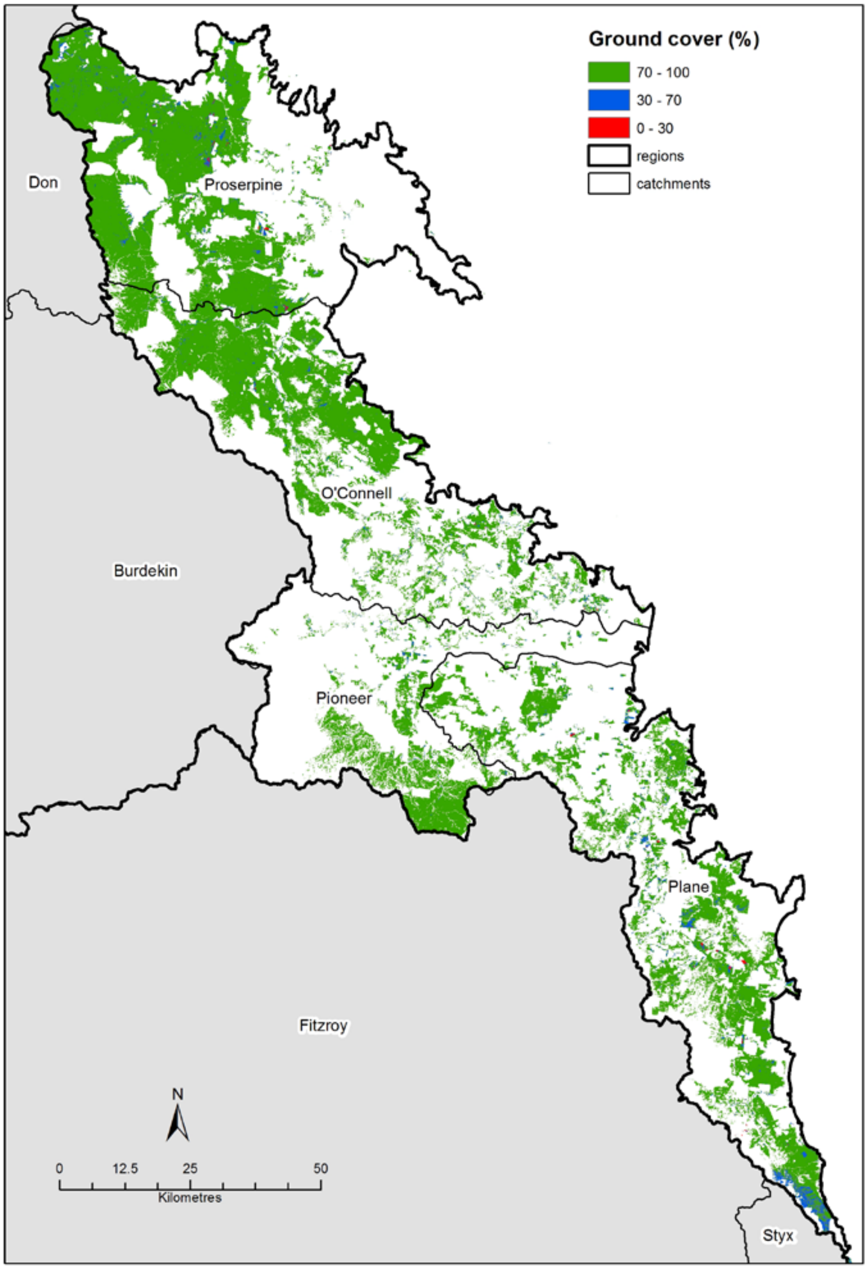


Figure 26: Late dry season ground cover levels for the Mackay Whitsunday region grazing lands.

The Mackay Whitsunday region had mean ground cover of 88 per cent in 2015 and consistently high mean ground cover from 1987 to 2015 with a 28 year mean ground cover level of 89 per cent. The area with ground cover less than 70 per cent has also been consistently low across all years, with a mean of six per cent for 2015 and five per cent for the 28 year period (Table 5 and Figure 25).

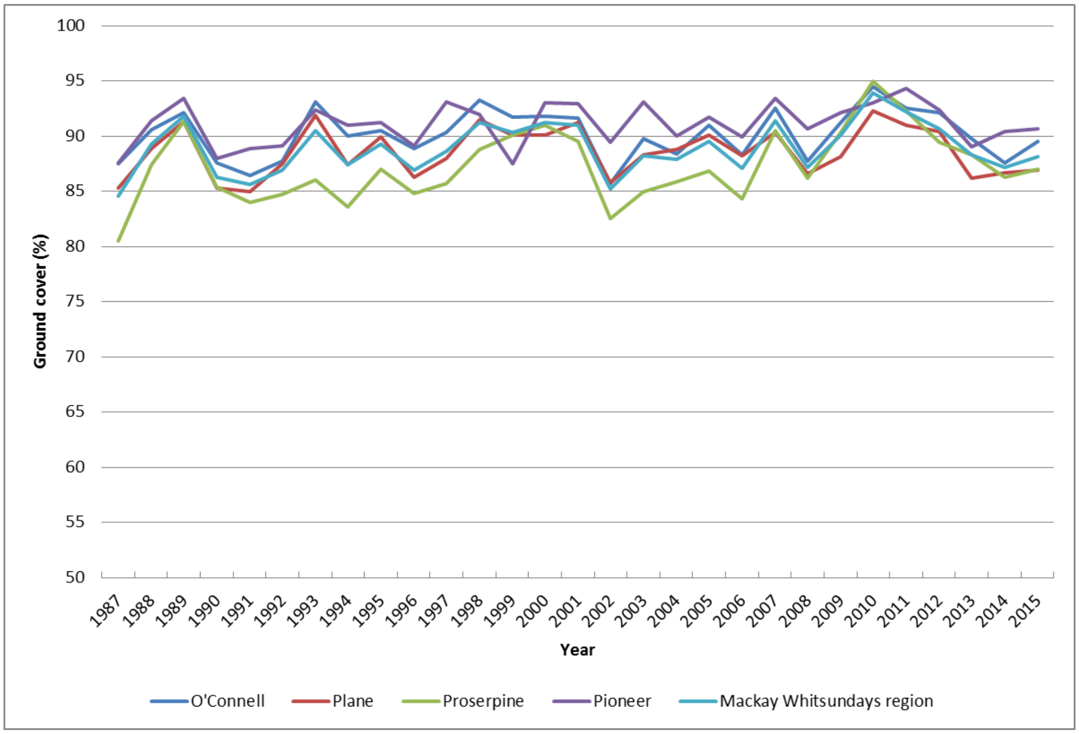


Figure 27: Mackay Whitsunday region and catchments - mean late dry season ground cover. Note the scale on the y-axis is between 50 per cent and 100 per cent ground cover.

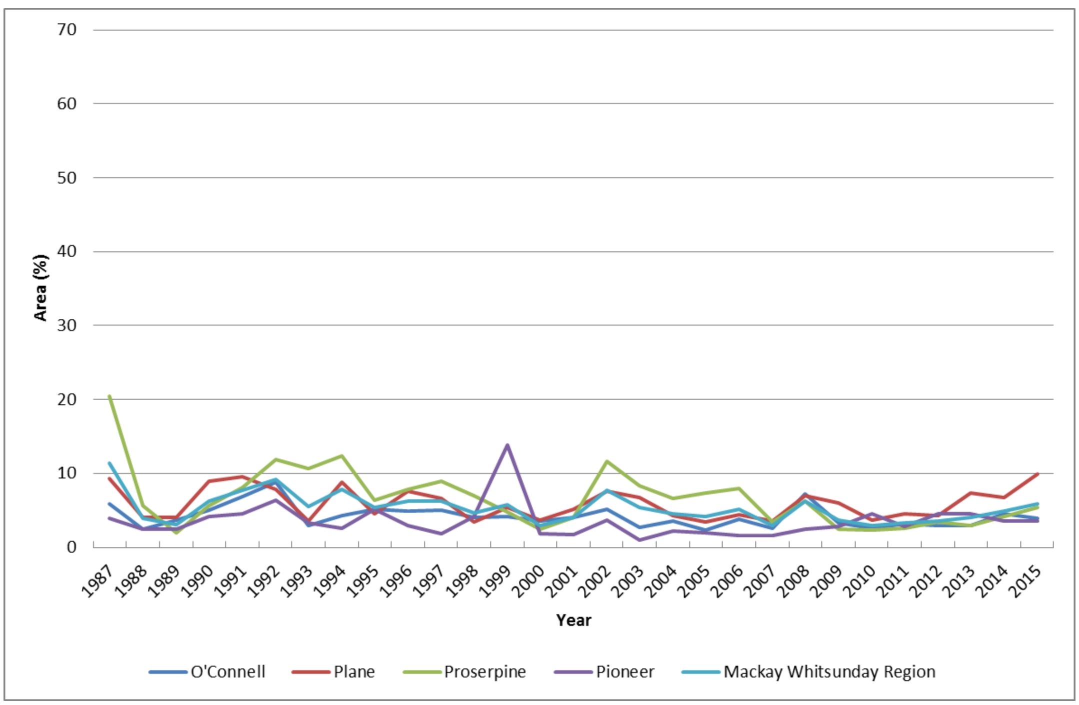


Figure 28: Mackay Whitsunday region and catchments - percentage area with ground cover below 70 per cent for the years 1987 to 2015.

The map of ground cover deciles (Figure 29) shows the spring 2015 ground cover in comparison to the long-term ground cover (1988 – 2012 baseline) for the spring season for the reporting regions. Red on the map indicates where ground cover is in the lowest deciles (i.e. the lowest level of ground cover that location has experienced relative to the baseline) while blue shows locations where ground cover is at the highest levels (or deciles) it has been relative to the baseline period. This map can be used as a guide to indicate areas of concern or improvement, or conversely, those areas that had good ground cover levels in 2015.

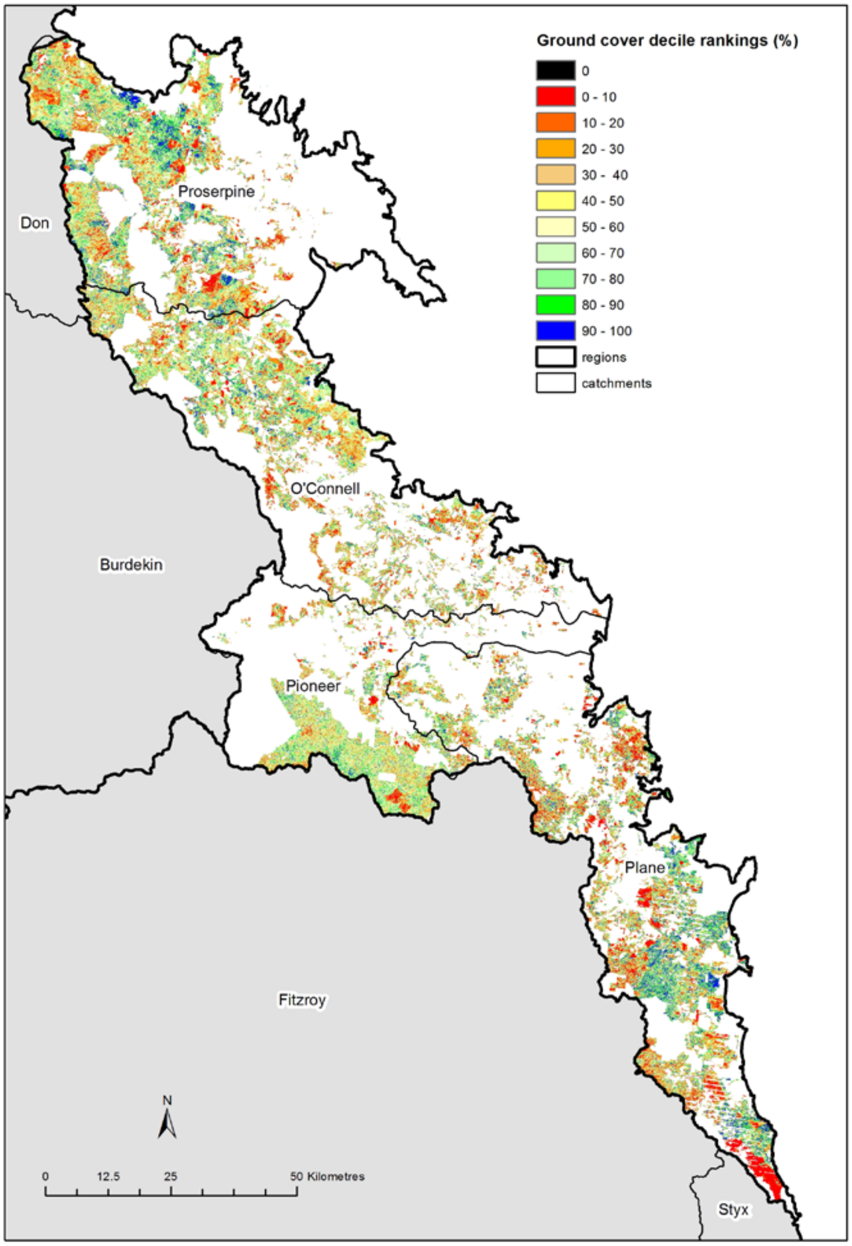


Figure 29: Mackay Whitsunday region ground cover decile rankings. This map shows spring 2015 ground cover in comparison to the long-term cover (1988 – 2012 baseline) for the same season. The lowest decile (red) indicates where ground cover was at the lowest level relative to the baseline period, and the highest decile (blue) indicates where ground cover was at the highest level relative to the baseline period.

The Mackay Whitsunday region is the second wettest of the regions reported (1526 millimetres mean annual rainfall). The preceding rainfall in 2014 was below the mean at 1393 millimetres and rainfall was also below the mean in 2015 (1090 millimetres) (Figure 30).

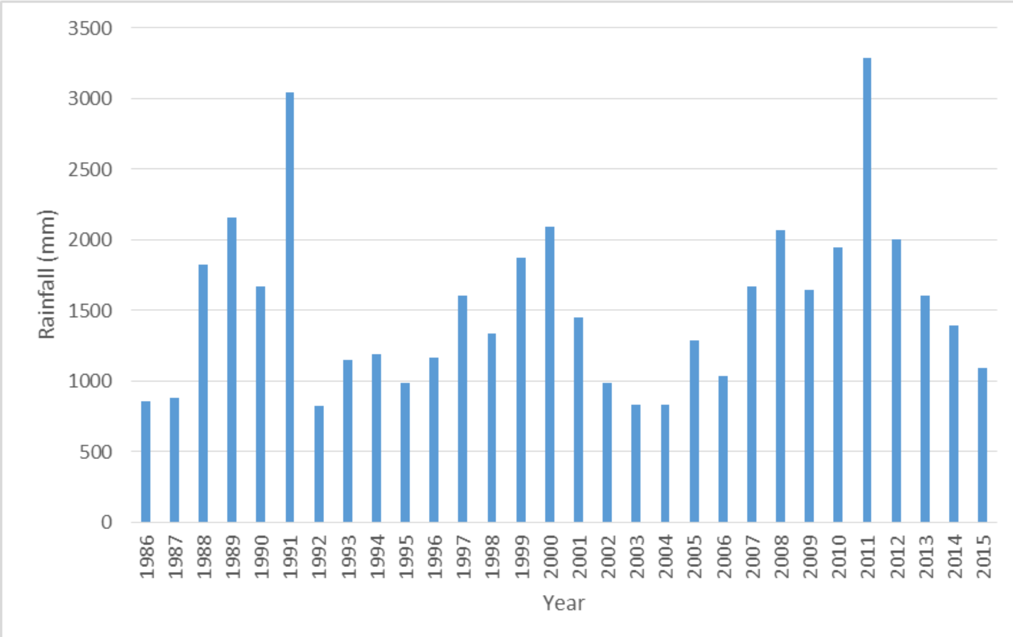


Figure 30: Mean annual rainfall for Mackay Whitsunday region for the years 1986 to 2015. Note that a year is from September to September to align with late dry season reporting.

Fitzroy

A
80%

Target: 70 per cent late dry season ground cover by 2018.

Very good: Late dry season mean ground cover across grazing lands was 80 per cent.

Table 6: Ground cover results for the Fitzroy region and catchments

Region	28 year mean ground cover (%)	2015 mean ground cover (%)	Area with less than 70% ground cover averaged over past 28 years (%)	Area with less than 70% ground cover in 2015 (%)
Boyne	87	90	6	2
Calliope	88	90	6	2
Fitzroy	79	79	21	18
Shoalwater	87	91	9	3
Styx	86	90	9	4
Water Park	87	88	8	7
Fitzroy region	79	80	20	17

The ground cover distribution for the Fitzroy region provides a visual representation of the results (Figure 31). The proportion of the region with less than 70 per cent cover is shaded blue and labelled (17 per cent). The distribution of the long-term mean ground cover levels is displayed as the dashed line, and the 2015 distribution of ground cover levels is the solid line. The median of the long-term mean and 2015 cover are presented (vertical lines), with the actual median value in 2015 (82 per cent) shown in red at the base of the line.

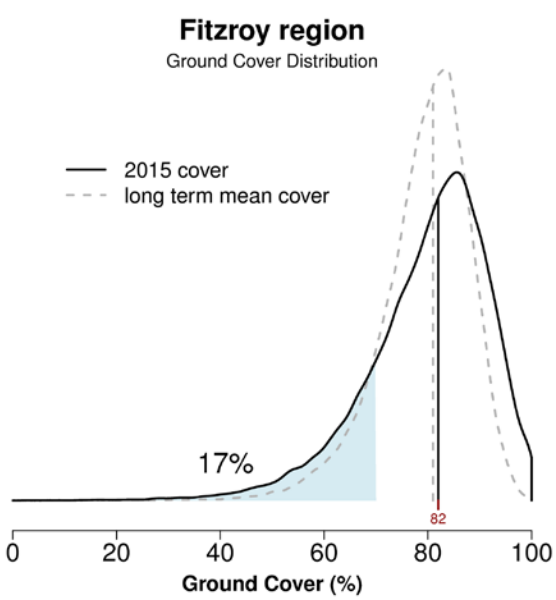


Figure 31: Fitzroy ground cover distribution.

The percentage of ground cover for the Fitzroy region and catchments is shown in Figure 32.

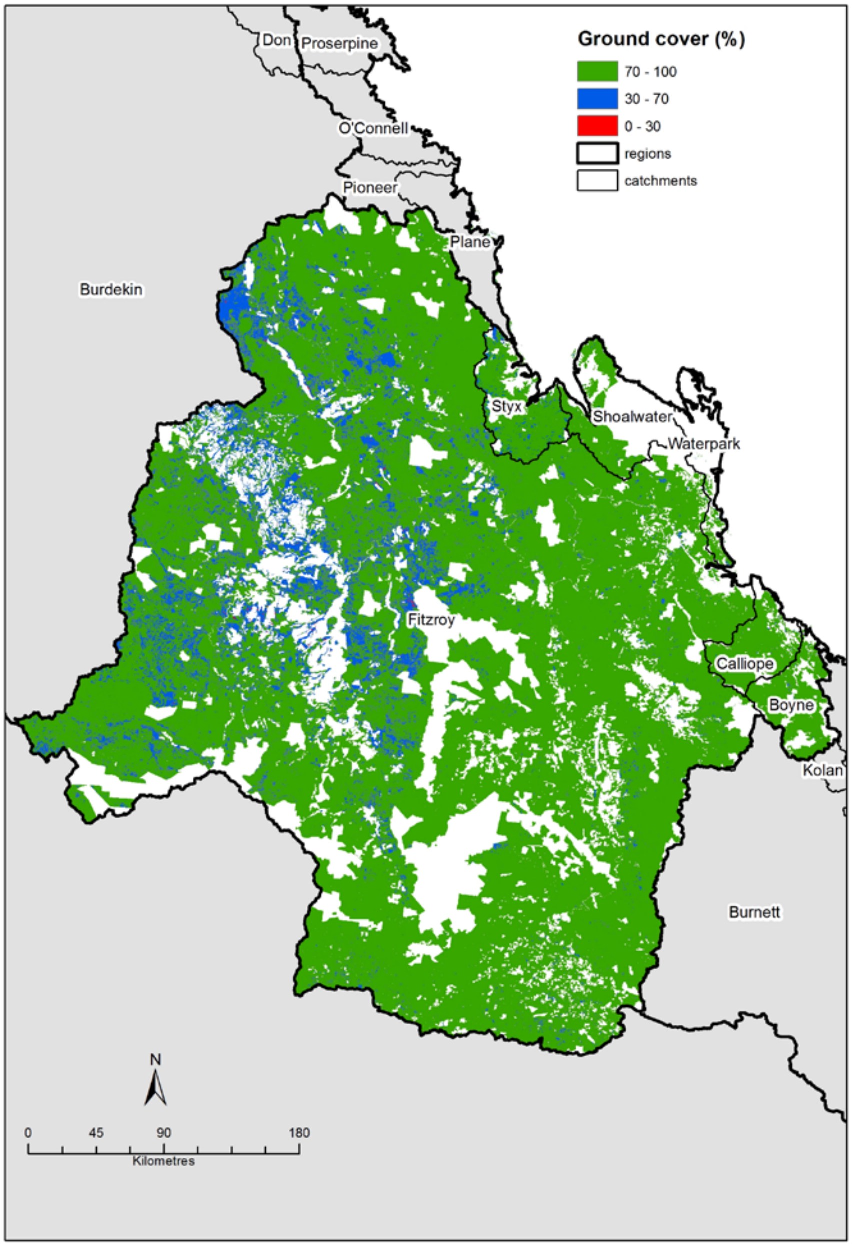


Figure 32: Late dry season ground cover levels for the Fitzroy region grazing lands.

The Fitzroy region had mean ground cover of 80 per cent in 2015 and 79 per cent for the 28 year period. Mean ground cover in the Fitzroy region fluctuates considerably over time. For example, in 2006 the mean ground cover was 71 per cent, while in 2008 it was 82 per cent, and in 2010 it was as high as 93 per cent. The proportion of grazing lands under the Reef Water Quality Protection Plan target of 70 per cent ground cover was 17 per cent in 2015 and 20 per cent for the 28 year period (Table 6 and Figure 31). Increases in the area with less than 70 per cent ground cover correspond to low mean late dry season ground cover and below average annual rainfall in the current and preceding years.

For example, in 1994 the mean late dry season ground cover was 73 per cent, the area with ground cover below 70 per cent was 38 per cent, and the mean annual rainfall had been declining since 1989. The annual rainfall was 396 millimetres in 1993; more than 250 millimetres lower than the region's mean annual rainfall for 1986 to 2015.

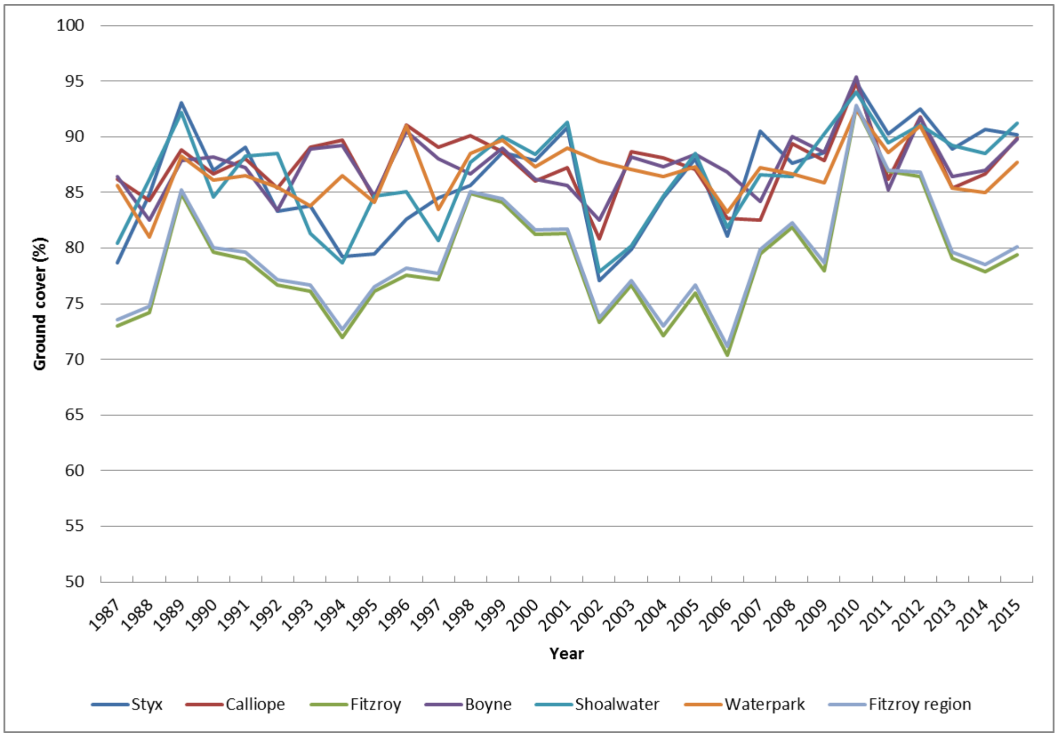


Figure 33: Fitzroy region and catchments - mean late dry season ground cover. Note the scale on the y-axis is between 50 per cent and 100 per cent ground cover.

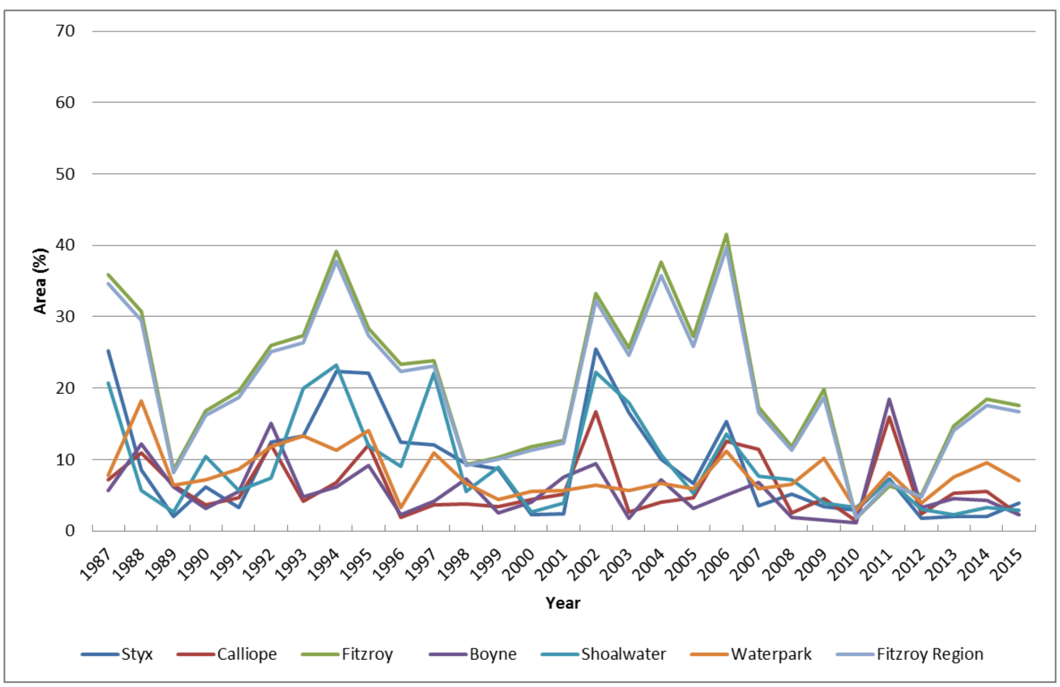


Figure 34: Fitzroy region and catchments - percentage area with ground cover below 70 per cent for the years 1987 to 2015.

The map of ground cover deciles (Figure 35) shows the spring 2015 ground cover in comparison to the long-term ground cover (1988 – 2012 baseline) for the spring season for the reporting regions. Red on the map indicates where ground cover is in the lowest deciles (i.e. the lowest level of ground cover that location has experienced relative to the baseline) while blue shows locations where ground cover is at the highest levels (or deciles) it has been relative to the baseline period. This map can be used as a guide to indicate areas of concern or improvement, or conversely, those areas that had good ground cover levels in 2015.

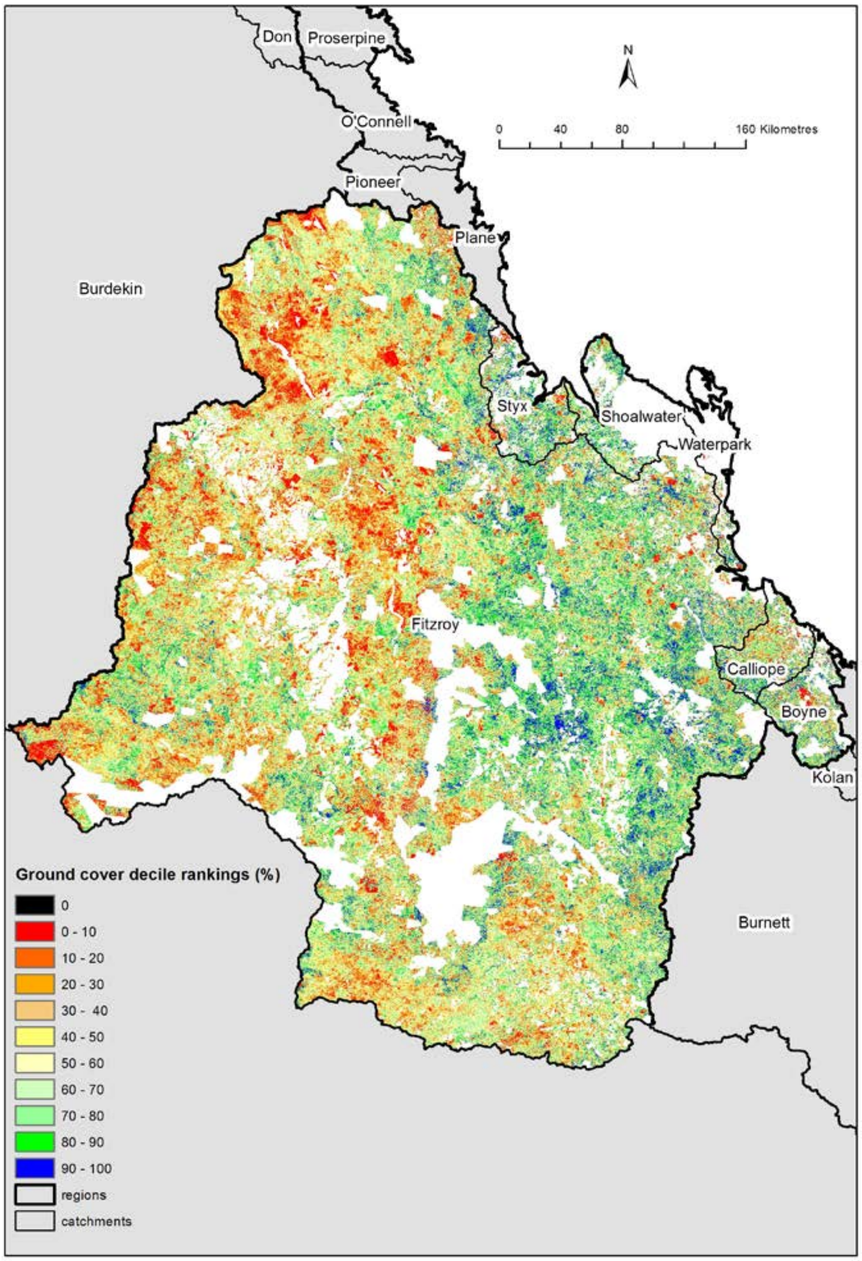


Figure 35: Fitzroy region ground cover decile rankings. This map shows spring 2015 ground cover in comparison to the long-term cover (1988 – 2012 baseline) for the same season. The lowest decile (red) indicates where ground cover was at the lowest level relative to the baseline period, and the highest decile (blue) indicates where ground cover was at the highest level relative to the baseline period.

The Fitzroy region is the second driest of the regions reported (663 millimetres mean annual rainfall). The preceding rainfall in 2014 was below the mean at 518 millimetres, and above the mean in 2015 (852 millimetres) (Figure 36). The mean annual rainfall for 2015 has been affected by the large volume of rainfall accompanying Tropical Cyclone Marcia in February 2015. This explains why even though large parts of the Fitzroy catchment were drought-declared for some of the reporting period, the mean annual rainfall is above the mean for 2015.

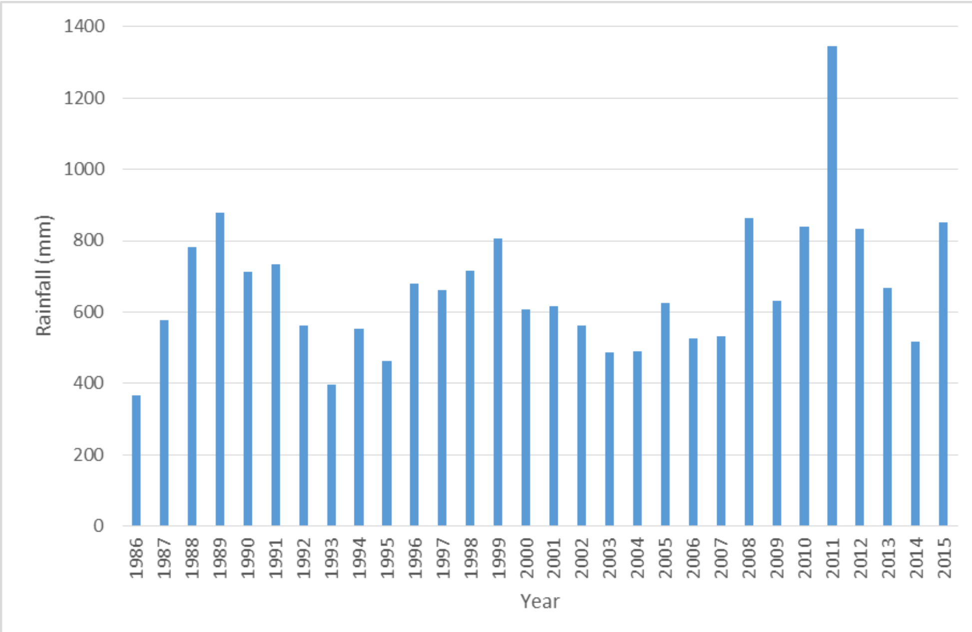


Figure 36: Mean annual rainfall for Fitzroy region for the years 1986 to 2015. Note that a year is from September to September to align with late dry season reporting.

Burnett Mary

A
89%

Target: 70 per cent late dry season ground cover by 2018.

Very good: Late dry season mean ground cover across grazing lands was 89 per cent.

Table 7: Ground cover results for the Burnett Mary region and catchments

Region	28 year mean ground cover (%)	2015 mean ground cover (%)	Area with less than 70% ground cover averaged over past 28 years (%)	Area with less than 70% ground cover in 2015 (%)
Baffle	89	90	5	3
Burnett	85	89	7	2
Burrum	87	90	8	5
Kolan	88	90	4	2
Mary	88	90	5	3
Burnett Mary region	86	89	7	2

The ground cover distribution for the Burnett Mary region provides a visual representation of the results (Figure 37). The proportion of the region with less than 70 per cent cover is shaded blue and labelled (two per cent). The distribution of the long-term mean ground cover levels is displayed as the dashed line, and the 2015 distribution of ground cover levels is the solid line. The median of the long-term mean and 2015 cover are presented (vertical lines), with the actual median value in 2015 (91 per cent) shown in red at the base of the line.

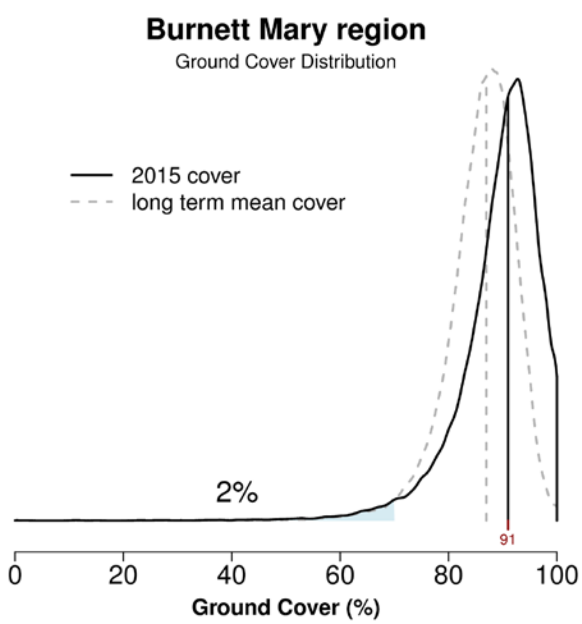


Figure 37: Burnett Mary ground cover distribution.

The percentage of ground cover for the Burnett Mary region and catchments is shown in Figure 38.

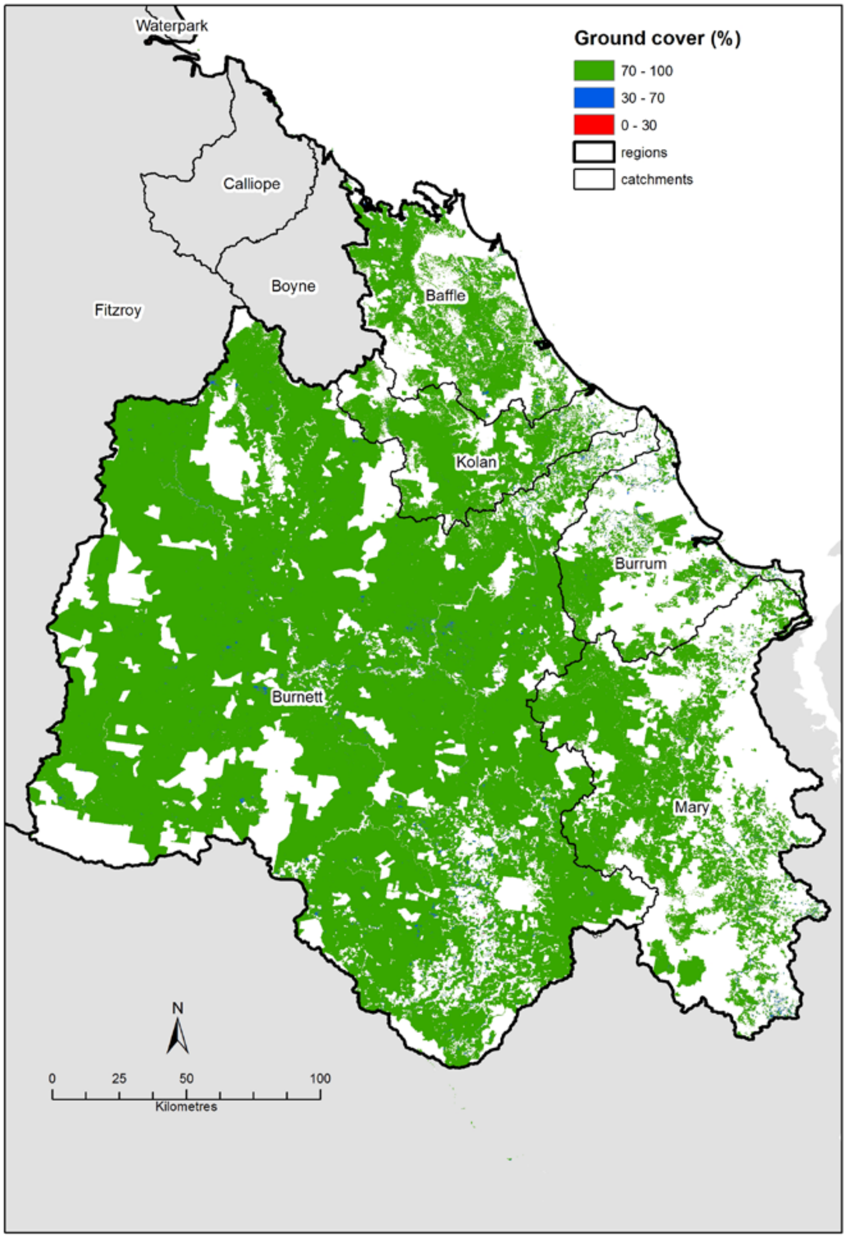


Figure 38: Late dry season ground cover levels for the Burnett Mary region grazing lands.

The Burnett Mary region had mean ground cover of 89 per cent in 2015 and consistently high mean ground cover from 1987 to 2015 with a 28 year mean ground cover level of 86 per cent; the lowest was 81 per cent in 1988 and 2014. The highest level of ground cover was in 2010 (94 per cent). The area with ground cover less than 70 per cent has been consistently low across all years, with a mean of two per cent for 2015 and a 28 year mean of seven per cent (Table 7 and Figure 37). The highest value was estimated in 1991 (14 per cent). This corresponded with a low rainfall year for the area, more than 250 millimetres below the mean annual rainfall.

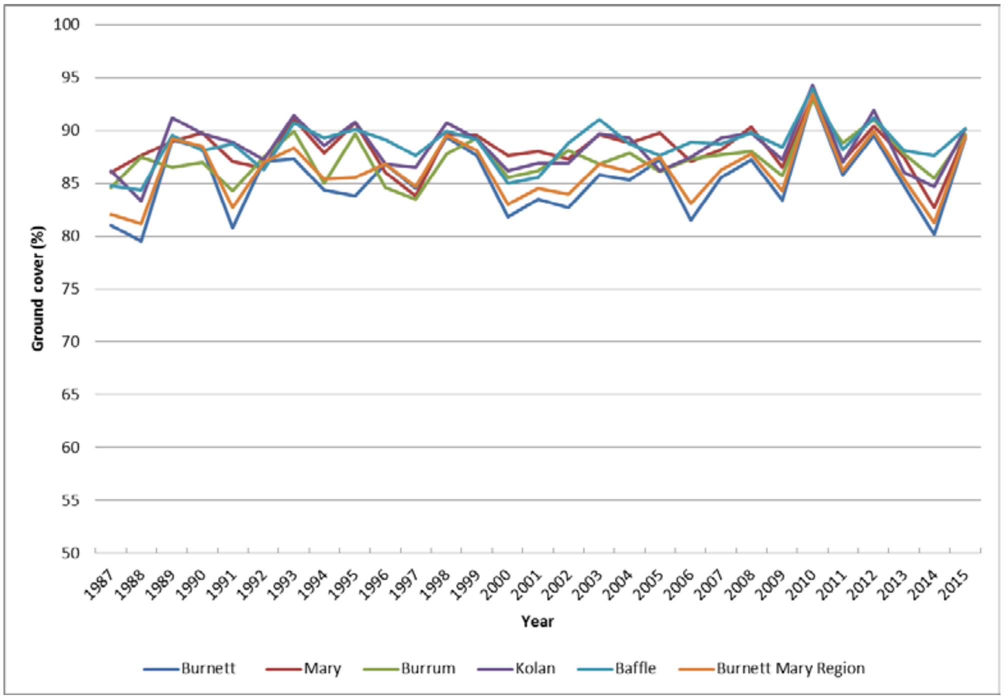


Figure 39: Burnett Mary region and catchments - mean late dry season ground cover. Note the scale on the y-axis is between 50 per cent and 100 per cent ground cover.

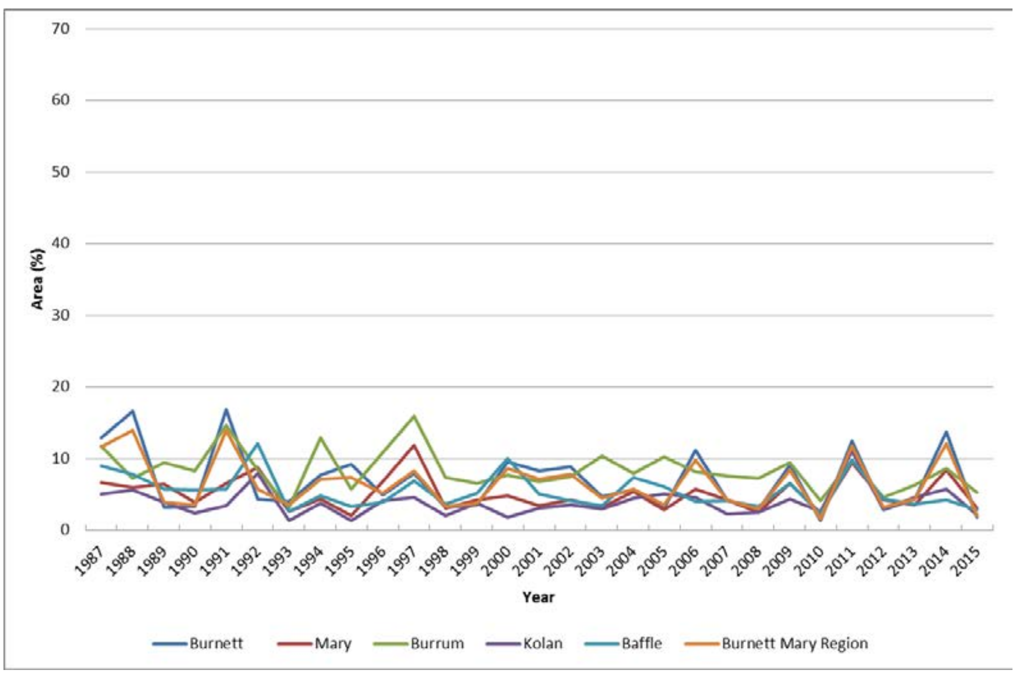


Figure 40: Burnett Mary region and catchments - percentage area with ground cover below 70 per cent for the years 1987 to 2015.

The map of ground cover deciles (Figure 41) shows the spring 2015 ground cover in comparison to the long-term ground cover (1988 – 2012 baseline) for the spring season for the reporting regions. Red on the map indicates where ground cover is in the lowest deciles (i.e. the lowest level of ground cover that location has experienced relative to the baseline) while blue shows locations where ground cover is at the highest levels (or deciles) it has been relative to the baseline period. This map can be used as a guide to indicate areas of concern or improvement, or conversely, those areas that had good ground cover levels in 2015.

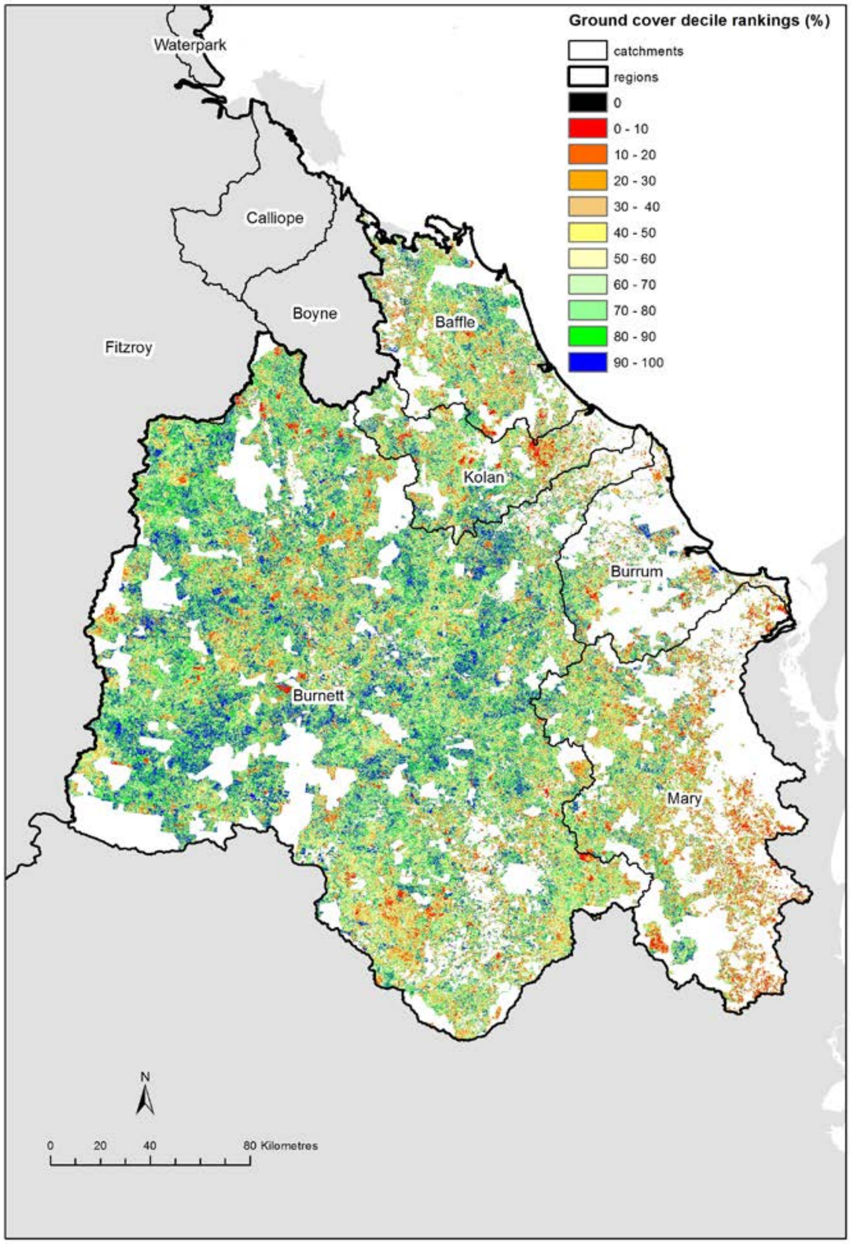


Figure 41: Burnett Mary region ground cover decile rankings. This map shows spring 2015 ground cover in comparison to the long-term cover (1988 – 2012 baseline) for the same season. The lowest decile (red) indicates where ground cover was at the lowest level relative to the baseline period, and the highest decile (blue) indicates where ground cover was at the highest level relative to the baseline period.

Mean annual rainfall for the Burnett Mary region, over the period 1986 to 2015, is approximately 808 millimetres. The preceding rainfall in 2014 was below the mean at 551 millimetres, and above the mean in 2015 (1103 millimetres) (Figure 42). The mean annual rainfall for 2015 has been affected by the large volume of rainfall accompanying Tropical Cyclone Marcia in February 2015.

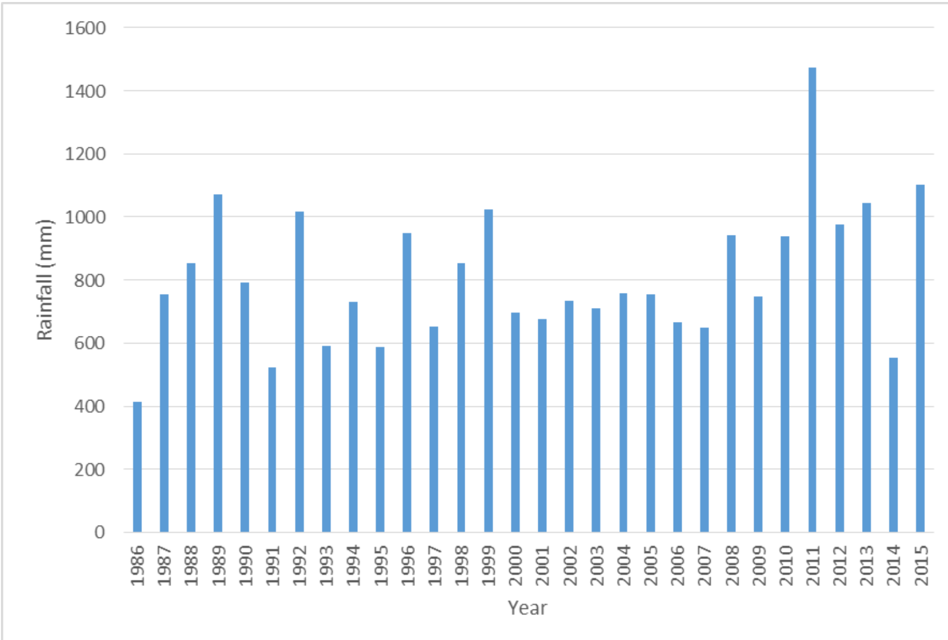
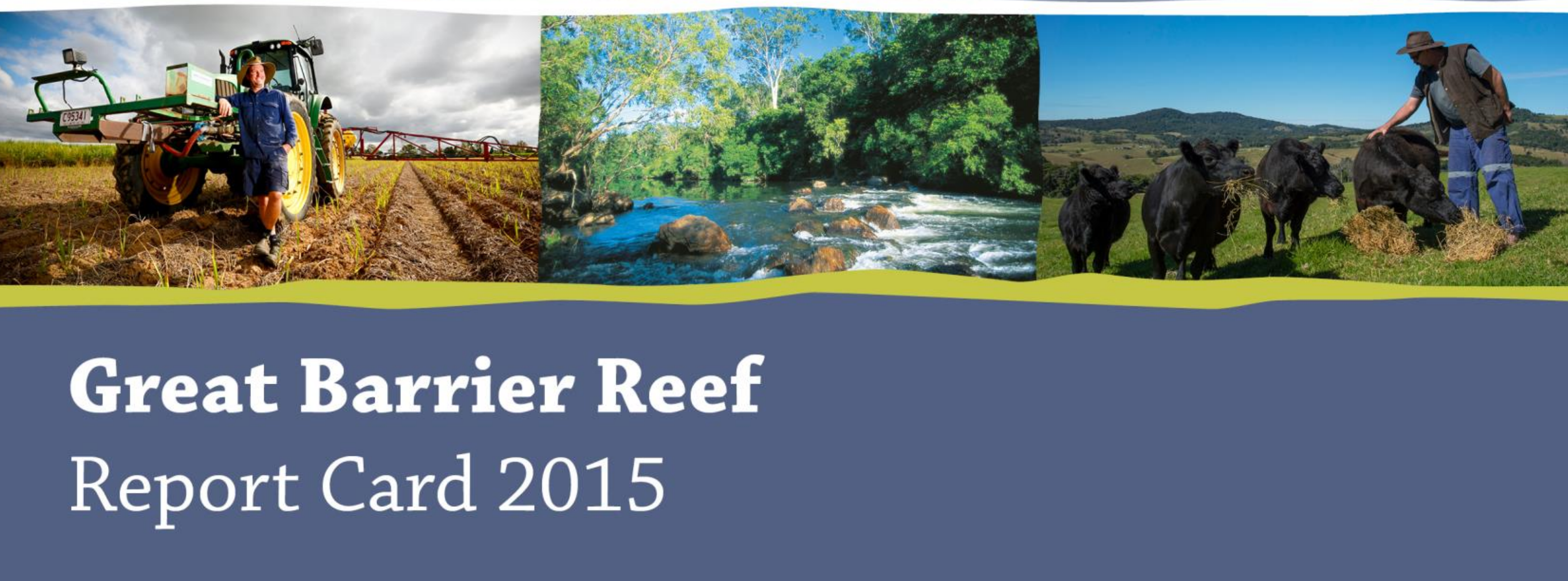


Figure 42: Mean annual rainfall for Burnett Mary region for the years 1986 to 2015. Note that a year is from September to September to align with late dry season reporting.

Catchment pollutant loads results



Great Barrier Reef

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Catchment pollutant loads results

The catchment pollutant loads targets in the Reef Water Quality Protection Plan 2013 are:

- At least a 50 per cent reduction in anthropogenic end-of-catchment dissolved inorganic nitrogen loads in priority areas by 2018.
- At least a 20 per cent reduction in anthropogenic end-of-catchment loads of sediment and particulate nutrients in priority areas by 2018.
- At least a 60 per cent reduction in end-of-catchment pesticide loads in priority areas by 2018.

The targets are based on the estimated load reductions that can be achieved through delivery of best management practice systems. The exception is the dissolved inorganic nitrogen target which remains ambitious and may not be achievable using current best practice alone.

The catchment loads targets are reported as cumulative progress since 2009.

Catchment pollutant loads – dissolved inorganic nitrogen

Target by 2018: *At least a 50 per cent reduction in anthropogenic end-of-catchment dissolved inorganic nitrogen loads in priority areas.*

Grade	Status	Criteria for June 2015	Colour
A	Very good progress towards target – "A high reduction in catchment load"	35% or greater reduction in load	Dark green
B	Good progress towards target – "A significant reduction in catchment load"	30 to <35% reduction in load	Light green
C	Moderate progress towards target – "A small reduction in catchment load"	25 to <30% reduction in load	Yellow
D	Poor progress towards target – "No or small increase in the catchment load"	20 to <25% reduction in load	Orange
E	Very poor progress towards target – "Increase in the catchment load"	Less than 20% reduction in load	Red

Catchment pollutant loads – sediment, particulate nitrogen, particulate phosphorus

Target by 2018: *At least a 20 per cent reduction in anthropogenic end-of-catchments loads of sediment and particulate nutrients in priority areas.*

Grade	Status	Criteria for June 2015	Colour
A	Very good progress towards target – "A high reduction in catchment load"	14% or greater reduction in load	Dark green
B	Good progress towards target – "A significant reduction in catchment load"	13 to <14% reduction in load	Light green
C	Moderate progress towards target – "A small reduction in catchment load"	11 to <13% reduction in load	Yellow
D	Poor progress towards target – "No or small increase in the catchment load"	9 to <11% reduction in load	Orange
E	Very poor progress towards target – "Increase in the catchment load"	Less than 9% reduction in load	Red

Catchment pollutant loads – pesticides (toxic equivalents)

Target by 2018: *At least a 60 per cent reduction in end-of-catchment pesticide loads in priority areas.*

Grade	Status	Criteria for June 2015	Colour
A	Very good progress towards target – "A high reduction in catchment load"	42% or greater reduction in load	Dark green
B	Good progress towards target – "A significant reduction in catchment load"	36 to <42% reduction in load	Light green
C	Moderate progress towards target – "A small reduction in catchment load"	30 to <36% reduction in load	Yellow
D	Poor progress towards target – "No or small increase in the catchment load"	24 to <30% reduction in load	Orange
E	Very poor progress towards target – "Increase in the catchment load"	Less than 24% reduction in load	Red

Great Barrier Reef-wide

Catchment modelling has been used to estimate the long-term annual load reductions due to the adoption of improved management practices. The model is run over a fixed climate period to account for climate variability.

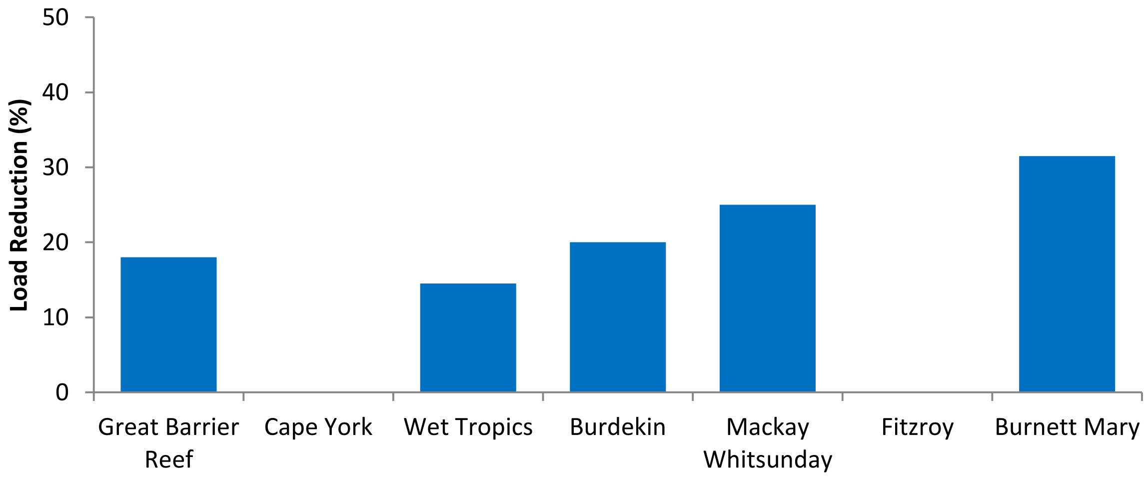
Dissolved inorganic nitrogen

E
18.1%

Target: At least a 50 per cent reduction in anthropogenic end-of-catchment dissolved inorganic nitrogen loads in priority areas by 2018.

Very poor progress: The estimated annual average dissolved inorganic nitrogen (DIN) load leaving catchments reduced by 18.1 per cent to June 2015. The greatest cumulative reduction (31.5 per cent) was in the Burnett Mary region. The greatest annual reduction was from the Burdekin region at four per cent, for a total of 20 per cent. The reductions in DIN in the Burdekin were predominantly due to improved nutrient management in cane resulting in reduced DIN losses.

Cumulative Dissolved Inorganic Nitrogen load reductions to 2014-2015



Note: Dissolved inorganic nitrogen reductions are only modelled for regions where sugarcane is grown.

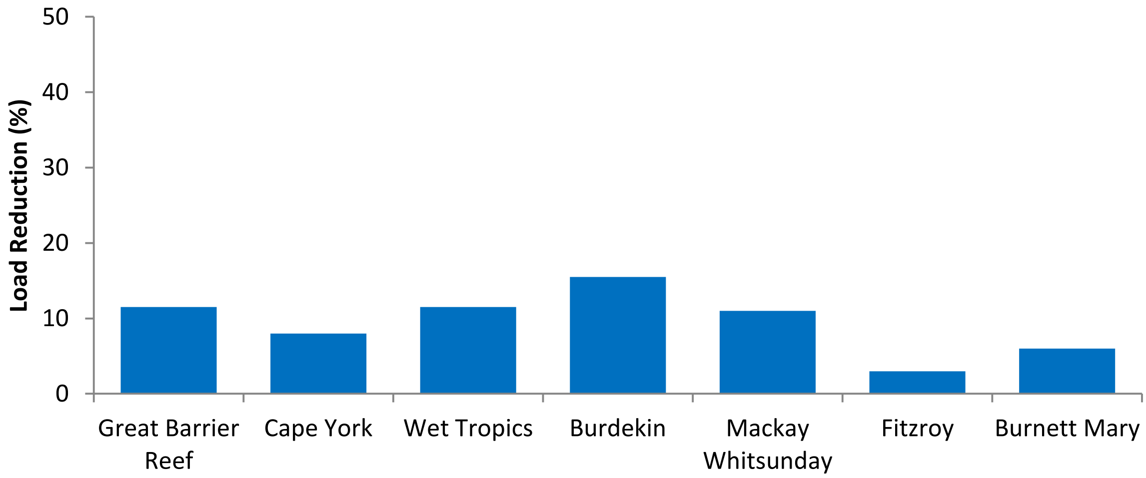
Particulate nitrogen

C
11.6%

Target: At least a 20 per cent reduction in anthropogenic end-of-catchment loads of particulate nutrients in priority areas by 2018.

Moderate progress: The estimated average annual particulate nitrogen load leaving catchments reduced by 11.6 per cent to June 2015. The greatest cumulative reduction (15.3 per cent) was in the Burdekin region, with 0.3 per cent reduction for the year. The reductions in the Burdekin were predominantly due to improved grazing management resulting in higher ground cover with a small number of projects in gully remediation.

Cumulative Particulate Nitrogen load reductions to 2014-2015



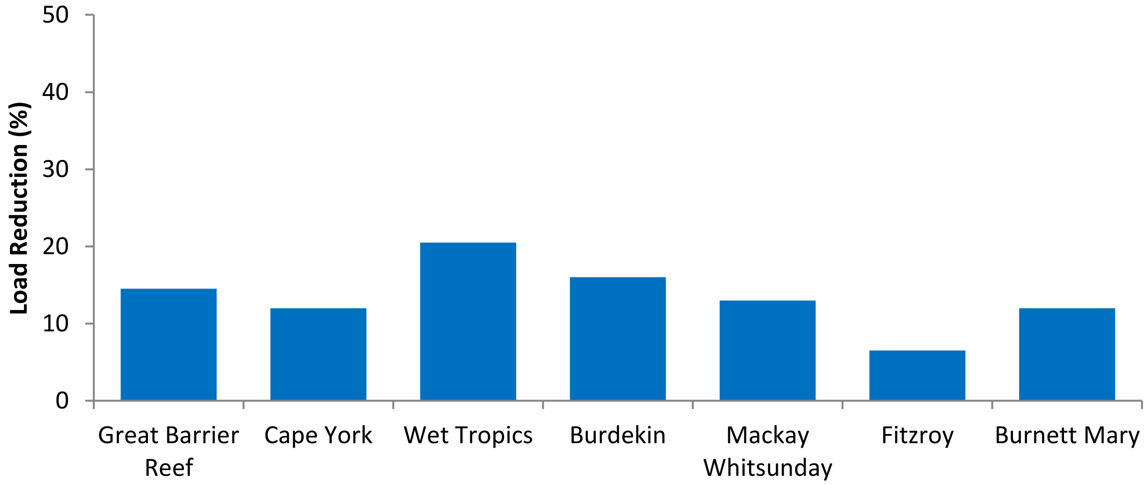
Particulate phosphorus

A
14.7%

Target: At least a 20 per cent reduction in anthropogenic end-of-catchment loads of particulate nutrients in priority areas by 2018.

Very good progress: The estimated average annual particulate phosphorus load leaving catchments reduced by 14.7 per cent by June 2015. The greatest cumulative reduction was from the Wet Tropics region (20.7 per cent). There were small reductions in particulate phosphorus loads in the past year (less than half a per cent) in Wet Tropics, Burdekin, Mackay Whitsunday and Fitzroy regions.

Cumulative Particulate Phosphorus load reductions to 2014-2015



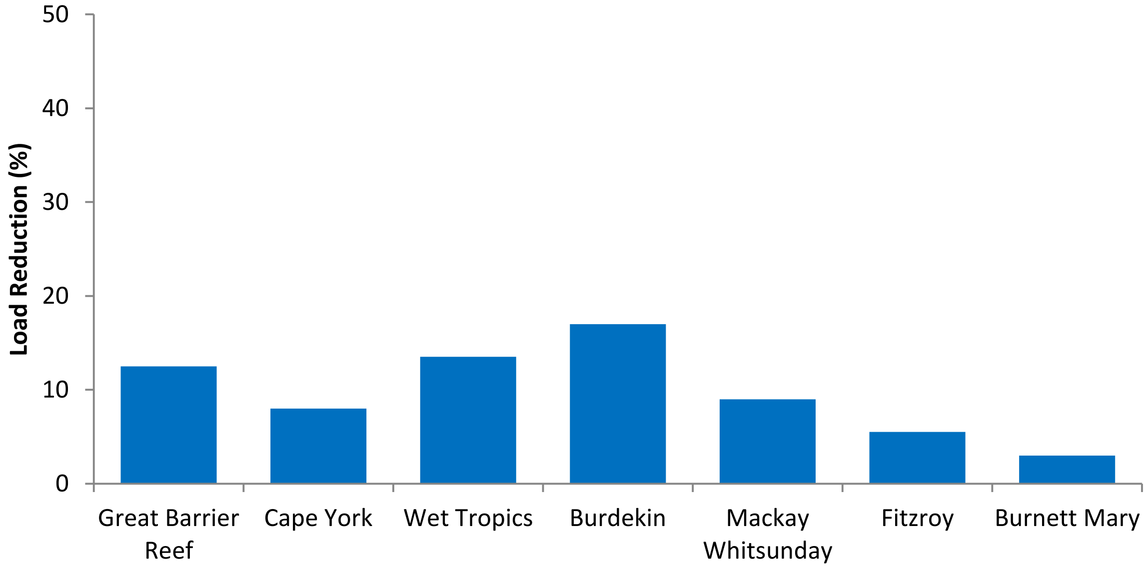
Sediment

C
12.3%

Target: At least a 20 per cent reduction in anthropogenic end-of-catchment loads of sediment in priority areas by 2018.

Moderate progress: The estimated average annual sediment load leaving catchments reduced by 12.3 per cent by June 2015. The greatest cumulative reduction was from the Burdekin region with 17.2 per cent. The largest reduction for the year was from the Fitzroy region at one per cent for a total of 5.5 per cent. The reductions in the Burdekin were predominantly due to improved grazing management resulting in higher ground cover with a small number of projects in gully remediation. Wet Tropics, Burdekin and Mackay Whitsunday regions all had small reductions (less than half a per cent) for the year.

Cumulative Total Suspended Sediment load reductions to 2014-2015

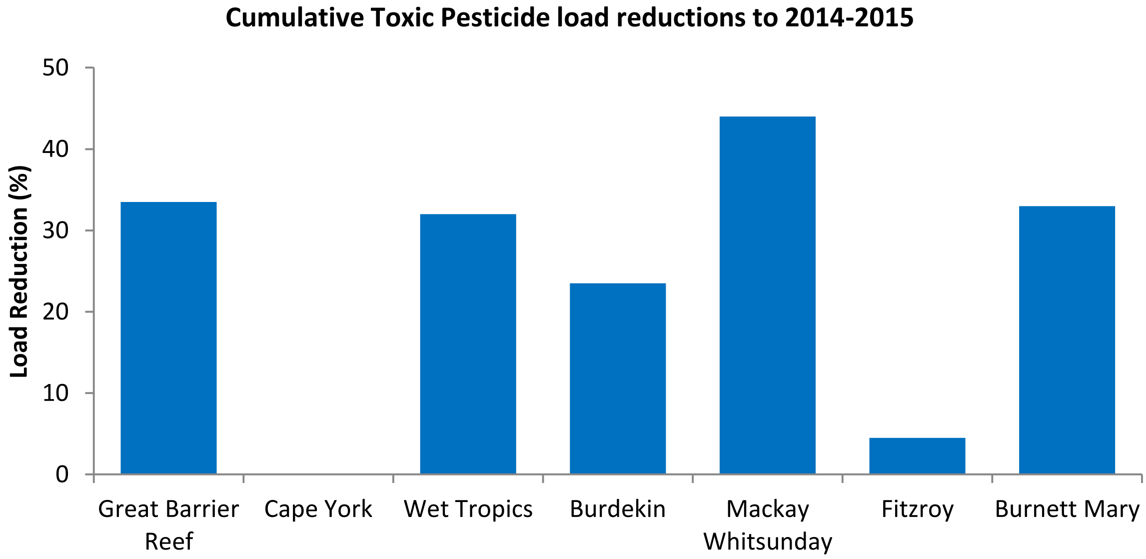


Pesticides

C
33.7%

Target: At least a 60 per cent reduction in end-of-catchment pesticides loads in priority areas by 2018.

Moderate progress: The estimated annual average toxic pesticide load leaving catchments reduced by 33.7 per cent by June 2015. The greatest cumulative reduction was the Mackay Whitsunday region with 44 per cent. The greatest annual reductions were from the Burdekin (23.6 per cent) and Wet Tropics (31.9 per cent) regions, an annual reduction of 3.6 per cent and 3.4 per cent respectively. The reductions in the Burdekin toxic loads were predominantly due to improved pesticide management in cane with a 10 per cent shift out of high to moderate risk practices into low and moderate-low risk management practices. Similarly for the Wet Tropics, the reductions in toxic loads were predominantly due to improved pesticide management in cane with a three per cent shift out of high to moderate risk practices into low and moderate-low risk management practices.



Note: No pesticide management data is available for Cape York.

Cape York

There was no change in load reductions in 2014-15 because only a small number of projects were undertaken in the Cape York region.

Dissolved inorganic nitrogen

Dissolved inorganic nitrogen reductions are only modelled in regions with significant sugarcane areas and investments in nitrogen reduction take place.

Particulate nitrogen

E **8%**

Target: At least a 20 per cent reduction in anthropogenic end-of-catchment loads of particulate nutrients in priority areas by 2018.

Very poor progress: The estimated average annual particulate nitrogen load leaving catchments remained at eight per cent by June 2015.

Particulate phosphorus

C **12%**

Target: At least a 20 per cent reduction in anthropogenic end-of-catchment loads of particulate nutrients in priority areas by 2018.

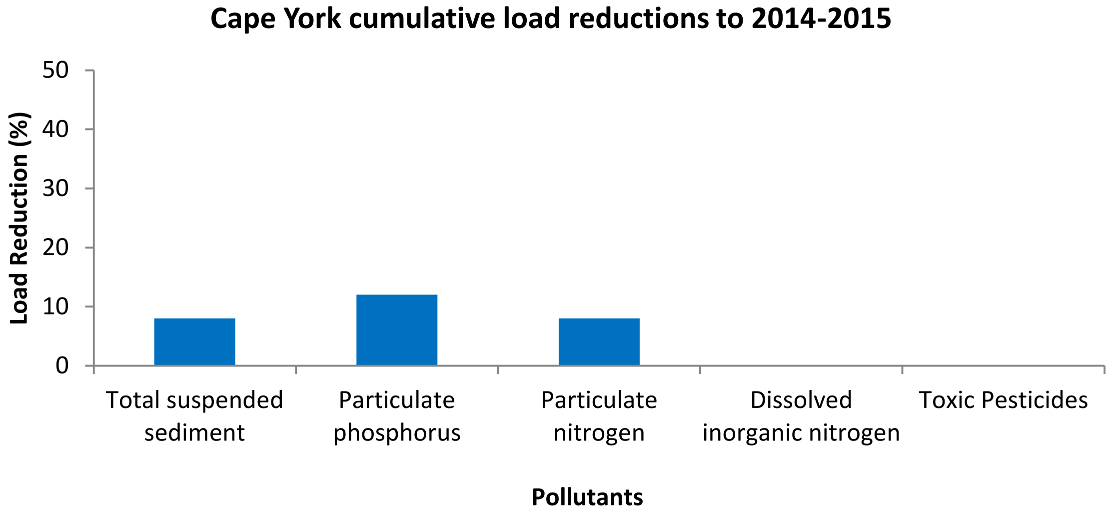
Moderate progress: The estimated average annual particulate phosphorus load leaving catchments remained at 12 per cent by June 2015.

Sediment

E **8%**

Target: At least a 20 per cent reduction in anthropogenic end-of-catchment loads of sediment in priority areas by 2018.

Very poor progress: The estimated average annual sediment load leaving catchments remained at eight per cent by June 2015.



Note:

- Dissolved inorganic nitrogen reductions are only modelled in regions with significant sugarcane areas.
- No pesticide management data is available for Cape York.

Wet Tropics

Dissolved inorganic nitrogen

E
14.7%

Target: At least a 50 per cent reduction in anthropogenic end-of-catchment dissolved inorganic nitrogen loads in priority areas by 2018.

Very poor progress: The estimated annual average dissolved inorganic nitrogen load leaving catchments decreased by 0.2 per cent to 14.7 per cent at June 2015.

Particulate nitrogen

C
11.6%

Target: At least a 20 per cent reduction in anthropogenic end of catchment loads of particulate nutrients in priority areas by 2018.

Moderate progress: The estimated annual average particulate nitrogen load leaving catchments decreased to 11.6 per cent at June 2015.

Particulate phosphorus

A
20.7%

Target: At least a 20 per cent reduction in anthropogenic end of catchment loads of particulate nutrients in priority areas by 2018.

Very good progress: The estimated annual average particulate phosphorus load leaving catchments decreased by 0.2 per cent to 20.7 per cent at June 2015, exceeding the target.

Sediment

B
13.6%

Target: At least a 20 per cent reduction in anthropogenic end of catchment loads of sediment in priority areas by 2018.

Good progress: The estimated annual average total suspended sediment load leaving catchments decreased to 13.6 per cent at June 2015.

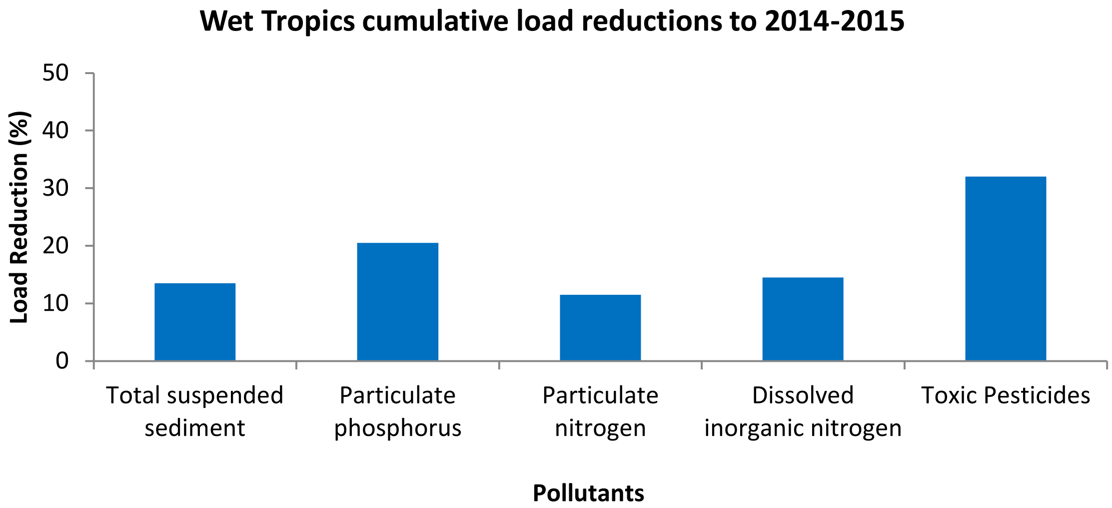
Pesticides

C

31.9%

Target: At least a 60 per cent reduction in end-of-catchment pesticide loads in priority areas by 2018.

Moderate progress: The estimated annual average toxic equivalent pesticide load leaving catchments reduced by 31.9 per cent, down 3.4 per cent to June 2015.



Note: Land management changes in the horticulture (other than bananas) and dairy industries have not been modelled.

Burdekin

Dissolved inorganic nitrogen

D
20%

Target: At least a 50 per cent reduction in anthropogenic end-of-catchment dissolved inorganic nitrogen loads in priority areas by 2018.

Poor progress: The estimated annual average dissolved inorganic nitrogen load leaving catchments reduced by 20 per cent to June 2015, a reduction of four per cent for the year.

Particulate nitrogen

A
15.3%

Target: At least a 20 per cent reduction in anthropogenic end-of-catchment loads of particulate nutrients in priority areas by 2018.

Very good progress: The estimated annual average particulate nitrogen load leaving catchments reduced by 15.3 per cent to June 2015, a reduction of 0.3 per cent for the year.

Particulate phosphorus

A
15.8%

Target: At least a 20 per cent reduction in anthropogenic end-of-catchment loads of particulate nutrients in priority areas by 2018.

Very good progress: The estimated annual average particulate phosphorus load leaving catchments reduced by 15.8 per cent to June 2015, a reduction of 0.3 per cent for the year.

Sediment

A
17.2%

Target: At least a 20 per cent reduction in anthropogenic end-of-catchment loads of sediment in priority areas by 2018.

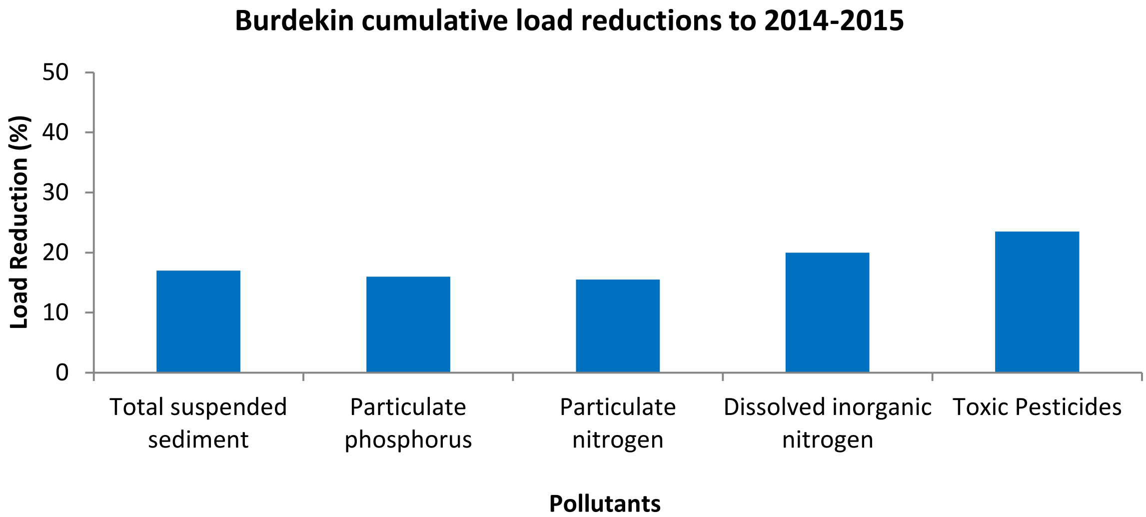
Very good progress: The estimated annual average total suspended sediment load leaving catchments decreased by 0.2 per cent to 17.2 per cent at June 2015.

Pesticides

E
23.6%

Target: At least a 60 per cent reduction in end of catchment pesticide loads in priority areas by 2018.

Very poor progress: The estimated annual average toxic equivalent pesticide load leaving catchments reduced by 23.6 per cent, down 3.6 per cent at June 2015.



Note: Land management changes in the horticulture industry have not been modelled.

Mackay Whitsunday

Dissolved inorganic nitrogen

C
25.1%

Target: At least a 50 per cent reduction in anthropogenic end-of-catchment dissolved inorganic nitrogen loads in priority areas by 2018.

Moderate progress: The estimated annual average dissolved inorganic nitrogen load leaving catchments reduced by 25.1 per cent to June 2015, a reduction of 1.1 per cent for the year.

Particulate nitrogen

C
11.1%

Target: At least a 20 per cent reduction in anthropogenic end-of-catchment loads of particulate nutrients in priority areas by 2018.

Moderate progress: The estimated annual average particulate nitrogen load leaving catchments reduced by 0.1 per cent for a total of 11.1 per cent at June 2015.

Particulate phosphorus

B
13.1%

Target: At least a 20 per cent reduction in anthropogenic end-of-catchment loads of particulate nutrients in priority areas by 2018.

Good progress: The estimated annual average particulate phosphorus load leaving catchments reduced by 0.1 per cent for a total of 13.1 per cent at June 2015.

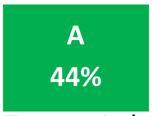
Sediment

D
9.1%

Target: At least a 20 per cent reduction in anthropogenic end-of-catchment loads of sediment in priority areas by 2018.

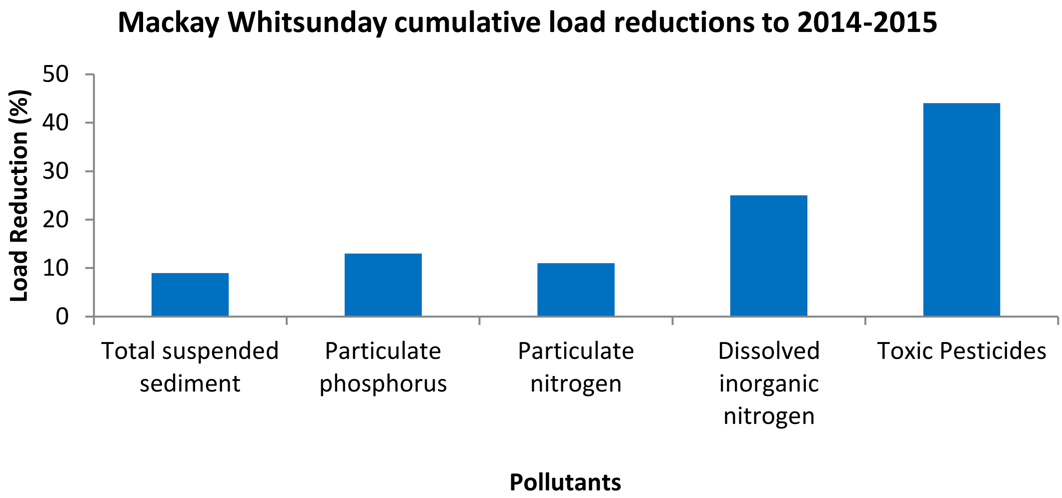
Poor progress: The estimated annual average total suspended sediment load leaving catchments reduced by 0.1 per cent for a total of 9.1 per cent t at June 2015.

Pesticides



Target: At least a 60 per cent reduction in end-of-catchment pesticide loads in priority areas by 2018.

Very good progress: The estimated annual average toxic pesticide load leaving catchments reduced by 44 per cent to June 2015, a reduction of three per cent for the year.



Note: Land management changes in the horticulture industry have not been modelled.

Fitzroy

Dissolved inorganic nitrogen
Dissolved inorganic nitrogen reductions are only modelled in regions with significant sugarcane areas and investments in nitrogen reduction take place.

Particulate nitrogen

E
3.2%

Target: At least a 20 per cent reduction in anthropogenic end-of-catchment loads of particulate nutrients in priority areas by 2018.

Very poor progress: The estimated annual average particulate nitrogen load leaving catchments reduced by 0.2 per cent for the year, a total reduction of 3.2 per cent at June 2015.

Particulate phosphorus

E
6.7%

Target: At least a 20 per cent reduction in anthropogenic end-of-catchment loads of particulate nutrients in priority areas by 2018.

Very poor progress: The estimated annual average particulate phosphorus load leaving catchments reduced by 0.2 per cent to 6.7 per cent at June 2015.

Sediment

E
5.5%

Target: At least a 20 per cent reduction in anthropogenic end-of-catchment loads of sediment in priority areas by 2018.

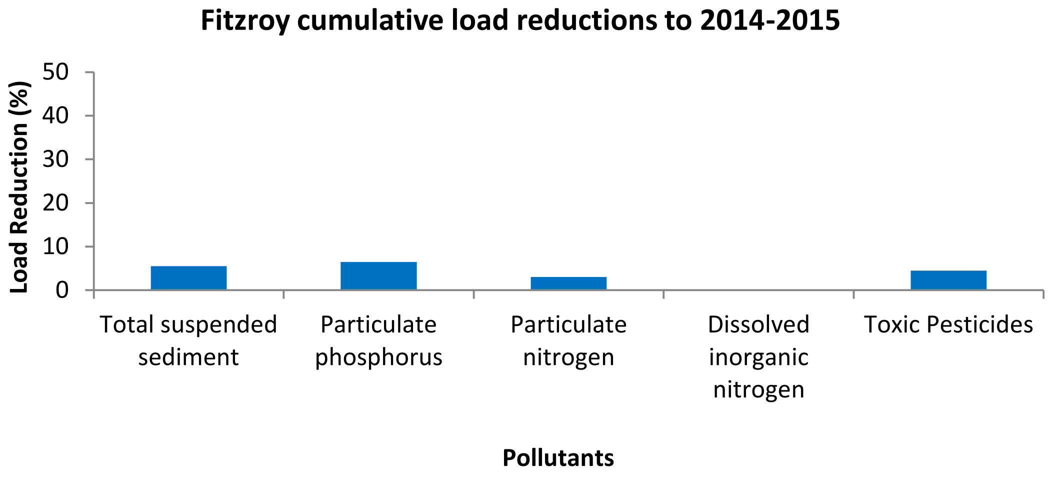
Very poor progress: The estimated annual average total suspended sediment load leaving catchments reduced by 5.5 per cent at June 2015. The Fitzroy region achieved the greatest reduction in sediment loads compared to other regions (an additional one per cent sediment reduction since last year).

Pesticides

E
4.3%

Target: At least a 60 per cent reduction in end-of-catchment pesticide loads in priority areas by 2018.

Very poor progress: The estimated annual average toxic pesticide load leaving catchments reduced by 4.3 per cent, down 0.3 per cent at June 2015.



Note:

- Dissolved inorganic nitrogen reductions are only modelled for regions with significant sugarcane areas.
- Land management changes in horticulture have not been modelled.

Burnett Mary

Dissolved inorganic nitrogen

B
31.5%

Target: At least a 50 per cent reduction in anthropogenic end-of-catchment dissolved inorganic nitrogen loads in priority areas by 2018.

Good progress: The estimated annual average dissolved inorganic nitrogen load leaving catchments remained at 31.5 per cent at June 2015.

Particulate nitrogen

E
6%

Target: At least a 20 per cent reduction in anthropogenic end-of-catchment loads of particulate nutrients in priority areas by 2018.

Very poor progress: The estimated annual average particulate nitrogen load leaving catchments remained at six per cent by June 2015.

Particulate phosphorus

C
12%

Target: At least a 20 per cent reduction in anthropogenic end-of-catchment loads of particulate nutrients in priority areas by 2018.

Moderate progress: The estimated annual average particulate phosphorus load leaving catchments remained at 12 per cent at June 2015.

Sediment

E
3%

Target: At least a 20 per cent reduction in anthropogenic end-of-catchment loads of sediment in priority areas by 2018.

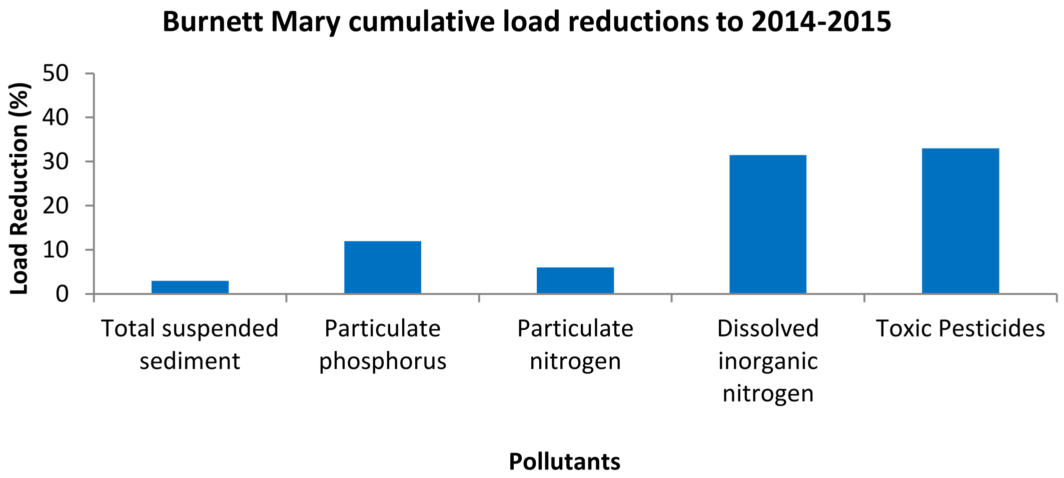
Very poor progress: The estimated annual average total suspended sediment load leaving catchments remained at three per cent by June 2015.

Pesticides

C
33.1%

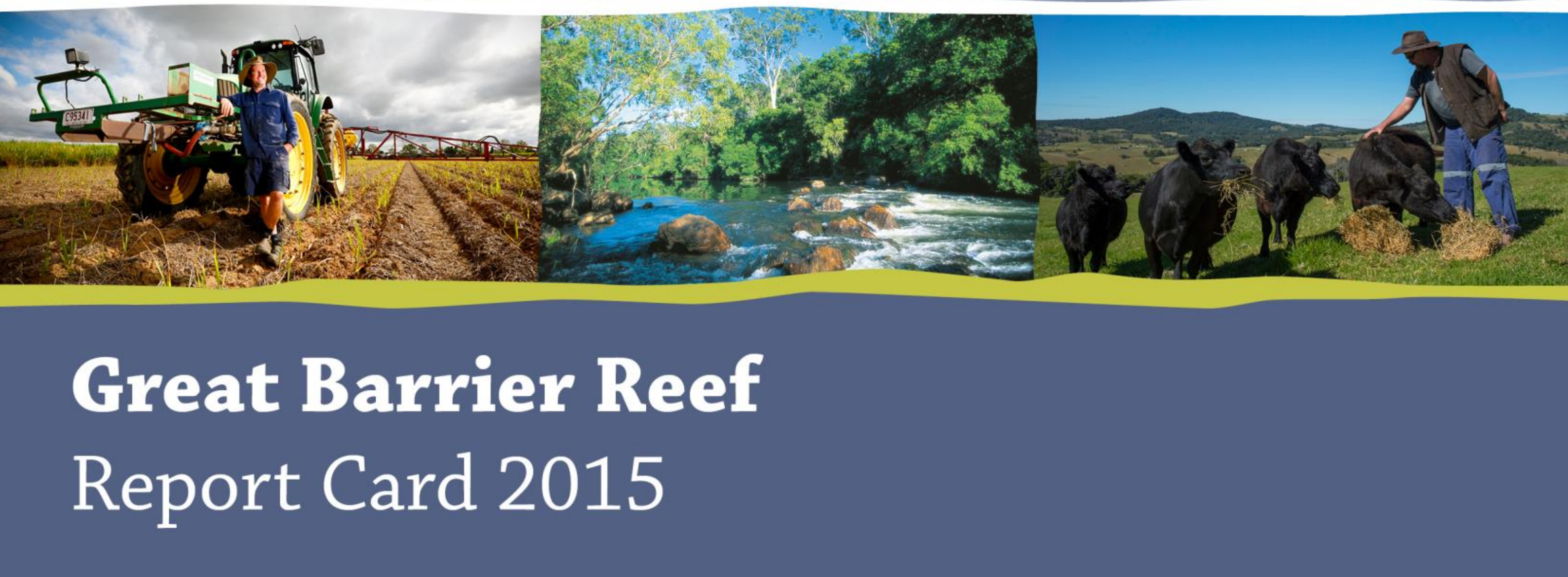
Target: At least a 60 per cent reduction in end of catchment pesticide loads in priority areas by 2018.

Moderate progress: The estimated annual average toxic pesticide load leaving catchments reduced by 0.1 per cent for a total of 33.1 per cent by June 2015.



Note: Land management changes in the horticulture industry have not been modelled.

Marine results



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Marine results

The objective of the Marine Monitoring Program (Great Barrier Reef Marine Park Authority 2016b) is *to assess trends in ecosystem health and resilience indicators for the Great Barrier Reef in relation to water quality and its linkages to end-of-catchment loads.* The Marine Monitoring Program directly supports the Reef Water Quality Protection Plan 2013 to *ensure that by 2020 the quality of water entering the Reef from adjacent catchments has no detrimental impact on the health and resilience of the Great Barrier Reef* (Department of the Premier and Cabinet 2013).

An ecosystem is considered healthy if it is able to maintain its structure and function in the face of external pressures (Costanza and Mageau 1999). A healthy reef is resilient – it has the ability to resist and/or recover quickly from disturbances while undergoing change, so as to still retain essentially the same function, structure, identity, and feedbacks (Walker 2004). The Reef ecosystem is underpinned by physical, chemical and ecological processes (Figure 1) which are interconnected, and the overall health of the ecosystem depends on them all being in good condition.

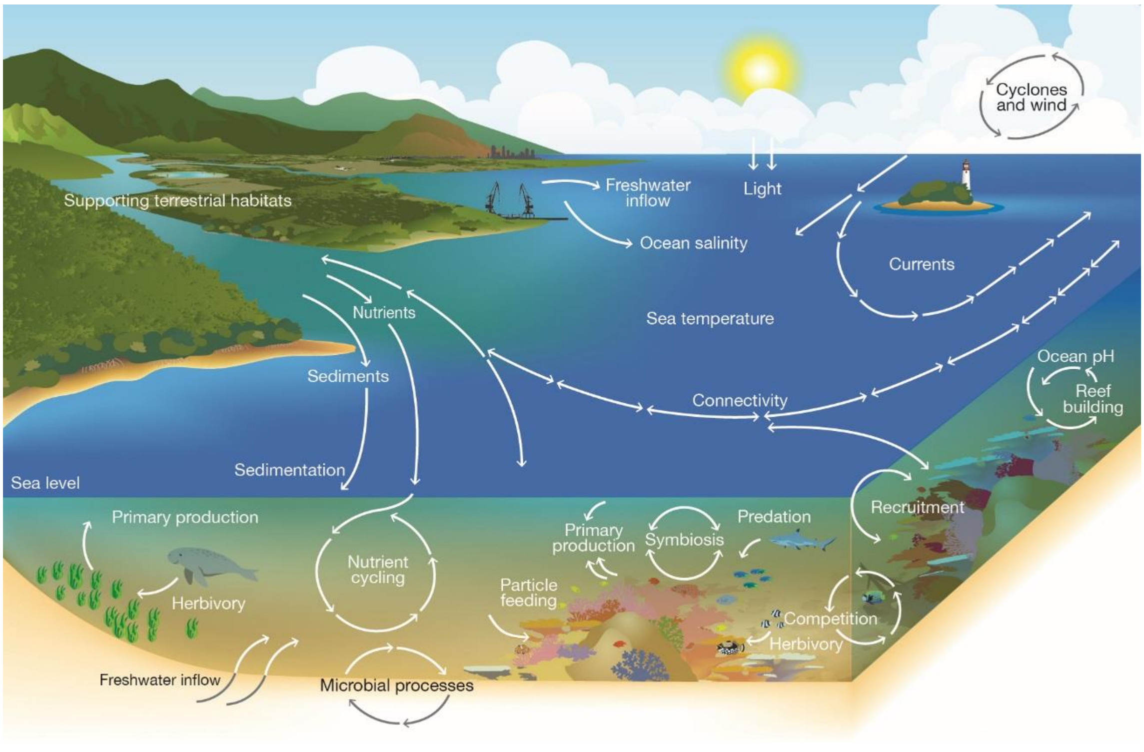


Figure 1 Major physical, chemical and ecological processes
The health of the reef ecosystem is assessed by considering its physical, chemical and ecological processes as well as the condition of its supporting terrestrial habitats. Outbreaks of pests and diseases are also considered as a guide to overall health. Reproduced from Outlook Report 2014 (Great Barrier Reef Marine Park Authority 2014b)

The Marine Monitoring Program covers the reef inshore environment (which makes up approximately eight per cent of the Great Barrier Reef Marine Park) and collects valuable information on long-term changes in the condition of water quality , seagrass and coral reefs. The main drivers, pressures and impacts on the Reef are described below, followed by an assessment of the current condition and trend of inshore water quality (Gallen *et al.* 2016; Lønborg *et al.* 2016; Tracey *et al.* 2016), seagrass (McKenzie *et al.* 2016) and coral (Thompson *et al.* 2016) at the reef-wide and regional level.

Pressures and impacts

Pressures from practices associated with agriculture (nutrients, pesticides and sediment from catchment runoff) continue to have an adverse impact on the quality of water entering the reef lagoon. Water in the inshore area is highly influenced by land-based runoff, particularly during the wet season (through increased river discharge), with flow-on effects for ecosystem health (Álvarez-Romero *et al.* 2013; Brodie *et al.* 2013a; Brodie *et al.* 2013b). Water quality at mid- and outer-shelf sites is generally good to very good overall, because it is less influenced by river discharge and catchment runoff. The condition of the inshore area is also strongly influenced by severe weather events, such as tropical cyclones and floods, which have had an impact in all regions historically.

Freshwater inflow

The 2014-15 wet season was characterised by neutral (neither El Niño nor La Niña) climatic conditions. Freshwater discharge following below average rainfall was below the long-term median for the reef catchment, for the first time since 2004-05 (Figure 2) (Lønborg *et al.* 2016).

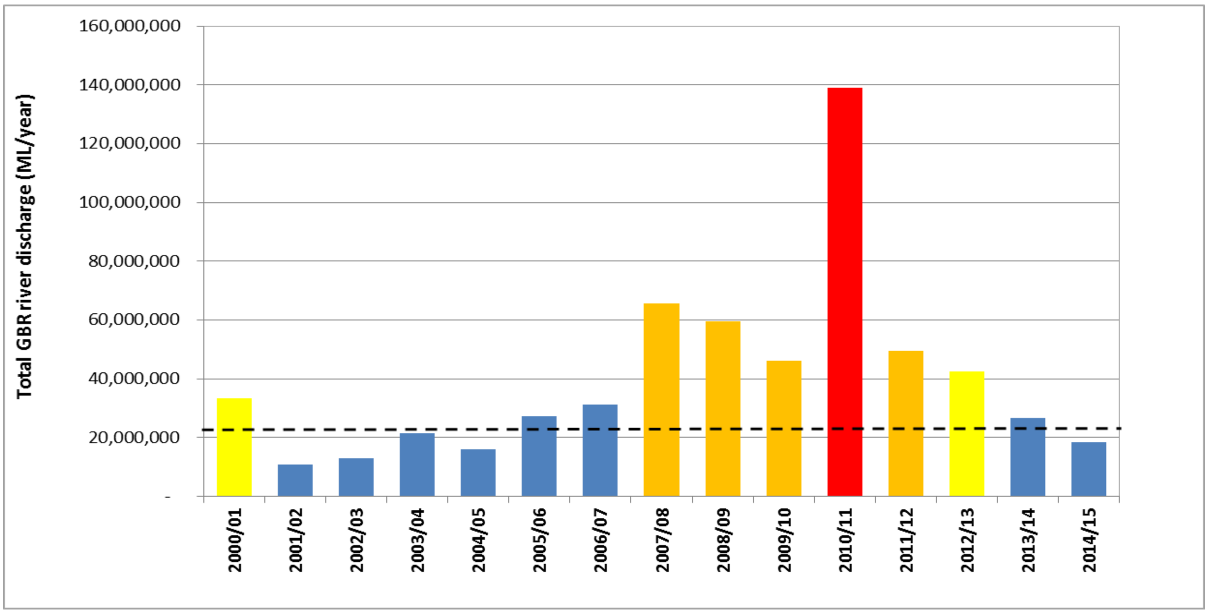


Figure 2: Long-term wet season discharge in megalitres per water year for main Reef catchment river basins. Annual discharge above the long-term median from water year 1970-1971 to 1999-2000 of 21,961,505 megalitres is shown in yellow (1.5-2 times), orange (2 to 3 times) and red (more than 3 times). Discharge below 1.5 times the long-term median is shown in blue. Reproduced from (Lønborg *et al.* 2016). Source: DNRM, http://watermonitoring.dnrm.qld.gov.au/host.htm

Impacts of nutrients, sediments and pesticides in catchment runoff

In general, the observed river discharges for 2014-15 were very much below long-term average discharge, and consequently the observed loads of sediment, nutrient and pesticides were atypical. In relative terms, loads of dissolved inorganic nitrogen, particulate nitrogen and pesticides remained highest in the Wet Tropics compared to all other catchments (Figure 3). Comparisons of pollutant loads delivered in 2014-15 (Figure 3) showed that Cape York, Wet Tropics and Mackay Whitsunday regions had lower loads of sediment and particulate nitrogen and phosphorus, relative to 2013-14 (Garzon-Garcia *et al.* 2015), correlating with below long-term mean and median discharge in 2014-15 (Figure 3). However, the Burdekin region had higher loads of sediment, particulate nitrogen and phosphorus but lower discharge compared to 2013-14 (Garzon-Garcia *et al.* 2015) and lower than average discharge in 2014-15 (Figure 3). Although the Burdekin had larger loads in 2014-15 than the previous year this difference is considered negligible due to the very much below average

river discharge compared to an annual average load. The Fitzroy and Burnett Mary had increased loads of sediment, dissolved inorganic nitrogen, particulate nitrogen and phosphorus compared to 2013-14 (Garzon-Garcia *et al.* 2015). The relatively high mean discharge (and higher than long-term median discharge) in the Burnett Mary was related to cyclone activity (see later section). Upon entering the lagoon, fine silt and clay may have been carried by prevailing currents, moving nutrients and other contaminants throughout the Reef.

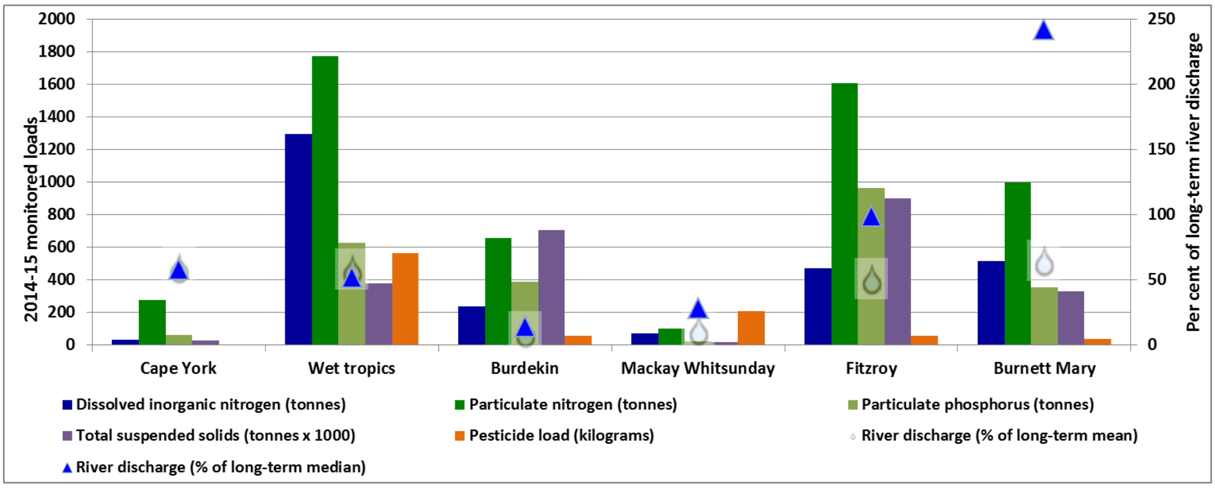


Figure 3: Combined annual monitored pollutant loads and discharge from major rivers in each region. Note: pesticides are not monitored in Cape York. River discharge is presented as a per cent of the long-term average (mean) or median. Source: (Department of Science, Information Technology and Innovation 2016).

Crown-of-thorns starfish

Outbreaks of the coral-eating crown-of-thorns starfish are one of the main direct causes of the decline in coral cover reef-wide (Osborne *et al.* 2011). An analysis of long-term monitoring data attributed 42 per cent of the decline in coral cover between 1985 and 2012 to the starfish (De'ath *et al.* 2012)

There have been four major outbreaks on the reef since the 1960s (in the 1960s, late 1970s, early 1990s and 2010). The fourth and current outbreak began in 2010. In 2013-14 the densities in the ‘initiation zone’ from Lizard Island to Cairns were at the highest levels recorded since 1986 (Miller and Sweatman 2013), but the same area was not surveyed this year. In 2014-15, outbreaks of crown-of-thorns starfish were recorded at 18 per cent of reefs monitored by the Australian Institute of Marine Science Long Term (Reef) Monitoring Program (Australian Institute of Marine Science Unpublish) (Figure 4).

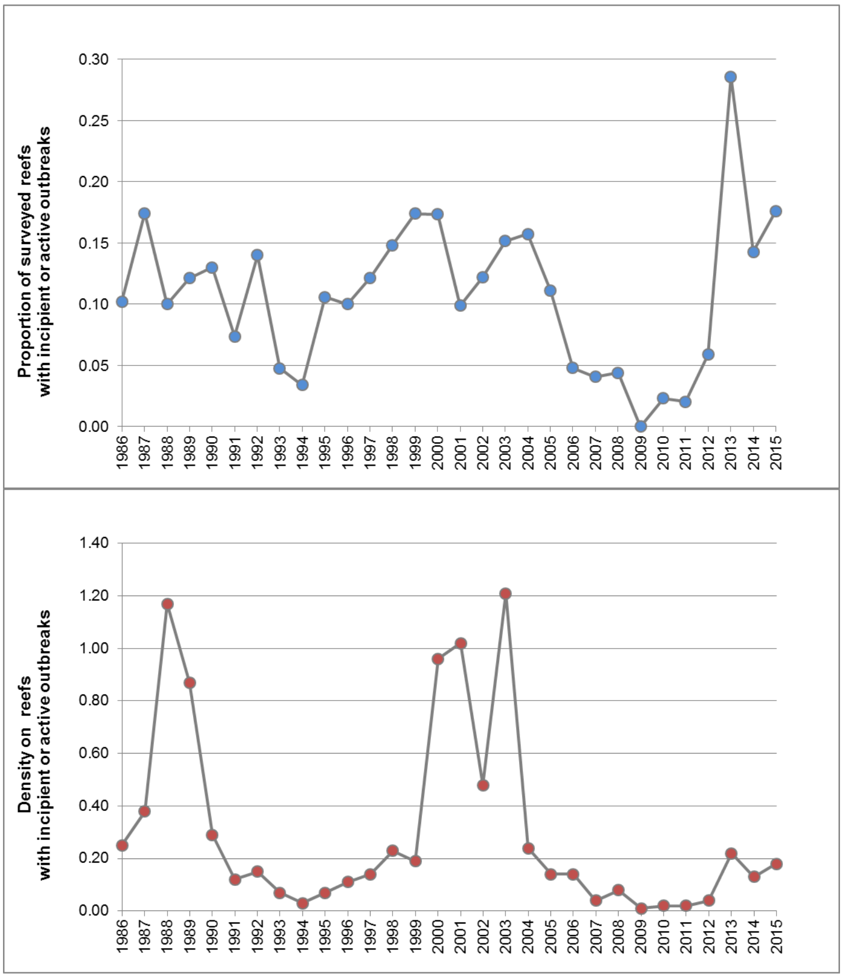


Figure 4: Extent of the crown-of-thorns starfish outbreaks in the Great Barrier Reef from 1985 to 2015
Density is the number of starfish per two minute manta tow. Note that the same reefs are not necessarily surveyed every year and some of the outbreaks of crown-of-thorns starfish overlap in time. Source: Australian Institute of Marine Science Long-term Monitoring Program (http://data.aims.gov.au/waCOTSPage/cotspage.jsp).

An active outbreak of crown-of-thorns starfish occurs when the starfish consume coral tissue faster than corals can grow. This is generally considered to be more than about 15 starfish per hectare when coral cover is moderate to high (Moran and De'ath 1992). However, many of the inshore and mid-shelf reefs affected by multiple severe weather events in recent years have lower coral cover (Thompson *et al.* 2016) and, therefore, reduced capacity to cope with these levels of starfish.

The current crown-of-thorns starfish outbreak is largely limited to the northern part of the reef and so has not reached reef-wide densities monitored in previous outbreaks (Figure 4). However, based on previous population increases, the outbreak is likely to move south in the coming years. Crown-of-thorns starfish outbreaks follow a pattern where they tend to spread north and south from the ‘initiation zone’, migrating south towards Innisfail between three and five years later, then Townsville five to eight years later, before reaching as far south as the Mackay region about 12 to 15 years after the outbreak started. There also appears to be a separate population near the Swains Reefs.

The primary outbreaks of crown-of-thorns starfish originate following exposure to excess nutrients in runoff (Fabricius *et al.* 2010; Furnas *et al.* 2013) and a change in climatic conditions (Wooldridge and Brodie 2015). The link between outbreaks and poor water quality, especially the level of

nutrients in flood waters, has been greatly strengthened after the multiple floods and severe weather events from 2009 to 2011 (Fabricius *et al.* 2010; Furnas *et al.* 2013; Brodie *et al.* 2013b).

Cyclones

Cyclone damage is one of several factors contributing to major losses in coral across the whole Great Barrier Reef (De'ath *et al.* 2012). Individual tropical cyclones can damage coral reefs on a regional scale (Great Barrier Reef Marine Park Authority 2011; Beeden *et al.* 2015; Wolff *et al.* 2016).

During 2014-15, severe Tropical Cyclones Marcia and Nathan affected the region (Bureau of Meteorology 2016a). Tropical Cyclone Marcia (category 5) affected the inshore fringing reefs in the southern Great Barrier Reef when it passed inland of the Keppel Island Group and crossed the coast at Shoalwater Bay (north northwest of Yeppoon) on 20 February 2015. There were approximately 960 reefs in the path of Tropical Cyclone Marcia. Aerial surveillance in the wake of the cyclone showed mangroves in the bay were largely intact and seagrass damage was patchy. The Great Barrier Reef Marine Park Authority's Eye on the Reef monitoring network recorded damage to coral in the Mackay-Capricorn region, including extreme damage to the structural integrity of some reefs, that was attributed to the high winds and physical damage from waves (Great Barrier Reef Marine Park Authority 2016a).

In the northern Great Barrier Reef, Tropical Cyclone Nathan (category 4) made landfall on 20 March 2015 at Yarranden, near Cape Flattery on the Cape York Peninsula. Following landfall, Nathan slowly tracked westwards across Cape York, emerging briefly over water again in Princess Charlotte Bay. Tropical cyclone Nathan maintained category 1 cyclone intensity all the way across Cape York Peninsula before entering the waters of the Gulf of Carpentaria on 21 March. The Great Barrier Reef Marine Park Authority's Eye on the Reef monitoring network recorded moderate and severe damage to coral reefs in the Cairns-Cooktown region. Monitoring also revealed impacts on seagrass abundance at Piper Reef and Shelburne Bay in Cape York (McKenzie et al. 2016), which were close to the path of the depression that strengthened into Tropical Cyclone Lam in February 2015 (Bureau of Meteorology 2016a).No information is available on the impacts on seagrass from Tropical Cyclone Nathan.

In the ten year period since the Marine Monitoring Program began in 2005, nine category 3 or above cyclones have affected the region. All of the category 5 cyclones that affected the region since 1970 have occurred in the last decade (including Tropical Cyclones Larry, Hamish, Yasi, Ita and Marcia) (Figure 5). The combined paths of all severe cyclones since 2005 have exposed more than 80 per cent of the region to gale force or stronger winds (Figure 6).

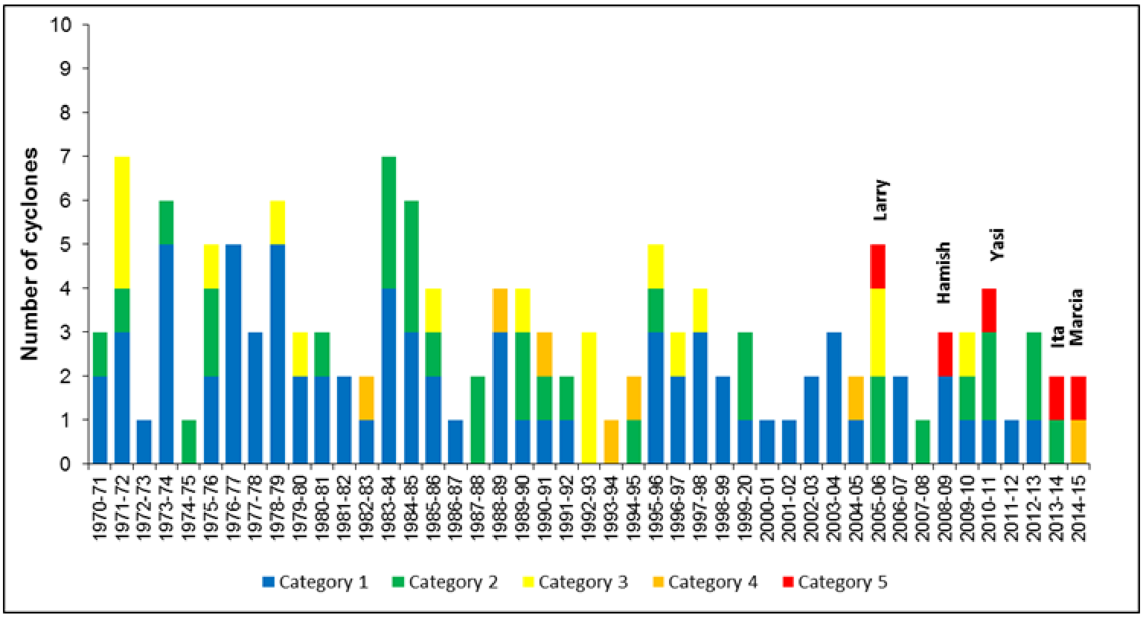


Figure 5: Number and severity of cyclones, 1970–2015
A number of severe cyclones have affected the region over recent years. Five category 5 cyclones have occurred in the last 10 years. Source: (Bureau of Meteorology 2016a).

The effect of multiple severe cyclones and associated floods on the health of the inshore area is still evident today (McKenzie *et al.* 2016; Thompson *et al.* 2016). Coral communities affected by Cyclone Ita in 2014 in the Wet Tropics are showing signs of recovery, consistent with the general increase in coral cover and recruitment of new corals evident on reefs affected by Cyclone Yasi in 2011 (Thompson *et al.* 2016).

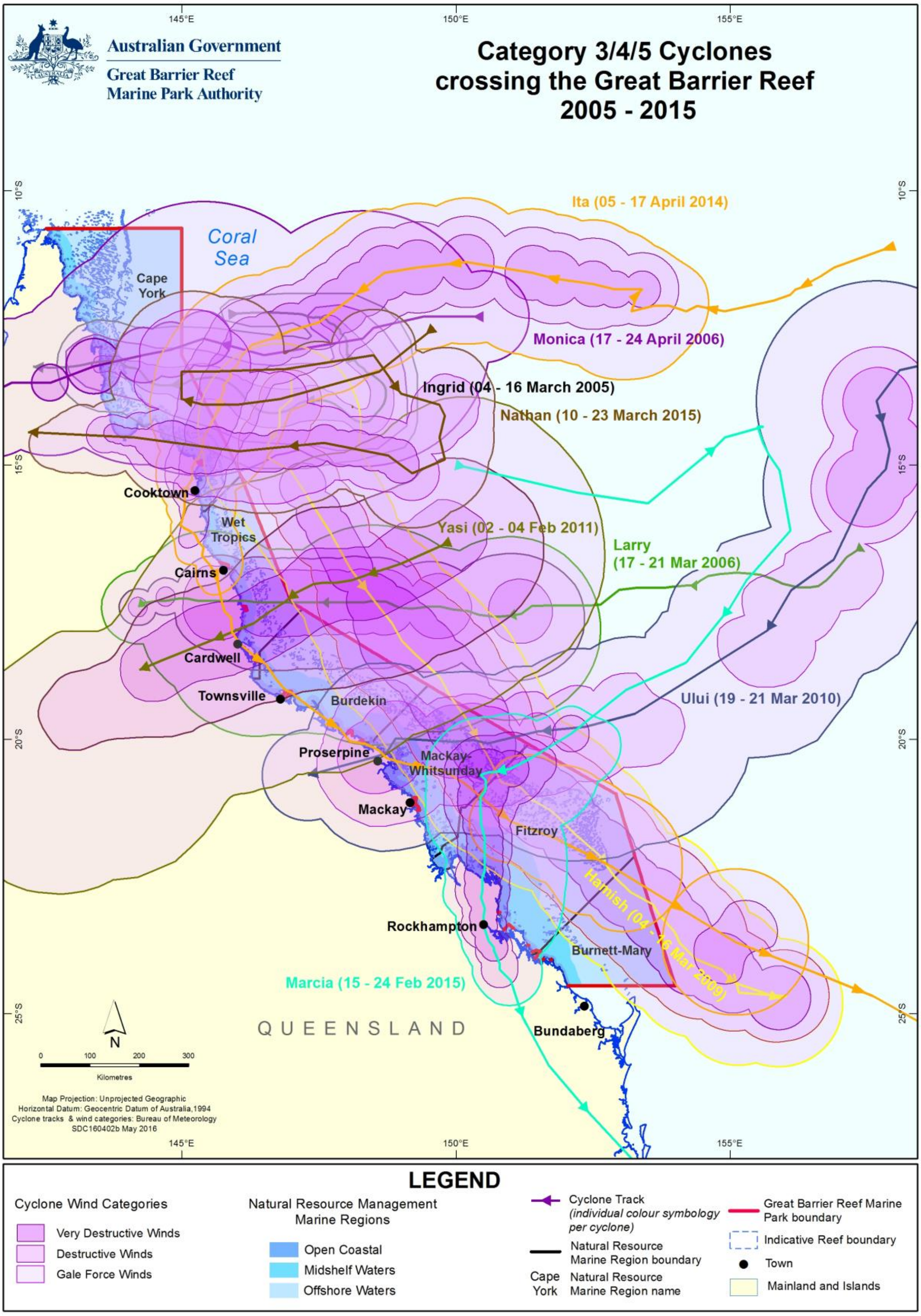


Figure 6: Cyclonic winds associated with category 3, 4 or 5 cyclones in the period 2005-2015
Source: (Bureau of Meteorology 2016a)

Significant losses of seagrass meadows occurred in the path of Tropical Cyclone Yasi (McKenzie *et al.* 2012). Seagrass communities are beginning to recover at locations that have been relatively free from disturbances in subsequent years (McKenzie *et al.* 2014; McKenzie *et al.* 2016).

The impacts of severe tropical cyclones on reefs may last for decades, and it may also take many years for diverse seagrass communities to re-establish (McKenzie *et al.* 2010; McKenzie and Campbell 2003; Birch and Birch 1984; McKenzie *et al.* 2012).

Elevated sea temperatures

Average sea surface temperatures in the Coral Sea have risen substantially over the past century. Since instrumental records began, 15 of the 20 warmest years have been in the past 20 years (Lough *et al.* 2012). The 2015 sea surface temperature anomaly in the Coral Sea was 0.47 degrees Celsius above average.

Influence of climate change

Climate change is recognised as the most serious threat to the Great Barrier Reef (Great Barrier Reef Marine Park Authority 2014a). Current and future climate change-related threats to the region's ecosystem include sea temperature increases, altered ocean currents, changed weather patterns, ocean acidification and rising sea level. Potential consequences for populations of species and groups of species and habitats are considered in many recent scientific studies (De'ath *et al.* 2012; Koch *et al.* 2013; Doropoulos *et al.* 2012; Poloczanska *et al.* 2013; Johnson and Marshall 2007; Reisinger *et al.* 2014). The effects, both individually and combined, are likely to have far-reaching consequences for the region's ecosystem and its Outstanding Universal Value as a World Heritage Area (De'ath *et al.* 2012; Poloczanska *et al.* 2012; Bustamante *et al.* 2012; Lough *et al.* 2012; Jones and Berkelmans 2014).

Cumulative impacts affecting resilience

The 2013 water quality scientific consensus statement (Brodie *et al.* 2013b) concluded that '*key Great Barrier Reef ecosystems are showing declining trends in condition due to continuing poor water quality, cumulative impacts of climate change and increasing intensity of extreme events*'. For example, coral cover on mid-shelf reefs along the developed coast of the central and southern Great Barrier Reef has declined to less than 50 per cent of what it was in 1985, while coral cover in the northern Great Barrier Reef has been less affected (De'ath *et al.* 2012).

The overall outlook for the reef is poor (Great Barrier Reef Marine Park Authority 2014b), due to a range of short-term acute and long-term chronic disturbances. The impact of individual disturbances on the reef depends on their frequency, duration and severity, as well as the state of the ecosystem (Great Barrier Reef Marine Park Authority 2014a; Osborne *et al.* 2011). Multiple acute disturbances in close succession usually have a combined negative effect on reef resilience that is greater than the effect of each disturbance in isolation.

A resilient coral community has high rates of recruitment and growth, which compensate for the losses from acute disturbances (e.g. cyclones). However, chronic pressures (e.g. poor water quality) may decrease the resilience of the reef ecosystem by slowing or inhibiting recovery from acute disturbances (Roff *et al.* 2013; McKenzie *et al.* 2012; Osborne *et al.* 2011; Meager and Limpus 2014; Jones and Berkelmans 2014; Folke *et al.* 2004).

Great Barrier Reef-wide

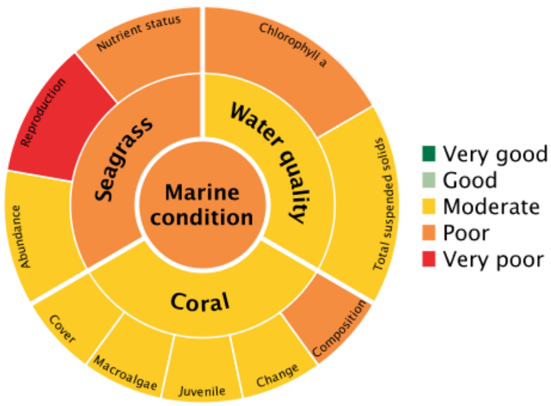


Figure 7: Overall condition of the inshore marine environment

The overall condition of the inshore marine environment remained poor in 2014-15 (Figure 7). Inshore water quality improved from poor to moderate. Pesticides were detected year round at all sites monitored across the reef. Inshore seagrass showed signs of recovery at locations that were relatively free from disturbances in recent years, but remained in poor condition overall. Inshore coral reefs improved from poor to moderate in 2014-15. Coral has continued to improve since 2011-12 when it was in its worst condition due to impacts from repeated disturbances.

Water quality

Inshore water quality for the reef was moderate in 2014-15 (Figure 8). The overall trend reflects the cumulative impacts of multiple floods and cyclones since 2007-08.

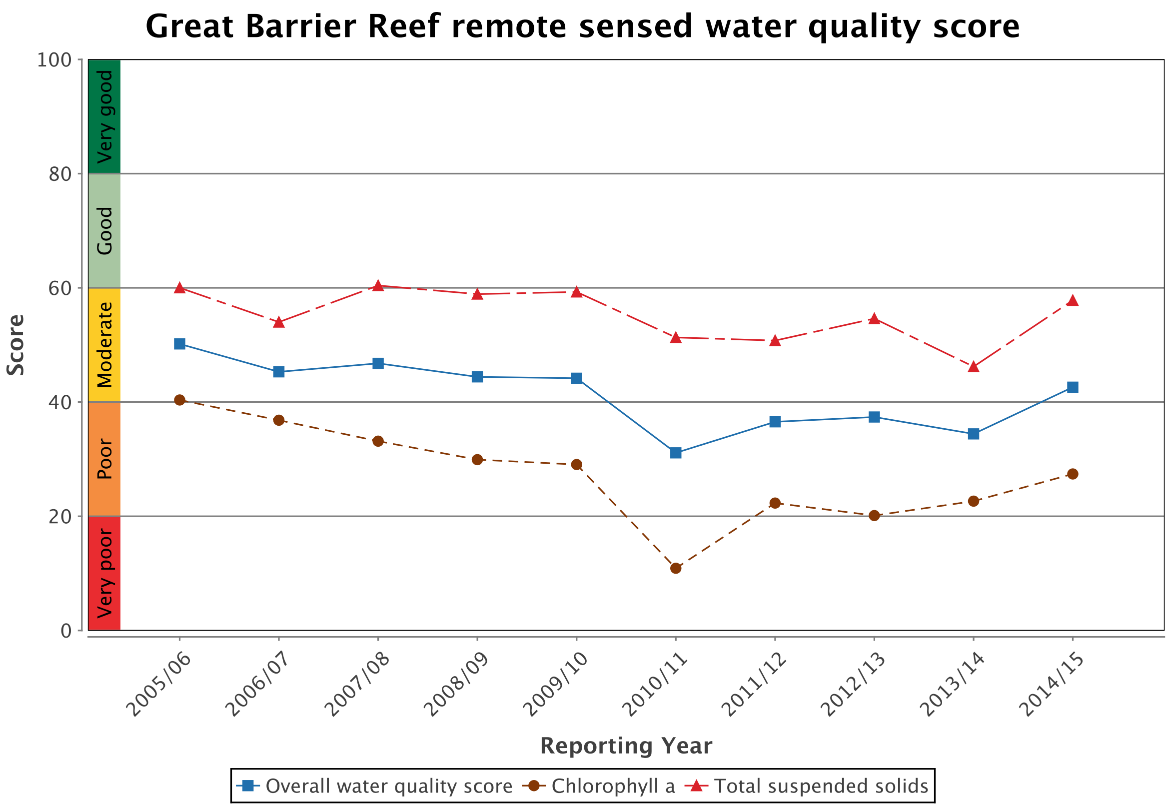


Figure 8: Trend in water quality for the inshore Great Barrier Reef based on remote sensing from 2005-06 to 2014-15

The overall water quality score for the reef is the average of the weighted component scores for chlorophyll *a* and total suspended solids for the Wet Tropics, Burdekin, Mackay Whitsunday and Fitzroy regions. Values are indexed scores scaled from 0-100; ■ = very good (81-100), ■ = good (61 - 80), ■ = moderate (41 - 60), ■ = poor (21 - 40), ■ = very poor (0 - 20). NB: Scores are unitless. Data source: (Bureau of Meteorology 2016b; Tracey *et al.* 2016).

Components scores for concentrations of chlorophyll *a* and total suspended solids were poor and moderate respectively in 2014-15 (Figure 8). The water quality scores are derived from remotely sensed information of chlorophyll *a* and total suspended solids (Bureau of Meteorology 2016b; Tracey *et al.* 2016). Information for Cape York and the Burnett Mary regions is not validated with field data so there is a high degree of uncertainty in scores derived from remote sensing in these regions, which were excluded from the assessment of the reef-wide score.

The inshore area of all regions had annual mean chlorophyll *a* concentrations that exceeded the Great Barrier Reef Water Quality Guidelines (the Guidelines) (Great Barrier Reef Marine Park Authority 2010b), with some areas approaching close to 100 per cent exceedance (from 97 per cent in the Burnett Mary region to 53 per cent in the Mackay Whitsunday region in 2014-15) (Figure 9). While some exceedance of the Guidelines is expected during the wet season, sustained high concentrations of chlorophyll *a* are indicative of high nutrient loading from the catchments (Figure 3).

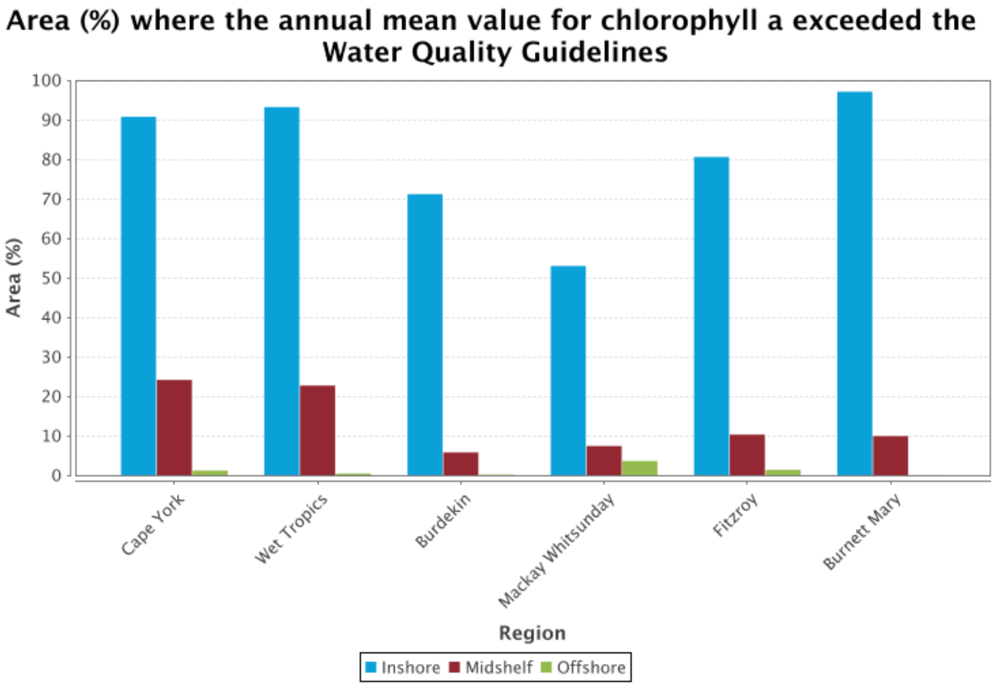


Figure 9: Relative area (%) of the inshore, mid-shelf and offshore water bodies where the annual mean value for chlorophyll *a* exceeded the Barrier Reef Water Quality Guidelines
Data from 1 May 2014 to 30 April 2015. Data source: (Bureau of Meteorology 2016b; Tracey *et al.* 2016).

Concentrations of total suspended solids also exceeded the Guidelines during the year (from 50 per cent in the Fitzroy region to 23 per cent in the Burnett Mary region in 2014-15) (Figure 10). This reflects the input of sediment to the lagoon from repeated flood events in recent years and the continual re-suspension of finer sediment particles by wind and wave action.

Regions where the Guidelines were exceeded had overall water quality scores ranging from poor in the Wet Tropics and Fitzroy regions, to moderate in the other regions, depending on the magnitude of exceedance.

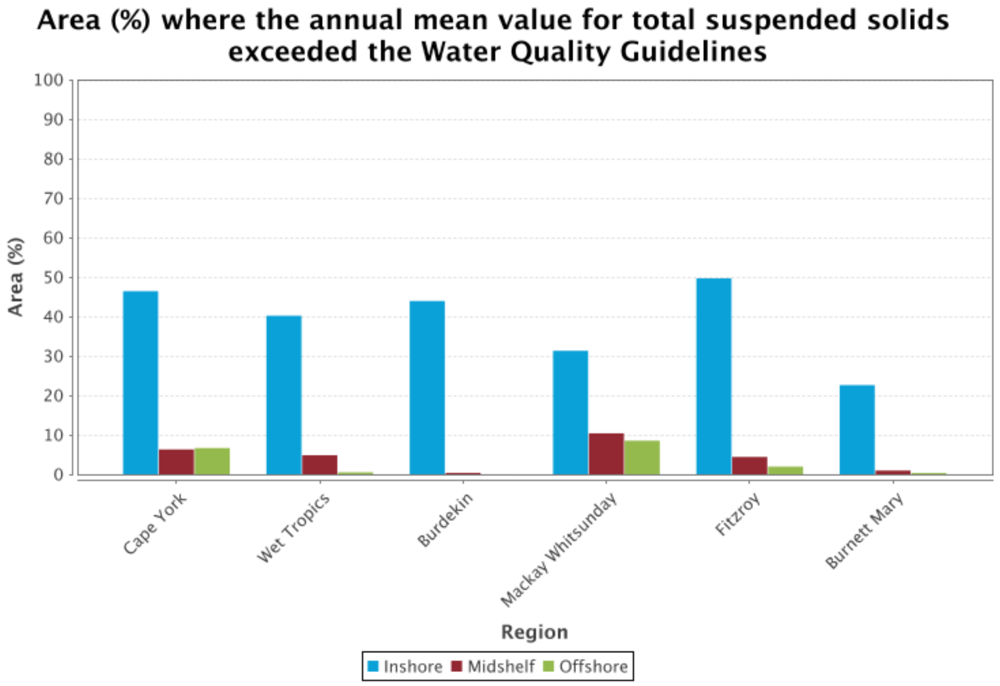


Figure 10: Relative area (%) of the inshore, mid-shelf and offshore water bodies where the annual mean value for total suspended sediment exceeded the Great Barrier Reef Water Quality Guidelines
Data from 1 May 2014 to 30 April 2015. Data source: (Bureau of Meteorology 2016b; Tracey *et al.* 2016).

Water quality showed a clear gradient of improvement from inshore areas more frequently exposed to flood waters to offshore areas. This gradient was supported by long-term assessments of water quality at specific sites, with variability between sites reflecting local hydrodynamic conditions and biological processes. Site-specific water quality data is not included in the water quality scores because while the overall trends are consistent between the two methods, the scores are not directly comparable. However, this water quality monitoring is important because it provides an overall assessment of water quality at each of the 20 water quality sampling locations.

Observations from the site-specific water quality monitoring program demonstrate large-scale and persistent changes in the water quality following the high loads of nutrients that entered the reef over the period 2008-2013. In particular, concentrations of dissolved organic carbon, dissolved nitrogen and turbidity levels have increased in all regions (Lønborg *et al.* 2016). These findings show that the mechanisms controlling the carbon and nutrient cycles in the reef lagoon have undergone changes.

Pesticides

Pesticides were frequently detected at all sites in 2014-15 with high variability in the profiles and concentrations between regions and seasons (Gallen *et al.* 2016). The most frequently detected pesticides in inshore waters (diuron, atrazine, hexazinone) are herbicides that inhibit photosynthesis (Photosystem II inhibiting (PSII)) (Gallen *et al.* 2016).

An index has been developed using PSII herbicide equivalent concentrations to assess the potential combined toxicity of these pesticides relative to the Guidelines. The PSII herbicide equivalent concentration incorporates the relative potency and abundance of individual PSII herbicides compared to a reference PSII herbicide, diuron. The five categories of the index reflect published effects on photosynthesis at levels of pesticides below Guideline levels, where Category 5 is no impact and Category 1 corresponds to the greatest impact and is equivalent to the Guideline for diuron for 99 per cent species protection (Great Barrier Reef Marine Park Authority (in press)).

Recent research indicates that persistent concentrations of pesticides below Guideline levels may have a longer-term, chronic impact on some marine organisms and the pesticide index is being revised (Gallen *et al.* 2016).

Overall, the maximum PSII herbicide equivalent concentrations of passive samplers were similar to or lower than the previous monitoring year (2013-14) (Gallen *et al.* 2016), which is consistent with the decreased river discharge observed in 2014-15. In this current monitoring year and since monitoring commenced, the PSII herbicide diuron was again the dominant contributor to the PSII herbicide equivalent concentrations at all fixed sites located in four regions (Gallen *et al.* 2016) due to its abundance and potency as a PSII inhibitor (Magnusson *et al.* 2008). The maximum PSII herbicide equivalent concentrations for each of the fixed passive sampling sites ranged from category 5 (lowest exposure) to category 3 (mid-range exposure) (Figure 11) - however none of the chemicals detected were at concentrations that exceeded the relevant Guidelines (Gallen *et al.* 2016).

Even though there were no exceedances of the Guidelines, biologically relevant concentrations of PSII herbicides (category 3 and 4) were present at sites in the Mackay Whitsunday region, with the highest levels detected at Sandy Creek (Figure 11). Flood waters in samples 'grabbed' from the Russell-Mulgrave Rivers, located in the Wet Tropics region, also had concentrations of PSII herbicides (categories 2 and 3) that suppress photosynthesis in marine species, which were mostly attributed to the presence of diuron.

Herbicide equivalent concentrations provide a single reporting parameter for PSII herbicides with a similar mode of action on photosynthesis. However, they may obscure differences in the abundance of individual herbicides detected in different regions because they also consider the potency of each herbicide. For example, a herbicide detected at a high concentration may have a low potency (with respect to the reference diuron) and thus the contribution to the overall PSII inhibition is very small. Therefore, the concentrations of individual herbicides are presented below (Figure 12).

Herbicide profiles were consistent with land use characteristics within regions. The most abundant and frequently detected PSII herbicides in the Wet Tropics, Burdekin and Mackay Whitsunday were diuron, atrazine and hexazinone (Figure 12) (Gallen *et al.* 2016). In the Fitzroy, the most abundant and frequently detected PSII herbicides were tebuthiuron, atrazine and diuron (Figure 12) (Gallen *et al.* 2016). Other emerging 'alternative' pesticides (i.e. 2,4-dichlorophenoxyacetic acid (2,4-D), 2-methyl-4-chlorophenoxyacetic acid (MCPA), chlorpyrifos and pendimethalin) were also detected in passive samplers at fixed sites (at low or sub ng L^{-1} concentrations), and also in passive samplers deployed in transects extending from rivers located in the Wet Tropics region (Figure 12) (Gallen *et al.* 2016).

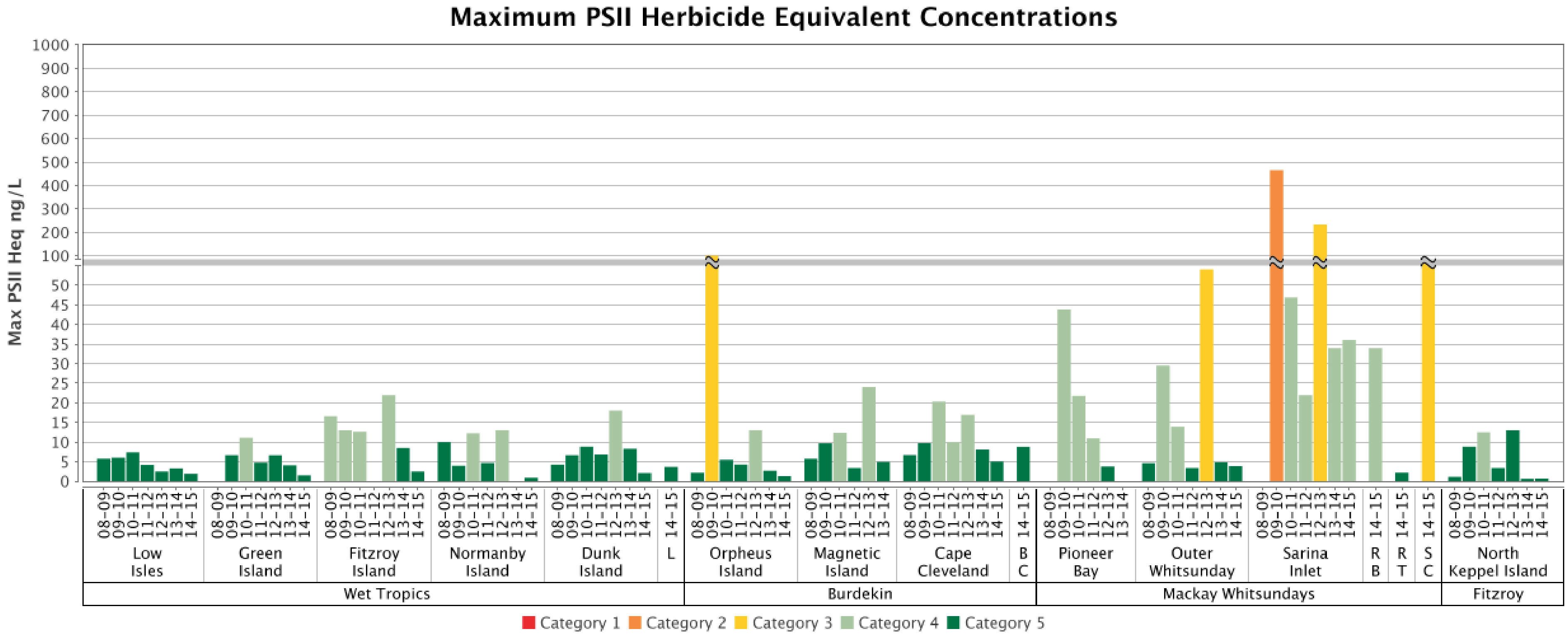


Figure 11: Maximum PSII herbicide equivalent concentrations at all sites monitored in the Great Barrier Reef in 2014-15 compared to previous years
New sites were monitored this year at Lucinda (L), Barratta Creek (BC), Repulse Bay (RB), Round Top Island (RT) and Sandy Creek (SC) and monitoring was discontinued at Magnetic Island and Pioneer Bay. Data source (Gallen *et al.* 2016).

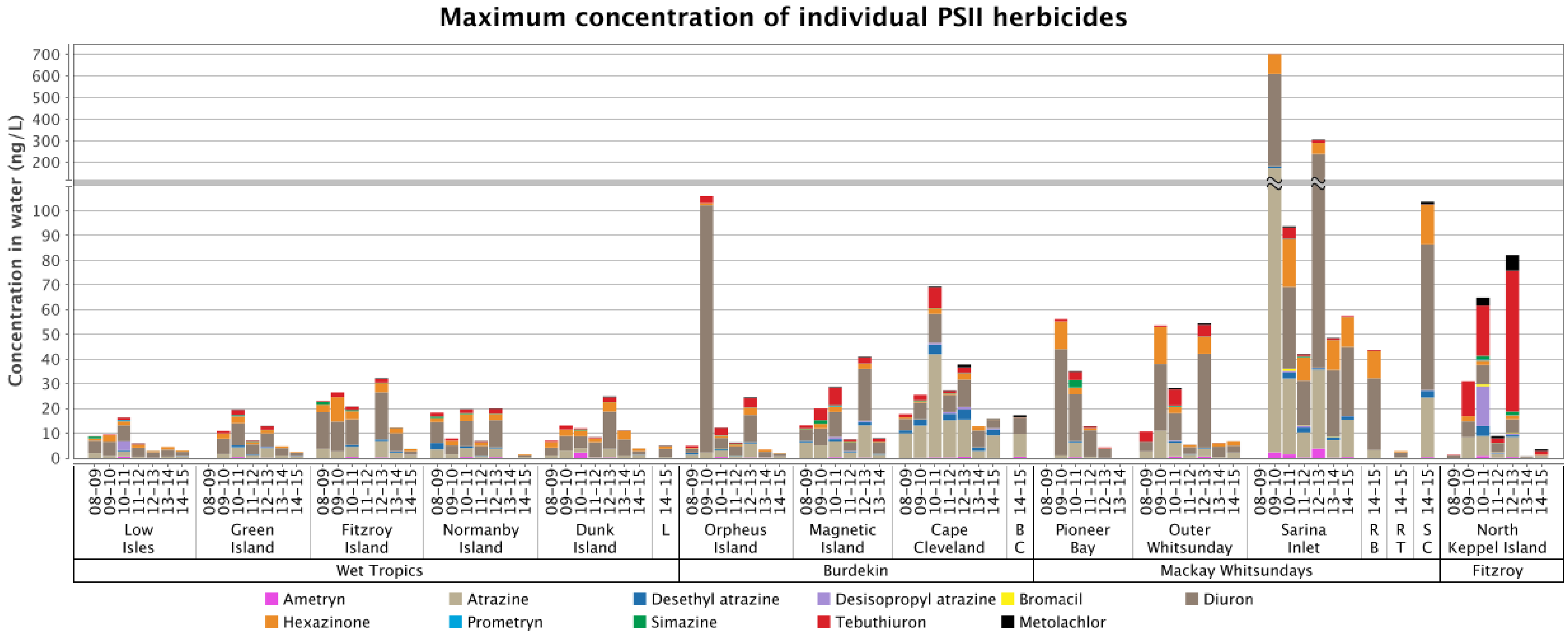


Figure 12 : Maximum concentration of individual PSII herbicides at all sites monitored across the reef in 2014-15 compared to previous years

New sites were monitored this year at Lucinda (L), Barratta Creek (BC), Repulse Bay (RB), Round Top Island (RT) and Sandy Creek (SC) and monitoring was discontinued at Magnetic Island and Pioneer Bay. The types of pesticides detected are often related to the land management activities in adjacent catchments. Data source (Gallen *et al.* 2016).

Seagrass

The overall reef-wide condition of inshore seagrass meadows remained poor in 2014-15. Seagrass abundance increased to moderate, while reproductive effort remained very poor and nutrient status declined to poor in 2014-15 (McKenzie *et al.* 2016)(Figure 11). At the regional level, overall seagrass condition improved slightly during 2014-15 in the Cape York, Wet Tropics and Mackay Whitsunday regions, even though the scores remained poor. In contrast, seagrass condition declined to very poor in the Fitzroy and remained poor in the Burnett Mary in 2014-15 (McKenzie *et al.* 2016); which may have been an effect of Tropical Cyclone Marcia. Seagrass in the Burdekin remained in moderate condition (McKenzie *et al.* 2016) (see following regional report sections for detail).

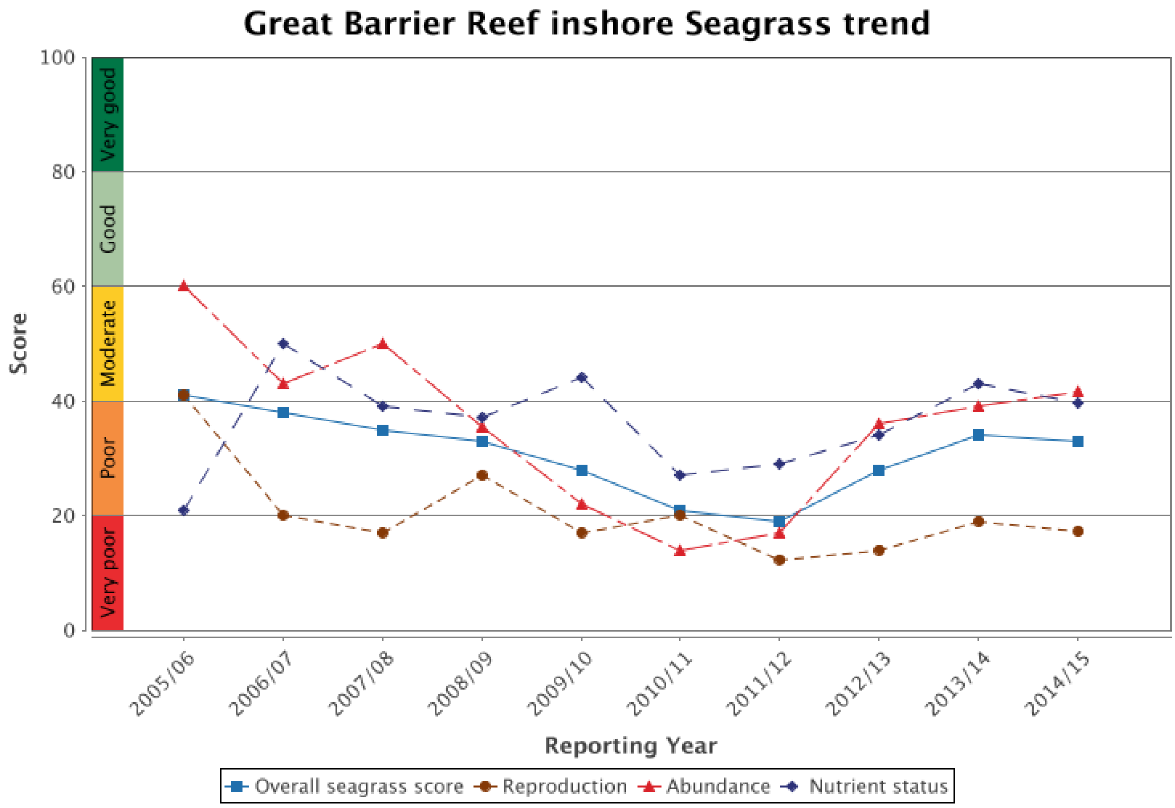


Figure 13: Trend in seagrass condition for the inshore Great Barrier Reef from 2005-06 to 2014-15
The overall seagrass score is the average of the component scores for reproduction, abundance and nutrient status. Values are indexed scores scaled from 0-100; ■ = very good (81-100), ■ = good (61 - 80), ■ = moderate (41 - 60), ■ = poor (21 - 40), ■ = very poor (0 - 20). NB: Scores are unitless. Data source: (McKenzie *et al.* 2016)

In the 2014-15 monitoring period, the Great Barrier Reef-wide seagrass abundance score continued to increase from the low point in 2011 following the extreme weather events (Figure 13) with improvements occurring across most regions (McKenzie *et al.* 2016). The regions with the greatest improvement in abundance were the Burnett Mary and Mackay Whitsunday, which both increased from poor to moderate (McKenzie *et al.* 2016). The only region where seagrass abundance score declined during 2014-15 was the Wet Tropics (McKenzie *et al.* 2016).

Overall reproductive effort declined and remained very poor in 2014-15 (McKenzie *et al.* 2016). Reproductive effort was poor in the Wet Tropics, Burdekin and Mackay Whitsunday, and very poor in Cape York, Fitzroy and Burnet Mary in 2014-15 (McKenzie *et al.* 2016). However there were regional differences in the trend of this indicator. Reproductive effort improved in the Wet Tropics, and Mackay Whitsunday. There were minor improvements in Cape York and Burnett Mary but declines in the Burdekin and Fitzroy in 2014-15. Seed banks, which are not currently included in the

reproductive effort metric of the report card, declined across all habitats in 2014-15, despite some signs of improvement in recent years (McKenzie *et al.* 2016).

Seagrass nutrient status scores (using only carbon to nitrogen ratios) reflect the amount of light available relative to growth potential. Scores declined in most regions in 2014-15 compared to previous years. In particular, nutrient status in the Fitzroy and Burnett Mary decreased to poor and moderate, respectively. Nutrient status remained poor in Cape York, Wet Tropics and Mackay Whitsunday and remained good in the Burdekin, despite small declines (McKenzie *et al.* 2016).

In summary, seagrass meadows across most of the regions are still recovering from multiple years of climate-related impacts and are still below 2008 levels. As seagrass meadows continue to recover in community structure, the proportion of persistent species has increased relative to the proportion of colonising species as part of natural meadow progression. The most substantial changes in 2014-15 occurred in coastal and reef subtidal habitats (McKenzie *et al.* 2016).

Coral

The overall reef-wide condition of inshore coral reefs improved to moderate in 2014-15 (Figure 14). This reflects the general improvement in coral indicators in many inshore areas of the reef during a year that was relatively free from disturbances, as well as a lower level of macroalgae at some sites (Thompson *et al.* 2016).

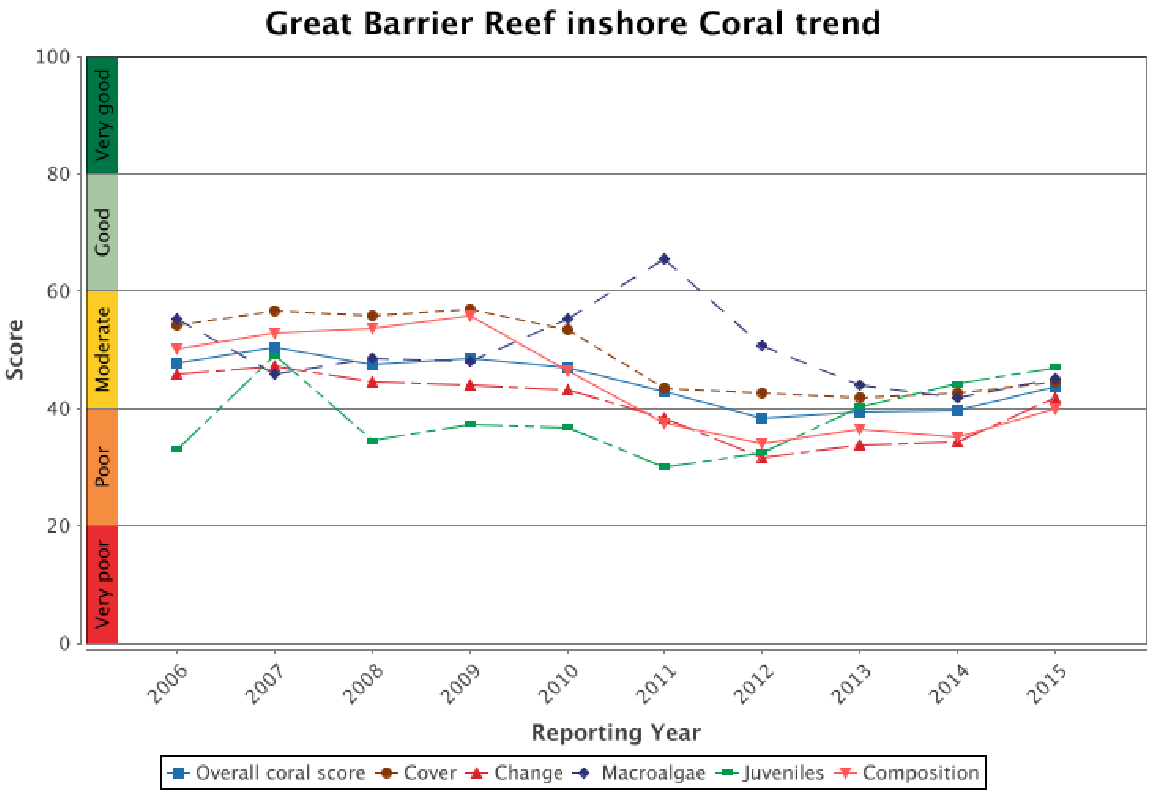


Figure 14: Trends in coral condition for the inshore Great Barrier Reef from 2006 to 2015
The overall coral score is the average of the component scores for combined hard and soft coral cover, coral change, proportional macroalgal cover, juvenile density and coral community composition for the Wet Tropics, Burdekin, Mackay Whitsunday and Fitzroy regions. Data includes monitoring in the Marine Monitoring Program and the AIMS Long Term Monitoring Program. The coral change indicator is calculated as the average rate of increase in coral cover compared to modelled predictions over the preceding four years. Note that the time series for coral has been recalculated and trend graphs in previous reports are not comparable. Values are indexed scores scaled from 0-100; ■ = very good (81-100), ■ = good (61 - 80), ■ = moderate (41 - 60), ■ = poor (21 - 40), ■ = very poor (0 - 20). NB: Scores are unitless. Data source: (Thompson *et al.* 2016).

Continued improvement in the overall condition of coral from the low point reached in 2011-12 indicates a degree of resilience in coral communities. However, the continued increase in macroalgae and the poor and very poor scores for macroalgal cover in the Burdekin and Fitzroy regions (Thompson *et al.* 2016) may indicate a phase-shift in the ecosystem.

Outlook for the Great Barrier Reef

The reef has declined markedly from its pre-European condition, especially in inshore areas adjacent to the developed coast. These changes are the result of cumulative impacts of climate and other drivers (influencing numerous activities including agriculture) in the region. The positive trend observed in the reef score in recent years (Figure 15) provides an indication of the resilience of the reef's habitats. The complex interactions between agriculture, river inputs and marine water quality and ecosystem health make it difficult to quantitatively assess the benefits of improved land management practices as a direct result of Reef Water Quality Protection Plan initiatives. The lag between management actions implemented now and improvements in resource condition is such that sediments and nutrients are projected to continue to affect the reef for the next 25 years.

Sustained improvements in the marine water quality of the inshore Great Barrier Reef above the 2005-06 monitoring baseline are not yet observed in the Marine Monitoring Program (Figure 15). Nevertheless, the trend for water quality in the reef has improved since 2011-12 following impacts from severe Tropical Cyclone Yasi.

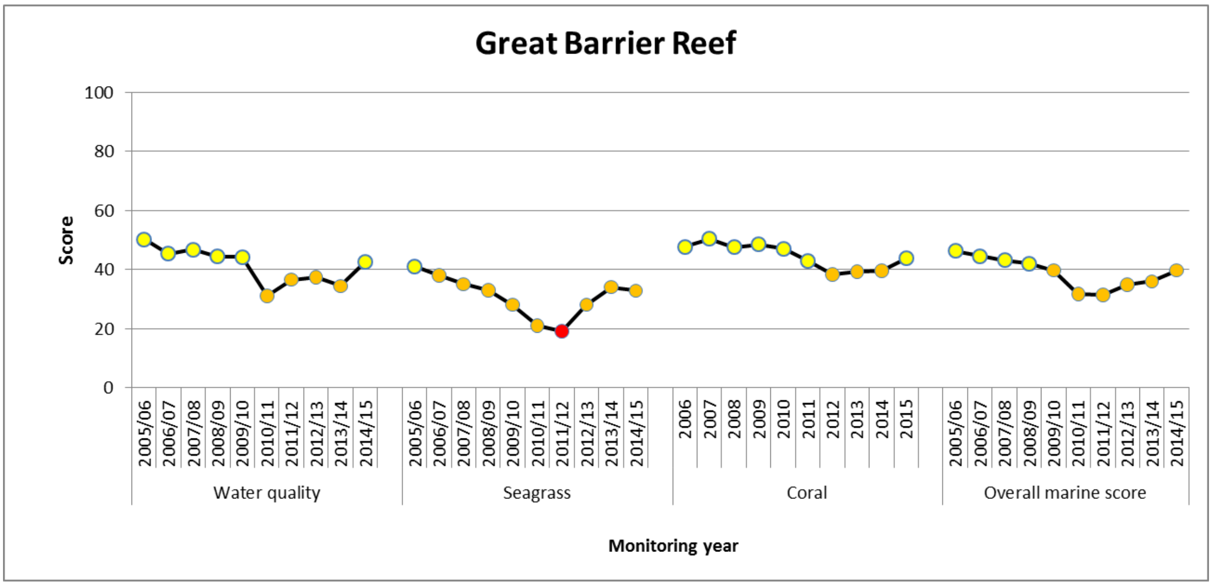


Figure 15: Trends in inshore water quality, seagrass and coral condition, and the overall Reef score from 2005-06 to 2014-15

The overall reef score is the average of the weighted component scores for water quality (in four regions), seagrass and coral condition (in four regions). Trends in coral score are not directly comparable to previous reports, as the metric changed this year with improvements to individual indicators and the addition of an indicator for community composition. Changes to the metrics have been hind-cast in the above summary. Values are indexed scores scaled from 0-100; ■ = very good (81-100), ■ = good (61 - 80), ■ = moderate (41 - 60), ■ = poor (21 - 40), ■ = very poor (0 - 20). NB: Scores are unitless.

Recovery of seagrass from the low point in 2011 could occur within the next one to two years (i.e. more than five years from impact) as long as conditions remain favourable (Birch and Birch 1984; Campbell and McKenzie 2004). The natural recovery of seagrass community structure is dependent on optimal light and nutrients and the absence of major physical disturbances. Above-average

within-canopy sea water temperatures and below-average light availability in 2014-15 may have slowed seagrass recovery in some locations (McKenzie *et al.* 2016). The absence of a seed bank at some sites and poor reproductive effort across the reef has left most of the inshore seagrass meadows vulnerable to further environmental perturbations (McKenzie *et al.* 2016).

The 2014-15 period demonstrated improvements in coral condition coinciding with reduced loads of nutrients and sediments entering the Great Barrier Reef lagoon in runoff, as well a recent reprieve from a period of frequent and intense disturbances over the last decade. Coral scores reflect responses to a range of different regional pressures. Increased turbidity and sedimentation affects coral recruitment by smothering and limiting the amount of light available to newly settled corals. In several regions, a high incidence of coral disease followed high discharges from local rivers, negatively affecting the rate at which coral cover increases. Further, macroalgae, which competes with the coral for space, can rapidly colonise following disturbances such as cyclones especially when nutrient availability is high. Improved land management practices have the potential to reduce levels of chronic environmental stresses that impact on coral reef communities. However, recent assessments raise the question whether these actions will be sufficient to ensure the resilience of the reef ecosystems into the future (Bartley *et al.* 2014; Kroon *et al.* 2016).

The amount and variability of rainfall has significantly increased in northern Australia over the past 100 years (Lough and Hobday 2011) and the severity of disturbance events is projected to increase as a result of climate change (Steffen *et al.* 2013). Degraded water quality may increase the vulnerability of seagrass and corals to further disturbances. Any increase in susceptibility to these disturbances as a result of local stressors, including poor water quality, will compound the pressures on sensitive species and potentially lead to profound changes in Great Barrier Reef inshore communities.

Cape York

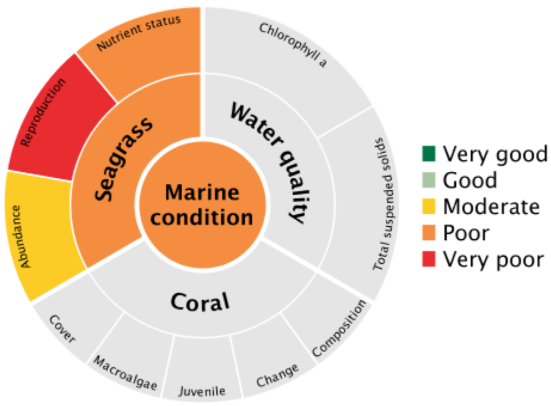


Figure 16: Overall marine condition adjacent to the Cape York region

Overall marine condition in Cape York remained poor in 2014-15 (Figure 16). It is based on inshore seagrass condition only. Inshore water quality was not assessed this year. There is no coral monitoring in the inshore waters of the Cape York region under the Marine Monitoring Program.

Acute pressures and impacts

Tropical Cyclone Nathan (category 4) made landfall on 20 March 2015 at Yarranden, near Cape Flattery. Despite this, rainfall was below the long-term average and river discharge in 2014-15 was less than half that of the previous year with flows close to the long-term median (McKenzie *et al.* 2016). However, wind was above the long-term average and may have continued to re-suspend fine sediments, possibly with nutrients absorbed to their surface.

Even though discharge of major rivers was below the long-term average, 52 per cent of coastal meadows were potentially exposed to river plumes in high risk categories, whereas offshore meadows and coral reefs were not potentially exposed at all in 2014-15 (Lønborg *et al.* 2016). The inshore waters of Cape York had exposure predominantly to river plume waters with high nutrient, intermediate salinity, low total suspended solids, and some river plume waters with high nutrient, turbidity and total suspended solids and low salinity through the wet season (December-April) (McKenzie *et al.* 2016).

At seagrass monitoring sites, within canopy temperatures were slightly above the previous period and 0.6°C warmer than the long-term average over the 2014-15 monitoring period (McKenzie *et al.* 2016). In 2014-15 sea water temperatures exceeded 38°C for a greater number of days than the previous year (cf. 3 in 2013-14) (McKenzie *et al.* 2016). Dominant influences on seagrass communities in the Cape York region include disturbance from waves/swell and associated sediment movement on reef communities, while temperature extremes and runoff also influence coastal communities.

Water quality

There is no comprehensive, ongoing site-specific water quality monitoring in the Cape York region. Estimates of chlorophyll *a* and total suspended solids have previously been derived from remote sensing only, which requires further field validation. These estimates have relatively low reliability compared to other regions, and have not been presented this year. A synthesis of water quality data collected between 1991 to 2015 highlighted that while there is limited data for Cape York, ambient water quality in open coastal, mid-shelf and offshore zones is in relatively good condition. There is variation in water quality from north to south within the region, with suspended sediment highest in Princess Charlotte Bay (Howley 2015). Both particulate nitrogen and particulate phosphorus in a range of zones have been found to exceed the Water Quality Guidelines (Howley 2015).

The Cape York region is relatively undeveloped compared to other regions. However, increasing pressure for expansion and intensification of agriculture (Australian Government 2015) and the associated impacts on water quality mean that Cape York is a high priority for increasing site-specific monitoring efforts.

Seagrass

The condition of inshore seagrass in the Cape York region remained poor in 2014-15 (Figure 17) (McKenzie *et al.* 2016). Seagrass abundance was moderate overall and reproductive effort remained very poor in 2014-15 (McKenzie *et al.* 2016) (Figure 17), indicating communities may have a low capability to recover from future environmental disturbances. Nutrient ratios of seagrass tissue remained poor in 2014-15 (McKenzie *et al.* 2016) (Figure 17), which may reflect local water quality conditions relative to the amount of light available for growth.

Although the Cape York seagrass index is the highest since 2011-12, the score remains well below the 2005-06 baseline (Figure 17). However, trends prior to 2012-2013 are based on only one sampling location at Archer Point. Additional seagrass monitoring locations at coastal intertidal (Shelbourne Bay and Bathurst Bay) and reef intertidal habitats (Farmer Island (Piper Reef), Yum Yum Beach, Stanley Island) were established in 2012 and are included in the Great Barrier Reef Report Card 2015 (Figure 17).

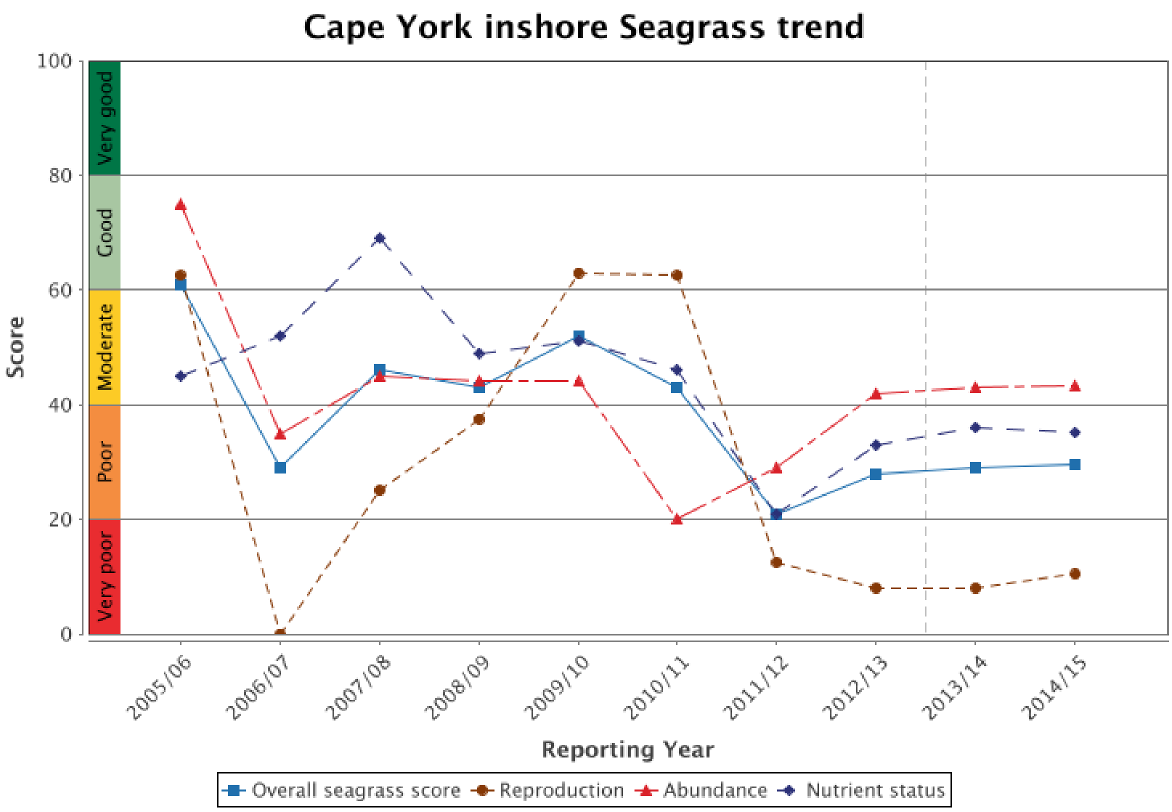


Figure 17: Trend in seagrass condition for the inshore the Cape York region from 2005-06 to 2014-15
The overall seagrass score is the average of the component scores for reproduction, abundance and nutrient status. The vertical dashed line indicates that new sites were included from 2012. Values are indexed scores scaled from 0-100; ■ = very good (81-100), ■ = good (61 - 80), ■ = moderate (41 - 60), ■ = poor (21 - 40), ■ = very poor (0 - 20). NB: Scores are unitless. Data source: (McKenzie *et al.* 2016).

At the intertidal reef habitat at Archer Point, which is a long-term monitoring site, there has been modest increase in abundance since Tropical Cyclone Yasi in 2011 until the late monsoon of 2014 (McKenzie *et al.* 2016), but a small decline in seagrass abundance in the late dry of 2014-15 (Figure

18). Abundance also decreased at Farmer Island (intertidal reef meadow) and Shelburne Bay (coastal intertidal meadow) in 2014-15 (McKenzie *et al.* 2016) which were close to the path of the tropical depression that strengthened into Tropical Cyclone Lam (Figure 18).

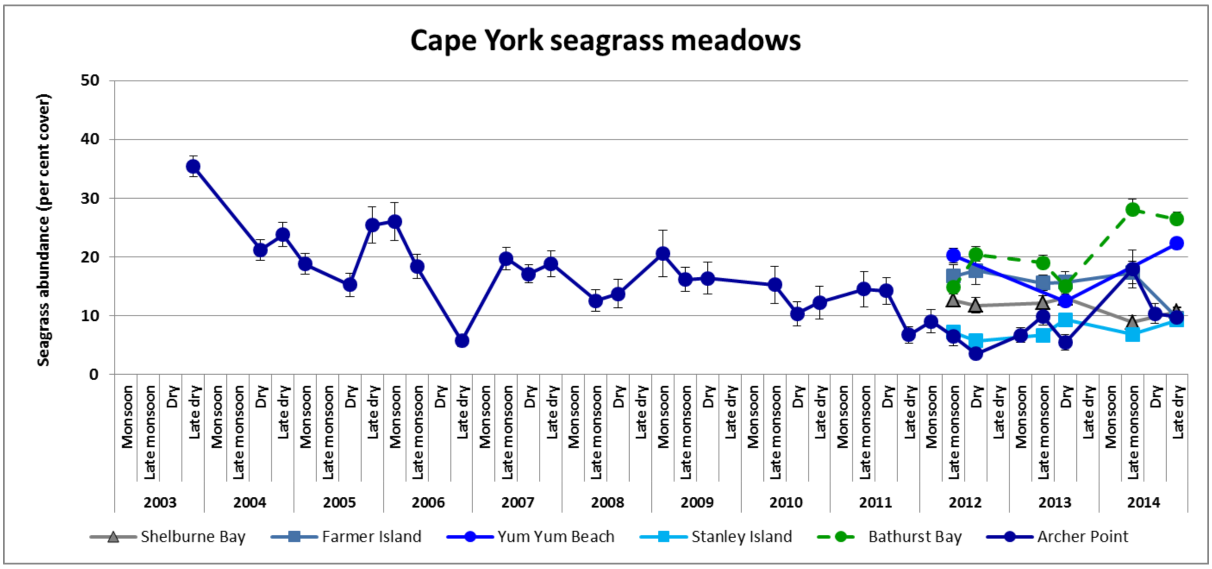


Figure 18: Seagrass abundance (per cent cover and standard error) at Shelburne Bay, Farmer Island, Yum Yum Beach, Stanley Island, Bathurst Bay and Archer Point since monitoring commenced to 2015
Seagrass meadows at Shelburne Bay and Bathurst Bay are coastal intertidal habitats and all other meadows are reef intertidal habitats. Seasons are summarised as monsoon (December-March), late monsoon (April-May), dry (June-August) and late dry (September-November). Data source: (McKenzie *et al.* 2016).

Coral

No coral monitoring occurs in the inshore waters of the Cape York region under the Marine Monitoring Program.

In 2012, the Australian Institute of Marine Science published a report that indicated mid-shelf and offshore coral communities in Cape York were healthy, having recovered to early 1980s condition following impacts of cyclones, crown-of-thorns starfish and bleaching over the intervening years. This was the only region in the reef where an increase in coral cover was observed up to 2012 (De'ath et al., 2012). These reefs have subsequently been severely impacted by Tropical Cyclones Ita (2014) and Nathan (2015) and their status is unknown.

Wet Tropics

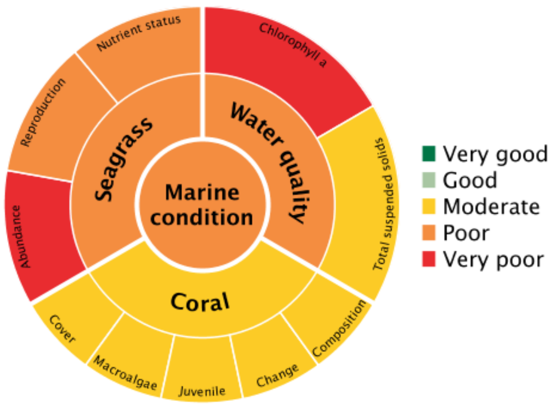


Figure 19: Overall marine condition adjacent to Wet Tropics region

Overall marine condition in the Wet Tropics remained poor in 2014-15 (Figure 19). Inshore water quality remained poor. Biologically relevant concentrations of PSII herbicides were detected in flood waters from the Russell-Mulgrave, Tully and Herbert Rivers. Inshore seagrass remained in poor condition and coral reefs remained in moderate condition. Improvements in coral cover, coral change, macroalgal cover and the number of juvenile corals were observed.

Acute pressures and impacts

In 2014-15, rainfall and river discharge was below the long-term average (almost half). The Russell-Mulgrave Rivers experienced high peak flows on the 8 February, 2015 (68,261 megalitres) and on the 12 March, 2015 (49,647 megalitres). The Tully River experienced two major peak flows on the 15 February, 2015 (46,579 megalitres) and on the 11 March, 2015 (66,291 megalitres).

Even though discharge of major rivers was below the long-term average, 92 per cent of Wet Tropics seagrass meadows were potentially exposed to river plumes in high risk categories. Coastal and inshore reef seagrass sites were potentially exposed to river plume waters with high nutrient, turbidity and total suspended solids, low salinity or to river plume waters with high nutrient, intermediate salinity, low total suspended solids for almost 100 per cent of the wet season (December 2014 to April 2015) (McKenzie *et al.* 2016). Coral reefs are situated further offshore and were not at high risk from exposure to flood plumes in 2014-15 (Lønborg *et al.* 2016).

Daily light within seagrass canopy was slightly lower than the long-term average, following very low light levels in early to mid-2014 (McKenzie *et al.* 2016). Overall, seawater temperatures in seagrass monitoring sites were likely to have been more stressful to intertidal seagrass than in previous years. The number of days above 35°C was the highest since 2008-09, but extreme temperatures (over 40°C) occurred on only one day (McKenzie *et al.* 2016). Wind exposure was below the long-term average and lower than the previous monitoring period. Dominant influences on seagrass communities in the Wet Tropics are thought to be elevated temperatures, seasonal runoff and disturbances from wave action and associated sediment movement.

Water quality

Inshore water quality was assessed by remote sensing of chlorophyll *a* and total suspended solids (Bureau of Meteorology 2016b; Tracey *et al.* 2016) Chlorophyll *a* remained very poor, total suspended solids remained moderate and the overall water quality score remained poor in 2014-15 (Figure 20). Component scores for chlorophyll *a* have been consistently worse than those for total suspended solids in all monitoring years (Figure 20).

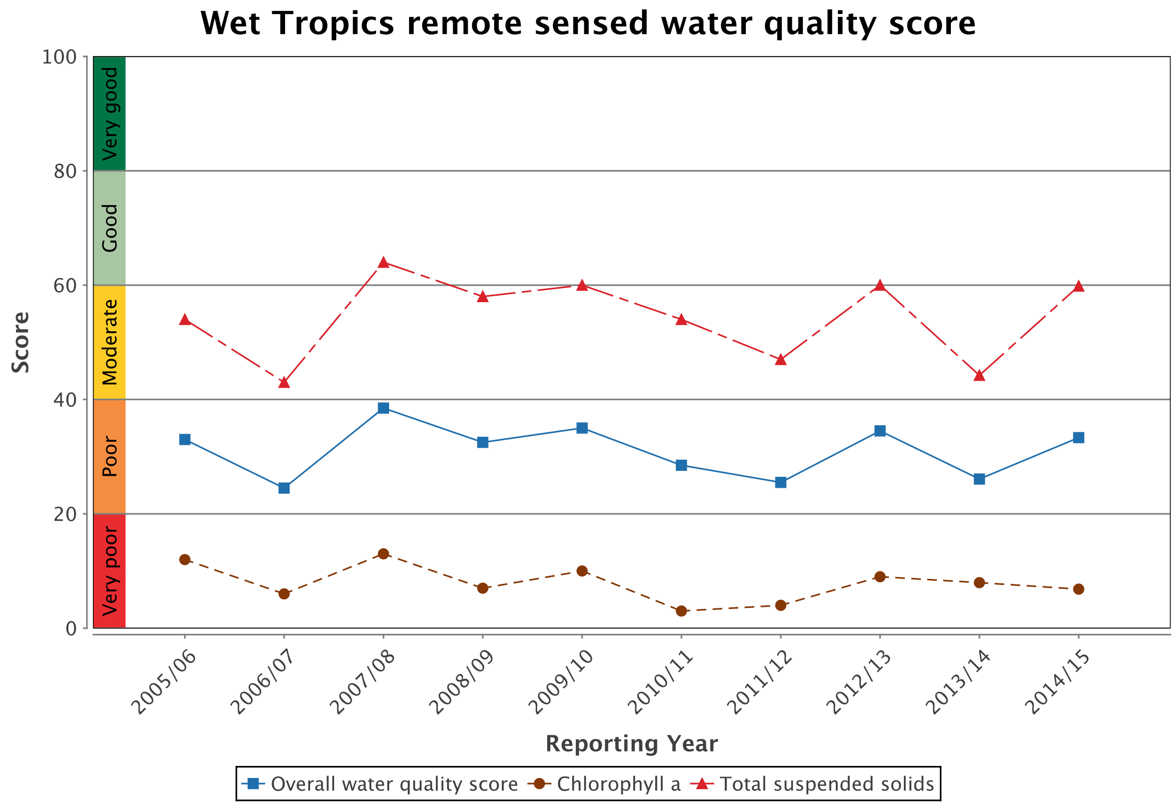


Figure 20: Trend in the water quality scores for the inshore Wet Tropics from 2005-06 to 2014-15
The overall water quality score is the average of the component scores for chlorophyll *a* and total suspended solids. Values are indexed scores scaled from 0-100; ■ = very good (81-100), ■ = good (61 - 80), ■ = moderate (41 - 60), ■ = poor (21 - 40), ■ = very poor (0 - 20). NB: Scores are unitless. Data source: (Bureau of Meteorology 2016b; Tracey *et al.* 2016).

Water quality across the region showed a clear gradient of improvement from inshore areas more frequently exposed to flood waters to offshore areas. This gradient was supported by long-term assessments of water quality at specific sites, with variability between sites reflecting local hydrodynamic conditions and biological processes. Site-specific water quality data are not included in the water quality scores because while the overall trends are consistent between the two methods, the scores are not directly comparable.

In 2014-15, water quality monitoring was expanded to focus on detecting changes in high risk catchments – the Russell-Mulgrave and the Tully. Overall, multi-year trends in wet season water quality parameters show some improvements after 2012 when river flow returned to lower values (Lønborg *et al.* 2016). However there was marked variation in water quality between southern and northern catchments of the region. In the Barron Daintree and Tully sub-regions, temporal trends in ambient water quality revealed that most were above or approaching threshold levels established in the Guidelines. In contrast, for the Russell-Mulgrave focus areas, most parameters examined were approaching or below their thresholds (Lønborg *et al.* 2016).

Site-specific water quality data reveals that the long-term average of a number of water quality variables exceeded the Guidelines at monitoring sites, including chlorophyll *a* (at Yorkey's Knob, Fairlead Buoy, High West and Dunk North), Secchi depth (at all sites except Green Island), nitrate/nitrite (at Snapper North and High West) and particulate phosphorus (at Cape Tribulation) (Lønborg *et al.* 2016).

Pesticides
The most abundant and frequently detected PSII herbicides in the Wet Tropics region were diuron, atrazine and hexazinone. There was a range of other herbicides and insecticides detected in 2014-15 including ametryn, the breakdown products of atrazine, simazine, tebuthiuron, metolachlor and imidacloprid.

Concentrations of PSII herbicides were below those known to have any effects on plants or animals based on toxicity or a reduction in photosynthesis (Category 5) at all fixed sites in the Wet Tropics including Low Isles, Green Island, Fitzroy Island and Dunk Island (Gallen *et al.* 2016). Since monitoring commenced, 74 per cent of values for maximum PSII herbicide equivalent concentrations in the Wet Tropics have been Category 5, and 26 per cent have been Category 4 (Gallen *et al.* 2016). Maximum concentrations of diuron at sites were lower than the previous year, by 1.8 to 4.5 times (Gallen *et al.* 2016). In 2014-15, concentrations of PSII herbicides from 'grab' samples of water collected during the wet season were equal to, or lower than, concentrations detected in 2013-14.

Grab samples of flood plumes from locations approximately 15 kilometres north-east of the Tully River and eight kilometres north-east from the Russell-Mulgrave River in the Wet Tropics region detected diuron, atrazine and hexazinone (Gallen *et al.* 2016). Grab samples collected near the Russell-Mulgrave river mouth had relatively high PSII concentrations (Category 2 and 3), as well as detections of the emerging 'alternatives' imazapic and metolachlor (Gallen *et al.* 2016). Prometryn was detected in a grab sample at the Tully River mouth (Gallen *et al.* 2016).

Seagrass
The overall condition of inshore seagrass in the Wet Tropics region remained poor in 2014-15 and has generally been poor since 2005-06 (McKenzie *et al.* 2016)(Figure 21). This is due to the cumulative impact of two category 5 cyclones in the last decade and complex interactions between the three indicators of seagrass condition (abundance, reproductive effort and nutrient status) which are highly variable between habitat types and from year to year.

The abundance of inshore seagrass in the Wet Tropics declined to very poor overall (McKenzie *et al.* 2016) (Figure 21). Reproductive effort across the region improved from very poor to poor in 2014-15 (McKenzie *et al.* 2016) (Figure 21). Leaf tissue nutrient content (C: N ratios) remained poor overall (McKenzie *et al.* 2016) (Figure 21). Taken together with the cover of epiphytes and other isotopic signatures, this finding suggests an excess of nitrogen in the inshore areas of the region (McKenzie *et al.* 2016).

Seagrass meadows were monitored at representative coastal and fringing reefs at various locations in the Wet Tropics (Figure 22). Trends in seagrass abundance varied within and between habitat types and showed clear seasonal patterns (McKenzie *et al.* 2016). At some sites in the region, abundance declined in 2014-15 (Low Isles and Green Island subtidal) (Figure 22), while at others there was an increase in abundance (Figure 22) and colonising species (Yule Point and Dunk Island) (McKenzie *et al.* 2016). Abundance at other sites (especially Low Isles, Lugger Bay and Dunk Island) remained low. Although reproductive effort increased this year at some sites, seed banks across the region remained poor, suggesting that capacity to recover from major disturbances is weak even if conditions remain optimal (McKenzie *et al.* 2016).

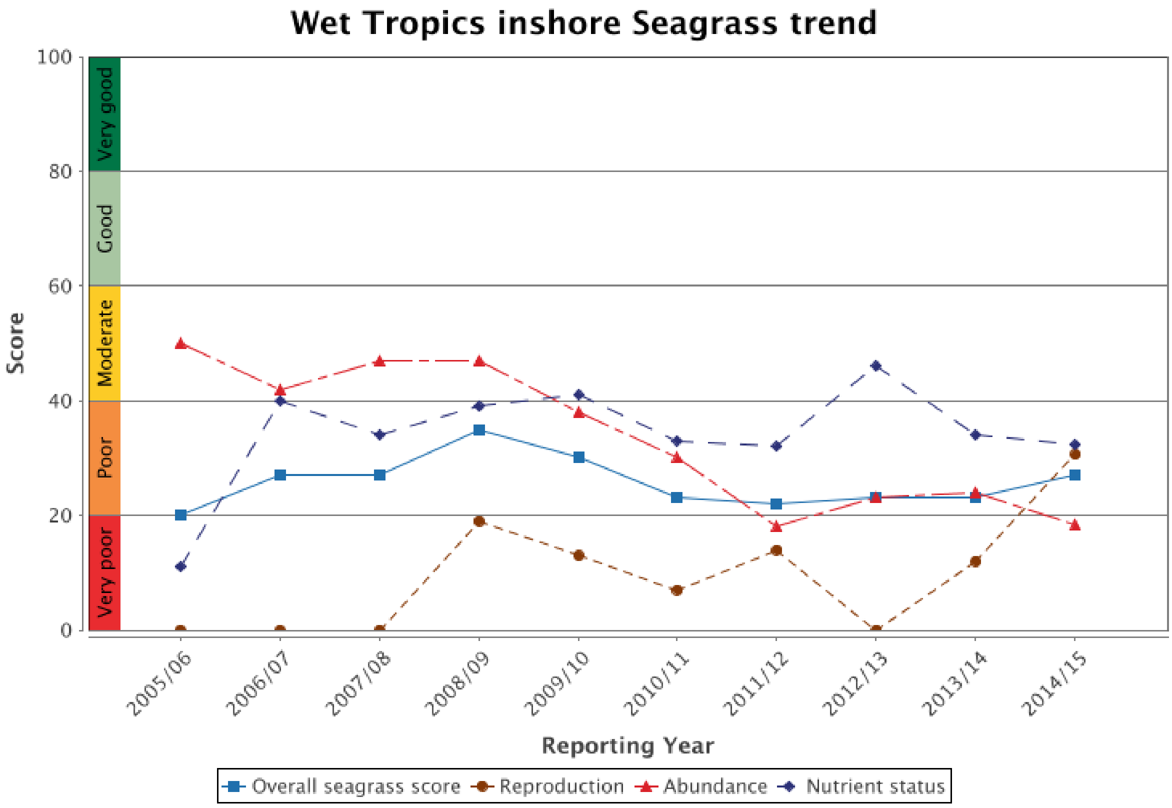


Figure 21: Trend in seagrass condition for the inshore Wet Tropics region from 2005-06 to 2014-15
The overall seagrass score is the average of the component scores for reproduction, abundance and nutrient status. Values are indexed scores scaled from 0-100; ■ = very good (81-100), ■ = good (61 - 80), ■ = moderate (41 - 60), ■ = poor (21 - 40), ■ = very poor (0 - 20). NB: Scores are unitless. Data source: (McKenzie *et al.* 2016).

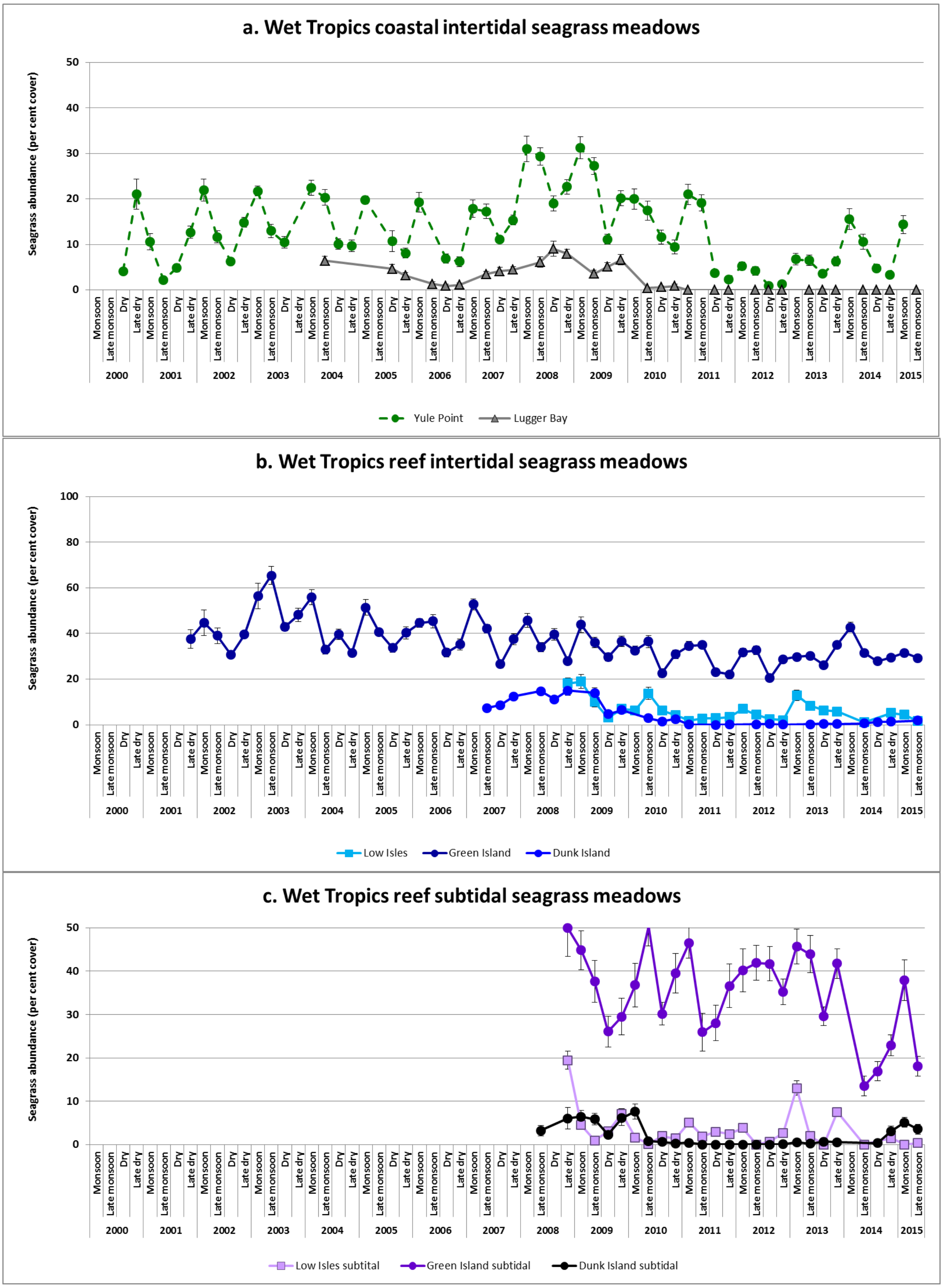


Figure 22: Seagrass abundance (per cent cover and standard error) at coastal intertidal (Yule Point and Lugger Bay), reef intertidal (Low Isles, Green Island and Dunk Island) and reef subtidal (Low Isles and Green Island and Dunk Island) seagrass meadows since monitoring commenced to 2015

Seasons are summarised as monsoon (December-March), late monsoon (April-May), dry (June-August) and late dry (September-November). Data source: (McKenzie *et al.* 2016).

Coral

The overall condition of inshore coral reefs in the Wet Tropics remained moderate in 2014-15 (Figure 23). In the Barron Daintree sub-region of the northern Wet Tropics, coral reef communities remain in moderate condition as a result of the recent impacts of Tropical Cyclone Ita in 2013-14. Coral communities in the Johnstone Russell-Mulgrave sub-region also remained in moderate condition, while those in the more southern Herbert Tully sub-region improved from poor to moderate in 2014-15 (Thompson *et al.* 2016).

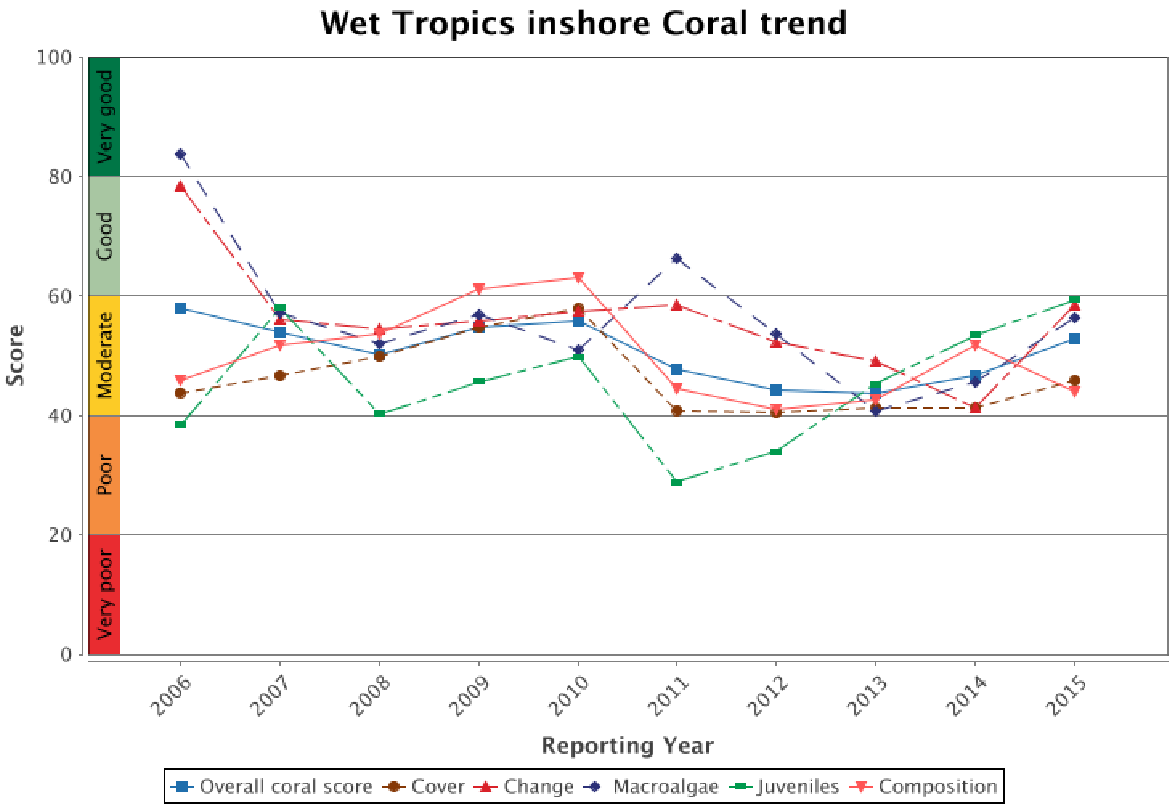


Figure 23: Trends in coral condition for the inshore Wet Tropics region from 2006 to 2015
The overall coral score is the average of the component scores for combined hard and soft coral cover, coral change, proportional macroalgal cover, juvenile density and coral community composition. Data includes monitoring in the Marine Monitoring Program and the AIMS Long Term Monitoring Program. The coral change indicator is calculated as the average rate of increase in coral cover compared to modelled predictions over the preceding four years. Note that the time series for coral has been recalculated and trend graphs in previous reports are not comparable. Values are indexed scores scaled from 0-100; ■ = very good (81-100), ■ = good (61 - 80), ■ = moderate (41 - 60), ■ = poor (21 - 40), ■ = very poor (0 - 20). NB: Scores are unitless. Data source: (Thompson *et al.* 2016).

Since 2000, the Wet Tropics region has been repeatedly affected by high freshwater flows, high levels of coral disease, outbreaks of crown-of-thorns starfish, coral bleaching and strong wind and wave action from severe storms and cyclones. All coral indicator metrics remained moderate overall in 2014-15 with improvements in scores for coral cover, coral change, macroalgae cover and juvenile density (Figure 23) (Thompson *et al.* 2016). The positive trends in most coral indicators (Figure 24) indicate coral communities in the Wet Tropics region have the potential to recover further if the frequency and intensity of disturbances decreases.

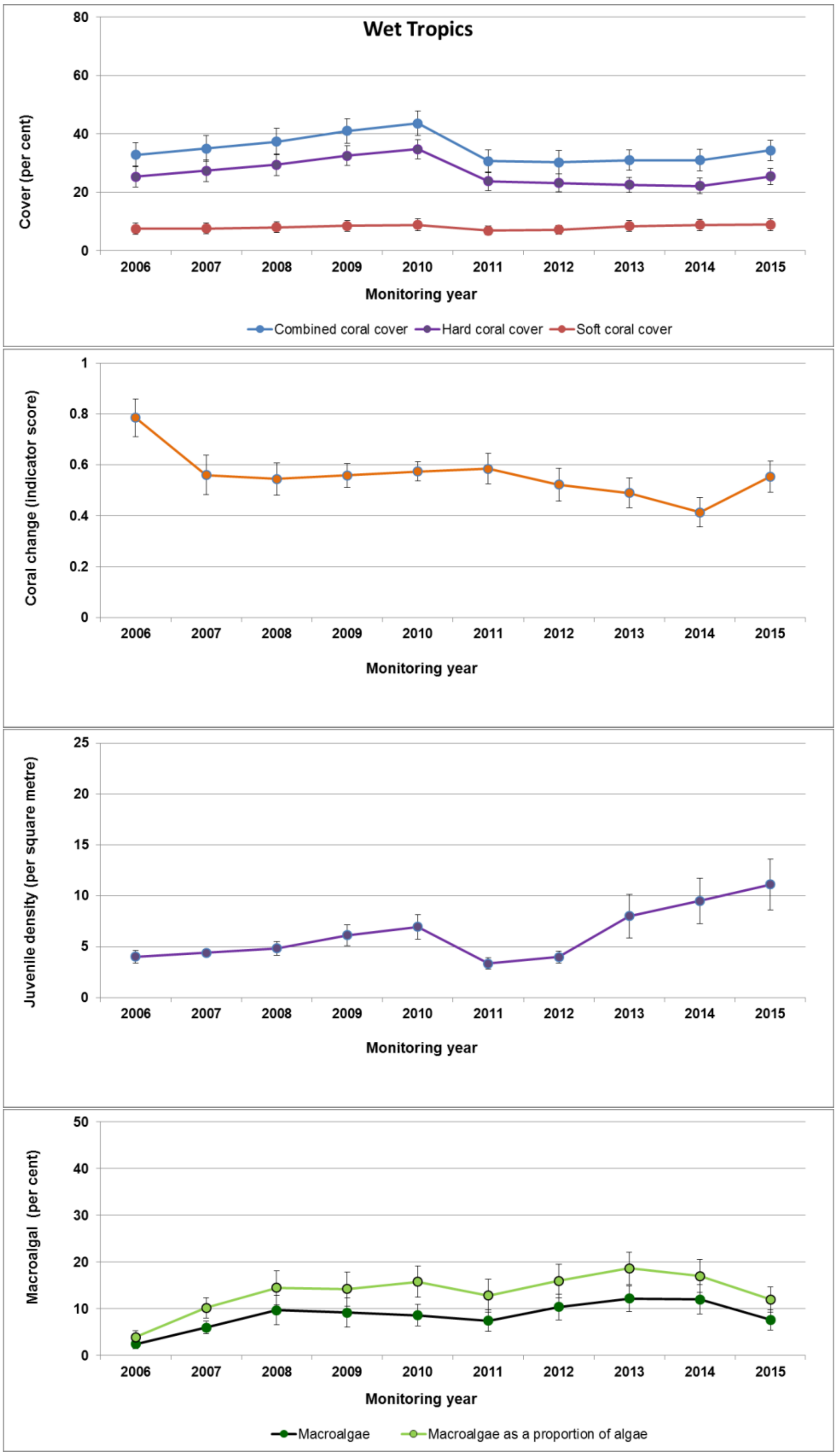


Figure 24: Average cover of corals, change in coral cover, density of hard coral juveniles and cover of macroalgae in the Wet Tropics region from 2006 to 2015

Note that the time series for coral has been recalculated and trend graphs in previous reports are not comparable. Data source (Thompson *et al.* 2016).

Burdekin

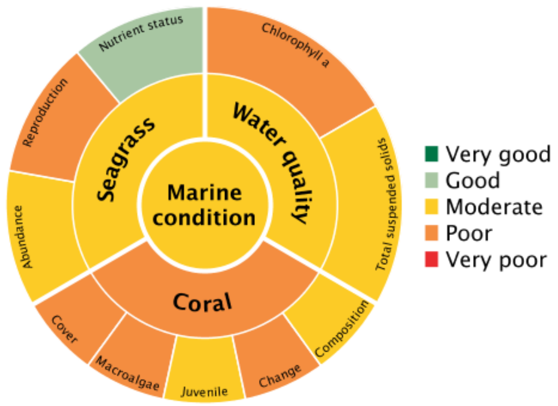


Figure 25: The overall marine condition adjacent to Burdekin region

Overall marine condition in the Burdekin remained moderate in 2014-15 (Figure **25). Inshore water quality improved from poor to moderate and inshore seagrass remained moderate. Coral reefs remained in poor condition; however there were signs of improvement in all coral health indicators in 2014-15.**

Acute pressures and impacts

Townsville had its driest year on record, receiving an annual total of 397.2 millimetres. Below average rainfall resulted in the lowest flow recorded for the Burdekin River in the past 15 wet seasons - being 14 per cent of the long-term average. The Burdekin River had two peak flows on the 14 December, 2014 (19,559 megalitres) and on the 24 March, 2015 (68,815 megalitres), and the latter was associated with Tropical Cyclone Nathan. However, long-term average levels of wind may have continued to re-suspend fine sediments delivered to the lagoon in previous wet seasons (McKenzie *et al.* 2016).

Even though discharge from the Burdekin River was below the long-term average, 83 per cent of coastal meadows were potentially exposed to high concentrations of sediment and nutrients. However, offshore seagrass meadows and inshore coral reefs were not exposed to flood plumes in 2014-15 (Lønborg *et al.* 2016). Inshore seagrass monitoring sites were exposed to river plume waters with high nutrient, turbidity and total suspended solids, low salinity or to river plume waters with high nutrient, intermediate salinity, low total suspended solids for 100 per cent of the wet season (December 2014 to April 2015) (McKenzie *et al.* 2016). Water temperature was generally very warm, with the number of days above 35°C the highest since 2008-09 (McKenzie *et al.* 2016), but meadows experienced no extreme temperatures (over 40°C).

Water quality

Inshore water quality was assessed by remote sensing of chlorophyll *a* and total suspended solids (Bureau of Meteorology 2016b; Tracey *et al.* 2016). Overall water quality and chlorophyll *a* improved to moderate in 2014-15 (Figure 26) and total suspended solids remained moderate (Figure 26).

Water quality across the region showed a clear gradient of improvement from inshore areas more frequently exposed to flood waters to offshore areas. This gradient was supported by long-term assessments of water quality at specific sites, with variability between sites reflecting local hydrodynamic conditions and biological processes. Site-specific water quality data are not included in the water quality scores because while the overall trends are consistent between the two methods, the scores are not directly comparable.

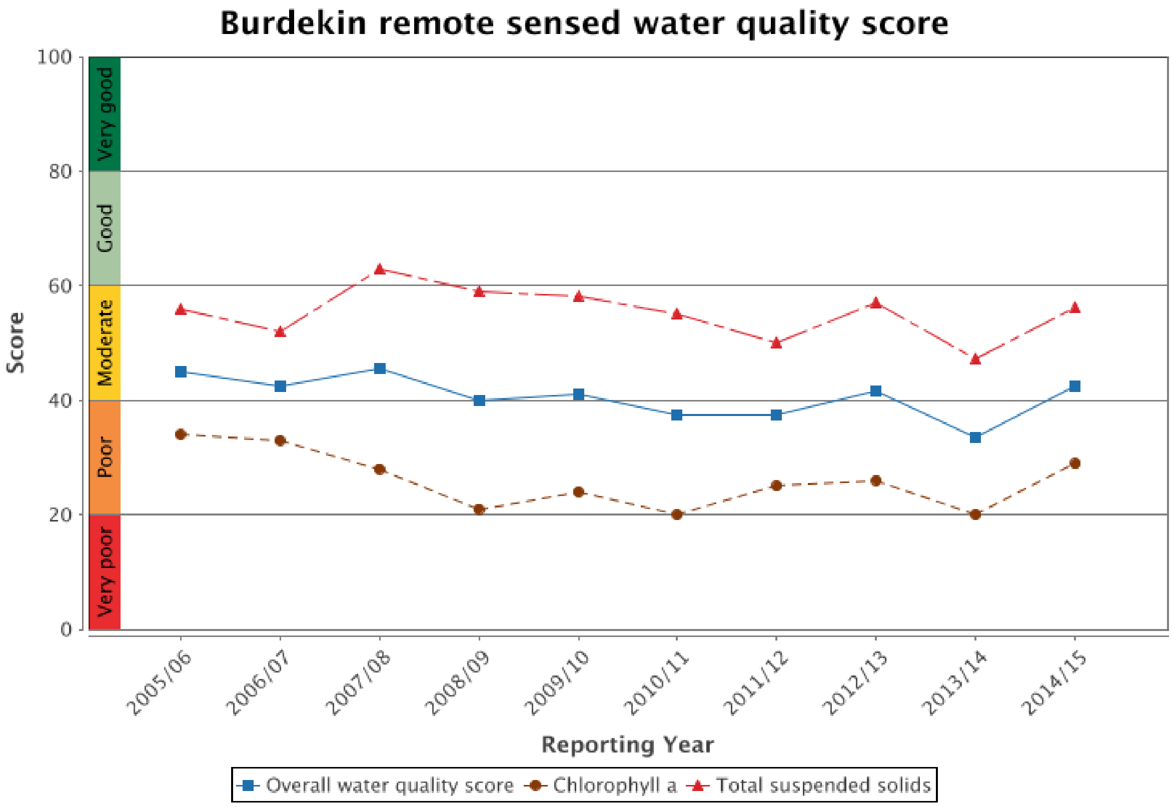


Figure 26: Trend in the water quality score for the inshore Burdekin from 2005-06 to 2014-15
The overall water quality score is the average of the component scores for chlorophyll *a* and total suspended solids. Values are indexed scores scaled from 0-100; ■ = very good (81-100), ■ = good (61 - 80), ■ = moderate (41 - 60), ■ = poor (21 - 40), ■ = very poor (0 - 20). NB: Scores are unitless. Data source: (Bureau of Meteorology 2016b; Tracey *et al.* 2016).

Site-specific ambient water quality monitoring for the region shows trends in concentrations of chlorophyll *a* declined slightly from the beginning of the program until 2015 when the trend-line exceeded, or was near or above, the Guideline. The trends in concentrations of total suspended solids, particulate nitrogen and particulate phosphorus have declined slightly over the course of the program, except for a period of slightly increased values around 2011-12, likely influenced by extreme flooding of the Burdekin River and Cyclone Yasi in 2011. However from 2007 onwards, their overall trend-lines were below the Guidelines. The concentrations of nitrate/nitrite increased from 2006 until 2009, and have since remained at levels close to or above the Queensland Water Quality Guidelines (Department of Environment and Heritage Protection 2009). Secchi depth has remained non-compliant with the Guideline values over the whole sampling period, with a slight decrease in 2015, which is most likely due to the increased amount of stations close to the Burdekin River mouth as part of the new sampling program (Lønborg *et al.* 2016).

Water quality data reveals that the long-term average of a number of water quality variables exceeded the Guidelines at specific monitoring sites, including guidelines for chlorophyll *a* (at Magnetic Island), Secchi depth (all sites), nitrate/nitrite (at Magnetic Island) and particulate phosphorus (at Magnetic Island and the Haughton) (Lønborg *et al.* 2016).

Pesticides

The most abundant and frequently detected PSII herbicides in the Burdekin were diuron, hexazinone and atrazine (Gallen *et al.* 2016). In 2014-15, concentrations of photosystem II (PSII) herbicides remained at category 5 at all fixed sites (Orpheus Island, Barratta Creek mouth and Cape Cleveland) (Gallen *et al.* 2016). A range of other pesticides were detected in the Burdekin region including

ametryn, simazine, and tebuthiuron (Gallen *et al.* 2016). The 'alternative' herbicides 2,4-D, MCPA and metolachlor were frequently detected at all sites but both fluazifop and haloxyfop were detected at Cape Cleveland only (Gallen *et al.* 2016).

In 2014-15, a transect along the Barratta Creek in the lower Burdekin from freshwater to marine was established with passive samplers deployed in the wet season at three locations. The concentrations of PSII herbicides at the freshwater sites were the highest of all monitoring sites – PSII herbicide equivalents of category 1 - with concentrations typically the highest at the Upper Barratta site. There appeared to be a clear dilution of pesticides as they moved from the upper to lower estuarine areas, with concentrations at the marine site detected at category 5 levels (although sampling was not optimal for detecting peaks in pesticide concentrations in this area this year) (Gallen *et al.* 2016).

Seagrass

The overall condition of inshore seagrass in the Burdekin region remained moderate in 2014-15 (Figure 27). This was a consequence of an improvement in seagrass abundance, but a decline in reproductive effect and nutrient status (McKenzie *et al.* 2016).

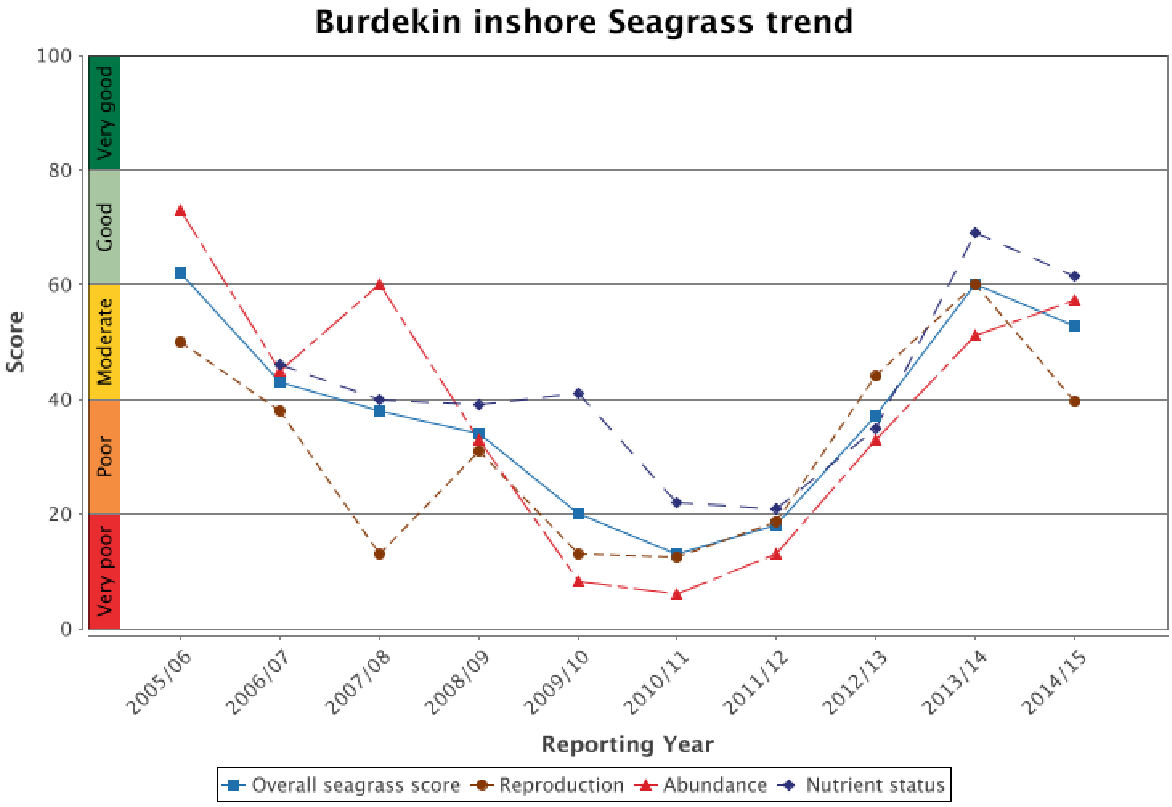


Figure 27: Trend in seagrass condition for the inshore Burdekin region from 2005-06 to 2014-15
The overall seagrass score is the average of the component scores for reproduction, abundance and nutrient status. Values are indexed scores scaled from 0-100; ■ = very good (81-100), ■ = good (61 - 80), ■ = moderate (41 - 60), ■ = poor (21 - 40), ■ = very poor (0 - 20). NB: Scores are unitless. Data source: (McKenzie *et al.* 2016)

The abundance of inshore seagrass in the region continued to improve but remained moderate in 2014-15, just below its highest levels since 2007-08 (Figure 27) (McKenzie *et al.* 2016). Reproductive effort declined to poor in 2014-15, suggesting reduced capacity to recover from future disturbances across the region (Figure 27). The nutrient status of seagrass tissue declined slightly in 2014-15, but remained good (Figure 27). However, although nutrient status is good, supporting evidence (e.g.,

cover of epiphytes and isotopic signatures) suggests there are levels of anthropogenically derived nitrogen in inshore areas of the region (McKenzie *et al.* 2016).

Seagrass meadows were monitored at representative coastal intertidal, reef intertidal and reef subtidal habitats at various locations in the Burdekin region (Figure 28). Trends in seagrass abundance in all three habitat types showed clear seasonal variability (McKenzie *et al.* 2016) (Figure 28). The impact of Cyclone Yasi in 2011 was pronounced in all habitats, but the subsequent recovery of seagrass (Figure 28) indicates meadows in the region are relatively resilient, perhaps due to their large seed banks (McKenzie *et al.* 2016).

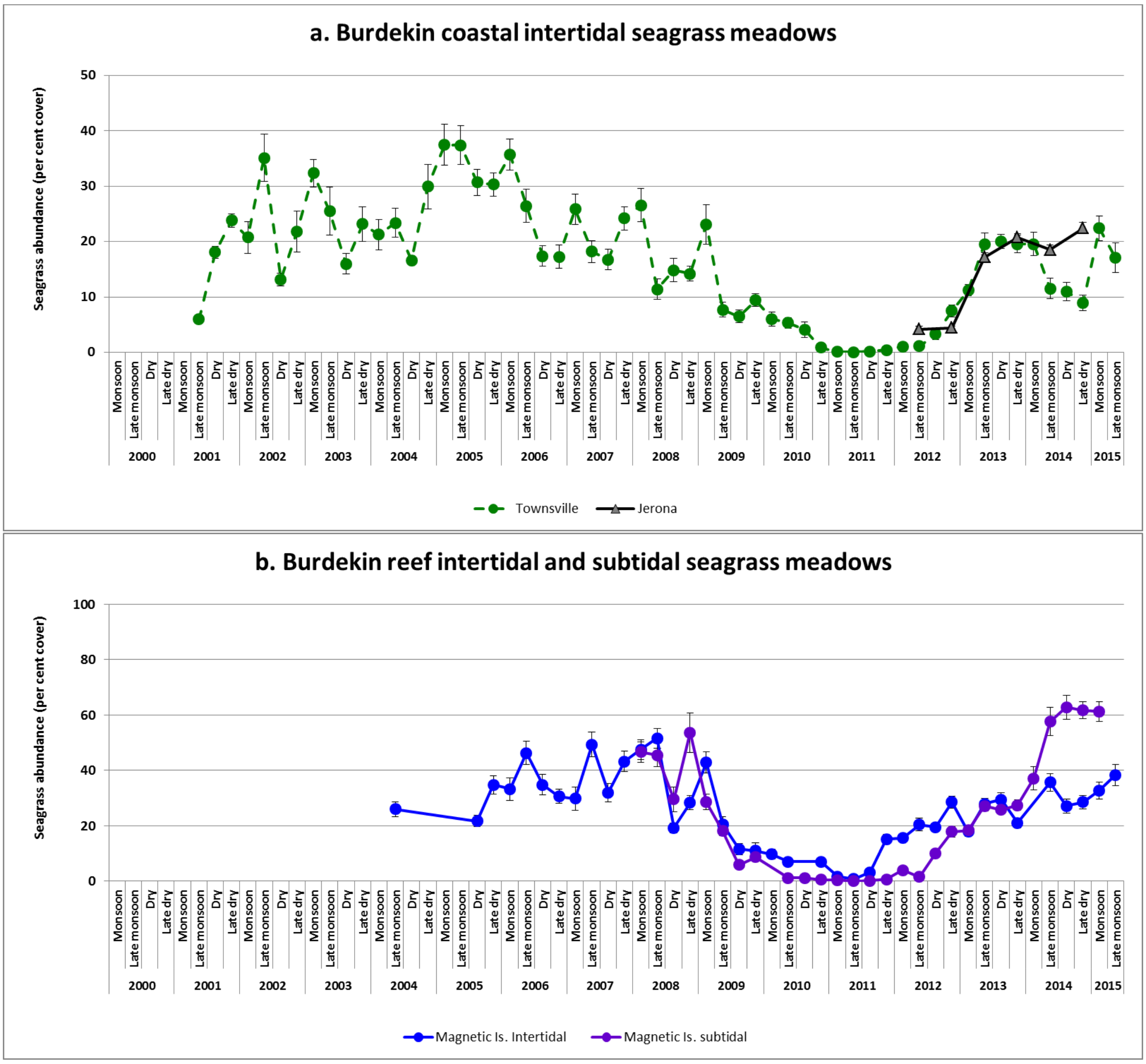


Figure 28: Seagrass abundance (per cent cover and standard error) at coastal intertidal (Townsville - Bushland and Shelly Beaches), and reef intertidal and reef subtidal (Magnetic Island) seagrass meadows from 2000 to 2015

Seasons are summarised as monsoon (December-March), late monsoon (April-May), dry (June-August) and late dry (September-November). Data source: (McKenzie *et al.* 2016).

Coral

The overall condition of inshore coral reefs in the Burdekin region remained poor in 2014-15, but improved slightly to levels comparable to 2010-11 (Figure 29). Coral cover and coral change scores across the Burdekin region improved slightly but remained poor in 2014-15 (Figure 29 and Figure 30) (Thompson *et al.* 2016).

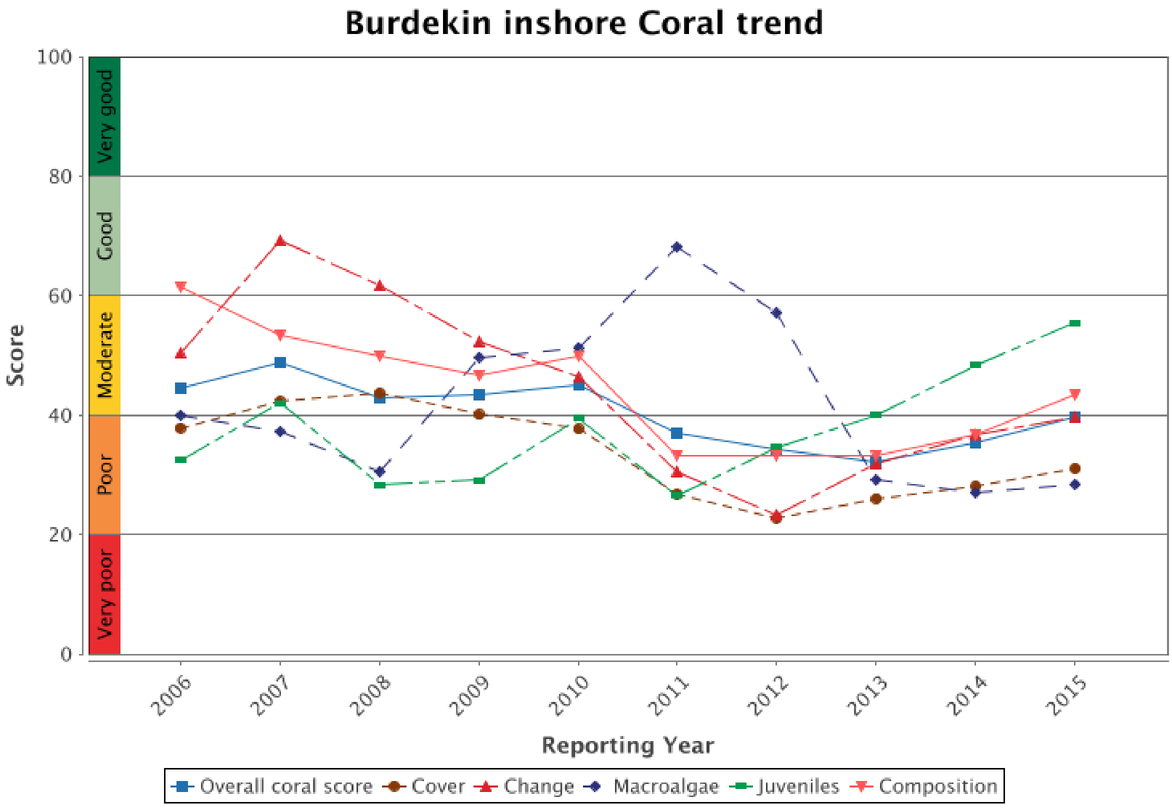


Figure 29: Trends in coral condition for the inshore Burdekin region from 2006 to 2015
The overall coral score is the average of the component scores for combined hard and soft coral cover, coral change, proportional macroalgal cover, juvenile density and coral community composition. Data includes monitoring in the Marine Monitoring Program and the AIMS Long Term Monitoring Program. The coral change indicator is calculated as the average rate of increase in coral cover compared to modelled predictions over the preceding four years. Note that the time series for coral has been recalculated and trend graphs in previous reports are not comparable. Values are indexed scores scaled from 0-100; ■ = very good (81-100), ■ = good (61 - 80), ■ = moderate (41 - 60), ■ = poor (21 - 40), ■ = very poor (0 - 20). NB: Scores are unitless. Data source: (Thompson *et al.* 2016).

Improvement in the overall score for coral condition were primarily driven by the increasing densities of juvenile corals and improvements in coral composition (Figure 29), indicating some recovery of reefs from the repeated disturbances since 2006, and in particular Tropical Cyclones Larry (2006) and Yasi (2011). In 2014-15, the indicator for macroalgae cover improved slightly, indicating more favourable conditions for coral settlement and survival. Notably, there has also been a reduction in coral disease observed over the past two years, in line with a decline in Burdekin River discharge to below-median levels (Thompson *et al.* 2016). Although slight improvements in coral condition have been observed in 2014-15, greater and prolonged periods free from disturbance may be needed for any substantial recovery of coral reefs in the Burdekin region (Thompson *et al.* 2016).

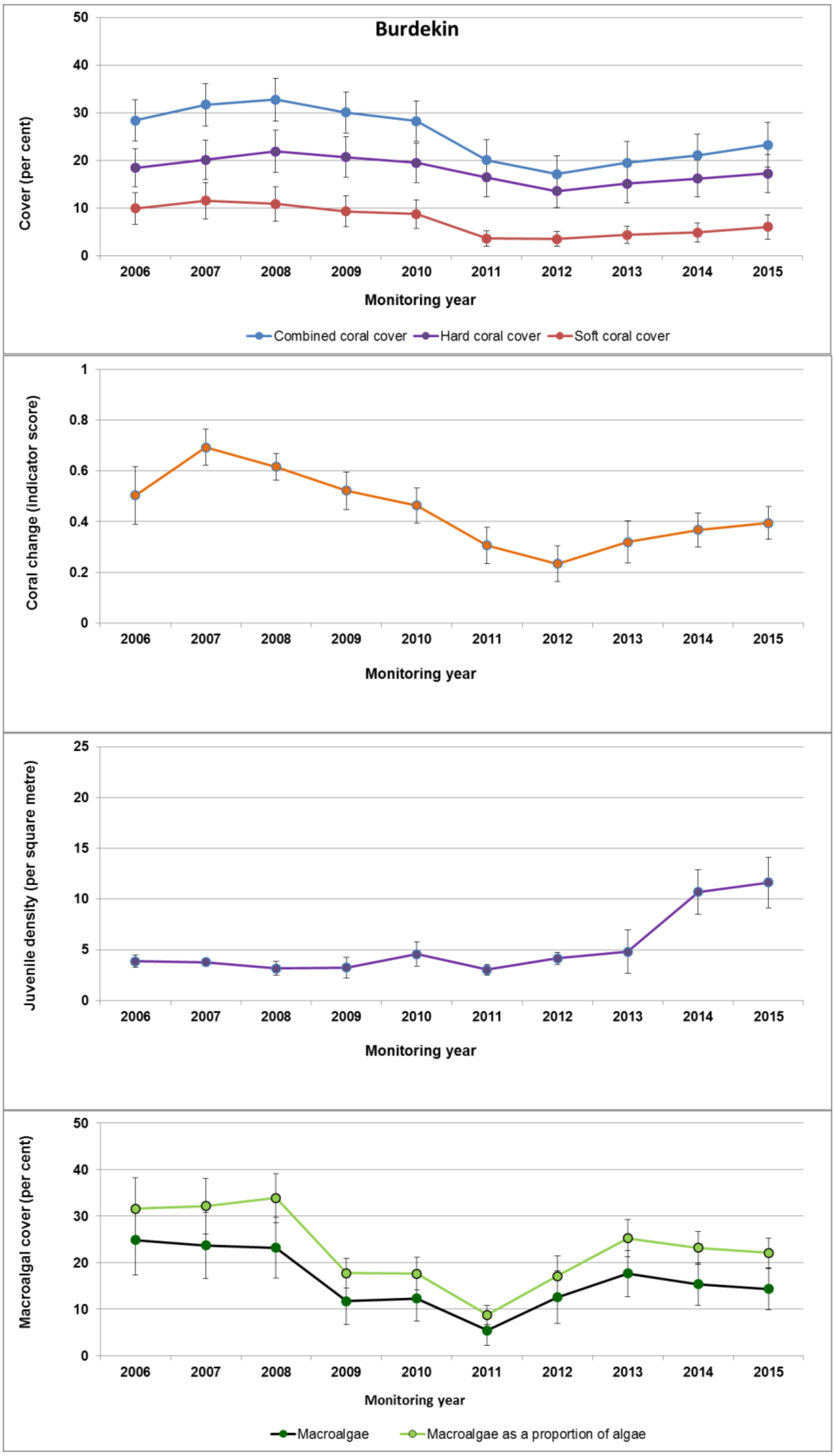
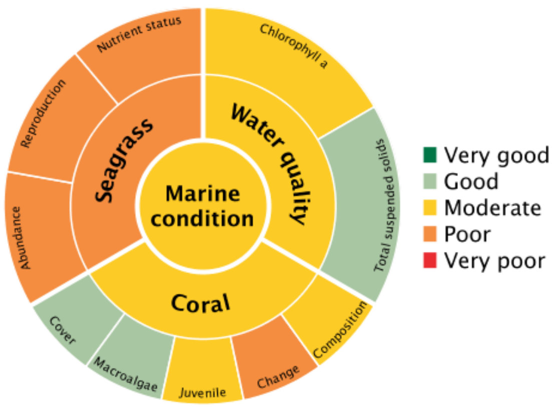


Figure 30: Average cover of corals, change in coral cover, density of hard coral juveniles, and cover of macroalgae in the Burdekin region from 2006 to 2015

Note that the time series for coral has been recalculated and trend graphs in previous reports are not comparable. Data source (Thompson *et al.* 2016).

Mackay Whitsunday



Overall marine condition in the Mackay Whitsunday improved from poor to moderate in 2014-15 (Figure 31). Inshore water quality was moderate. Biologically relevant concentrations of PSII herbicides were present at two routine monitoring sites. The condition of inshore seagrass remained poor in 2014-15 and coral remained moderate in 2014-15.

Figure 31: The overall marine condition adjacent to Mackay Whitsunday region

Acute pressures and impacts

Rainfall and river discharge was below the long-term median during 2014-15. Rainfall only exceeded 100 millimetres for one week in mid-January. However wind speeds were above average (McKenzie *et al.* 2016), which increases risk of exposure of nearshore ecosystems to re-suspension of sediments and nutrients delivered in previous flows (Fabricius *et al.* 2013).

Even though discharge of major rivers was below the long-term average, three per cent of reef area and 58 per cent and 13 per cent coastal meadows and offshore meadows, respectively, were potentially exposed to high concentrations of sediment and nutrients in the Mackay Whitsunday region.

The majority of inshore seagrass habitats were exposed to river plume waters with high nutrient, turbidity and total suspended solids, low salinity or to river plume waters with high nutrient, intermediate salinity, low total suspended solids for 100 per cent of the wet season. Therefore, within canopy daily light was below average (McKenzie *et al.* 2016). Above-average seawater temperatures exposed meadows to warm conditions throughout the year, however these were unlikely to have been particularly stressful as no extreme temperatures (over 40°C) were recorded (McKenzie *et al.* 2016). Key environmental forces acting on seagrass communities in this region include a high tidal range, exposure at very low tides and variable catchment runoff.

Water quality

Inshore water quality was assessed by remote sensing of chlorophyll *a* and total suspended solids (Bureau of Meteorology 2016b; Tracey *et al.* 2016). Overall water quality and chlorophyll *a* scores improved from poor to moderate in 2014-15 (Figure 32), and total suspended solids improved to good.

Water quality across the region showed a clear gradient of improvement from inshore areas more frequently exposed to flood waters than offshore areas. This gradient was supported by long-term assessments of water quality at specific sites with variability between sites reflecting local hydrodynamic conditions and biological processes. Site-specific water quality data are not included in the water quality scores because while the overall trends are consistent between the two methods, the scores are not directly comparable.

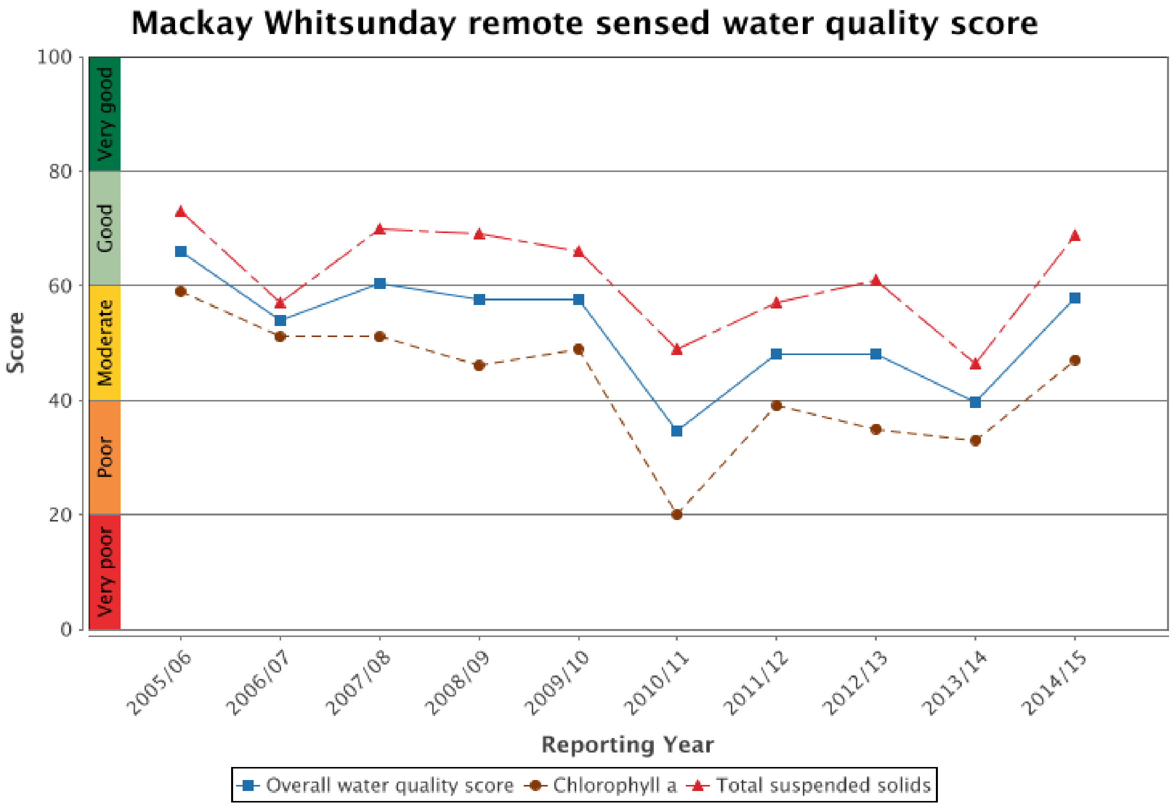


Figure 32: Trend in the water quality score for the inshore Mackay Whitsunday from 2005-06 to 2014-15
The overall water quality score is the average of the component scores for chlorophyll *a* and total suspended solids. Values are indexed scores scaled from 0-100; ■ = very good (81-100), ■ = good (61 - 80), ■ = moderate (41 - 60), ■ = poor (21 - 40), ■ = very poor (0 - 20). NB: Scores are unitless. Data source: (Bureau of Meteorology 2016b; Tracey *et al.* 2016).

In 2014-15, water quality monitoring was expanded to detect changes in a high risk catchment – the O'Connell. Site-specific water quality parameters indicate a steady decline in ambient water quality for this region over the last 10 years. The concentrations of chlorophyll *a* are generally just above the Guidelines, while total suspended solids and particulate phosphorus exceeded Guideline values from 2011. The overall trend for particulate nitrogen is stable. Nitrate/nitrite increased concentrations sharply after the first above-median river flows in 2007 and has since increased further with the trend-line approaching Guideline values. Secchi depth has declined steadily since 2008 remaining on levels non-compliant with the Guideline (Lønborg *et al.* 2016).

Water quality data reveals that the long-term average of a number of water quality variables exceeded the Guidelines at specific monitoring sites, including guidelines for chlorophyll *a* (at all sites - Double Cone, Daydream Island, Pine Island, Seaforth Island and Repulse Island), Secchi depth (at all sites), nitrate/nitrite (at Pine Island) and particulate phosphorus (at Daydream Island, Pine Island, Seaforth Island and Repulse Island) (Lønborg *et al.* 2016).

Pesticides were monitored at sites at Outer Whitsunday, Sandy Creek, Repulse Bay, Round/Flat Top Island and Sarina Inlet. The most frequently detected PSII herbicides in the Mackay Whitsunday region were diuron, hexazinone and atrazine. Other PSII herbicides detected included ametryn, simazine and tebuthiuron. Other pesticides such as imidacloprid, 2,4-D and metolachlor were regularly detected, and metsulfuron-methyl and metribuzin were detected in this region only (Gallen *et al.* 2016).

The risk of exposure to biologically relevant concentrations of pesticides is of concern, especially at Sarina Inlet and the newly established site at Sandy Creek. At Sandy Creek, maximum concentrations of PSII herbicide equivalents were the highest for this monitoring year of all fixed monitoring sites (category 3) (Gallen *et al.* 2016). In 2014-15, biologically relevant concentrations of PSII herbicides (category 4) were also detected at Sarina Inlet (Gallen *et al.* 2016). In the past, Sarina Inlet has had the highest concentrations of PSII herbicides monitored across the reef. This variability in detection reflects a combination of local pesticide usage patterns, land management practices and the proximity of the passive samplers to river discharge.

Seagrass

The overall condition of inshore seagrass in the Mackay Whitsunday region improved, but remained poor in 2014-15, with levels comparable to those in 2009-10 (Figure 33) (McKenzie *et al.* 2016).

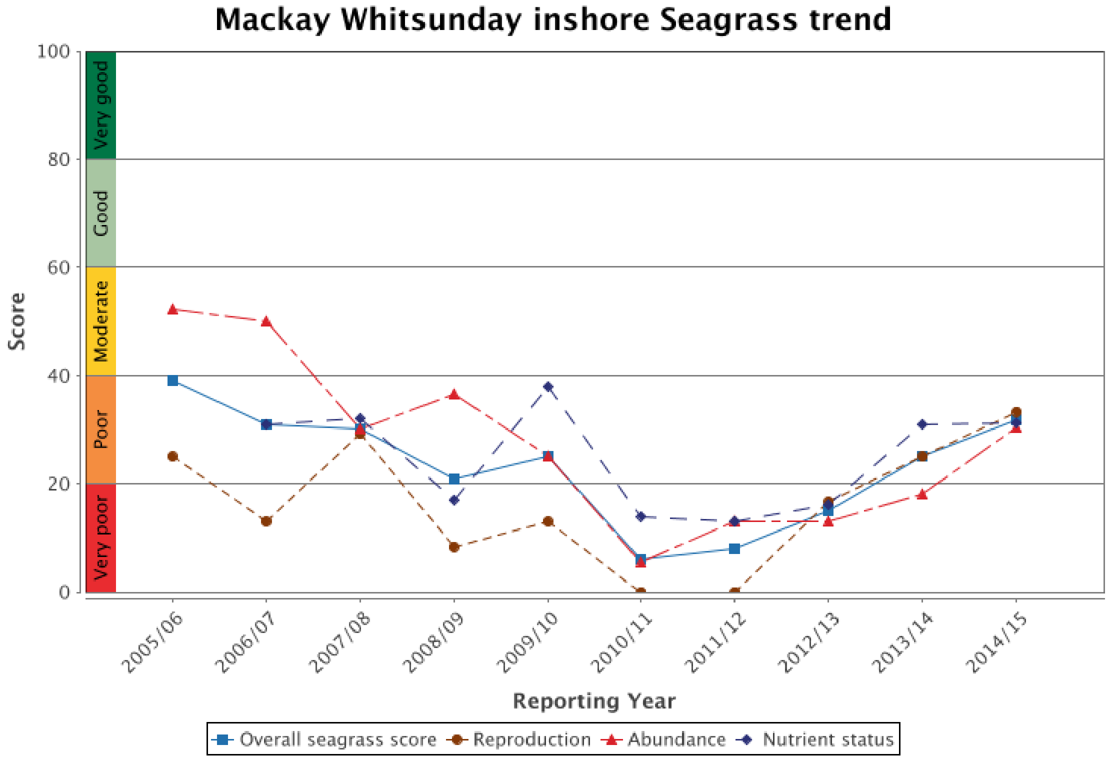


Figure 33: Trend in seagrass condition for the inshore Mackay Whitsunday region from 2005-06 to 2014-15
The overall seagrass score is the average of the component scores for reproduction, abundance and nutrient status. Values are indexed scores scaled from 0-100; ■ = very good (81-100), ■ = good (61 - 80), ■ = moderate (41 - 60), ■ = poor (21 - 40), ■ = very poor (0 - 20). NB: Scores are unitless. Data source: (McKenzie *et al.* 2016).

Seagrass abundance improved from very poor to poor in 2014-15, from record low levels in 2010-11 following Tropical Cyclone Yasi (Figure 33) (McKenzie *et al.* 2016). Reproductive effort improved, but similarly remained poor in 2014-15 (Figure 33). Nutrient status remained poor in 2014-15 (Figure 33), and may provide an integrated assessment of the quality of the surrounding waters relative to the amount of light available for growth.

Seagrass meadows were monitored at representative estuarine, coastal and fringing reef locations in the Mackay Whitsunday region (Figure 34). Trends in seagrass abundance in all habitat types showed limited seasonal variability (McKenzie *et al.* 2016), although there was variation within and between habitat types. Long-term trends in abundance in this region (Figure 34) suggest that seagrass is still in a vulnerable state, especially at reef intertidal sites, with low resistance and reduced capacity to recover from any further large disturbances.

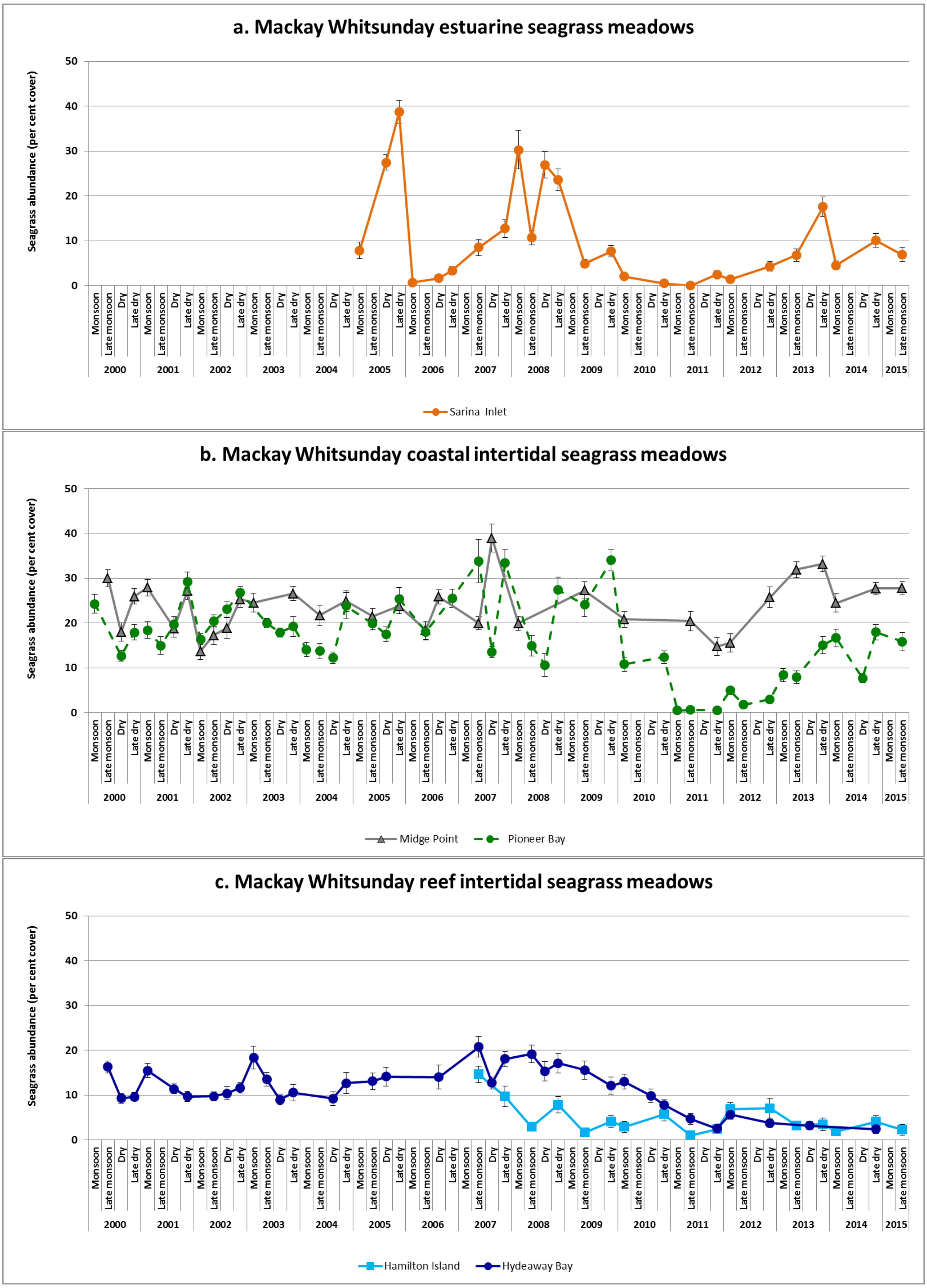


Figure 34: Seagrass abundance (per cent cover and standard error) at estuarine (Sarina Inlet), coastal intertidal (Midge Point and Pioneer Bay) and reef intertidal (Hamilton Island and Hydeaway Bay) seagrass meadows since monitoring commenced to 2015

Seasons are summarised as monsoon (December-March), late monsoon (April-May), dry (June-August) and late dry (September-November). Data source: (McKenzie *et al.* 2016).

Coral

The overall condition of inshore coral reefs in the Mackay Whitsunday region has remained moderate since 2009-10 (Figure 35), reflecting both the limited incidence of severe disturbances and the predominance of coral species tolerant of high turbidity and nutrient levels.

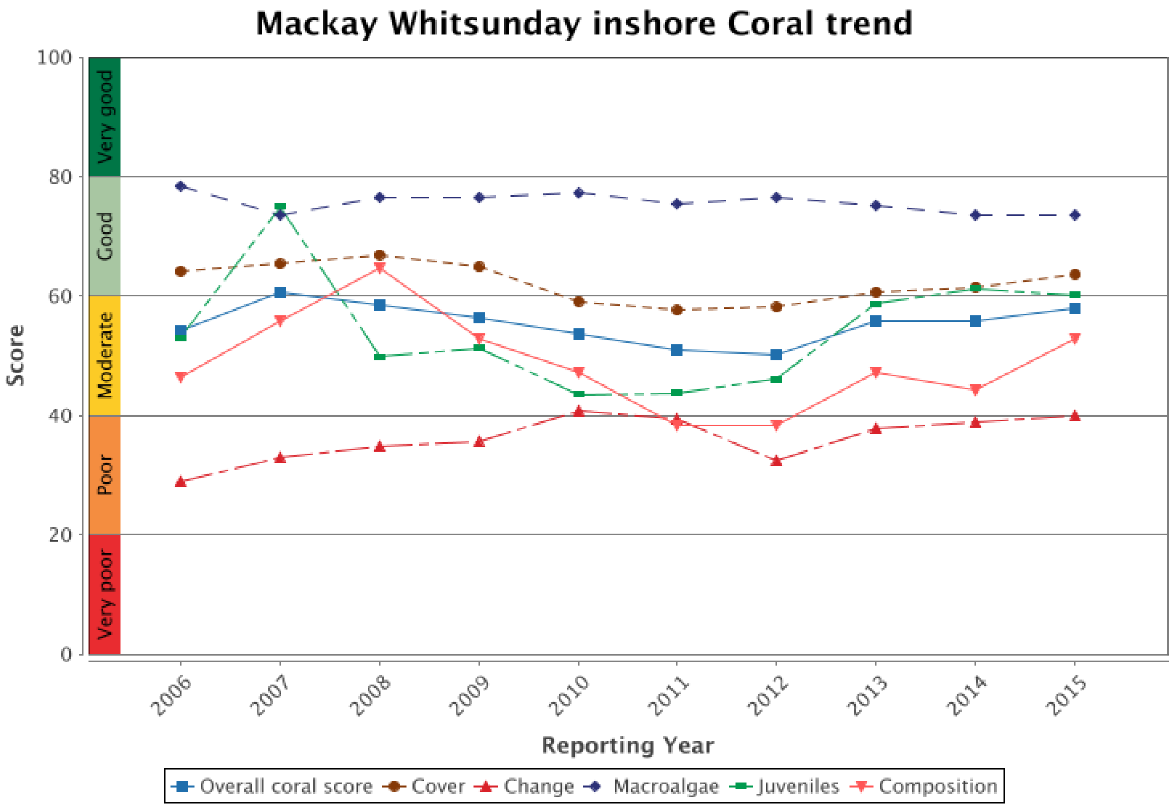


Figure 35: Trends in coral condition for the inshore Mackay Whitsunday region from 2006 to 2015. The overall coral score is the average of the component scores for combined hard and soft coral cover, coral change, proportional macroalgal cover, juvenile density and coral community composition. Data includes monitoring in the Marine Monitoring Program and the AIMS Long Term Monitoring Program. The coral change indicator is calculated as the average rate of increase in coral cover compared to modelled predictions over the preceding four years. Note that the time series for coral has been recalculated and trend graphs in previous reports are not comparable. Values are indexed scores scaled from 0-100; ■ = very good (81-100), ■ = good (61 - 80), ■ = moderate (41 - 60), ■ = poor (21 - 40), ■ = very poor (0 - 20). NB: Scores are unitless. Data source: (Thompson *et al.* 2016).

Most indicators remained the same as in 2013-14 (Figure 35 and Figure 36), with coral cover and macroalgal cover both good and coral change scores moderate (Figure 35). Juvenile density decreased from good to moderate, and coral composition score remained moderate with an improving trend, which indicates some recovery following disturbances from floods and cyclones in 2011-12 (Figure 35).

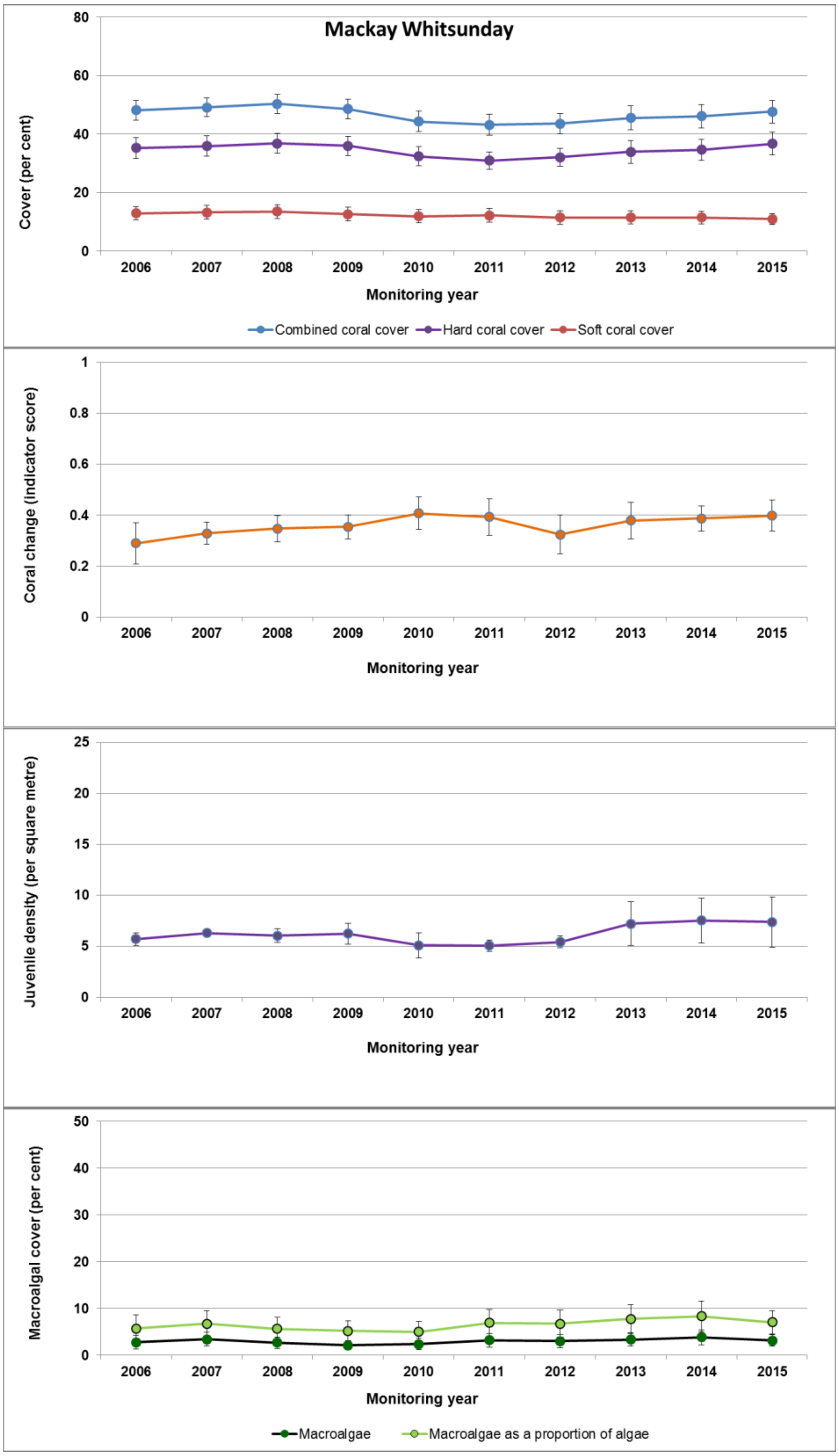


Figure 36: Average cover of corals, change in coral cover, density of hard coral juveniles and cover of macroalgae in the Mackay Whitsunday region from 2006 to 2015

Note that the time series for coral has been recalculated and trend graphs in previous reports are not comparable. Data source (Thompson *et al.* 2016).

Fitzroy

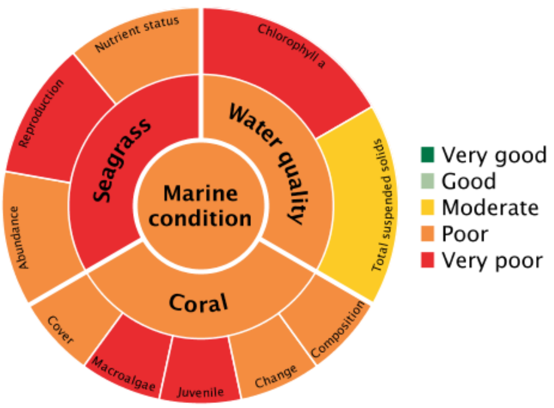


Figure 37: The overall marine condition adjacent to Fitzroy region

Overall marine condition in the Fitzroy remained poor in 2014-15 (Figure 37). Inshore water quality remained poor and inshore seagrass declined to very poor. The condition of coral reefs, which had been very poor since 2011-12 following multiple disturbances, improved to poor in 2014-15.

Acute pressures and impacts

In the Fitzroy region, rainfall and river flow were close to the long-term average as a consequence of Tropical Cyclone Marcia, making it relatively wetter than other regions in 2014-15. For example, up to 300 millimetres of rainfall was recorded in six to eight hours over the Don and Dee Rivers and Callide Creek in the Fitzroy River catchment area. Marcia passed quickly but caused considerable physical damage from wind and tidal surge as well as elevated rainfall and river flow.

Almost all coastal seagrass meadows had potential high risk exposure to river plumes (235 square kilometres or 95 per cent), whereas only five per cent of offshore meadows and coral reefs were at high risk from exposure to river plumes in 2014-15 (Lønborg *et al.* 2016).

Despite the high river flow which exposed seagrass meadows to river plume waters with high nutrient, turbidity and total suspended solids, low salinity or to river plume waters with high nutrient, intermediate salinity, low total suspended solids for 100 per cent of the wet season, daily light was similar to the long-term average, except at reef habitats (McKenzie *et al.* 2016).

Seagrass experienced above average seawater temperatures for the third consecutive year, with more days above 35°C (including extreme temperatures - over 40°C) (McKenzie *et al.* 2016), which may have reduced growth in some species. Key environmental forces acting on seagrass in the Fitzroy include exposure at very low tide and high turbidity, and variations between habitats also reflected differences in nutrient and light availability.

Water quality

Inshore water quality was assessed by remote sensing of chlorophyll *a* and total suspended solids (Bureau of Meteorology 2016b; Tracey *et al.* 2016). Overall water quality in the Fitzroy region remained poor in 2014-15 (Figure 38). Changes in inshore water quality have been driven by relatively larger fluctuations in chlorophyll *a* compared to total suspended solids. Chlorophyll *a* declined to very poor in 2014-15, and total suspended solids remained moderate.

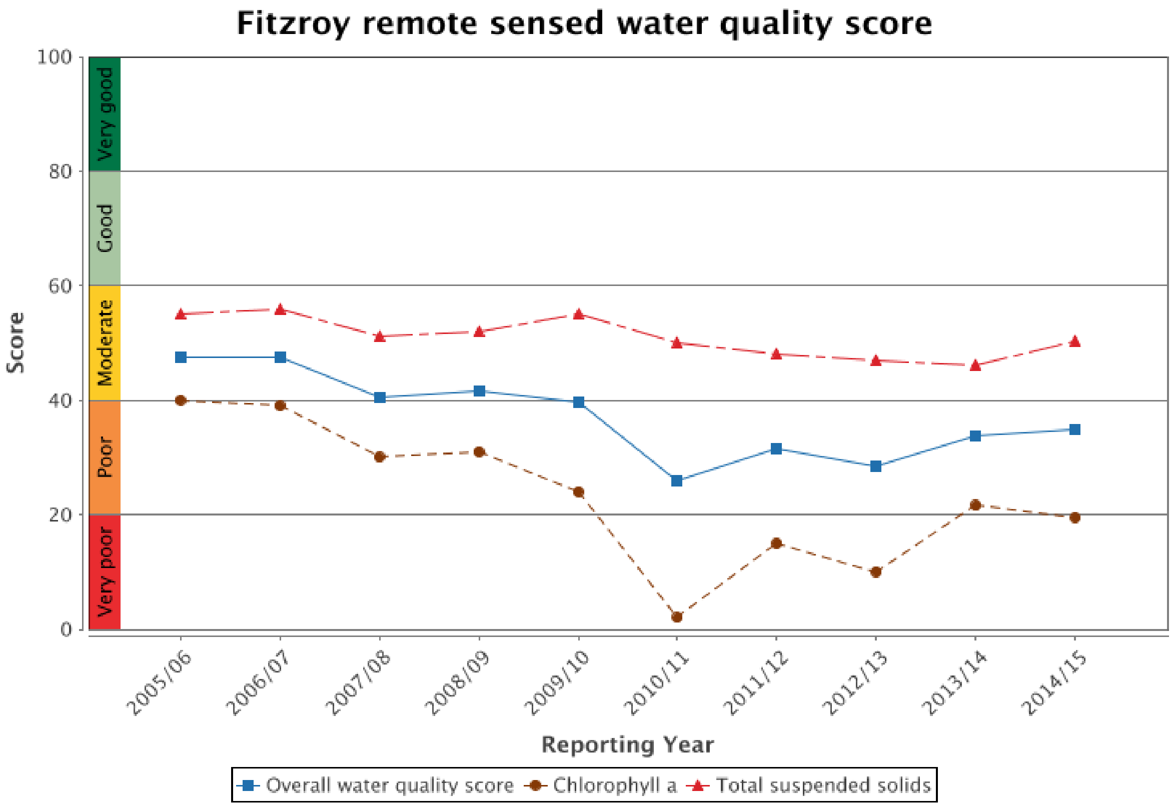


Figure 38: Trend in the water quality scores for the inshore Fitzroy region from 2005-06 to 2014-15
The overall water quality score is the average of the component scores for chlorophyll *a* and total suspended solids. Values are indexed scores scaled from 0-100; ■ = very good (81-100), ■ = good (61 - 80), ■ = moderate (41 - 60), ■ = poor (21 - 40), ■ = very poor (0 - 20). NB: Scores are unitless. Data source: (Bureau of Meteorology 2016b; Tracey *et al.* 2016).

Water quality across the region showed a clear gradient of improvement from inshore areas more frequently exposed to flood waters than offshore areas. This gradient was supported by long-term assessments of water quality at specific sites with variability between sites reflecting local hydrodynamic conditions and biological processes. Site-specific water quality data were not collected in the monitoring program in the Fitzroy region in 2014-15.

The only pesticide monitoring site in the Fitzroy region is at North Keppel Island, where concentrations of PSII herbicides were below those known to have any effects on plants or animals based on toxicity or a reduction in photosynthesis (category 5) (Gallen *et al.* 2016). PSII herbicide concentrations have consistently been category 4 or 5 since sampling commenced in 2005. The herbicides detected with the greatest frequency include atrazine, diuron and tebuthiuron (Gallen *et al.* 2016). Other pesticides detected included hexazinone (Gallen *et al.* 2016).

Seagrass
The condition of inshore seagrass in the Fitzroy region declined to poor in 2014-15, and has been on a declining trajectory since 2005-06. Abundance remained poor in 2014-15, reproductive effort remained very poor, and nutrient status decreased to poor, which may have been an effect of Tropical Cyclone Marcia (Figure 39) (McKenzie *et al.* 2016).

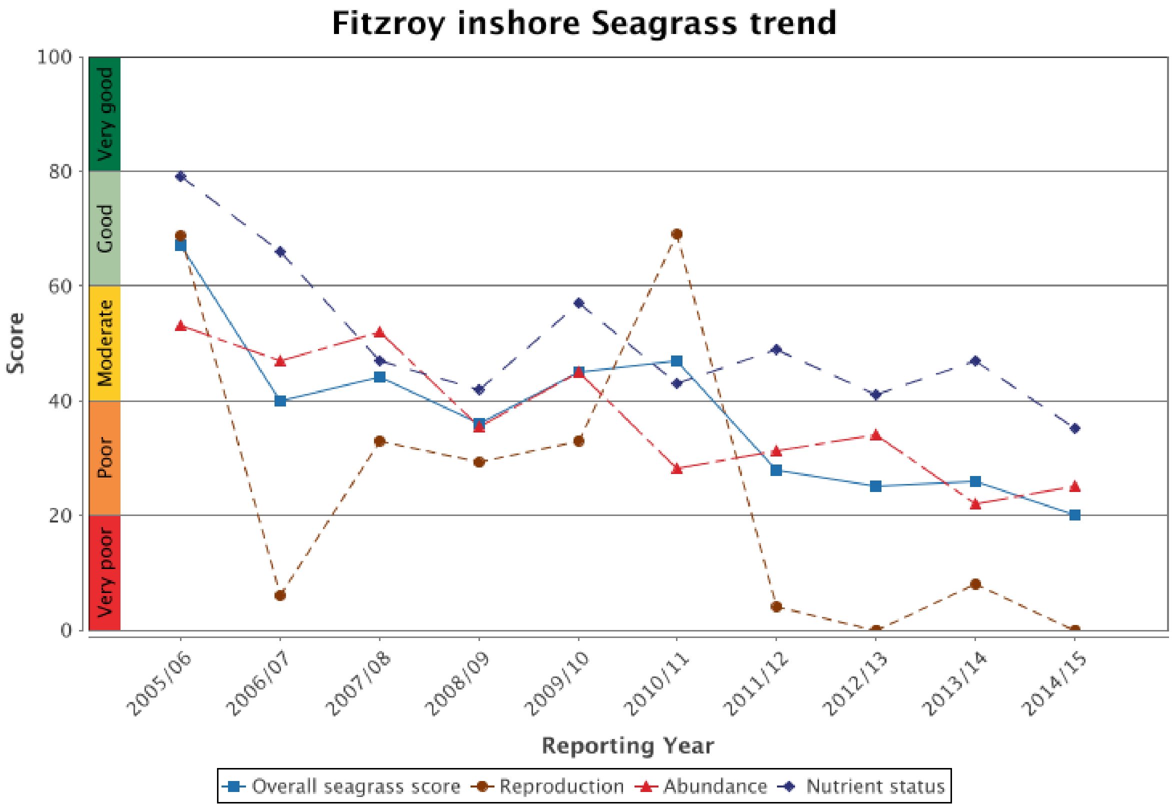


Figure 39: Trend in seagrass condition for the inshore Fitzroy region from 2005-06 to 2014-15
The overall seagrass score is the average of the component scores for reproduction, abundance and nutrient status. Values are indexed scores scaled from 0-100; ■ = very good (81-100), ■ = good (61 - 80), ■ = moderate (41 - 60), ■ = poor (21 - 40), ■ = very poor (0 - 20). NB: Scores are unitless. Data source: (McKenzie *et al.* 2016).

Seagrass abundance improved slightly in 2014-15, but remained poor. Reproductive effort remained very poor. The nutrient status of seagrass tissue declined from moderate to poor overall (McKenzie *et al.* 2016). Seagrass meadows across the region are still recovering from years of repeated environmental disturbances and they will be susceptible to further impacts until abundance and community composition recover to long-term average levels (Figure 39).

Seagrass meadows were monitored at representative estuarine, coastal and fringing reef locations in the Fitzroy region (Figure 40). Trends in seagrass abundance varied within and between habitat types and showed clear seasonal patterns (McKenzie *et al.* 2016). Long-term data shows very low levels of abundance at intertidal seagrass at Keppel Island, which was disturbed again in 2014-15 by Cyclone Marcia (Figure 40).

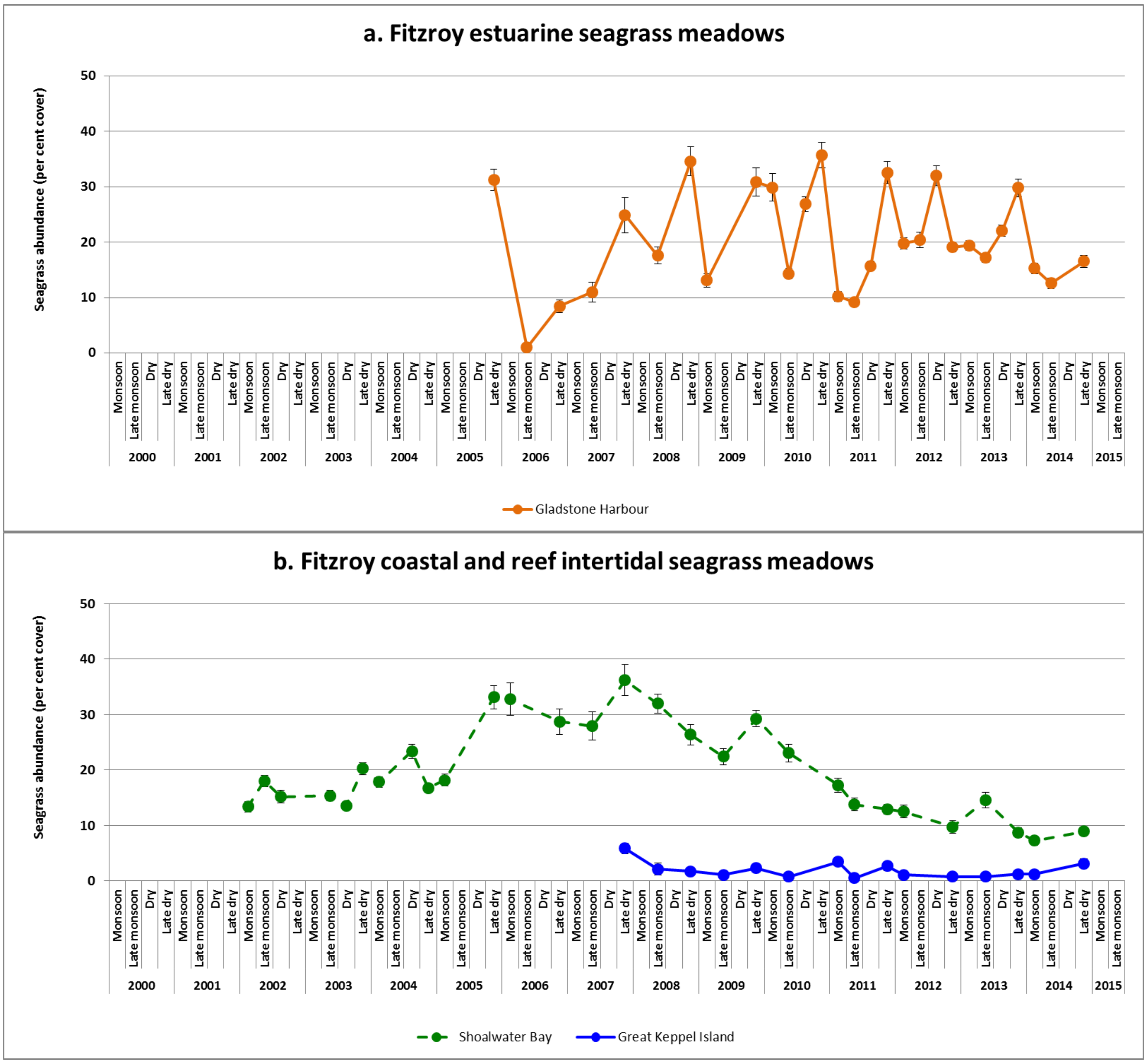


Figure 40: Seagrass abundance (per cent cover and standard error) at estuarine (Gladstone Harbour), coastal intertidal (Shoalwater Bay) and reef intertidal (Great Keppel Island) seagrass meadows since monitoring commenced to 2015

Seasons are summarised as monsoon (December-March), late monsoon (April-May), dry (June-August) and late dry (September-November). Values are indexed scores scaled from 0-100; ■ = very good (81-100), ■ = good (61 - 80), ■ = moderate (41 - 60), ■ = poor (21 - 40), ■ = very poor (0 - 20). NB: Scores are unitless. Data source: (McKenzie *et al.* 2016).

Coral

The overall condition of inshore coral reefs in the Fitzroy region improved from very poor to poor condition in 2014-15 (Figure 41) (Thompson *et al.* 2016). The influence of repeated and intense flooding, extreme temperatures and a series of severe storms since 2008 have contributed to the overall decline in coral reef condition up to 2013-14 (Figure 41) (Thompson *et al.* 2016).

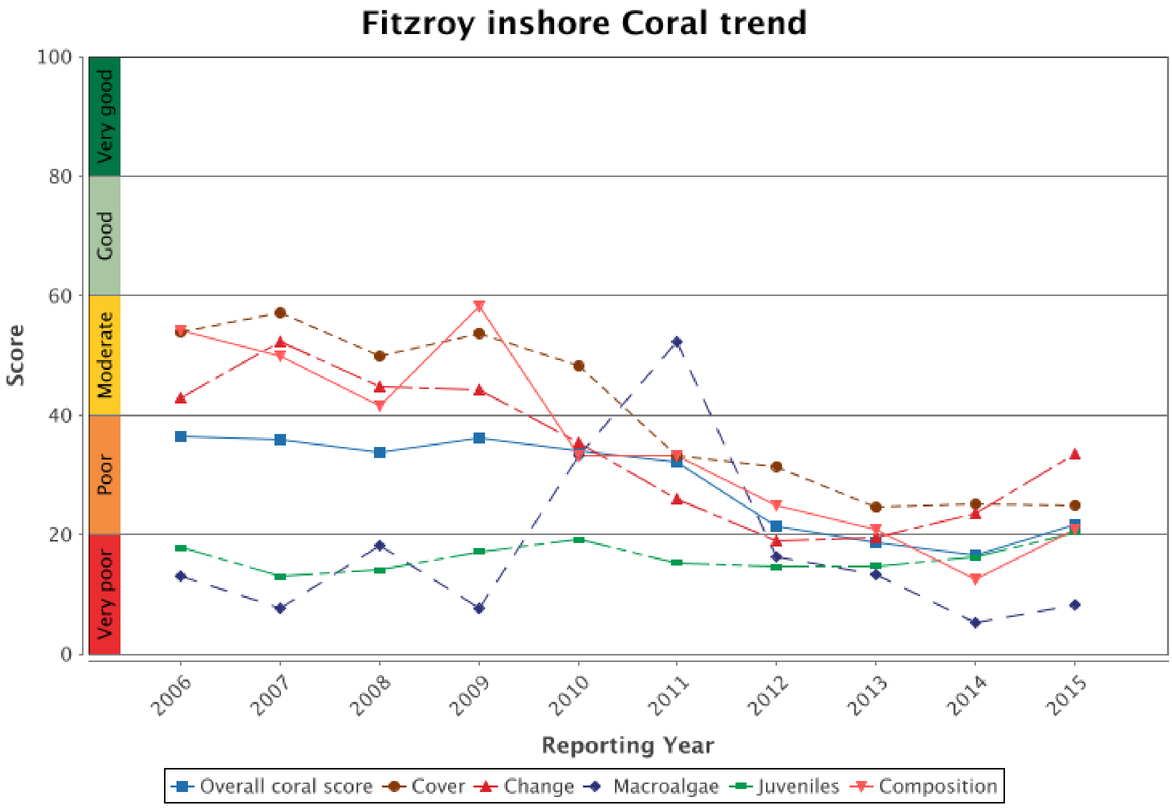


Figure 41: Trends in coral condition for the inshore Fitzroy region from 2006 to 2015
The overall coral score is the average of the component scores for combined hard and soft coral cover, coral change, proportional macroalgal cover, juvenile density and coral community composition. Data includes monitoring in the Marine Monitoring Program and the AIMS Long Term Monitoring Program. The coral change indicator is calculated as the average rate of increase in coral cover compared to modelled predictions over the preceding four years. Note that the time series for coral has been recalculated and trend graphs in previous reports are not comparable. Values are indexed scores scaled from 0-100; ■ = very good (81-100), ■ = good (61 - 80), ■ = moderate (41 - 60), ■ = poor (21 - 40), ■ = very poor (0 - 20). NB: Scores are unitless. Data source: (Thompson *et al.* 2016).

Coral health scores and indicators for coral change, juvenile density and coral composition all showed an improving trend (Figure 41), with juvenile density improving from very poor to poor in 2014-15 (Figure 44) (Thompson *et al.* 2016). Coral cover remained poor, with a small increase evident in soft coral cover throughout the region (Figure 42). Macroalgae cover continued to be in very poor condition in 2014-15 (Figure 41) (Thompson *et al.* 2016). High incidences of coral disease were observed in the Fitzroy region following major floods (Thompson *et al.* 2016), demonstrating a link between poor water quality and chronic stress on coral communities.

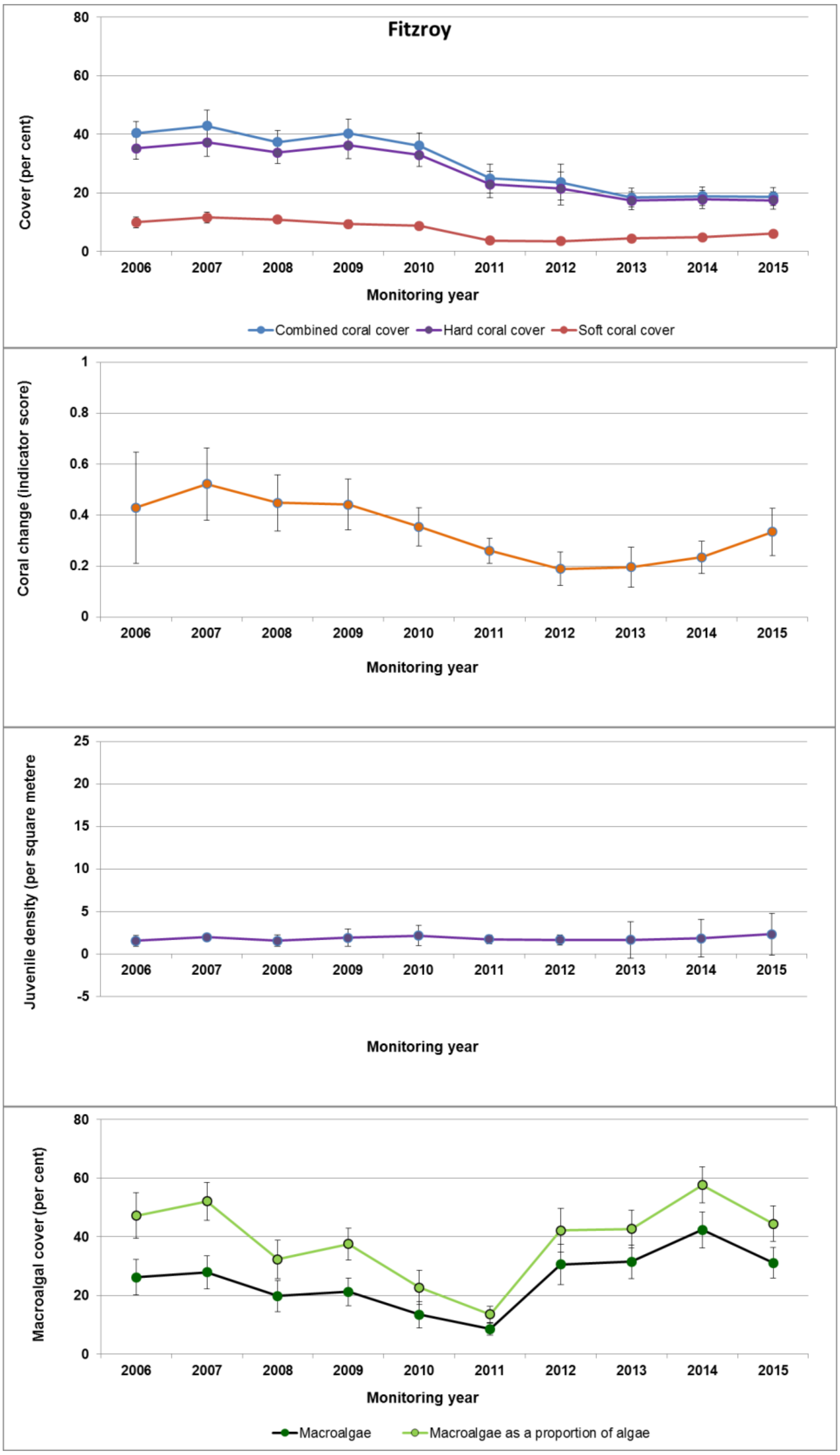
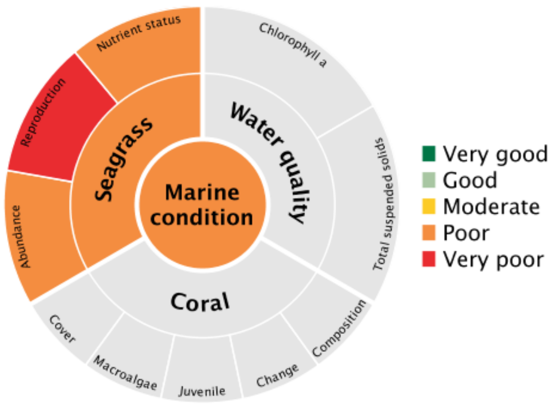


Figure 42: Average cover of corals, change in coral cover, density of hard coral juveniles and cover of macroalgae in the Fitzroy region from 2006 to 2015

Note that the time series for coral has been recalculated and trend graphs in previous reports are not comparable. Data source (Thompson *et al.* 2016).

Burnett Mary



Overall marine condition in the Burnett Mary remained poor in 2014-15 (Figure 43). It is based on inshore seagrass condition only. Inshore water quality was not assessed this year. No coral monitoring occurs in the Burnett Mary region through the Marine Monitoring Program.

Figure 43: The overall marine condition adjacent to Burnett Mary region

Acute pressures and impacts

The Burnett Mary region was the only region to be affected by above-average annual river discharge in 2014-15. The passage of ex-tropical Cyclone Marcia brought heavy rains. Flooding above the major flood level occurred in the Burnett River and Three Moon Creek in the Burnett River catchment and in the Mary River, Six Mile Creek and Tinana Creek in the Mary River catchment. The Burnett River recorded a total wet season discharge of 723,081 megalitres(more than three times its long-term median) and the Mary River had a total wet season discharge of 899,142 megalitres(between one and half and two times its long-term median).

River discharges resulted in inshore meadows being exposed to river plume waters with high nutrient, turbidity and total suspended solids, low salinity for nearly the entire wet season (McKenzie *et al.* 2016). As a consequence, daily light continued to decline in 2014-15 to well below the long-term average (McKenzie *et al.* 2016). About 89 per cent of the coastal seagrass meadows were potentially at high risk from river plumes, but offshore seagrass meadows and inshore coral reefs were not exposed in 2014-15 (Lønborg *et al.* 2016).

Water temperatures were above average for most of the year, but the lower window of tidal exposure and strong winds in 2014-15 may have provided some respite for seagrass from the elevated temperatures (McKenzie *et al.* 2016). The main environmental factors influencing seagrass at the monitoring sites in the Burnett Mary are wind, waves, elevated temperatures, land-based runoff and turbid waters.

Water quality

There is no comprehensive, ongoing site-specific water quality monitoring in the Burnett Mary region. Estimates of chlorophyll *a* and total suspended solids have previously been derived from remote sensing only, which requires further field validation. These estimates have relatively low reliability compared to other regions, and have not been presented this year. The region is known to be subject to large freshwater, sediment and nutrient input through flooding (Butler *et al.* 2013). The water quality threats to coastal and marine ecosystems including coral and seagrass were reviewed in 2014 (Coppo *et al.* 2014) for the Water Quality Improvement Plan, but more recent information is unavailable.

Seagrass

The overall condition of inshore seagrass in the Burnett Mary region declined slightly but remained poor in 2014-15. This decline was largely a result of declines in leaf nutrient status (Figure 47) (McKenzie *et al.* 2016), related to low growth rates resulting from low light levels present for almost the entire wet season, and a fertiliser and/or sewage influence in the primary source of nitrogen (McKenzie *et al.* 2016). Seagrass meadows remain in a vulnerable state with reduced capacity to recover from any further large disturbances due to very poor levels of reproductive effort and poor abundance.

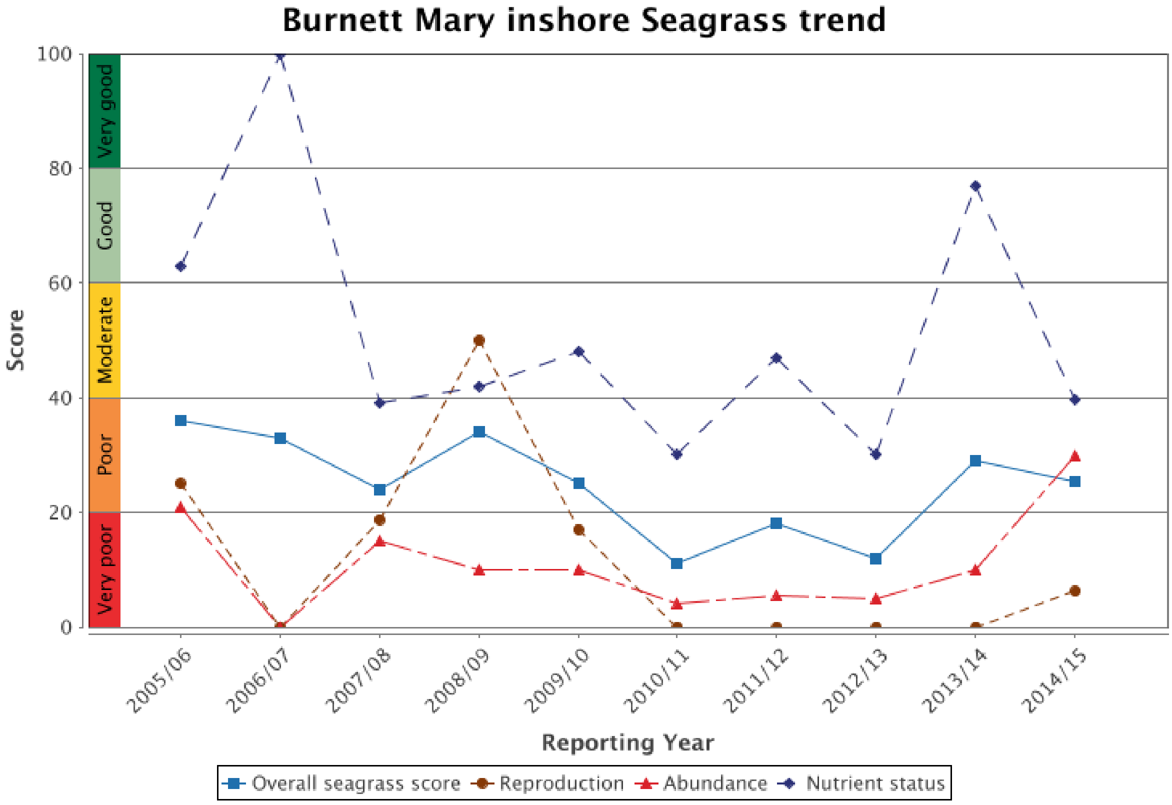


Figure 44: Trend in seagrass condition for the inshore Burnett Mary region from 2005-06 to 2014-15
The overall seagrass score is the average of the component scores for reproduction, abundance and nutrient status. Values are indexed scores scaled from 0-100; ■ = very good (81-100), ■ = good (61 - 80), ■ = moderate (41 - 60), ■ = poor (21 - 40), ■ = very poor (0 - 20). NB: Scores are unitless. Data source: (McKenzie *et al.* 2016).

Seagrass is monitored at representative estuarine sites at Rodds Bay and Urangan, in the north and south of the Burnett Mary region respectively (Figure 45), and at a coastal intertidal site at Burrum Heads. Trends in seagrass abundance varied within and between habitat types and showed clear seasonal patterns (McKenzie *et al.* 2016). Long-term trends show very low abundance and slow recovery following cumulative impacts in the region since 2006 (Figure 45).

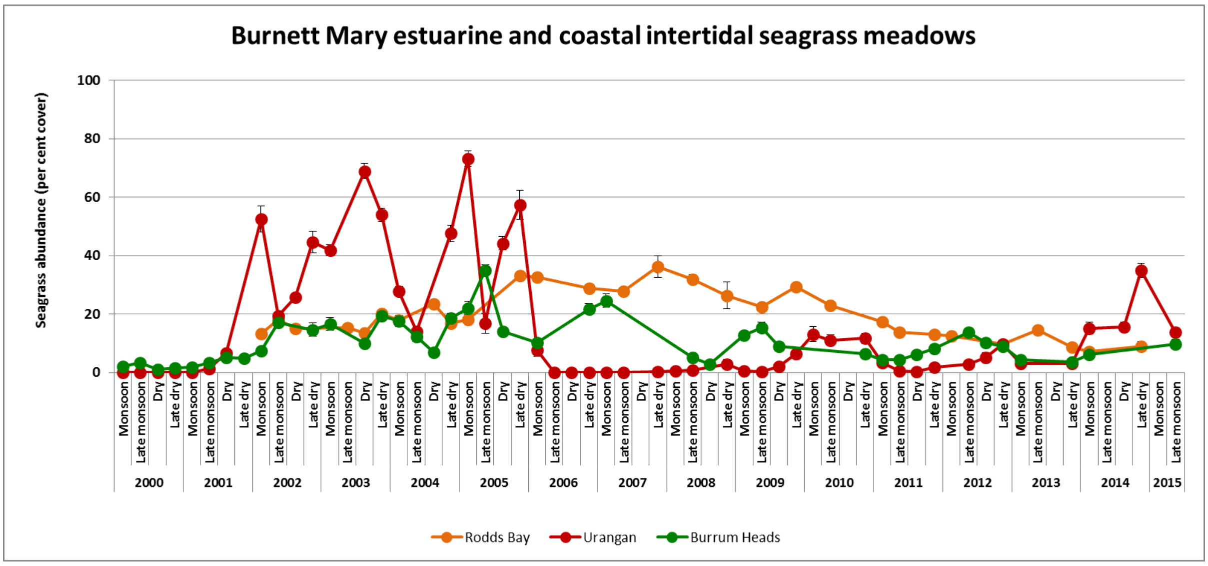


Figure 45: Seagrass abundance (per cent cover and standard error) at estuarine (Rodds Bay and Urangan), and coastal intertidal (Burrum Heads) seagrass meadows since monitoring commenced to 2015
Seasons are summarised as monsoon (December-March), late monsoon (April-May), dry (June-August) and late dry (September-November). Data source: (McKenzie *et al.* 2016).

Coral

There is no monitoring of coral in the Burnett Mary region.

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