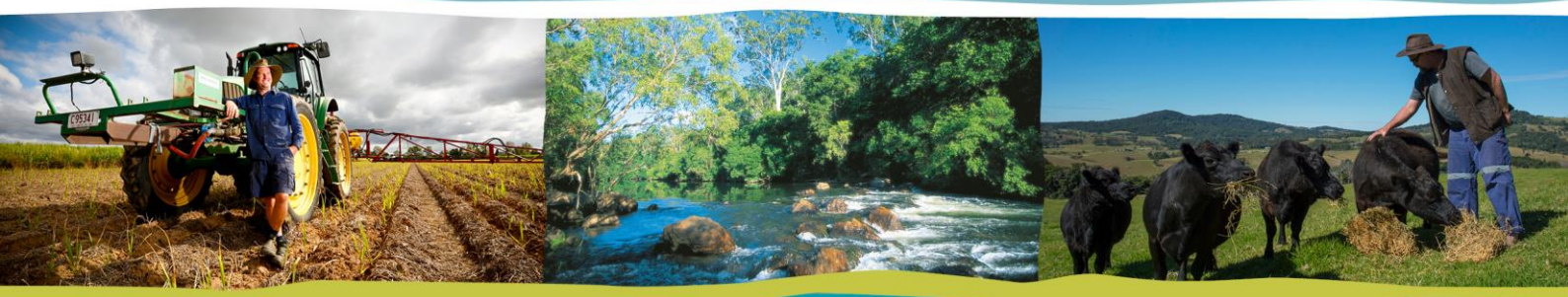
Management practice methods



Great Barrier Reef
Report Card 2015

Australian Government

Queensland Government

Management practice methods

This report summarises the development of revised management practice baselines for the Reef Water Quality Protection Plan 2013 and the means of describing progress toward the plan's target for adoption of best practice:

- *90 per cent of sugarcane, horticulture, cropping and grazing lands are managed using best management practice systems (soil, nutrient and pesticides) in priority areas by 2018*.

Paddock to Reef Program Water Quality Risk frameworks

The Paddock to Reef Integrated Monitoring, Modelling and Reporting Program (Paddock to Reef program) has developed water quality risk frameworks for each agricultural industry. These frameworks articulate best practice in relation to the Reef Water Quality Protection Plan adoption target. Features of the Paddock to Reef water quality risk frameworks are:

- The suites of practices relevant to each pollutant are described in the frameworks. This does not mean all of the practices in the production system, only those practices that pose the greatest potential water quality risk through movement of sediments, nutrients, or pesticides off-farm.
- Not all practices are equal. The frameworks allocate a percentage weighting to each practice depending upon its relative potential influence on off-farm water quality.
- The 'best practice' level is that targeted by Reef Water Quality Protection Plan investments.

These practices are described in terms of their relative water quality risk from Low to High.

For the purpose of describing industry status and progress in relation to the Reef Water Quality Protection Plan 2013 adoption target, best management practice (BMP) is defined as the area managed under Low and Moderate-Low risk levels.

Table 1: Paddock to Reef program classification of management practices in the grazing industry based on relative risk to water quality

Water Quality Risk	Low	Moderate-Low	Moderate-High	High
Resource condition objective	Practices highly likely to maintain land in good (A) condition and/or improve land in lesser condition	Practices are likely to maintain land in good or fair condition (A/B) and/or improve land in lesser condition	Practices are likely to degrade some land to poor (C) condition or very poor (D) condition	Practices are highly likely to degrade land to poor (C) or very poor (D) condition

For sugarcane, horticulture and grains, the water quality risk framework describes management practices relating to managing nutrients, pesticides and sediments. For grazing systems, the framework describes management practices relating to dominant sources of soil erosion; pasture (hillslope), streambank and gully erosion.

Table 2: Paddock to Reef program classification of management practices in the cropping industries (sugarcane, bananas, grains and horticulture)

Water Quality Risk	Low	Moderate-Low	Moderate-High	High
Description	Lowest water quality risk, commercial feasibility not well understood	Best Management Practice	Minimum Standard	Superseded

Water quality risk frameworks provide the basis for describing:

- Industry status in relation to achievement of best practice systems. The Paddock to Reef program has developed new management practice baselines to correspond with the revision of targets, actions and investments under Reef Water Quality Protection Plan 2013.
- Annual progress from these 2013 baselines toward the 90 per cent adoption target.

Establishing farm management baselines for Reef Water Quality Protection Plan 2013

Paddock to Reef program management practice and management system benchmarks have been developed for each agricultural industry sector, and in each major river basin within each region. There are varying levels of uncertainty or confidence in these benchmarks for many reasons.

Table 3: Summary of data sources and uncertainty around management system baselines developed for Reef Water Quality Protection Plan 2013

Industry	Primary data sources	Confidence in management system baselines	Sources of uncertainty
Bananas	• 1:1 growers survey • Banana BMP Guide (anonymous, aggregated) • Reef Programme grant applications (anonymous)	Good	• High level of heterogeneity within the industry, particularly with respect to farm size. There are a relatively small number of very large farms which can skew results.
Grains	• Grains BMP program (anonymous) • Expert agronomist workshops	High	• Over 80 per cent of industry represented in baseline sample. However there are some Grains BMP questions which do not allow discrimination of practices at a fine level.
Grazing	• Grazier 1:1 survey	Good	• Survey has enabled an excellent appreciation of farm management. However there is an assumption that good management corresponds to good resource condition. • Some river basins have insufficient sample size to develop a baseline that is specific to that basin. In these instances the broader regional baseline is employed.

Horticulture	Growcom Farm Management System (anonymous)	High	• Very large proportion of industry represented in baseline sample (depending on region). However there are some Horticulture farm management systems (FMS) questions which do not allow discrimination of practices at a fine level.
Sugarcane	• 1:1 grower surveys • Smartcane BMP program (anonymous, aggregated) • Reef Programme grant applications (anonymous)	High	• Uncertainty around management related to timing of fertiliser and herbicide applications. Mostly relates to variance in interpretation from field staff capturing data on-farm. • Alternate lines of evidence validate baseline distributions for key practices.

Grazing

The prevalence of different management practices utilised in grazing businesses was determined through surveying of commercial-scale graziers between late 2011 and early 2014. Surveys took the form of one on one, semi-structured interviews conducted on-farm by experienced professional grazing extension officers. Survey questions were designed to align with the practices articulated in the Grazing Water Quality Risk framework, i.e. the responses recorded align with varying degrees of water quality risk associated with that management. The framework further aligns these practices with the erosion process that is most directly influenced by those practices. While the key management categories remained consistent, the questions and practice descriptions used in wet coastal landscapes were different to those used in rangelands grazing systems.

For reporting and Paddock to Reef program modelling purposes, the specific management practice data was analysed to develop management system ratings (from Low to High risk) that reflect the water quality risk of the mix of individual practices on a farm. Survey responses to individual questions (practice descriptions) were weighted and aggregated to develop a water quality risk score for the practices associated with each erosion process (pasture (hillslope) erosion, streambank erosion, and gully erosion). Table 4 below provides an example for one question that relates to the objective determination of long-term carrying capacity.

Table 4: Grazing land management survey question 11 - the categories of response and the water quality risk score allocated for each category of response

Survey Question: For long-term planning what do you base your average carrying capacity on?	Score	Risk level
Historical experience and/or anecdotal advice (not documented)	0	High
Long-term stock and stocking rate records (documented in diaries, paddock records etc.)	4	Moderate
Some objective measure of safe stocking rate calculations, including property map and based on historical data, subjective assessment of resource condition	7	Low-moderate
Documented records, including property map and safe stocking rate calculations based on land type, property infrastructure and objective assessments of land condition.	10	Low

This survey question (table 4) accounts for 10% of the total water quality risk score for practices related to hillslope erosion risk. The 'best practice' response is allocated a score of 10, and the least sophisticated management is allocated a score of zero. A total water quality risk score for the practices related to hillslope erosion was derived through combining scores for all relevant questions.

Scores for each erosion process were then assigned a management risk rating (table 5), based on expert review of specific combinations of management practices.

Table 5: Water quality risk scores used to categorise management risk ratings

Erosion Process	Water Quality Risk Rating			
	Low	**Low-Moderate**	**Moderate**	**High**
Hillslope	81-100	59-80	33-58	0-32
Streambank	100	66-99	33-65	0
Gully	85-100	62-84	32-61	0-31

Table 6: Key grazing management categories and their weightings in developing water quality risk scores and ratings

Erosion Process	Management category (each informed by a suite of practices)	P2R Weighting
Hillslope erosion	**1.** Average stocking rates imposed on paddocks are consistent with district long-term carrying capacity benchmarks for comparable land types, current land condition, and level of property development	20%
	2. Retention of adequate pasture and ground cover at the end of the dry season, informed by (1) knowledge of ground cover needs and (2) by deliberate assessment of pasture availability in relation to stocking rates in each paddock during the latter half of the growing season or early dry season.	40%
	3. Strategies implemented to recover any land in poor or very poor condition (C or D condition)	25%
	4. The condition of selectively-grazed land types is effectively managed	15%
	Hillslope erosion assessment	100%
Streambank erosion	**5.** Timing and intensity of grazing is managed in frontages of rivers and major streams (including associated riparian areas) and wetland areas.	100%
Gully erosion	**6.** Strategies implemented, where practical and affordable, to remediate gullied areas	30%
	7. Linear features (roads, tracks, fences, firebreaks, and water points located and constructed to minimise their risk of initiating erosion	40%
	1 – 4 Hillslope erosion assessment	30%
	Gully erosion assessment	100%

Grazing management system baselines for Reef Plan 2013 were based on management system ratings for individual businesses, aggregated to form baselines for representative river basins within natural resource management (NRM) regions. These individual ratings and baselines were reviewed by regional experts and compared with corresponding data where available, (such as aggregated, anonymous assessments conducted by graziers participating in the Grazing BMP program). Where insufficient samples were available to discriminate management at the level of river basins, the baseline for the entire NRM region is used.

Table 7: Number of individual grazing businesses and area represented in grazing baseline estimates

Region	Rangelands	Wet Coastal	Area represented (% of region)	
Cape York (Normanby)	11 +17*	-	1,263,673 ha	(58%)
Wet Tropics	8	117	123,129 ha	(18%)
Burdekin	98	-	3,103,197 ha	(24%)
Mackay Whitsunday	-	28 + 43*	154,089 ha	(38%)
Fitzroy	98	-	991,677 ha	(8%)
Burnett Mary	55	30	368,130 ha	(10%)

**additional detailed samples provided courtesy of Cape York Sustainable Futures and Reef Catchments Mackay Whitsunday Isaac NRM.*

Sugarcane

Key management practices relevant to water quality risk of sugarcane farming systems were articulated in a water quality risk framework for sugarcane in 2013.

Table 8: Key management categories articulated in the Paddock to Reef program water quality risk framework for sugarcane

Management category	Weighting
Sediment (runoff and soil loss)	
Crop residue cover (green cane trash blanketing)	30%
Controlled Traffic Farming	25%
Land management during cane fallow	25%
Tillage in plant cane (land preparation)	20%
Nutrients (nitrogen)	
Matching nitrogen supply to crop nitrogen requirements	60%
Timing of fertiliser application with respect to rainfall or irrigation	30%
Application method (surface or subsurface)	10%
Pesticides	
Timing application of residual herbicides	40%
Targeting application to reduce the volume of herbicide applied	40%
Residual herbicide use in ratoons	20%
Water	
Calculating the amount of water to apply	70%
Managing surface runoff	30%

The prevalence of each of these key management practices in the sugarcane industry was estimated through a benchmarking process conducted throughout 2013-14.

- A suite of questions directly relating to the Paddock to Reef program water quality risk framework was the basis of a survey conducted by regional NRM organisations on behalf of the program. Sampling was targeted as much as possible to ensure that up to 50 per cent of the growers sampled had not previously had high levels of engagement with Reef Water Quality Protection Plan initiatives. In each region there was a target of a minimum of 100 randomly selected growers across catchments.
- Congruent datasets were obtained through the Smartcane BMP program and recent applications (2012-13 and 2013-14 where available) for the Australian Government's incentive programs.
- In each region small expert panels were convened to review the adoption levels indicated by the various source data and confirm adoption estimates for each practice level, for each management issue. The proportion of growers and area at each level were checked for sensibility and modified if sufficient supporting evidence was available. Supporting evidence was in the form of discrete data (mills, local productivity service organisations, specific project data, other Paddock to Reef program data on rates and volumes of nutrient and pesticide use) and weight of local opinion.

Best management practice systems for sediment, nutrient, or pesticide management are described through aggregating the adoption levels of each practice according to their framework weighting.

Bananas

The Paddock to Reef program water quality risk framework for bananas is based on the Australian Banana Grower's Association (ABGC) *Banana BMP Guide* (http://bmp.abgc.org.au/). The specific practices that are most relevant to water quality risk of the banana farming system were collated into a focused framework that also aligns with the management practice monitoring system utilised by Terrain NRM (the regional NRM organisation in the Wet Tropics). Prioritising and weighting these practices for relative water quality risk occurred through

consultation with Queensland Government scientists, officers from the ABGC, Terrain NRM and extension officers from the Queensland Department of Agriculture and Fisheries.

The pollutants of most concern with respect to the banana industry are sediments and nutrients. There is little to no use of the residual herbicides (with relatively high ecological toxicities) that are common in other cropping sectors. Herbicides that are commonly used in bananas have relatively low ecological toxicity and are not priorities for Reef Water Quality Protection Plan 2013. Offsite movement of these products - when it occurs - is largely a function of runoff and soil loss, which is a focus area in the framework.

Table 9: Key management categories articulated in the Paddock to Reef program water quality risk framework for bananas

Management category	Weighting
Sediment (runoff and soil loss)	
Crop removal	10%
Fallow management	20%
Tillage – plant crop	15%
Ground cover (inter-rows and headlands)	35%
Controlling runoff (contouring)	10%
Controlling runoff (drains)	5%
Sediment traps	5%
Nutrients	
Timing application of residual herbicides	40%
Targeting application to reduce the volume of herbicide applied	40%
Residual herbicide use in ratoons	20%
Water	
Calculating the amount of water to apply	70%
Managing surface runoff	30%

The prevalence of each of these key management practices in the Wet Tropics was estimated through a benchmarking process conducted during 2013-14. There was no data available to support baseline development in the banana production areas of southern Cape York, although this may change during 2015. Anonymous data sources for the Wet Tropics included:

- A grower survey conducted in 2012 by Terrain NRM and the ABGC, representing 125 growers and approximately 75 per cent of the cropped area of bananas.
- Management practice data collected by Terrain NRM as a component of 2012-13 applications for the Australian Government's Reef Rescue program.
- Aggregated anonymous data from the *Banana BMP Guide*, available for discussion while reviewing adoption benchmarks with experienced extension officers.

Horticulture

The Paddock to Reef program water quality risk framework for the horticulture industry is based on the Water Quality Management module of Growcom's *Hort360* best management practice program (see http://www.growcom.com.au/land-water/hort360/). The fifty management issues covered in the FMS module were reviewed in collaboration with Growcom to focus on a smaller subset of seventeen management issues with greatest influence on offsite water quality.

Table 10: Key management categories articulated in the Paddock to Reef program water quality risk framework for horticulture

Management category	Weighting
Sediment (runoff and soil loss)	
Use of vegetated buffers	5%
Fallow management	35%
Managing in-field runoff	20%
Managing inter-rows	25%
Managing roads and headlands	10%
Sediment trapping	5%
Nutrients	
Soil testing to inform nutrient budgeting	10%
Leaf testing to inform nutrient budgeting	10%
Objective nutrient budgeting	30%
Fertiliser application method	25%
Determining crop nutrient requirements	25%
Pesticides	
Determining pesticide requirements	30%
Managing risk of runoff and drift	30%
Integrated Pest Management (IPM)	40%
Water	
Irrigation scheduling	30%
Matching irrigation interval and volume with crop requirements	50%
Water recapture and use	20%

Anonymous data from growers completing FMS modules during 2012-2014 was analysed according to the water quality risk framework weightings. This specific management practice data was analysed to develop management system ratings (from Low to High risk) that reflect the water quality risk of the mix of individual practices on a farm. Data was available for the Burnett Mary, Fitzroy, and Burdekin NRM regions. FMS data was not available for the Wet Tropics and the Mackay Whitsunday NRM regions (where there is no current Reef Water Quality Protection Plan investment focus in horticulture).

Table 11: Number of individual horticulture businesses and area represented in horticulture baseline estimates

Region	Businesses	Area
Burnett Mary	303	21,900 ha
Fitzroy	45	2025 ha
Burdekin	122	22,056 ha

Grains

The Paddock to Reef program water quality risk framework for the grain farming industry is based on a range of key management areas selected from four modules of the Grains BMP program (www.grainsbmp.com.au). Eighteen management issues were assigned weightings according to their potential for influencing offsite water quality. These weightings were developed through a review process by Queensland Government scientists and experienced Central Queensland agronomists and agricultural consultants.

Table 12: Grains BMP program modules and management questions used in developing the Reef Water Quality Protection Plan 2013 management baseline

BMP Module	Management category	Weighting
Sediment (runoff and soil loss)		
Property design layout	Use of contour and diversion banks in sloping cropping areas	15%
Property design layout	Sediment trapping devices	5%
Property design layout	Waterways and drainage lines	5%
Making best use of rainfall	Stubble volume and persistence	15%
Making best use of rainfall	Retain stubble during the fallow	20%
Making best use of rainfall	Cropping frequency	10%
Making best use of rainfall	Need for tillage	20%
Making best use of rainfall	Wheel traffic	10%
Pesticides		
Pesticide application	Pest identification	5%
Pesticide application	Resistance management	10%
Pesticide application	Product selection	5%
Pesticide application	Risk of residual pesticide movement	40%
Property design layout	Pesticide and sediment movement	40%
Nutrients		
Crop nutrition	Records of crop yield and quality	10%
Crop nutrition	Frequency of soil testing for nitrogen	30%
Crop nutrition	Influence of stored soil moisture on yield and fertiliser decisions	30%
Crop nutrition	Impact of seasonal outlook on making fertiliser decisions	20%
Crop nutrition	Application timing to minimise potential losses and maximise uptake	10%

Anonymous data from BMP program participants was analysed according to these weightings in order to develop management system ratings (from Low Risk to High Risk) that reflect the water quality risk of the mix of individual practices on a farm. Where insufficient samples were available to discriminate management at the level of river basins, the baseline for the entire NRM region was used for Paddock to Reef reporting.

The number of businesses represented in management system baselines for each category was:

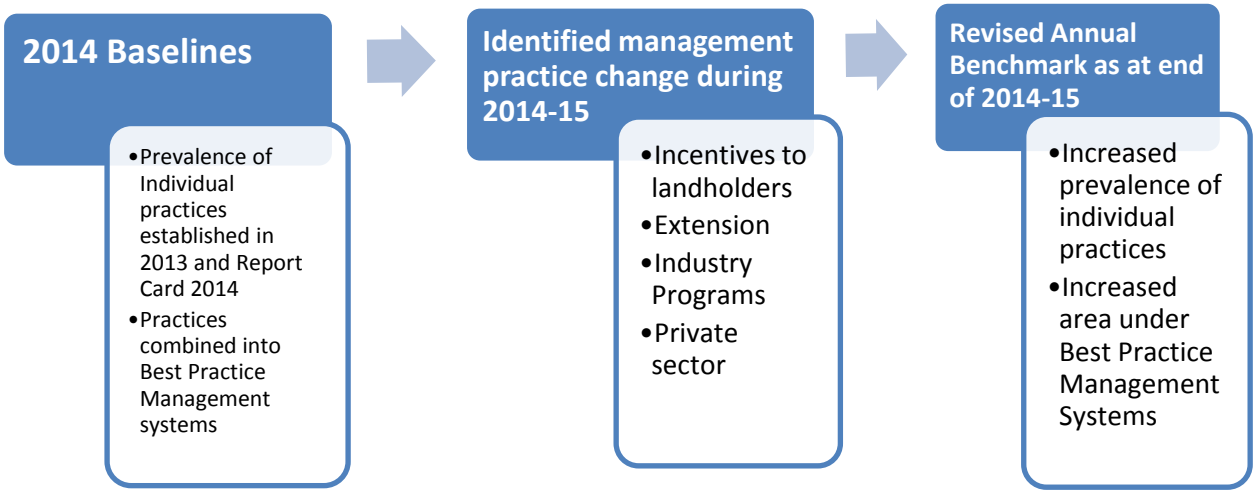
- Sediment (runoff and soil loss): 301
- Pesticides: 327
- Nutrients: 262

Table 13: Area of grain farms represented in baselines by region and river basin

Region	River basin	Area
Burnett Mary	Barambah	961 ha
	Burnett	2275 ha
Burdekin	Suttor	76,054 ha
Fitzroy	Boyne	285 ha
	Comet	74,869 ha
	Dawson	62,463 ha
	Fitzroy	12,140 ha
	Isaac	16,076 ha
	Mackenzie	31,022 ha
	Nogoa	75,248 ha

Describing annual progress toward adoption the Reef Water Quality Protection Plan 2013 adoption target

Management practice baselines are available for each of the critical practices, for each agricultural industry, in each region (and river basin). At the farm scale, these management practices combine to form a management system. Progress in terms of the adoption over time of improved and/or best management practice is monitored. Where management change has occurred, the 2013 baseline is amended to reflect that change.



The limitations with this approach are:

- Management change is identified where and when it is reported to have occurred. This relies largely on organisations adequately reporting on their activities and what the impacts of those activities are. The Paddock to Reef program describes and reports on the impacts of change for which there is reasonable and sensible evidence.
- Any regression of practices (i.e. adopting practices with greater water quality risk) is difficult to detect as these are unlikely to be reported. However, the method can appropriately reflect regression if necessary.

Evidence of management practice change

Organisations receiving funding through Reef Water Quality Protection Plan 2013 for the purpose of improving adoption of best management practice are required to report the impacts of their work as per the relevant industry water quality risk framework.

This occurs through reporting on how individual sites or farm enterprises are managed – the practice descriptions in water quality risk frameworks – both before an intervention, and after (as a result of) that intervention. The 'intervention' may be in the form of a financial incentive, capacity building extension, industry training or self-driven change.

A critical element of this process put in place for the 2014 and 2015 Great Barrier Reef Report Cards is the provision of spatial data describing the exact location of reported impacts. The process is abbreviated as:

1. Delivery organisations provide annual evidence of impact to the Paddock to Reef program, in the form of GIS data (geographic information system data, or electronic mapping of locations) and detailed management practice data.
2. This data is reviewed by the Paddock to Reef program on a site by site basis to provide assurance that reporting towards adoption targets and modelled pollutant load reductions is sensible. This review includes:
    - identification of data handling errors
    - checking that the nature of the intervention aligns with the reported impact
    - checking that the degree of impact (farm management change) is sensible and realistic
    - checking that individual sites and impacts on those sites have not previously been reported to the Paddock to Reef program and included in estimates of progress towards Reef Water Quality Protection Plan targets
    - checking that the reported impacts correspond with other independent lines of evidence available to the Paddock to Reef program.
3. The best management practice adoption baseline is adjusted on an annual basis to reflect the areas validated through the above steps.
4. For every site (usually a paddock or farm), the degree of management change is aligned to modelling simulations which best represent the management in place on that site (for example, the tillage regime, the nutrient rates, the weed and irrigation management on a cane farm).
5. The GIS data and aligned modelling simulations are provided to the Paddock to Reef program catchment modelling team for the purposes of modelling estimated annual average pollutant load reductions expected as outcomes of the reported farm management change.

The degree of adoption of best management practice during 2014-15 is likely to be a conservative estimate. There were many investments aiming at facilitating the adoption of best management practice on farms during 2014-15 (reported investments are summarised in table 14). Most were able to describe the extent of their engagement (i.e. the people they interacted with) and evidence of impact in terms of improved knowledge and skills of participants. However, not all of these were able to provide evidence of the spatial extent and the degree of change which could be attributed to the program. In some instances this was due to no or inadequate impact evaluation, or because the impacts will not be apparent until later. There are several programs and projects that will report impacts for the first time in the 2015-16 year.

Table 14: Program investments reviewed for Great Barrier Reef Report Card 2015

Region	Sector	Program	Total reported spatial extent of engagement reviewed for Report Card 2015 (hectares, or km of stream)	Spatial extent utilised in determining progress toward Reef Plan targets for adoption and pollutant load reduction
Burnett Mary	Sugarcane	Australian Government Reef Programme	343	3243
		Smartcane BMP	12,166	-
	Grazing	Grazing BMP, QLD Government extension	240,000	-
		Australian Government Reef Programme	645	4645
			31km	31km
	Dairy	Australian Government Reef Programme	71	
Fitzroy	Grazing	Grazing BMP, QLD Government extension	1,700,000	-
		Australian Government Reef Programme (collaboration with Grazing BMP)	32,235	32,235
			399km	399km
	Grains	Australian Government Reef Programme (collaboration with Grains BMP)	22,033	22,033
	Horticulture	Australian Government Reef Programme	258	258
	Cotton	Australian Government Reef Programme	4237	-
Mackay Whitsunday	Sugarcane	Smartcane BMP	44,294	-
		QLD Government extension	2890	-
		Australian Government Reef Programme	24,047	17,306
	Grazing	Australian Government Reef Programme	1376	1376
			18km	18km
Burdekin	Sugarcane	Smartcane BMP	21,738	-
		QLD Government extension		
		Australian Government Reef Programme	26,615.0	26,615.0
Burdekin	Grains	Australian Government Reef Programme (collaboration with Grains BMP)	24,447	7013

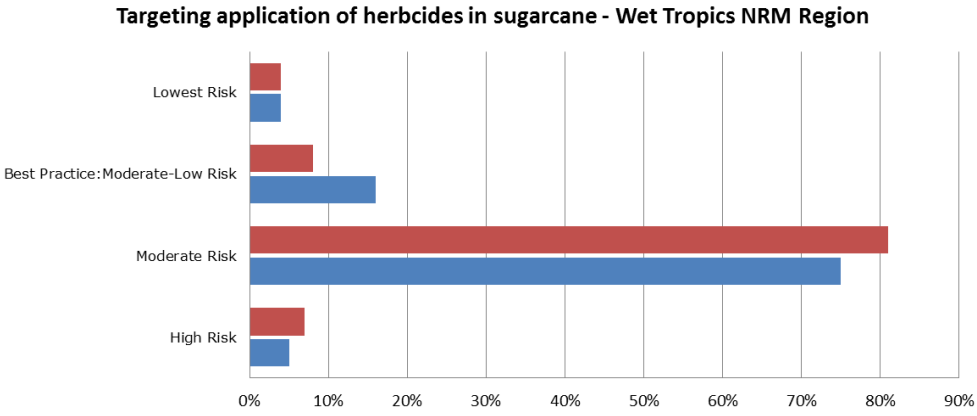
Region	Sector	Program	Total reported spatial extent of engagement reviewed for Report Card 2015 (hectares, or km of stream)	Spatial extent utilised in determining progress toward Reef Plan targets for adoption and pollutant load reduction
	Grazing	Grazing BMP, QLD Government extension	7,700,000	
		Australian Government Reef Programme (inc collaboration with Grazing BMP)	451,024	313,052
			97km	97km
	Horticulture	Australian Government Reef Programme	4504	4504
Wet Tropics	Bananas	Australian Government Reef Programme	1768	1768
	Horticulture	Australian Government Reef Programme	1885	-
	Dairy	Australian Government Reef Programme	242	-
	Sugarcane	Australian Government Reef Programme	19,307	19,307
		Smartcane BMP	74,697	-
		QLD Government extension	70,000	-
Cape York	Grazing	Australian Government Reef Programme	52,880	36,484
			107km	107km

Tracking the adoption of individual practices

The Paddock to Reef program monitors the adoption of the most important management practices over time, which is important for prioritising investments and for understanding the impacts of the broader management practice system. Practice change reporting, linked to spatial reporting, means that practice adoption can be tracked at fine or broad scale.

The example below describes the change in the level of adoption for practices related to targeting the application of herbicides in sugarcane, in this instance at the level of the entire NRM region.

For all sectors, best management practice systems for sediment, nutrient, or pesticide management are described through aggregating the adoption levels of each major component practice according to their framework weighting.



	High Risk	Moderate Risk	Best Practice:Moderate-Low Risk	Lowest Risk
2013 Baseline	7%	81%	8%	4%
2014 Revised Baseline	5%	75%	16%	4%

Describing progress

Management practices that are at the Moderate-Low Risk and Lowest Risk levels are taken to be best management practices. These are summed in describing the proportion of area managed at best practice. In the example above (at the individual practice level), the area managed at best practice in the 2013 baseline was 12 per cent, increasing to 20 per cent by the end of the 2013-14 year.

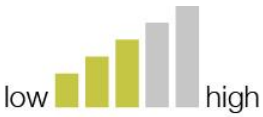
Reporting the progress toward the adoption target of 90 per cent includes colour coding based on five categories.

Table 15: The Paddock to Reef program scoring system for Report Card 2015

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

Qualitative confidence rankings

Sugarcane



Grazing

Horticulture

Grains

A multi-criteria analysis was used to qualitatively score the confidence in each indicator used in the Great Barrier Reef Report Card from low to high. The approach combined the use of expert opinion and direct measures of error for program components where available.