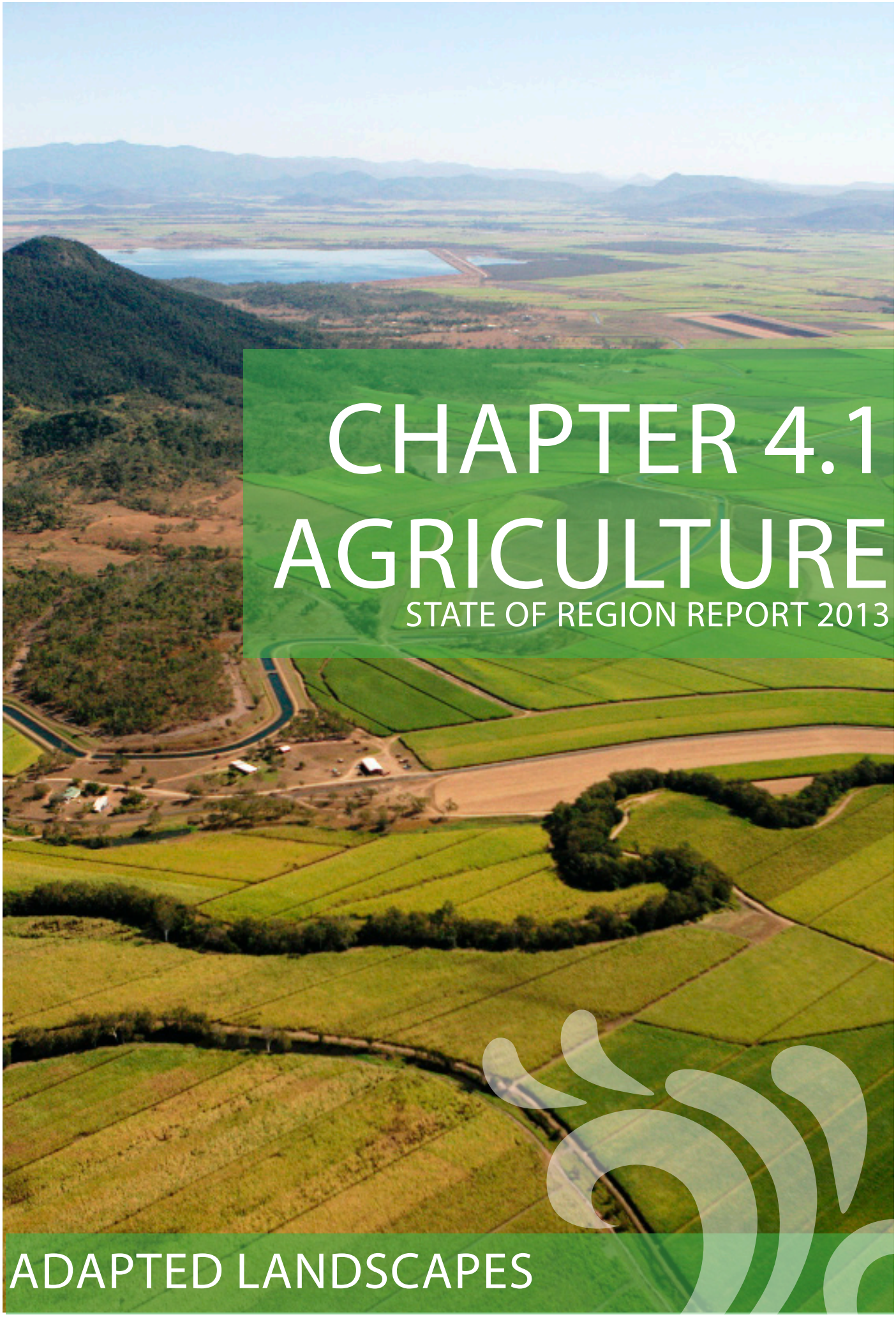

CHAPTER 4.1
AGRICULTURE

STATE OF REGION REPORT 2013

ADAPTED LANDSCAPES

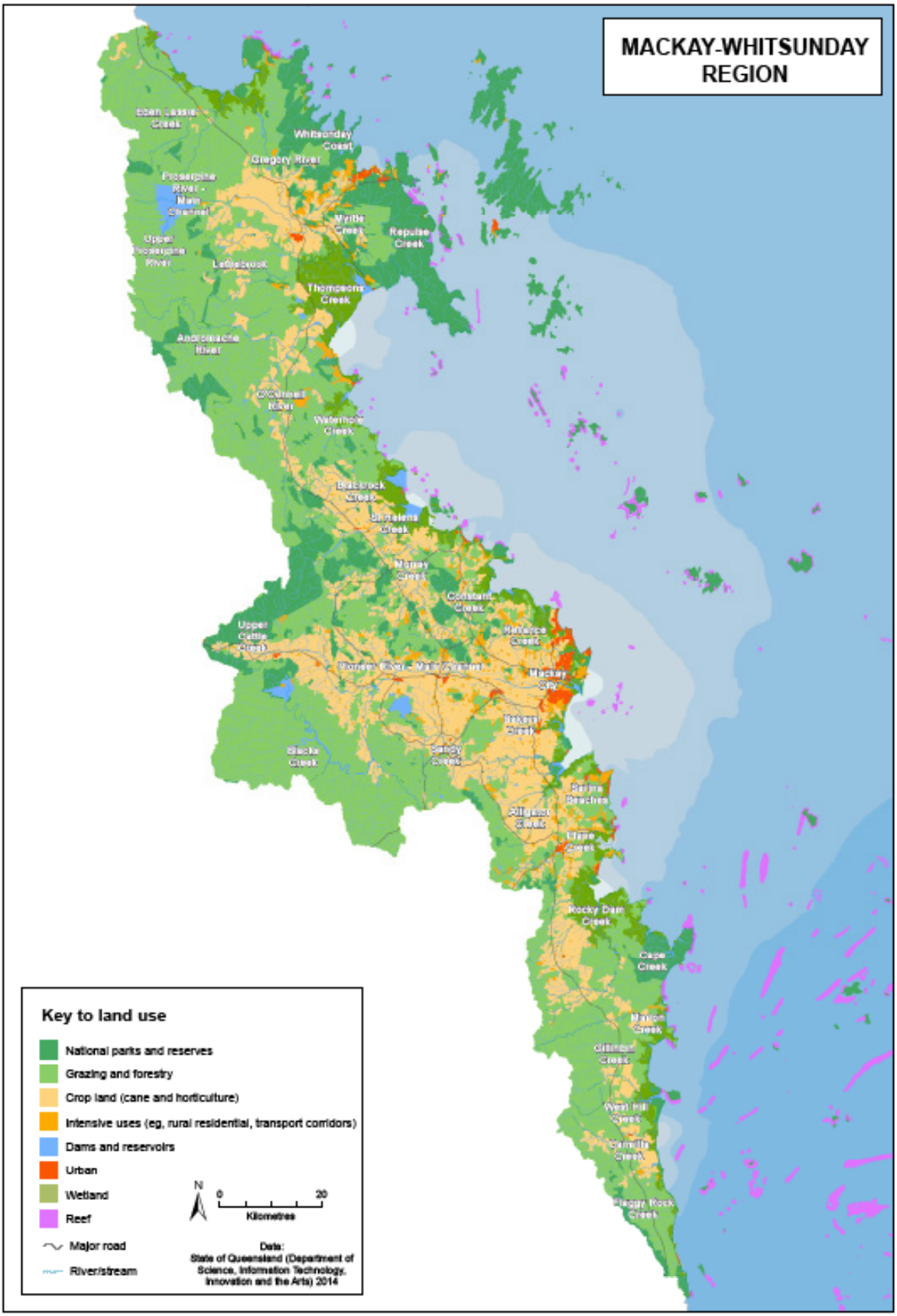

Figure 1 Land use in MWI 2013

N.B. Intensive Agriculture is defined as 1) 'Intensive horticulture' to 'intensive horticulture', 'shadehouses', 'Glasshouses' and 'Glasshouses (hydroponic)'; 2) 'Intensive animal production' to 'intensive animal production', 'Dairy sheds & yards', 'Poultry farms', 'Piggeries', 'Aquaculture', 'Other intensive animal husbandry' and 'Stockyards/ saleyards'.

Agriculture

"A farming or grazing system is said to be sustainable at the farm level if it 'satisfies the farm/grazing manager's needs over time while conserving the natural resource' (Gomez et al. 1996). Sustainable production systems include virtually all agriculture related land use enterprises in the landscape that rely on natural resources of land, vegetation, and water, and certainly includes cattle grazing, cropping, horticulture and agroforestry systems."

Pastures Mackay Whitsunday Region, Bishop (2007, 95)

SUMMARY

The regions agriculture and diverse scenic amenity define the character and image of the area, which is highly valued by both local residents and visitors.

Major intensive agriculture industries in the region are sugarcane, cattle farming and horticulture. The primary intensive agricultural land use is sugarcane which, while only making up about 18 per cent of the catchment area, constitutes land use close to 96 per cent of the intensive agriculture in the region. Grazing has the largest land use in region, accounting for 65 per cent of the region. It is estimated that more than 50 per cent of the regions beef cattle are run by approximately 10 per cent of enterprises and that 11 per cent of grazing is undertaken on improved pastures (Bishop 2007).

SUGARCANE

The Central Region Sugar Industry is located north and south of Mackay in North Queensland (Mackay Regional Advisory Group, 2005). Cane growing areas are situated on the coastal floodplains to the east of the dividing range from Flaggy Rock in Broadsound Shire through Sarina shire, Mirani shire, Mackay City and north to Bowen in Bowen shire. Cane growing is organised around two milling groups; Mackay Sugar Co-operative Association Limited (Mackay) and Wilmar International Limited (Proserpine and Plane Creek).

Each of these milling groups operates mills selling raw sugar to Queensland Sugar Limited which, in turn, is either exported through the Mackay Port or sold to the region's sugar refinery at Racecourse, owned by CSR Limited.

CATTLE GRAZING

The beef business is centred on breeding and sale of weaners, stores or cull cows, although an increase in fattening operations is occurring. A key influence of this change is the movement of many sugarcane growers toward the use of sown pastures on what was sugarcane production land. The distribution of beef enterprises is approximately 80 per cent coastal and 20 per cent hinterland.

Cattle grazing occurs mainly on improved pastures totalling an area of 74,000 hectares, while both natural or native pasture and agroforestry occupy around 427,000 hectares.

Meat processing is undertaken in the main at Thomas Borthwick & Sons (Borthwicks) abattoir in Bakers Creek south of Mackay, with 90 per cent of throughput exported and 10 per cent retained for domestic sales.

HORTICULTURE

Horticulture comprises 0.7 per cent of the NRM region and approximately 3.6 per cent of intensive agriculture land area. The Mackay Whitsunday council region supply in total more than 60 per cent of Queensland's horticulture products, the majority occurring within a 50 kilometre coastal strip in and around the townships from Bowen to

Molongle Creek, although the majority of this occurs outside the catchment boundary. Horticulture crops include mangoes, tomatoes, capsicum, green beans, pumpkin and sweet corn, and eggplant. Only a small proportion of horticultural produce from the region (5-10 per cent) is exported.

DAIRY

Dairy is confined in the main to three dairy operations within the Marani shire, which in 2012 generated 3 mega litres of milk (compared with 8.8 mega litres in 2001), before being sent to Rockhampton to be processed

AQUACULTURE

There are 38 approved aquaculture facilities in the region valued at approximately $8.6 million per annum. The aquaculture species cultured in this region include black tiger prawns (Penaeus monodon), barramundi (Lates calcarifier) and redclaw crayfish (Cherax quadricarinatus).

WATER RESOURCES

The groundwater and waterway systems of the region support the region's agricultural industries. Since European settlement, most of the regional watercourses have been subject to human development inputs including point-source discharges (e.g. sewage, industrial waste) and diffuse (non-point) sources resulting from land clearing and development, agricultural, urban stormwater and recreation activities.

In the region there exist several highly developed catchments with regulated flow, mainly as a result of cane farming. Management areas with high proportions (>40 per cent) of cane farming include Reliance Creek, Sandy Creek, Alligator Creek, Mackay City and Bakers Creek. Management areas with flow regulation include Pioneer River and Rock Dam Creek.

VALUES AND SERVICES

"Land suitable for agricultural production is a valuable, finite commodity that is to be managed to ensure its long-term protection for future generations. Use of land with both agricultural production values and biodiversity values should seek to achieve a balance between the protection of ecological processes and natural systems, economic development and the wellbeing of communities"

(DLGP 2012, 69).

The value of agricultural production in the Mackay, Whitsunday and Isaac council regions was $891 million in 2010–11, or 9.3 per cent of Queensland's total value of agricultural production (DAFF, 2013). All agricultural land-use types have seen significant market value increases for the period from 2001 to 2012, ranging from 36 to 456 per cent (DAFF, 2013).

SUGAR CANE

"Cane growing and sugar production underpins the economic stability of many coastal communities. It is the social fabric that has woven itself through the development of coastal townships up and down the coast."

Canegrowers, n.d.

Sugarcane is grown across 168,000 ha or 15 per cent of the Mackay, Whitsunday and Isaac institutional region (REDC, 2012), and represents 30 per cent of the sugarcane growing area in Queensland. Sugarcane grown in the region in 2011 was worth $240 million. In 2012 the highest land value was for the irrigated sugarcane land of the Mackay Regional Council at $18,000 per hectare, which is the highest price for that land type in Queensland.

The central region sugar industry has a value chain which commences with growing of the sugar cane plant and ends with processing of harvested cane into raw and refined sugars, molasses, electricity and ethanol. The value chain has linkages to other suppliers and is contained by the environment and supported by the Central region's economy.

Mackay Port hosts one of the world's largest bulk sugar terminals exporting raw and refined sugar totaling close to 2 million tonnes per year.

Mackay Sugar in 2012 completed the construction of a $120 million power plant at its Racecourse Mill. The power plant will have the capacity to generate one third of the Mackay region's electricity requirements from bagasse (sugar cane fibre waste), provide power and steam for the Racecourse Mill and Refinery, and allow for the export of 27MW electricity into the national grid.

CATTLE GRAZING

The use of sown pasture systems since the 1960s replaced native pastures that provided low weight gains at low stocking rates (Partridge, 1992). Areas of native pasture in the region occur mainly in the hilly range country where slope and shallow soils, forests and woodland vegetation rule out cropping options and conditions are not favourable for replacement pastures. Historically the three broad native pasture communities in the region are;

1. Pastures sparse or absent, includes two coastal communities (littoral or marine and heath) and closed forests (rain forest) are grouped together as they have limited usefulness for grazing production in the natural state due to low grass cover and or low productive value. An exception is some of the tidal flats where valuable seasonal grazing is obtained from some couch species. Prominent soil in the rainforest areas are friable earths and fertile loams, in littoral areas they soils are grey clay subsoils and heath areas infertile sandy earths dominate.

2. Blady grass (Imperata cylindrical) - includes a composite of sandy coastal lowlands and undulating low hills with open forest and woodland communities. The major trees are tea tree/paper bark (Melaleuca species), Eucalyptus and Corymbia species and swamp Mahogany species (Lophostemon). The characteristic grasses are Kangaroo grass (Themeda triandra), blady grass (Imperata cylindrical) and giant spear grass (Heteropgon triticeus). Soils area generally infertile and intensive use of these soils for sown/improved pasture activity is only possible in areas with deeper top soils.

3. Black spear grass (Heteropogon contortus) is the most extensive native pasture in the region and is found woodlands and open forests on undulating plains and low hills to higher range areas. Tree vegetation consist of mainly Eucalyptus species such as Iron Bark (E.creba/E. drepanophylla), Grey Gum (E. mollucana), Blue gum/Forest red gum (E. tereticornis), Mortern bay ash/Carbeen (Corymbia tessellaris).

In the past the most common grass planted was Kazungula setaria and Rodd's bay plicatulum, which made up more than 90% of the grass component of sown pastures. Over the past decade Rhodes grass and signal grass have been the most planted with Bisset creeping blue also becoming popular. Today the new stylos and four joint vetch legumes are better production options (Bishop, 2007).

There is little intensive grazing in the area in the form of feedlots, for example. However, there are nursery grounds in operation that provide weaner cattle for large cattle farms to the west of the NRM region, due to the regionally reliable feed available for weaning cows.

	Area harvested for milling (ha)		Percentage for region		Cane crushed (t)		Percentage for region		Commercial Cane Sugar		Sugar Produced (t)		Percentage for region	
	2006	2011	2006	2011	2006	2011	2006	2011	2006	2011	2006	2011	2006	2011
Northern	80,558	68,678	21.26	19.48	5,631,724	3,626,646	17.00	13.77	11.83	12.89	660,370	453,211	14.60	12.94
Herbert-Burdekin	127,321	132,033	33.60	37.44	12,921,548	12,471,413	39.01	47.37	14.06	13.54	1,853,542	1,671,450	40.97	47.72
Mackay Proserpine	116,026	105,796	30.62	30.00	9,745,779	6,697,741	29.42	25.44	13.47	13.35	1,347,357	894,014	29.78	25.52
South Queensland	55,061	46,139	14.53	13.08	4,824,881	3,533,503	14.57	13.42	13.59	13.47	662,389	483,992	14.64	13.82
Queensland	**378,966**	**352,646**	**100.00**	**100.00**	**33,123,932**	**26,329,304**	**100.00**	**100.00**	**13.44**	**13.31**	**4,523,658**	**3,502,667**	**100.00**	**100.00**

Table 1 Queensland sugar production statistics, 2012. Source: Australian Milling Council (2012a) N.B: The hectares noted does not include fallow and other farmland i.e. headland, farm sheds/houses included in the 168,000 ha cane area in previous section

Local NRM Body Boundaries	Estimated cattle numbers	No of producers	Estimated gross value $ M at the farm gate.	Grazing nature vegetation	Grazing modified	Area (ha)
Terrain	1,956,190	35	11	675,600	45,600	893,800
Burdekin Dry Tropics	851,518	510	245	11,196,400	261,400	13,036,500
Mackay Whitsunday	1,150,700	201	326	270,500	29,000	432,700
Fitzroy	1,956,190	2,756	555	9,003,200	1,224,200	12,914,400
Burnett Mary	863,025	910	245	2,479,100	158,500	4,018,800

Table 2 Meat cattle state as at 30th June 2006. Source: Agforce data (composite of DPI & F original data)

HORTICULTURE

Perennial horticulture occurs on 1,534 ha or 0.02 per cent of the Mackay, Whitsunday, Isaac institutional region, while annual horticulture occurs on 8,580 ha or 0.1 per cent of the region. The overall gross value of horticultural crops in the Mackay, Whitsunday Isaac council region for 2010-2011 was around $207.5 million (previously $250 million in 2006), with approximately 200 businesses farming around 1,100 ha of productive land, while employing at least 3000 staff during peak season.

However, this boundary includes the highly productive Bowen area north to Gumlu, which overlaps in part yet lies predominantly just outside of the Reef Catchments' area. It is however noteworthy that in 2011 the Bowen area grew 58 per cent of Queensland's capsicums, 41 per cent of the state's beans, 38 per cent of tomatoes, 28 per cent of sweet corn, 20 per cent of mangoes and 17 per cent of melons. Within the NRM area exists one of the biggest egg plant growers in Australia, at Eden Lassie Creek, and numerous small farmers whose produce is sold at local market and as a result is not captured by statistics.

Other perennial horticulture crops in the region include lychees (around Bowen, Proserpine, Mackay and Sarina), bananas (Bowen and north of Mackay), pineapples (Bowen, Sarina and Koumala), macadamias (Bowen and Eton), coffee (Proserpine) and limes (Bowen).

Horticulture produce from the region goes to the domestic fresh markets, with 75 per cent being transported by road (the Bruce Highway) to Brisbane, and 25 per cent to Townsville. Produce is mostly packed on-farm, but there are some packing facilities for vegetables in Gumlu and one in Mackay for bananas.

PRESSURES

LAND CONDITION DECLINE

Decrease in condition occurs as a result of management practices associated with monoculture production systems, excessive cultivation, long term high grazing pressure, increased/prolonged use of inorganic petrochemical crop supplements, more frequent wetting and drying cycles from irrigation, and infrequent use of break cropping.

The key natural resource management pressures linked to the land are the loss of nutrients, pesticides and sediments and export of these into water and waterways that feed into the Great Barrier Reef lagoon, mainly from both diffuse and point sources of pollution (Drewry et al, 2006). The use of inorganic fertilisers and petroleum based pesticides for sustained crop production is associated with loss of direct nutrients/pesticides or their derivatives in soluble forms. Such use is attributed to a lack of targeted application of such supplements, and a lack of awareness or resources to enable compliance with environmental best practice (Fletcher, J. 2013 pers.comms. 4 July 2013).

Intensively cropped and grazed land commonly has a higher percentage of nitrogen and phosphorus in a soluble form than under natural conditions (Mitchell et al 2005; Drewry et al. 2006). As the dominant land use, grazing also contributes about one third of the total regional load of particulate nutrients and sediment (Drewry et al. 2006).

Within the region the loss of sediment and soluble nutrients (e.g. nitrogen) from intensive agriculture production systems is nearing 459,000 tonnes of sediment per annum and 1,920 tonnes of dissolved inorganic nitrogen per annum and 1,510 tonnes of particulate nitrogen per annum (Drewry et al, 2006). While the impact of sediment and nutrient loss from land and its impact on aquatic ecosystem health is relatively well understood, little work has been undertaken in the region to evaluate the impact of soil loss and soluble nutrient loss on the long term impacts toward soil/land fertility and hence land condition sustainability (Hardy, 2004). One can assume however that loss of fertile topsoil and soluble nutrients would have a significant negative impact on soil/land condition and intensive agriculture production.

Further general information on water quality pollutants in this region is available elsewhere (e.g., Faithful 2003; Brodie 2004; Rohde et al. 2008; Australia and Queensland Government, 2012).

Furthermore, yield decline is not always specifically related to fertiliser use. Other factors impact the system including dentrification, soil pathogens, poor variety selection, pH level, and elevation. The focus on reduction in inputs to achieve reduced run-off requires further evaluation with a more holistic approach to multiple and interrelated influencing factors.

Sediment and nutrient quantities in soil are closely related to ground cover and erosion (Rayment and Neil, 1996). Not all the pasture forage grown is to be made available for grazing. Some of the pasture dry matter needs to be retained for soil conservation to achieve more than a 70% ground cover and improved recovery of pastures during spelling or rotation (Weston, 1988).

> "Key to land condition is also the prevalence of weeds which impact upon business viability and productivity. Weeds by definition are plants out of place. Weeds in pastures decrease diet quality and animal carrying capacity. Weeds also compete with pasture species for nutrients and moisture. Because most weeds are not grazed they grow faster and can quickly dominate pasture. Weeds can therefore be a cause and symptom of poor pasture and land management. Weeds are also rated by Mackay Whitsunday graziers as one of the major issues with regard to productivity, viability and maintaining sustainable land condition. A highly variable rainfall combined with fluctuating commodity prices places extra pressures on land use management systems. In the main grazing land managers see the implementation of correct stocking rates as critical issues in reducing weed competition on the land and hence competition with pasture species and even stock poisoning from toxic weed pests."
>
> Bishop, 2007;15

WATER ALLOCATION

Irrigated agriculture accounts for around 80 per cent of water use in the region. Most of this use is associated with sugarcane and horticulture in the Proserpine, Pioneer Valley and Sarina areas. The cost of developing water storage and supply infrastructure is high and many agricultural producers may struggle to afford water from the proposed sources. For example, the expansion of sugarcane west of Proserpine will be limited by access to an affordable irrigation water supply. Existing irrigation allocations are close to being fully committed, however cane growers may not use their full allocations as a result of the increased costs (pumping, equipment maintenance, wages etc.) in applying irrigation.

CLIMATE

Australia already has one of the most variable climates in the world, and Mackay, Whitsunday and Isaac region is one of the most climatically variable in Australia. Even without the threat of a changing climate the region faces challenges to continue the production of agricultural goods. While experienced in flood and drought adaptation efforts, the increased frequency of such events will emerge as one of the key challenges to the future of farming in the region.

Because each region will respond differently to variations in climate, the same can be anticipated of the impact at local mill areas, with the success of crops differing greatly inter-regionally between farms.

"When the sky falls, and cyclones hit, finding the positive side of life can be an industry challenge. When agricultural industries are exposed to the extreme vagaries of climate, productivity is impacted – and recovery is rarely achievable in a single season, particularly in an industry reliant on ratoon crops with new planting only occurring every four to five years. Consequently, there is a need to look more closely at a range of indicators, and recognise the value and investment in industry risk management. In our 2011 Review we estimated that approximately six million tonnes of cane had been left unharvested in the 2010 season as a result of the never-before-seen rainfall during that year's crushing season. This estimate proved correct with 6.18 million tonnes of stand-over cane being harvested and crushed during the 2011 season. This is a record amount of two year old cane for the Queensland industry to process and created significant challenges to both harvesting and processing. When handling large amounts of stand-over cane, mills' crushing rates needed to be reduced by up to 25 per cent, to ensure that raw sugar of an acceptable quality continues to be produced. On the upside, industry stakeholders always learn from such experience, and will have an enhanced capacity to adapt response strategies, should wet conditions that prevailed across 2010 — 2012 affect the industry again."

Australian Sugar Milling Council (2012, 7)

LAND COMPETITION

The following are considered key threats to agricultural production in the region:

- Sugarcane production areas in coastal areas have been impacted by infiltration of seawater into freshwater aquifers and by urban and industrial expansion around Mackay. Urban expansion also affects infrastructure supporting agricultural production;
- There is resistance to plantation forestry from some local governments and some sectors of the sugarcane industry due to perceived competition for land;
- Mining operations in the Bowen Basin and related infrastructure are currently expanding into high-productivity grazing land northwest and southeast of Dysart and along the Isaac River, and this will affect production levels and have flow-on impacts to supply chains. These soils are also suited to cropping, so it also threatens future expansion of cropping in the affected areas;
- The significant expansion of mining infrastructure (including rail and road corridors across high-productivity grazing and cropping areas) reduces production and affects agricultural operations, access to stock routes and stream/water flows.

Land exists that could be developed for agriculture, subject to the provision of a secure water supply (DERM, 2013), however the likelihood of this new land being opened up to account for agricultural land lost is unknown.

Regional water supply infrastructure does not have the capacity to meet present demands. The short-term strategy is to improve the efficiency of existing irrigation systems and to facilitate small-scale infrastructure works (e.g.farm dams).

"Good quality agricultural land is a valuable asset to be recognised and protected. Alienation and loss of this resource through fragmentation, urban development, mining or other high impact development will not be supported, unless there is an overriding need in the public interest for the proposed use, and there are no alternative locations available"

MIW Regional Plan, Department of Local Government and Planning (2012, 69).

COMPETITION FOR QUALIFIED STAFF AND LOSS OF KNOWLEDGE

Grudnoff (2012) states that much of the decline in agriculture and other parts of the economy (tourism, manufacturing, construction) can be attributed as a consequence of the mining boom due to the upward pressure on the exchange rate which in turn reduces the competitiveness of other Australian industries.

> Since the beginning of the mining boom Australia's rural sector has lost $43.5 billion in export income. This includes $14.9 billion in 2010-2011 alone. These losses have occurred because the mining boom has forced the Australian dollar to historic highs… Within the rural sector the beef and veal industry has also been adversely impacted with exporting income being cut by $2 billion in 2010-2011 and $6.2 billion over the boom. The sugar industry lost $566 million in 2010-2011 and $1.8 billion over the boom… The growth in the mining sector has come at a cost to other sectors of the economy, especially the rural sector – and these costs are substantial.
>
> The mining boom has not been managed well. It has been allowed to expand with little consideration for the collateral damage it causes to other sectors of the economy. The rural sector is one part of the economy that has been badly affected", Still beating around the bush: The continuing impacts of the mining boom on rural exports,
>
> Grundoff (2012, 1).

Agriculture has also experienced continued loss of knowledge and skills on farms due to generational changes in interest with fewer young people undertaking studies in agricultural fields and returning to the farm with this knowledge. Key to this is the low productivity and high input required for farming, which can be unattractive to young people commencing their career.

CONDITIONS AND TRENDS

"The Australian economy, like all modern economies, is diverse and ever changing. In 1951 agriculture accounted for just over 30 per cent of Australia's GDP—much bigger than mining has ever been—but today agriculture represents just 2.6 per cent of GDP. Sixty years ago it would have been inconceivable to imagine agriculture shrinking to less than a tenth of its size as a share of the economy. By the same token, nobody would have predicted that the telecommunications sector would become so large; the mobile phone industry employed virtually nobody in the 1980s. But change is a signature feature of a healthy economy, and these things did indeed take place."

Mining the Truth, Richardson and Denniss (2011, 1)

AGRICULTURE IN THE REGION

The value of agricultural production in the Mackay, Whitsunday and Isaac council regions has increased slightly from 8.5 per cent of Queensland's production value in 2006, to 9.3 per cent in 2010 (DAFF, 2013). However, agriculture in Queensland has experienced steady decline since the boom in late 1990s, early 2000s. The Queensland Government's Agricultural Land Audit (2013) focuses on reversing this decline and doubling the value of agricultural production in the state by 2040 as one of the four pillars of the Queensland economy (tourism, agriculture, resources and construction).

INDUSTRY	VALUE $M	STATUS AT 2013
	2005-2006	
Sugar cane	380	Decline due to multiple factors including weather events, world sugar prices and high Australian Dollar driven by global commodities market
Horticulture and other crops	250	Decline despite an expected growth due to land managers looking at on farm income diversification from sugarcane
Livestock grazing	24.4	Slight increase in production following on from fair seasonal condition and commodity prices. Large numbers of investors/retirees are also entering the commodity with small blocks.
Livestock dairy	3.3	Significant decline in the number of dairies with the likelihood of more losses of dairy enterprises from the region (Fisher 2006).
Aquaculture	1.7	Sustained increase in production over the past few years
Timber and forests	0.5	Strong growth in private plantations and interest in native forest harvesting amongst the grazing sector.

Table 3 Overview of industry gross value and current status

Efforts have been made to identify potential productive agricultural land according to infrastructure capacity. Improvements to transport infrastructure including the Bruce Highway upgrade will enable faster and more efficient transport of agricultural produce and inputs. Infrastructure development as a result of mining growth in surrounding areas are viewed by the Queensland Government as opportunities to improve agricultural commodities transport also.

The Queensland Agricultural Strategy (DERM, 2013) outlines four key pathways to grow the sector; by securing and increasing resources availability, driving productivity growth across the supply chain, securing and increasing market access, and minimising the costs of production.

NUTRIENTS, SEDIMENTS AND PESTICIDES

Loss of key nutrients via rivers has increased from 2-5 times for nitrogen and 4-10 times for Phosphorous over the last 150 years representing the impact of long term intensive agricultural use (Moss et al, 1993).

However, agricultural industries have made significant advances in improving management practices, evidenced by an estimated decrease in fertiliser use by some 15 per cent across the state over the past 5 years. Nitrogen and Phosphorus fertiliser usage rates in sugar cane industry have dropped by 53kg/ha and 15kg/ha respectively in the past 10 years.

2011 - 2012	
• Suspendant sediment load reduced by approximately	28,328 t/yr
• Particulate Nitrogent load reduced by approximately	98 t/yr
• Particulate Phosphorus load reduced by approximately	91 t/yr
• Dissolved Inorganic Nitrogen load reduced by approximately	86 t/yr
• Filterable Reactive Phosphorus load reduced by approximately	28 t/yr
• Total Pesticides load reduced by approximately	331 kg/yr
2008 - 2012	
• Suspendant sediment load reduced by approximately	189,380 t/yr
• Particulate Nitrogent load reduced by approximately	399 t/yr
• Particulate Phosphorus load reduced by approximately	222 t/yr
• Dissolved Inorganic Nitrogen load reduced by approximately	240 t/yr
• Filterable Reactive Phosphorus load reduced by approximately	50 t/yr
• Total Pesticides load reduced by approximately	1618 kg/yr

Figure 2 Reef Rescue total Estimated Load Reductions from Current Water Quality Grants New Impact Area, Mackay Whitsunday Isaac (NRM Regions) in 2011-2012 and 2008-2012

Over 40 per cent of sugar cane growers in the region use legume crops on fallow ground and 8 per cent of the sugar cane areas use GPS control traffic technology. Little information on fertiliser usage rates and adoption of new farming technology (e.g. GPS) is known within the horticulture and beef industries within the region.

Mill mud, a nutrient rich by-product of the milling process, was previously blanket spread on the field in an ad hoc manner at a nominal rate of 150 tonnes per hectare (t/ha). With the commission of new spreaders that allow for precision application directly onto rows, mill mud is now applied at a reduced rate of 50t/ha effectively tripling the land one manager can service with their mud allocation.

In October 2003 the Queensland and Australian governments signed the Reef Water Quality Protection Plan (Reef Plan) that aimed to halt and reverse the decline of water quality on the Great Barrier Reef. Since Reef Plan (2003) an updated Reef Water quality Protection plan has been endorsed (Queensland Government, 2009) with a number of implementation and monitoring programs established including Reef Rescue, Reef Regulations and the Paddock to Reef programs, which provide on-ground initiatives necessary to achieve the targets.

As a result of the Reef Plan (2009) and Reef Rescue, since 2008 cane and horticulture farmers have improved management of soil, nutrients and herbicides on more than 75 per cent of the intensive cropping land in the catchment and graziers have improved pasture management on more than 1,000 hectares of pasture. This includes cane farmers purchasing equipment, such as GPS guidance and inter-row spray shields and implementing new farming practices (break cropping, mill mud application, zonal tillage, control traffic via GPS) to reduce inputs such as fuel and/or chemicals while maintaining productivity and ensuring future economic profitability and environmental sustainability.

For cattle farmers this includes stocktake training, land-type fencing, establishing pasture monitoring sites, soil testing, riparian fencing, off-stream watering points and industry/partnership projects. The collective investment in these activities since 2008 has been $88,085,029 from industries (service providers and landholders) and $32,480,973 from grants in the Mackay, Whitsunday and Isaac catchments.

Agriculture

According to the Reef Water Quality Projection Plan Report Card (Australia and Queensland Government, 2012), the overall marine condition in the Mackay, Whitsunday, Isaac catchments in 2009–2010 was moderate and that progress toward Reef Plan targets was encouraging, although inshore water quality and coral reefs remained moderate and seagrass meadows remained poor. The report found that:

- 60 per cent of sugarcane growers, 44 per cent of horticulture producers and 15 per cent of graziers have adopted improved land management practices;
- The greatest proportional catchment load reduction was the pesticide load with an estimated 376kg (18 per cent) less;
- Flow management has been improved through waterhole mapping that enables a better understanding of the volumes of water required to maintain critical fish habitat;
- Riparian management has been improved on 33 km of the O'Connell River by graziers who have erected riparian fencing and off stream watering points;
- Barriers to migration have been removed through the construction of fish passage structures on all major barriers and in stream habitat has been restored through the installation of a series of engineered log jams at priority areas.

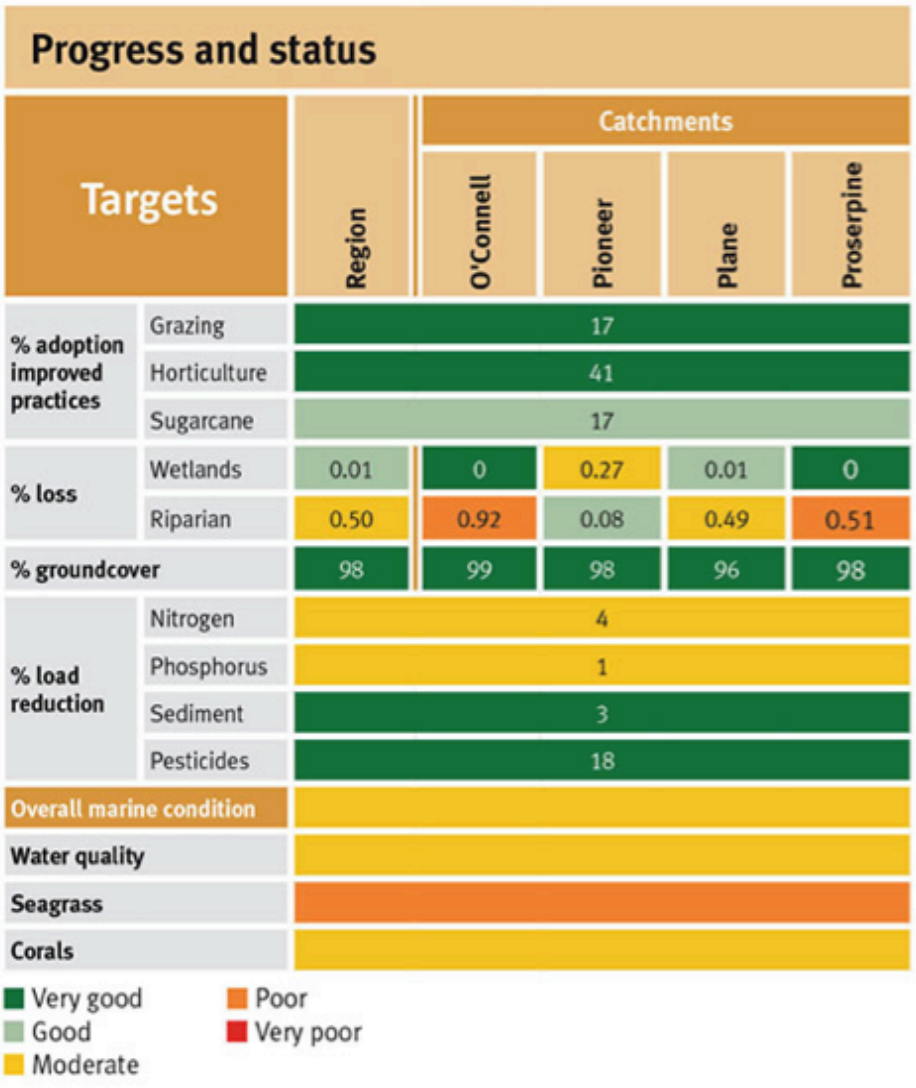

Figure 3 Progress report for MWI from Reef Water Quality Protection Plan Report Card 2013

Agriculture

"Agriculture has become more diverse and increasingly export-oriented since the 1980s, and now includes some non-traditional commodities and processed products. There are several niche processing facilities for products such as gourmet dairy products, sauces, dried fruit and vegetables, and frozen vegetables.

There are growing market-specific opportunities—for example, grass-fed 'branded' beef and sheep. There are also opportunities for organic produce. In the western regions, organic beef is cost-effective and reliable because drier conditions reduce the risk of pests and diseases" DAFF, 2013; 8.

The current condition of grazing lands in the Mackay Whitsunday Region has not been monitored in any detail since a survey carried out in 1979 (Anderson et al, 1983). Sown pasture development reached a peak in 1974-75 of around 5,000 ha/annum, which corresponded with an increase in beef cattle numbers; from 80,000 in 1967 to 200,000 in 1980 and over 300,000 cattle and calves being sold in 2001. This is compared to 29,000 cattle grazing sown pastures in 2006.

GOVERNANCE

All agricultural enterprises in the region are supported/influenced by a number of state and federal government Acts and operational policies and guidelines including:

- Sugar Industry Act 1999: The principal objective of which is to facilitate an internationally competitive, export oriented sugar industry based on sustainable production the benefits those in the industry and the wider community. Key amendments to the Sugar Act were made in 2004 resulting from the sugar industry reform act 2004.
- Land Protection (Pest and stock Route Management) Act 2002: This Act declares invasive species and requirements for landholders to control them.
- Integrated planning Act 1999: A whole of government approach to identifying the risks of impacts from agriculture and to develop a planned framework for agricultural industries. General development of the environment is assessed against a code (Integrated development Assessment scheme – IDAS) under the Act to protect biodiversity, prevent land degradation and ensure development is sustainable.
- Environmental Protection Act 1994: This Act specifies a general environmental duty whereby a person must not carry out an activity that causes or is likely to cause environmental harm unless the person takes all reasonable and practical measures to prevent or minimise the harm. Several polices provide more detail for achieving the objectives of the Environmental Protection Act 1994, i.e. The Environmental (Water) Policy 1997 which includes guidelines, indicators and monitoring procedures for management of issues such as storm water and acid sulphate soils.
- Great Barrier Reef Marine Park Act 1975: This includes management of perceived risk of damage to the Great Barrier Reef from runoff and sediment discharge from farms.
- Great Barrier Reef Protection Amendment Act 2009
- Chemical Usage (Ag and Vet) Control Act 1988 and Regulation 1999: These outline farm use of chemicals such as; use of chemicals as per label instructions; Require a permit for off label use; Must specify hazard areas for spray drift and permit and license needs; Require material safety data sheets (MSDS) for all chemical used.
- Vegetation Management Act 1999: Regulates native vegetation on freehold land by: Providing a state policy and code accessing clearing applications; regional vegetation management plans; declaration of areas of high conservation value or areas subject to degradation.

In addition, agricultural industries have guidelines for best management practice focusing on a wide range of farming practices and inputs, which are updated regularly and endorsed by industry. All the programs in place operate within an agricultural natural resource management framework called "Farm Management Systems" or FMS (e.g. Growcom, 2006). The FMS approach is designed to support agricultural enterprises by having better planning, risk assessment, management actions, monitoring and review of farm operations. The system therefore supports growers to;

- Better plan their farm management processes;
- Assess their individual management performance and effectiveness of management practices;
- Identify opportunities for improvements or efficiencies;
- Demonstrate management practices and outcomes to external stakeholders.

INDICATORS

Key indicators of land condition that can be evaluated over time fit into two broad categories of measurement:

- Directly definable land condition parameters which can be easily measured;
- Practice changes associated with known land condition improvements.

The requirement for these broad categories is reflective of the fact that changes/improvements in land condition may not be measureable for a significant period of time despite the positive changes in land management being undertaken. Remembering that it may take some time for the biological processes associated with land condition to reach an optimum balance.

Key symptoms of declining land/soil condition as a result of poor land management include:

- Increase in pest competition (e.g. weeds, insects);
- Decrease in organic carbon based levels in soil;
- Decreased in water holding capacity and water infiltration rates;
- Increased wind and water induced erosion;
- Increased rates of fertiliser to maintain production standards; and
- Decrease in agricultural production.

All intensive agricultural industries have in place natural resource management frameworks via the Farm Management Systems (FMS) program. The FMS program seeks to support farm operations in improved planning, risk assessment, management actions, monitoring and review of farm operations. The key focus areas of operations for improved land management in intensive agriculture industries are:

- Improvements in soil structure (biological and physical);
- Improvements in nutrient management;
- Improvements in water use management; and
- Improvements in the use of pesticides.

To assess the effectiveness of improved land management practices and land condition, targets set need to benchmark land manager adoption rates and land condition (physical, nutrient and biological), to assist producers and communities to understand the improved practices are improving land condition. Setting key adoption targets is a collaborative process and the scale of monitoring important as it enables land managers and agriculture commodity groups to evaluate improvements in shorter time frames than monitoring at a catchment scale. Reference farms or trial sites provide indicators of success, while qualitative social data will best capture trending community attitudes that might influence adoption.

A well accepted agricultural best practice framework is the ABCD, which outlines a suite of practices that are 'Aspirational', 'Best Practice', 'Current' or 'Dated' related to nutrient, pesticide, soil and water management at the farm scale. A benchmark study was undertaken to relate water quality in 2007 to the percentage of industry that were adhere to the defined principals of either A, B, C or D for each of the management areas. This allowed the effort needed (i.e. moving from Dated to Best Practice for nutrient management), to be quantified for each area to achieve the water quality targets

The Water Quality Improvement Plan for the region (Drewry et al, 2007 currently being updated) measures water quality in a number of locations, which can be used to target management actions to improve water quality and ecosystem health. For example, at Carmila Creek (figure 4) ambient water quality was generally good in this catchment in 2007 with a low level of management action required to keep water quality in good condition.

Myrtle Creek (figure 5) in contrast is substantially more developed than Carmila Creek, with 31 per cent sugarcane production in this management area. Nutrients such as DIN, dissolved and particulate phosphorus were above water quality objectives in 2007, and therefore management was recommended to improving water quality such as increasing the level of adoption of best management practices.

Key Pollutant	Ambient Freshwater Quality Values			
	Objective 2050	Current Condition 2007	Target 2014	Action
Dissolved Inorganic Nitrogen µg/L	CC	8	CC	L H
Particulate Nitrogen µg/L	CC	78	CC	L H
Dissolved Inorganic Phosphorus µg/L	CC	5	CC	L H
Particulate Phosphorus µg/L	CC	10	CC	L H
Total Suspended Sediment mg/L	CC	3	CC	L H
Ametryn µg/L	CC	<LOD	CC	L H
Atrazine µg/L	CC	<LOD	CC	L H
Diuron µg/L	CC	<LOD	CC	L H
Hexazinone µg/L	CC	0.01	CC	L H
Tebuthiuron µg/L	CC	<LOD	CC	L H
Dissolved Oxygen % saturation	40-120	12-89	40-120	L H
pH	CC	7.3-7.8	CC	L H
Electrical Conductivity µS/cm	CC	279	CC	L H

CC = Current condition; **LOD** is Limit of detection which is 0.01 ug/L for all herbicides

Figure 4 Ambient Water Quality Carmilla Creek

Key Pollutant	Ambient Freshwater Quality Values			
	Objective 2050	Current Condition 2007	Target 2014	Action
Dissolved Inorganic Nitrogen µg/L	30	154	77	L H
Particulate Nitrogen µg/L	CC	112	CC	L H
Dissolved Inorganic Phosphorus µg/L	25	34	25	L H
Particulate Phosphorus µg/L	20	41	20	L H
Total Suspended Sediment mg/L	5	7	5	L H
Ametryn µg/L	CC	0.04	CC	L H
Atrazine µg/L	CC	0.11	CC	L H
Diuron µg/L	CC	0.11	CC	L H
Hexazinone µg/L	CC	0.08	CC	L H
Tebuthiuron µg/L	CC	<LOD	CC	L H
Dissolved Oxygen % saturation	85-120	12-56	85-120	L H
pH	CC	7.2-7.3	CC	L H
Electrical Conductivity µS/cm	CC	654	CC	L H

CC = Current condition; **LOD** is Limit of detection which is 0.01 ug/L for all herbicides

Figure 5 Ambient Water Quality Mrytle Creek

Under continuous heavy grazing any surviving desirable pasture plants will have a small root system and be slow to restart growing with the resulting bare ground left vulnerable to erosion and chemical and nurtient runoff (Aisthorpe and Paton, 2004; Schulke, 2003). The Grazing Land Management Program provides participants the tools and skills to monitor and manage land condition via adult action learning, including grazing pressure with variable rainfall, grass/tree balance, pastures and weeds and fire. The Stocktake Workshop provides a tool for balancing pasture supply with forage demand while still maintaining good land condition.

Monitoring currently occurs as part of the Australian Government's Reef Rescue initiative. The Reef Plan (2009) aims to improve the quality of water entering the reef and maintain its health and resilience. Positive changes have been observed in the catchments across the Great Barrier Reef region, and there has been good progress by land managers towards Reef Plan targets. As a result of this change, the estimated average annual pollutant loads entering the reef have reduced as outlined in table 4. Ongoing on ground activities and monitoring as part of Reef Rescue will continue to indicate the condition and trends of improved land management practices and the resulting impact on water quality in the Great Barrier Reef lagoon (Brodie et al., 2013).

POLLUTANT	UNIT	OBJECTIVE	CURRENT CONDITION	TARGET 2013	ACHIEVED	REDUCTION	PERCENTAGE OF TARGET
Dissolved Inorganic Nitrogen	Tonnes/year	1310	2100	1550	1666	435	69% of target due to cane nutrients
Particulate Nitrogen	Tonnes/year	1210	1770	1410	1568	202	56%of target due to combined cane and grazing soil
Filterable Reactive Phosphorus	Tonnes/year	130	350	250	271	79	69% of target due to cane nutrients
Particulate Phosphorus	Tonnes/year	280	650	500	566	84	56% of target due to combined cane and grazing soil
Total Suspended Sediment	Tonnes/year	520000	528000	520000	523520	4480	56% of target due to combined cane and grazing soil
Ametryn	Kg/year	120	160	120	134	26	65% of target due to cane pesticide
Altrazine	Kg/year	1210	1620	120	645	975	65% of target due to cane pesticide
Diuron	Kg/year	2870	4680	3510	3920	761	65% of target due to cane pesticide
Hexazinone	Kg/year	890	1190	890	995	195	65% of target due to cane pesticide

Table 4 Exert from forthcoming Water Quality Improvement Plan Review (2014). Includes only voluntary adoption programs such as Reef Rescue and supporting industry programs.T

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