Chapter 7

Queensland Agricultural Land Audit

Charters Towers

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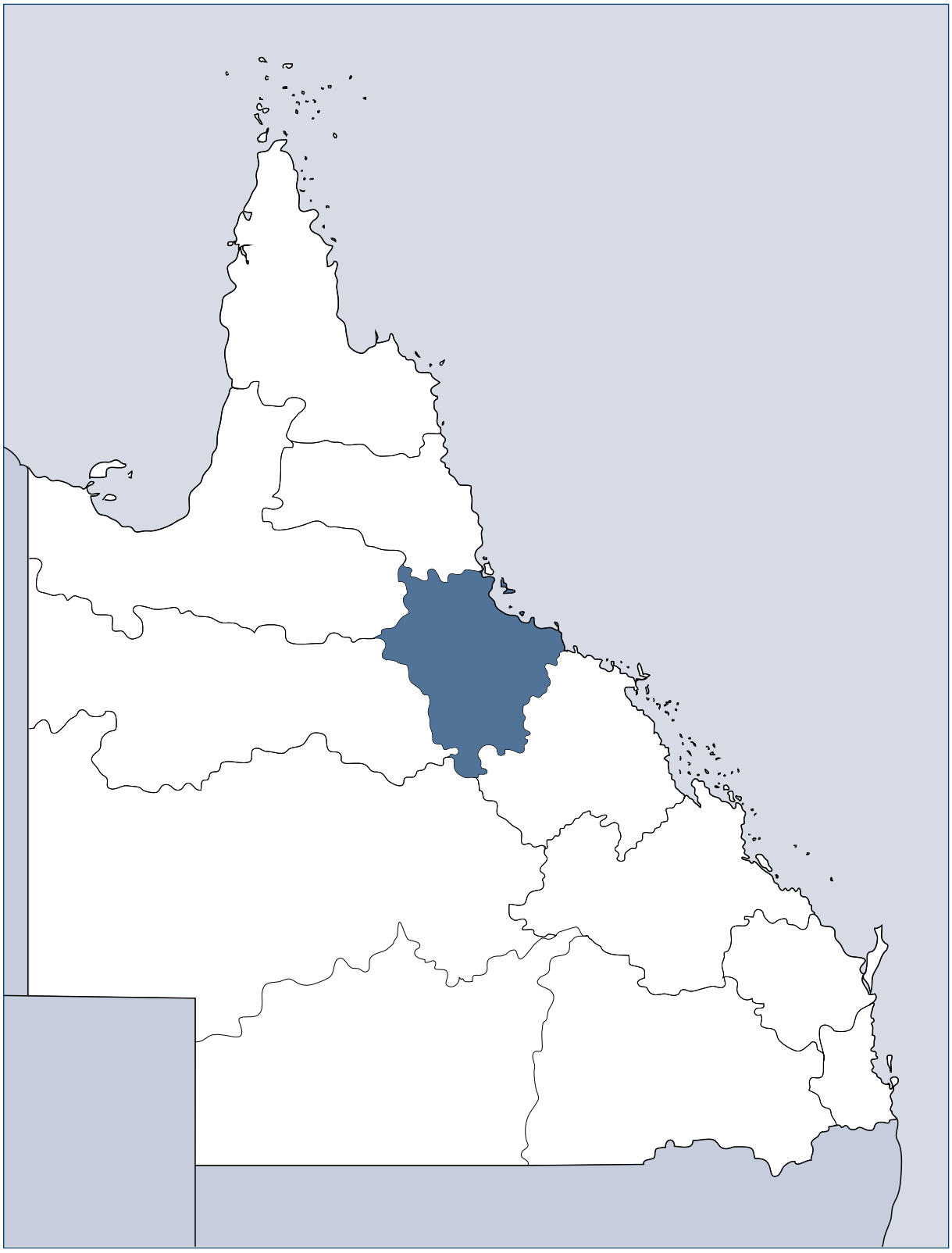

7.1.1 Economic profile

The Charters Towers region is on the east coast of Queensland from just south of Home Hill to just north of Ingham and west to Greenvale, Pentland and Lake Buchanan. Only mainland areas are included in the agricultural land audit assessment. The region comprises the local government areas of Burdekin Shire Council, Charters Towers Regional Council, Hinchinbrook Shire Council and Townsville City Council (see Map 7.1). It has a total area of 79 604 km^2, or 4.6 per cent of the total area of the state.

The main agricultural industries for this region are sugar, beef cattle and production horticulture. Other important industries are timber, aquaculture and lifestyle horticulture and seafood. There are extensive areas of sugarcane around Ayr – Home Hill and Ingham. There are pockets of perennial and annual horticulture along the coast. The predominant horticultural crops for the region are mangoes, melons, capsicum, beans, sweet corn and potatoes. Tropical fruit growing is important in the region, which grows nearly 36 per cent of the state's mangoes and 25 per cent of the state's rambutan.

The value of agricultural production in the region in 2010–11 was $641 million, which was 6.7 per cent of Queensland's total value of agricultural production. In 2010–11 the major agricultural commodities in the region were sugarcane at $344 million, livestock products and slaughtering at $204 million (primarily cattle at $193.5 million, poultry at $2.4 million and eggs at $6.6 million) and horticulture at $84 million (including mangoes at $19.7 million and vegetables at $52.8 million).

Currently there are 1524 farm businesses in the region, 907 of which are sugarcane farms covering 109 633 hectares and with an average output of 11.7 million tonnes of sugarcane per year. The Burdekin and Hinchinbrook local government areas have strong sugarcane production industries. Sugarcane is crushed at six mills (two in Hinchinbrook and four in the Burdekin) and most is exported from the Townsville and Lucinda bulk sugar terminals. Opportunities to add value to the sugar industry in the region include cogeneration, ethanol, bioplastics and furfural.

Cattle production is predominantly extensive grazing on native pastures in the inland areas and several mixed enterprises in the coastal areas, which have native pastures, sown pastures and some irrigated pastures. Most of the production is centred on breeding and selling weaners, store cattle and finishing cattle to meet the specifications for the Japanese export market (2.5–3.5 years old in inland areas and 2–3 years old in coastal areas). A large number of cattle are sold to other regions in Queensland for fattening and slaughter. There is a large abattoir in Townsville, and meat products and live cattle are exported from the Port of Townsville.

An array of fruit and vegetables are grown in this region. The total land area of all vegetables grown is 2874 hectares, while fruit (excluding grapes) is grown on 2053 hectares. The major products sold are mangoes, pineapples and potatoes. Most fruit and vegetables are sent to South East Queensland or interstate markets, and 10–15 per cent are sent to export markets. There are opportunities to export North Queensland fruit and vegetables, especially tropical fruits, to Asia.

There is also a good-sized aquaculture industry in this region and the majority of enterprises produce marine prawns as well as some barramundi. In 2009–10, 3504 tonnes of aquaculture product with a farm gate value of $44 million were grown in the region. The vast majority of this product was sold within Australia. Aquaculture is emerging as an industry of importance for the region, with efficiency and production increasing.

The key centres for provision of agricultural and service facilities are Charters Towers, Townsville, Ingham, Ayr and Home Hill. At 30 June 2011, the estimated population of the Charters Towers region was 222 486 people, or 4.9 per cent of the state's population. Townsville is the fourth largest city in Queensland (after Brisbane, the Gold Coast and the Sunshine Coast) and functions as a capital of the north.

The region's population is projected to increase to 343 260 over the next 20 years, which is an increase of approximately 54 per cent. This represents an annual average growth rate of 1.9 per cent, which is slightly higher than the state's projected average of 1.8 per cent growth for the same period. Population growth will result in an increased demand for infrastructure, energy, water, land and services, as well as environmental demands, all of which will impact on the ability of agribusinesses to use infrastructure and access inputs, resources and services.

The unemployment rate for the Charters Towers region for the June quarter 2012 was 6 per cent, compared with 5.5 per cent for Queensland. The Burdekin Shire Council has the lowest unemployment rate in the region (5.3 per cent) and Charters Towers Regional Council has the highest unemployment rate in the region (7.8 per cent).[1]

At the time of the 2011 census, health care and social assistance was the largest industry of employment for the region, with 12 per cent of the region's employed labour force engaged in this industry. Public administration and retail were the next highest employers in the region, both employing 10.7 per cent of the region's labour force. Agriculture, in comparison, represented just 3.3 per cent of the employment for the Charters Towers region.

Of business categories registered in 2010–11 in the region, agriculture represented the second largest number at 15.9 per cent (after construction, which registered 20.2 per cent). The Charters Towers region accounts for 5.8 per cent of the total businesses registered in the agriculture, forestry and fishing industries for the state.[2]

Land values across the region vary according to the productivity of the land (see Table 7.1). Most agricultural land types have seen significant market value increases for the period from 2001 to 2012, with the highest increase being 400 per cent in the desert uplands, although it had a relatively low starting base compared with other land types. After 2001 the boost in the value of cattle meant that the price per beast area generally doubled. The 2006 peak in the cattle market has subsequently dropped, but is reflected in land value increases in grazing land for this period.

The irrigated sugarcane land in the Burdekin did not change in value and dryland sugarcane land in Hinchinbrook rose 7 per cent for the period. Despite there being no increase in value, the highest value land in 2012 was the irrigated sugarcane land of the Burdekin Shire Council at $13 000 per hectare, which was the lowest price for that land type for the state. Similarly, dryland sugarcane in Hinchinbrook Shire was the lowest price for the state at $7100 per hectare.

Table 7.1 The change in land values for the Charters Towers region

Local authority	Land type	Market valuation ($/ha)			Percentage change 2001–12	State market valuations range 2012 ($/ha)
		Pre-boom 2001	Boom (market peak) 2007	Post-boom 2012		
Burdekin Shire Council	Grazing	750	1 800	1 800	+140	20 to 25 000
	Cane (irrigated)	13 000	15 000	13 000	0	13 000 to 18 000
Charters Towers Regional Council	Goldfields	50	250	200	+300	200
	Scrub	100	500	400	+300	400 to 1 600
	Desert uplands	20	120	100	+400	100
Hinchinbrook Shire Council	Grazing	3 000	5 000	3 500	+17	20 to 25 000
	Cane (dryland)	6 650	10 000	7 100	+7	7 100 to 17 000
Townsville City Council	Grazing	750	1 800	1 800	+140	20 to 25 000

Source: Data provided by the Department of Natural Resources and Mines, State Valuation Service, July 2012

1 Australian Bureau of Statistics 2012, Queensland regional profiles (generated 14 December 2012), Office of Economic and Statistical Research, Queensland Treasury and Trade, ‹http://statistics.oesr.qld.gov.au/qld-regional-profiles›.

2 Australian Bureau of Statistics 2012, *Counts of Australian businesses, including entries and exits, June 2007 to June 2011*, cat. no. 8165.0, Australian Bureau of Statistics, Canberra.

7.1.2 Strengths, weaknesses, opportunities and threats

Key regional issues

- The region has infrastructure and water to support existing operations and future growth in agriculture. Although some roads are susceptible to flooding in the wet season, meat processing in Townsville is not affected because it closes during this time.
- The proximity to Asia and existing port facilities at Townsville provide opportunities for exporting fresh horticultural commodities to Asia.
- Land degradation has lowered the carrying capacity of the grazing land in the region and there are many invasive plants. There are opportunities to raise production through improved land management.

A range of socio-economic and environmental characteristics shape agricultural industries in the Charters Towers region and will affect their growth in the region. Outlined below are the strengths (existing factors that favour agricultural production), weaknesses (unfavourable conditions that hamper the success of agricultural production), opportunities (actions that could be taken to enhance future agricultural production) and threats (issues that could negatively impact on agricultural production), which provide a snapshot of some of the key issues impacting on the potential for agricultural growth in the region.

Strengths

The strengths of the region include the following:

- The region has a favourable climate for agriculture. Warm temperatures and good rainfall volumes with adequate sunny days along the coast are suitable for sustaining sugarcane and horticulture. The western areas receive lower rainfall and can get frost in winter and are used mostly for grazing.
- A reliable supply of water is available from the Burdekin Falls Dam to support current and future agriculture. (See Section 7.1.4 for more information on water resources.)
- For sugarcane, there is established processing and transport infrastructure including six sugar mills, extensive sugarcane tramways (to transport sugarcane to the mills for processing) and sugar ports at Lucinda and Townsville.
- A major abattoir with high processing rates (approximately 900 head per day) is located at Townsville and there is a cattle saleyard at Charters Towers. Townsville also has a sea port and provides access to major road and rail links to southern markets.
- Along the coast, there are labour pools associated with major population centres (including Townsville, Ayr, Home Hill and Ingham) and for horticulture, seasonal labour is provided by backpackers and the National Harvest Trail.
- There are many professionals (agricultural, finance, legal, educational and medical) to support agriculture as well as local research and development expertise in tropical agriculture (e.g. from James Cook University, CSIRO and the Queensland Government).

Weaknesses

The weaknesses of the region include the following:

- Key biosecurity issues for agricultural production in the Charters Towers region include
  - invasive plants and animals—for example, feral pigs, wild dogs, lantana, rubber vine, chinee apple and hymenachne
  - insect pests and diseases of plants—for example, fruit fly, fungal leaf spots and banana pests
  - animal pests and diseases—for example, bovine Johne's disease, botulism and internal parasites.
- The region has high evaporation rates, poor rainfall distribution over the year and risk of extreme weather events such as cyclones, floods and droughts. (See Section 7.1.3 for more information on climate.)

- Transport costs can be high because of the distance to markets for fresh fruit and vegetables, especially with increasing fuel prices. There is not a critical mass of horticulture crops in the region to enable the leveraging of competitive transport rates. However, some backloading to large southern centres can reduce costs.
- There is considerable degradation in natural resource condition, particularly soil erosion. Land condition decline in the last 30 years has led to widespread soil erosion and export of eroded material into catchments and the Great Barrier Reef lagoon.[3] Land condition decline (including gully erosion and rising groundwater) also reduces agricultural productivity.
- Heavy reliance on roads for transporting cattle in the region raises the cost of transport when fuel prices increase, and creates problems for transport during extreme weather events.
- Currently, under the *Vegetation Management Act 1999*, 87 per cent of the area is classified as remnant vegetation and cannot be cleared. The northern part of the region is in the southern part of the Wet Tropics World Heritage Area and includes areas that are protected from clearing. (See Section 7.1.6 for more information on vegetation.)

Opportunities

The opportunities for expanded agricultural production in the region include the following:

- Expand irrigated agriculture by raising the Burdekin Falls Dam spillway (increasing water supply), if water is affordable and land is available.
- Export mangoes and a range of other commodities to South-East Asia.
- Expand aquaculture production if domestic and overseas demand increases, viable shipping facilities and routes are established for export and approvals processes can be streamlined.
- Improve supply-chain infrastructure for some commodities, including providing cold storage, to complement recent improvements such as the Townsville port access road.
- Increase forestry production from some areas of existing grazing country, through managing for both timber (thinning and harvesting trees) and grazing, creating silvopastoral systems (production systems that combine forestry and grazing in a mutually beneficial way). Increased forestry production will in turn support growth in the down-stream timber processing sector.
- Use renewable energy (e.g. biofuel from bagasse, wood, solar energy, wind) to reduce energy costs.
- Increase the use of travelling labour (backpackers, grey nomads) and promote this type of agritourism.
- Promote locally grown produce 'windows of production excellence' for fruit and vegetables that can be grown out of the southern seasons (and in doing so highlight local production enterprises and employment).

Threats

The threats to agricultural production in the region include the following:

- Urban expansion will place increasing pressure on traditional sugarcane production areas through loss of land for urban, rural residential and industrial developments.
- There are trends of increasing temperature and projections of more intense rainfall events. Fewer, but more intense, tropical cyclones are expected.
- Mining operations are expanding in the region, creating competition for access to transport, labour and water, with potential impacts on production levels and flow-on impacts to supply chains.
- An increase in the haulage of products on the road network could significantly impact on road surfaces, infrastructure and safety levels.
- Woodland thickening is reducing pasture growth and lowering carrying capacity.

3 Dight, I 2009, *Burdekin water quality improvement plan*, NQ Dry Tropics, Townsville, ‹http://www.nqdrytropics.com.au/burdekin-water-quality-improvement-plan-1›.

7.1.3 Climate

The region has an average daily temperature range of 16.9–29.3 °C. Rainfall is highly variable across the region and also between wet and dry seasons. Coastal communities such as Ingham can receive over 2000 mm of rain annually whereas inland areas have annual rainfalls closer to 600 mm. The wet season delivers approximately four times the rainfall of the dry season. Evaporation is very high in the region, with average annual potential evaporation (2025 mm) being more than twice the average annual rainfall (813 mm).

The trend of increasing temperatures since 1910 is projected to continue, together with an increase in extreme weather events, including heat waves, prolonged dry periods and floods. These changes would affect all forms of agricultural production. Projected increases in temperature, potential evaporation and the incidence of prolonged dry periods will affect water supplies and availability.

7.1.4 Water resources

The water resources for the Charters Towers region are outlined in Map 7.2. The Burdekin Basin water resource plan covers much of the Charters Towers region. The northern coastal area (around Ingham) is included in the draft Far North Queensland water resource plan area, and there is a moratorium on new water licences for that area while the plan is being developed. There is no water resource plan for the coastal areas between Mutarnee and just south of Townsville.

The Burdekin Basin water resource plan covers a significant amount of surface water, but does not include groundwater. Water trading is allowed across the Burdekin Basin water resource plan area, but tends to occur within one zone or sub-catchment. The Burdekin Falls Dam has a capacity of 1 800 000 ML of water and provides supplemented water to the Burdekin–Haughton Water Supply Scheme. There is also 72 853 ML of unsupplemented water in the lower Burdekin, Haughton and Bowen rivers water management areas, part of which is available in the Charters Towers region (Map 7.2).

There is unallocated water available in each of the Burdekin Basin sub-catchments within the Charters Towers region, but the release of this water is yet to be determined. There is 15 000 ML of unallocated water available in the Cape Campaspe and upper Burdekin sub-catchments. In these inland sub-catchments there are small pockets of land suitable for cropping, which could grow horticultural crops or forage and grain for use in feedlots. There is a total of 130 000 ML of unallocated water in the Belyando–Suttor sub-catchment, which lies across the Mackay, Isaac and Whitsunday and Charters Towers land audit regions, so only a portion of this water would be available in the Charters Towers region.

In the lower Burdekin sub-catchment, 50 000 ML of unallocated (unsupplemented) water can be used for irrigation. Overland flow is regulated and landholders with works greater than 250 ML need to have a licence.

Plans by the Queensland Government to raise the Burdekin Falls Dam spillway could add 150 000 ML in supplemented strategic reserve for particular projects in the future. (Part of this may be available for agriculture.)

A water resource plan for the Wet Tropics area is currently under development. There is a moratorium on additional use of surface water and groundwater, as there is evidence emerging of over-extraction. For example, some creeks that historically ran all year are now dry and some groundwater bores (including some used for town water supply) have become less reliable during the dry season. The coastal area around Ingham is within the Wet Tropics water resource plan area and groundwater is used if the end of the growing season is dry. During the wet season it is not needed for sugarcane, but may be used to irrigate bananas.

7.1.5 Infrastructure

The region's services and freight network for agriculture are based around Townsville, Charters Towers, Ingham, Home Hill and Ayr as outlined in Map 7.3. Townsville is on the junction of the Bruce and the Flinders highways and has a dedicated transport corridor linking the Port of Townsville with the major industrial areas in the Townsville State Development Area. Townsville is also an important rail hub, being on the junction of the Brisbane–Cairns line and the Mount Isa line to the west. The Townsville rail depot has major shunting and maintenance facilities.

The Gregory Developmental Road is a major inland north–south transport route through Charters Towers. It is currently only partially sealed.

Ten-year regional transport priorities are currently being developed for the northern and western regions. These will assess freight, passenger transport and active transport (walking and cycling). They aim to enhance transport efficiency of agricultural products and inputs and will consider which products are best transported by rail and road. The increase in mining activities in the north and north-west is expected to reduce access of agricultural products to rail freight, as has occurred in other parts of the state.

Upgrades to the road and railway infrastructure will be needed to support agricultural growth. For example, upgrading the rail and road to sea port access in Townsville would enable longer trains and road trains to access the port and improve supply-chain routes across North Queensland. Currently it is difficult for mills in Ayr, Home Hill and Giru to gain rail transport access to transport bulk sugar from the mills to the port at Townsville. Similarly, road train access to the port for live cattle export is restricted. Roads and bridges are vulnerable to damage and being cut during floods and cyclones.

Townsville provides major agricultural infrastructure requirements including an international sea port, an airport, bulk sugar terminals, a large abattoir and a saw mill. There are six sugar mills in the region: two at Ingham, two at Ayr, one at Giru and one at Home Hill. Lucinda has a bulk sugar terminal for exporting sugar.

Several research institutes are located in Townsville. These include CSIRO, the Australian Institute of Marine Science (AIMS), James Cook University and the Marine and Tropical Sciences Research Facility. CSIRO undertakes research to assist with improving water quality, wetland integrity and fisheries while enhancing agricultural productivity—all of which are goals of the Reef Water Quality Protection Plan. The Department of Agriculture, Fisheries and Forestry (Queensland) also has the Spyglass Beef Research Facility on the Burdekin River north-west of Charters Towers and the Tropical Weeds Research Centre in Charters Towers.

7.1.6 Vegetation

The Charters Towers region is characterised by large areas of eucalypt forest and woodland (box and ironbark) on a range of soils, open downs, brigalow/gidgee, alluvial plains and coastal rainforest (in the north). These support a range of cattle enterprises, sugarcane, horticulture and forestry.

Some areas have been extensively cleared for agricultural production. These include coastal rainforest for sugarcane and brigalow/gidgee for grazing and cropping, as well as forests and woodlands for grazing. Remnants of brigalow and softwood scrub provide important refuges for a wide variety of flora and fauna species.

Some areas of land within the Charters Towers region are restricted from further clearing for agricultural purposes under the *Vegetation Management Act 1999* (see Map 7.4). Almost 886 000 hectares (11 per cent of the region) can be cleared, has been cleared or is naturally open and 140 000 hectares (1.8 per cent of the region) requires further verification or approval before clearing. Including national parks and state forests, 6.9 million hectares (87 per cent of the region) cannot be cleared. However, large areas are only lightly covered in trees and clearing for grazing purposes may not be beneficial.

National parks and state forest cover 366 000 hectares (4.6 per cent of the region). The lowland sclerophyll forests in the coastal areas north of Toomulla are habitat for the endangered mahogany glider. It is estimated that less than 20 per cent of the original area of lowland sclerophyll forests remains, as they were extensively cleared for agriculture, forestry and infrastructure.[4] This northern area also sits within the southern reach of the Wet Tropics World Heritage Area and contains national parks and conservation parks.[5]

Amendments to the *Vegetation Management Act 1999* (tabled in Parliament in March 2013) will remove constraints on clearing high-value regrowth vegetation on freehold land across the state, and create opportunities to clear vegetation for high-value agriculture. The audit mapping will be updated in the future to reflect these amendments when the laws come into force.

4 Department of Environment and Heritage Protection 2012, 'Endangered animals: mahogany glider', Queensland Government, viewed 3 January 2013, ‹http://www.ehp.qld.gov.au/wildlife/threatened-species/endangered/endangered-animals/mahogany_glider.html›.

5 Department of National Parks, Recreation, Sport and Racing 2012, 'Wet Tropics', Queensland Government, viewed 3 December 2012, ‹http://www.nprsr.qld.gov.au/world-heritage-areas/wet-tropics/index.html›.

7.2 Current and potential agricultural land use

Current land use in the Charters Towers region is presented in Map 7.5. Based on the current datasets, 86 per cent of the region's land area is used for agriculture, with the vast majority (83.6 per cent) used for grazing. The region is important for sugar, with 32 per cent of the land area in Queensland under sugarcane occurring in this region (Table 7.2).

The region is important for grazing, with a range of enterprise types supplying store cattle for fattening in other regions and in feedlots. The western areas have mostly breeding and growing enterprises, and as such are important in an efficient cattle supply chain.

Table 7.2 presents the current and potential areas for the range of agricultural land-use categories investigated by the audit. The total potential land-use area exceeds 100 per cent, as some areas may be suitable for more than one category. The forestry area includes land that is used for forestry and silvopastoral systems (native forestry or plantation forestry together with grazing). Other land uses (14 per cent of the region) include a large area of defence land, national parks, conservation areas, water bodies, urban areas and mining (Map 7.5).

Table 7.2 Current and potential land area

Queensland Land Use Mapping Program (2009)	Current land use			Potential land use*	
	Area (ha)	Percentage of region	Percentage of ALUC† that occurs in region	Area (ha)	Percentage of region
Broadacre cropping	8 314	0.10	0.23	151 311	1.90
Sugarcane	180 839	2.27	32.00	1 192 741	14.98
Perennial horticulture	4 167	0.05	4.74	1 469 648	18.46
Annual horticulture	1 232	0.02	2.61	1 553 376	19.51
Grazing	6 650 663	83.56	4.50	6 877 721	86.40
Sown pastures	903 868	11.35	5.63	1 531 329	19.24
Intensive livestock	78	0.00	0.21	2 254 730	28.32
Aquaculture	605	0.01	13.31	14 696	0.18
Other land use (non-agricultural land uses and also may include some forestry)	1 113 360	13.99	5.55		
Total	**7 959 258**	**100.00**			
Forestry‡ (see Section 11.2.2)					
Managed in silvopastoral systems (mixed native or plantation forestry and grazing)	5 709 748	71.73	5.58		

Note: Refer to Sections 7.2.2 (under 'Forestry') and 7.3 ('Data confidence') for a further explanation regarding the forestry datasets and methodology used.

* Potential areas include where the majority of current production occurs as well as where production could potentially occur. Refer to Section 7.3 ('Data confidence').

† Agricultural land-use category.

‡ Forestry includes land, irrespective of tenure, that has been established as forestry (native or plantation), but can also be used for other purposes such as grazing. Current plantation forestry locations are developed from data from the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), HQPlantations Pty Ltd and Forest Enterprises Australia Holdings. Current native forestry is based on data from the Department of Agriculture, Fisheries and Forestry (Queensland) and the Department of Environment and Heritage Protection. See Section 7.2.2 (under 'Forestry') for further information about forestry data.

Along the coast there is sugarcane, horticulture (vegetables, mangoes, bananas and lychees) and forestry (Map 7.5). The coastal area around Ingham produces sugarcane and some horticulture, primarily melons, pumpkins and pineapples. There are also some areas of timber plantation, particularly to the west of Ingham.

The area around Ayr and Home Hill produces sugarcane and horticulture. It is the major mango production area in Queensland, and also produces vegetables and melons. Bananas have more recently been grown in this area, following successive cyclones destroying the majority of the banana crop in Far North Queensland. Legumes are grown in rotation with sugarcane, either as a green manure crop or for grain.

Beef production is important for the region and most of the region is grazed by beef cattle. The area produces mainly store cattle for feedlots or fattening in other regions, although there are several land types that are suitable for finishing (e.g. basalt, black soils, alluvial soils and cleared brigalow and gidgee). Small areas of irrigated pastures on the coast are used for finishing cattle (see Map 7.5).

Aquaculture currently occurs in several locations along the coast, primarily around Townsville (see Map 7.11). The area produces primarily marine prawns and barramundi and most production systems are pond-based; there are very few cage-based systems.

7.2.1 Important agricultural areas

In the Charters Towers region, two areas have been identified as important agricultural areas.

An important agricultural area is an area that has all the requirements for agriculture to be successful and sustainable, is part of a critical mass of land with similar characteristics and is strategically significant to the region or the state. Map 7.6 shows the general location of the important agricultural areas for the Charters Towers region.

Herbert River and Ingham area

The area around Ingham, up the Herbert and Stone rivers and south to Rollingstone (see Map 7.6) is an important sugarcane growing area, has soils and climate suitable for broadacre cropping and has grazing, forestry, aquaculture and some horticulture.

The area grew 32 per cent of the region's sugarcane and 12 per cent of Queensland's sugarcane in 2010–11. The value of sugarcane grown in the area in 2010–11 was $109.8 million. The area also supports horticultural crops including bananas and lychees, which were worth $2.4 million and $0.5 million respectively in 2010–11.

The area has very high pasture growth and is suitable for sown pastures. It supports the finishing of cattle and there is a supply of store cattle in the west of the region. The value of cattle sold from the area in 2010–11 was $8.6 million. The area has an established plantation forestry industry and potential for both hardwood and softwood plantations. There is also potential for silvopastoral systems (where forestry and grazing occur together) and for sugarcane and legume systems with or without grazing. Potential sites for marine aquaculture also exist along the eastern edge of the area.

There is infrastructure established for sugarcane with two sugar mills, sugarcane tramways and the sugar export facility at Lucinda. There is also irrigation infrastructure, which is used primarily for horticulture and sugarcane. Townsville is just south of the area and has a port, abattoir and sawmill.

Lower Burdekin

The area around Home Hill and Ayr, west to Giru and south along the Burdekin River (see Map 7.6) is an important sugarcane and horticulture area. It is also suitable for hardwood timber plantations and broadacre cropping. The eastern part of the area has potential for aquaculture.

The total value of agricultural produce from the area in 2010–11 was approximately $315 million, which is nearly half of the total value of agricultural produce from the Charters Towers region. Sugarcane from the area in 2010–11 was worth $227.3 million; it was 68 per cent of the region's sugarcane and 25.6 per cent of Queensland's sugarcane for the year.

Most of the region's vegetable crop and all of the region's sweet corn comes from the lower Burdekin area. In 2010–11, the region's sweet corn was worth $12.5 million, which represented 35 per cent of Queensland's total sweet corn crop. The region is also important for mango and melon production, with 27 per cent of Queensland's mangoes and 19 per cent of the state's melons for 2010–11 grown here. Horticulture fills seasonal windows, supplying produce when other regions are out of season. This ensures continuity of supply of vegetables and fruit throughout the year from different regions in Queensland. The region's proximity to Asia and port facilities in Townsville means there is potential for increased production of tropical fruit for export to Asia if market conditions are suitable.

The area has existing infrastructure for sugarcane production including four sugar mills, sugarcane tramways and an export terminal at Townsville. The Burdekin Falls Dam and Burdekin–Haughton Water Supply Scheme provide a reliable supply of water for irrigation.

The area has very high pasture growth for grazing, and cattle can be finished in the area. There are sugarcane/legume production systems, which improve the soil health of sugarcane growing areas. The legumes can be pulse crops or may be grazed by cattle.

7.2.2 Industry profiles

Broadacre cropping

Current

Land used for broadacre cropping in the Charters Towers region makes up less than 1 per cent of the region and just 0.2 per cent of broadacre cropping land in Queensland.

There are pockets of dryland and irrigated cropping scattered across the region (Map 7.7), mostly along the rivers. The vast majority are outside the potential cropping areas identified. Many of these are irrigated pastures and forage crops such as sorghum, which are grown opportunistically and/or in pockets of better quality soils. There is approximately 1000 hectares of cotton, and some maize is grown when southern maize growing areas lack rainfall.

In 2010–11, the total value of grain crops in the region was $1.8 million. Pulse crops were worth $1.2 million and cotton less than $1 million. The total value of fodder crops was $1.5 million.

Potential

The area with potential for broadacre cropping in the Charters Towers region is 151 311 hectares or 1.9 per cent of the region (Table 7.2). This area is currently used primarily for sugarcane (72 per cent) and grazing (20 per cent).

Maps 7.7 and 7.8 clearly show the potential cropping areas coinciding with the sugarcane growing areas. These areas have existing infrastructure for sugarcane growing, rather than grain growing. In addition, there are constraints to cropping including the high cost of water relative to the returns for grain and poor access to transport to markets. The land suitable for cropping is generally used for higher value sugar. The risk of soil erosion and flooding from high-intensity rainfall in summer also limits the dryland cropping potential along some of the coastal areas.

Some of the western areas may be suitable for irrigated cropping if water is available. There is some unsupplemented water available in the western areas, but landholders would need their own water harvesting and storage infrastructure and would compete on price with other users. Use of land for agricultural purposes is limited to the grasslands on black soil plains due to the Queensland Vegetation Management Framework. There are additional areas of land suitable for fodder cropping along these major watercourses, but much of this cannot be cleared. However, there are areas on the lower Belyando and Suttor rivers that have previously been cleared and are suitable for growing fodder or grain crops. Other constraints to broadacre cropping in those areas include labour and skills shortages, salinity risks, areas of basalt rock, long distances to markets and processing facilities, a lack of roads suitable for bringing in harvesters, and a lack of infrastructure for storage and transport of grain.

Potential new water infrastructure being considered, such as the Hellsgate Dam near Greenvale or raising of the Burdekin Falls Dam spillway, may provide extra water for irrigation.

Sugarcane

Current

Sugarcane is grown on 180 839 hectares, which is 2.3 per cent of the region (Table 7.2). However, this represents 32 per cent of the sugarcane growing area in Queensland. Sugarcane is grown in two distinct coastal areas, one around Ingham and the other in the Burdekin area around Home Hill and Ayr and extending up the Burdekin River (see Map 7.8). The northern area has good sugarcane growing conditions, and irrigation from groundwater is only used if there is a dry end to the growing season. Pulse crops (mung beans, soy beans and navy beans) are grown in rotation with sugarcane in the Burdekin.

There are six mills in the region—two at Ingham, two at Ayr, one at Home Hill and one at Giru. The mills are relatively old, but not all are used at capacity. Existing mills could be upgraded if required to cope with expansion of sugarcane growing, so it would not be necessary to build new mills in different areas.

Sugarcane is transported primarily via the sugarcane tramways network to one of the six sugar mills. Road transport is used for sugarcane from outside the tramway network, including from Dalbeg. The viability of road transport varies with the price of sugar, but generally it is considered to be economical only over short distances. Transport by sugarcane tramways is more economical than by road.

Sugarcane grown in the region in 2010–11 was worth $344 million and was nearly 38 per cent of Queensland's total sugarcane crop.

Potential

The area of biophysical potential shown in Map 7.8 is much greater than the area currently under sugarcane—15 per cent of the region (1.2 million hectares) is suitable for growing sugarcane (Table 7.2). Most of the potential area is currently used for grazing (85 per cent), but the area currently under sugarcane sits largely within this area. Sugarcane is currently grown in 10 per cent of the potential sugarcane area.

In the western areas, limited access to water, high frequencies of rock in the basalt land types, high costs of transport to a mill and slower growth rates (due to cooler night-time conditions) make it currently uneconomical to grow sugarcane. While sugarcane can grow in the western areas, the consistently cooler temperatures at night in winter and the large number of days over 40 °C in summer severely restrict sugarcane growth. In the north-west of the region, the key constraints to growing sugarcane are limited access to water and long distances to mills.

The sugar industry has diversified in recent times so that in the future, the region could produce ethanol and other fermentation products in addition to sugar products. Cogeneration plants can use bagasse as feedstock to produce energy for the mill's use and put excess power into the grid. Higher sugar prices could drive an expansion of sugarcane growing areas.

Horticulture

Current

Perennial horticulture occurs in 0.05 per cent of the region, along the coast and around Charters Towers, with the key horticulture area being in the Burdekin around Ayr and Home Hill (Map 7.10). This area and the area around Townsville are the primary mango growing areas in Queensland. The total value of perennial horticulture from the region in 2010–11 was $35.3 million. In 2010–11, the region produced nearly $20 million of mangoes, which represents 36 per cent of Queensland's mango crop.

Other perennial horticulture crops in the region include tropical fruit, citrus (Charters Towers area), pineapples (Townsville area) and bananas (Ingham area). Cassava is grown south of Home Hill and a pilot mill has been established nearby.

Annual horticulture occurs on 0.02 per cent of the region, which represents 2.6 per cent of the total annual horticulture area in Queensland (Map 7.9 and Table 7.2). In 2010–11, the region produced 35 per cent of Queensland's sweet corn crop, 38 per cent of the state's potatoes for processing and 19 per cent of the state's melons.

Horticulture produce from the region goes to the domestic fresh markets, and is transported by road (refrigerated trucks) to southern markets, including Brisbane and Sydney. Some mangoes are exported. Produce is mostly packed on-farm and stored on-farm in cold storage.

The total value of annual horticultural commodities in the region was $52.8 million in 2010–11. This included sweet corn ($12.5 million), melons ($10.2 million), beans ($6 million), capsicums ($5.2 million) and potatoes for processing ($4.7 million).

Lifestyle nurseries generated $7 million for the region in 2010–11.

All horticultural crops in the region are irrigated. Along the coastal areas, most labour comes from the National Harvest Trail, backpackers and local residents. Further west, labour is scarce and expensive.

Potential

The area of biophysical potential for production is shown in Maps 7.9 and 7.10. In this region, 18.5 per cent of land is suitable for perennial horticulture and 19.5 per cent is suitable for annual horticulture (Table 7.2). Currently horticulture covers a much smaller area than the biophysical potential area identified. Most of the potential area is currently used for grazing (88 per cent) and growing sugarcane (5 per cent). The primary land type in the grazing lands that have potential for horticulture is basalt country, which has extensive areas of rock. The rock limits more intensive land use such as horticulture.

Horticulture crops have very specific climatic requirements and expansion depends on those specific needs. Bananas, lychees and other tropical fruit trees are sensitive to the impacts of cyclones and intolerant to frost.

Access to water is particularly important for horticulture. Water for horticulture in the region comes from the Burdekin Falls Dam or from farm dams (water harvesting) and from rainfall.

Many socio-economic factors affect the viability and expansion of horticulture in a particular region. These include markets, the value of the Australian dollar (for exports), access to labour, cost and ease of transport, and access to and cost of water. Maps 7.9 and 7.10 show the 50 km radius from each town with a population of 2000 or more—this indicates areas with reasonable access to labour. However, the towns need to be able to supply affordable accommodation and other services to attract and retain the labour. Coastal towns in the region are often in tourism areas and can provide backpackers, grey nomads and other travellers for employment for picking and packing. Labour, transport and water become more problematic further west, with fewer roads and larger distances to population centres.

In some coastal areas, existing land uses such as sugarcane and urban expansion are likely to limit expansion of horticulture. However, enhanced opportunities to export fruit and vegetables could drive an expansion of horticulture in the region.

Intensive livestock

Current

Intensive livestock operations include feedlots, piggeries and aquaculture (see Map 7.11). Feedlots and piggeries currently occur on 78 hectares or 0.001 per cent of the region and aquaculture on 605 hectares or 0.01 per cent of the region (Table 7.2).

There are a small number of feedlots marked on the map, although some of those may be operating only opportunistically when cattle prices and/or grain prices are suitable. They may have some areas of soil suitable for cropping and be running the feedlot when climatic conditions and soil moisture support a crop.

Feedlots tend to be located close to grain supplies and areas with cropping potential. This allows for lower cost of accessing feed grains as well as the ability to spread effluent across cropping soil.

There are a few smaller on-farm feedlots (of less than 50 head) not marked on Map 7.11 that can grow their own grain using irrigation or opportunistically when climatic conditions are right.

Cattle from feedlots are mostly sold directly to works at Townsville, Mackay, Rockhampton, Brisbane or Ipswich.

There are three piggeries in the region and pigs are slaughtered at local abattoirs. There is a goat abattoir in Charters Towers, and several towns (including Cloncurry and Hughenden) have local abattoirs. The total value of pigs, goats and poultry slaughtered in the region in 2010–11 was $3.4 million, which is a small fraction (0.5 per cent) of the Queensland total. There are also egg farms around Townsville and Black River. Egg production in the region was worth $6.6 million in 2010–11.

There are several aquaculture production areas along the coast (see Map 7.11). These produce mostly marine prawns and barramundi. In 2009–10, 3504 tonnes of aquaculture with a farm gate value of $44 million was produced in the region. This represented 44 per cent of the total aquaculture production in Queensland. Larger enterprises have primary processing and cold storage on site and will process product from local, smaller enterprises. Produce is transported mostly by refrigerated truck to southern markets, usually the large supermarket chains. The vast majority of sales occurred in Australia.

Potential

The potential areas for locating intensive livestock production are marked in Map 7.11. The total area appears large, but expansion of feedlots in the region would require locally grown grain or fodder crops to be profitable, as transporting grain to the region would likely be too costly.

Transport of cattle to abattoirs can be problematic during the wet summer months, when many roads in the region are cut or flood-damaged.

Expansion opportunities in the region are also limited by poor access to labour, particularly in the west away from the backpacker market. Currently there is low unemployment and a shortage of suitable labour in the region.

Constraints to expansion of piggeries include nearby urban expansion, long distances from grain and poor access to water.

Aquaculture is emerging as an industry of importance for the region, with efficiency and production increasing. Coastal areas provide the best return on investment and are close to transport and facilities. Aquaculture sites require access to cost-effective water (to manage high salinity levels caused by evaporation) and access to three-phase power. Also, they need to avoid impacts from other intensive agriculture, including run-off from sprays and high concentrates of animal waste. Pond-based aquaculture enterprises have planning requirements, to accommodate the large pond structures. Due to their proximity to the Great Barrier Reef, potential enterprises need to demonstrate that they can manage their off-site impacts.

Grazing

Current

Cattle are grazed across nearly 84 per cent of the region (Table 7.2). Pasture production (and liveweight gains) vary markedly across the region, with higher pasture growth occurring on the land types with higher fertility soils, such as basaltic soils, alluvial soils and cleared brigalow/gidgee. There are significant areas of 'low' pasture growth in the region, averaging less than 1500 kg/ha/year (Map 7.12). The lower rainfall away from the coast limits pasture growth on better quality soils. In the south-west, lack of rainfall also limits the amount of water available for stock, and the quality of the bore water in that area is variable.

The region supports a range of grazing production systems across the different land types, and producers tend to focus on one enterprise, either breeding or finishing. Inland, extensive grazing on native pastures and some sown pastures produces weaners, store steers and cattle for the Japanese export market (2.5–3.5 years old), depending on land types. Coastal system grazing lands are characterised by native pastures, sown pastures and some irrigated pastures, and produce weaners, store steers, cattle for the Japanese export market (2–3 years old) and local butchers steers.

Sown pastures (Map 7.14) are generally buffel on higher fertility inland cleared areas (including along the Belyando and Suttor rivers), rhodes grass on the coastal soils and aerially sown stylo pastures across much of the inland grazing land. Para grass is also sown in wetter areas around Ingham, Home Hill and Ayr. Some sown species, including stylos and buffel, have colonised additional areas. Indian couch has spread to large areas around Charters Towers, but is not a sown pasture species.

There are saleyards at Charters Towers and an abattoir at Townsville. Although cattle sold directly to works may be sent to any abattoir in the state, from this region they are most likely to be sent to Townsville, Mackay or Rockhampton to minimise transport costs. Store steers are generally sold out of the region for fattening before slaughter. They may go to feedlots in the south, to higher quality pastures (including Mitchell grass plains) to the west or to buffel country in Central Queensland for finishing. Cattle are also exported live out of the Port of Townsville.

During the wet season, there is very little mustering or movement of cattle and the Townsville abattoir closes. The highways to Pentland and the south tend to flood in most years during the wet season. Cattle from the region are transported by road, although some live export cattle are transported by rail from the Charters Towers holding yards to Townsville. Prices paid for cattle tend to be higher in the wet season due to shortage of supply, and some producers muster cattle to sell prior to the wet season and have them in a nearby paddock ready for transport to capitalise on this opportunity.

The value of cattle sold in 2010–11 in the region was $193.5 million, with nearly $163 million of that coming from the Charters Towers local government area. This equates to nearly 6 per cent of the total cattle sales in Queensland.

Map 7.12 shows the areas growing different amounts of pasture, assuming all the land is in condition B. In reality, the land condition varies across the region, with some in condition A (best possible condition) and some that is more degraded. Maps 7.12 and 7.13 demonstrate the difference that land condition can make to productivity and carrying capacity. Map 7.13 shows the higher productivity expected when the land is all in condition A.

Potential

The potential area for grazing in the region is 6.9 million hectares or 86 per cent of the region (Table 7.2). However, the most significant opportunity for growth in the industry is not from expanding the area, but from improving land condition and herd management. Beef cattle productivity can be improved through good pasture management, using appropriate stocking rates, introducing perennial legumes into existing pastures, and enhanced herd and business management. This opportunity applies statewide, but particularly in this region, as land condition here declined rapidly in the 1980s as a result of high stock numbers and prolonged drought, leading to pasture degradation, soil erosion and loss of productivity. Widespread soil erosion resulted in export of material into catchments and the Great Barrier Reef lagoon.

In this region, over-sowing existing pasture with legumes (such as stylos) can nearly double the carrying capacity of the sown area. Areas suited to mechanical sowing are mapped in Map 7.14, but most of the region can be over-sown aerially to suitable legumes. Also, stylos are becoming naturalised.

Constraints to growth include the extremely variable climate, closure of roads and the meatworks in the wet season and, to a lesser extent, limited access to skills and labour in the west.

There are opportunities for increased grazing and timber production in some native forested grazing areas where commercial timber species naturally occur; these silvopastoral systems are described more fully under 'Forestry' below. Managing trees through thinning and harvesting (to reduce competition between trees, allowing the remaining trees to grow larger more quickly) also reduces competition on pastures, resulting in increased grazing production.

Forestry

Current

The region currently has low forestry production and low associated timber processing activity. It currently generates less than 5 per cent of Queensland's plantation forestry production and less than 5 per cent of the state's native hardwood forestry production. Forestry production predominately comes from timber resource areas (native and plantation) on state-owned lands administered under the *Forestry Act 1959*, plus native forest practice notification areas on private (freehold) land under the *Vegetation Management Act 1999*[6] and plantation forestry on private land. Most of this land is also grazed and generally managed as silvopastoral systems (see 'Grazing' above).

Native forestry currently occurs across the region on state-owned land and private land, which is also generally used for grazing (Map 7.15). Native forestry in the region, predominately hardwood, produces forest products suitable for a number of uses including sawn construction and appearance timber, poles, bridging girders, fencing timbers and craftwood. In addition, native Queensland sandalwood is harvested for its aromatic timber properties. Hardwood fencing timbers are an important resource for grazing and other agricultural land uses. The key commercial native forestry hardwood tree species in the Charters Towers region include wet sclerophyll forest species in highly productive sites and various ironbarks, stringybarks and bloodwoods, lemon-scented gum, Moreton Bay ash, forest red gum and Queensland sandalwood.

6 Under the *Vegetation Management Act 1999*, 'forest practice' includes felling and removing trees for commercial gain. A landholder who conducts a native forest practice on remnant vegetation must do so according to the *Code applying to a native forest practice on freehold land* and must give formal notice of the location through a 'Notice of forest practice' form.

On state-owned land, the denotation of a management unit (MUID)[7] on the lot on plan indicates commercial native forestry (or quarry material) interest. However, the actual native forest production area is restricted to the forested area within the parcel. So although there are currently timber interests based on MUIDs on 5.7 million hectares, which is 71.6 per cent of the region (Table 7.3), this figures is not the actual area of native forestry production on state land. These forested areas include land that potentially has areas of native Queensland sandalwood. Harvesting of these MUIDs is scheduled on a routine basis in conjunction with the current state timber supply commitments and market demand.

Native forestry on private (freehold) land forest practice notifications (which involves managing, felling and removal of native trees for commercial purposes) covers 810 hectares or 0.01 per cent of the region (Table 7.3). The actual area of production is restricted to the forested portions of those areas.

Plantation forestry in the region, predominantly exotic softwood, is relatively small at 8331 hectares or 0.1 per cent of the region (Table 7.3). Plantation forestry (Map 7.16) aims to produce a number of forest products including sawlogs, round timbers and pulpwood for a broad range of appearance and construction timber processing purposes, plus aromatic timber (exotic sandalwood).

The exotic softwood plantations in the region were established by the Queensland Government for sawlog production from the 1980s. The estate on state-owned land was licensed, and that on freehold land was sold to private interests in 2010.

Exotic softwood plantation forestry areas, including fallow areas, cover 8329 hectares and are located around Ingham. Exotic softwood plantations have a dense tree canopy, and generally only combine with grazing after the initial establishment period for about the first 5 years of a crop rotation (until tree canopy closure).

There are a number of small single- and mixed-species hardwood plantations, but only one plantation of 2 hectares has been mapped. This hardwood plantation is too small to identify on the map but is located near Ingham and grows African mahogany. It was established in the 2000s for sawlog production. There is also approximately 250 hectares of 'irrigated' Indian sandalwood located near Ayr that is not mapped. The hardwood and sandalwood plantations are presently immature and are expected to come onstream for harvest after 2020. African mahogany plantations are generally managed as silvopastoral systems. Irrigated Indian sandalwood plantation forestry areas are generally not grazed.

A small facility near Townsville processes some of the current forestry production. Timber processing facilities outside the region also process some of the current forestry production. A number of portable/bush sawmills and fencing timber processors (not mapped) service the region's forestry production. Commercial haul distances can be 400 km or more, but the value of the product will determine the economical haul distance.

Potential

There is potential for increased forestry production in the region, including softwood plantation and native hardwood, plus some hardwood plantation. However, for plantation forestry, the risk of cyclone damage will need to be carefully considered, given the recent experience with plantations in tropical Queensland. Increased forestry production would provide further resources for existing timber processing facilities within and near to the region once increased supply comes onstream.

The areas identified for potential plantation forestry (total 336 006 hectares, 4.2 per cent of the region) are generally limited to the higher rainfall areas. There are 314 454 hectares identified as suitable for softwood and 21 552 hectares for hardwood, which are 4 and 0.3 per cent of the region's area (Table 7.3). Included in these areas are 140 544 hectares that have potential for mixed-species plantation. The current uses of land that has potential for softwood are grazing (46 per cent), sugarcane (28 per cent) and native forestry (6 per cent). Those for land that has potential for hardwood are sugarcane (60 per cent), grazing (24 per cent) and native forestry (6 per cent).

7 MUID—management unit inventory data.

Exotic pine, African mahogany and Indian sandalwood (irrigated) plantation varieties are considered the best options for plantation expansion in the region. Native kauri pine also has some potential for expansion but is limited to fertile soils. Expansion of African mahogany has the advantage of possible integration into the existing grazing landscape as silvopastoral systems.

Exotic pine varieties have performed well on a range of soils, particularly less-fertile soils that receive annual average rainfall of greater than 800 mm in 7 out of 10 years. African mahogany has performed well on a range of soils that receive an annual average rainfall greater than 700 mm in 7 out of 10 years. Indian sandalwood requires irrigation to perform commercially. Native kauri pine performs well on fertile soils that receive an annual average rainfall of greater than 800 mm in 7 out of 10 years.

Native forestry has been mapped as high, medium and low potential production areas (see Map 7.15 and Table 7.3). The high and medium potential areas are modest—216 041 hectares for high potential and 309 371 hectares for medium potential (2.7 and 3.9 per cent of the region respectively). The area of low potential is 4.3 million hectares, which is 53.6 per cent of the region (Table 7.3). There are opportunities to create silvopastoral systems by increasing native forestry production on the mapped potential areas on a long-term basis while having minimal impacts on the other pastoral land uses.

The existing timber processor has only limited capacity to expand production. Investment in new or upgrading of existing facilities is required and this would require an increased long-term log timber supply. Currently, demand for native hardwood forest products is high and that for exotic softwood forest products is medium to high. These demand levels are expected to be sustained in the medium to long term.

The region has a high risk of severe cyclone damage, which is a constraint to plantation expansion. However, it also has:

- areas with good rainfall and suitable soils (in the areas mapped as potential) that could produce commercial growth rates for plantation exotic pine, African mahogany and Indian sandalwood (irrigated) hardwood species, and kauri pine softwood species
- some areas with relatively affordable land prices (in the areas mapped as potential)
- potential access to a range of existing timber processing facilities, domestic markets (Cairns and Townsville) and port facilities (Townsville and Mourilyan Harbour).

Overall, the region has small timber production output; however, there is some opportunity for forestry production growth, which in turn would provide the opportunity for industry investment and growth in the associated down-stream timber processing.

Table 7.3 Current and potential land area for forestry

Forestry[†]	Current land use			Potential land use[*]	
	Area (ha)	Percentage of region	Percentage of ALUC[‡] that occurs in region	Area (ha)	Percentage of region
Plantation forestry (ABARES, HQPlantations, FEA Holdings)					
Hardwood	2	0.00	0.01	21 552	0.27
Softwood	8 209	0.10	3.90	314 454	3.95
Mixed species (softwood and hardwood)	14	0.00	4.66	140 544	1.77
Fallow (where plantation not currently planted to trees)	106	0.00	35.46		
Total	**8 331**	**0.10**			
Native forestry					
State-owned land timber interests (area based on entire lot on plan; forestry restricted to forested area within that)	5 700 607[§]	71.61	5.77		
Private land (native forest practice notifications)	810	0.01	0.03		
High potential				216 041	2.71
Medium potential				309 371	3.89
Low potential				4 264 834	53.58
Total	**5 701 417**	**71.62**		**4 790 246**	**60.18**

[*] Potential areas include where the majority of current production occurs as well as where production could potentially occur. Refer to Section 7.3 ('Data confidence').

[†] Forestry includes land, irrespective of tenure, that has been established as forestry (native or plantation), but can also be used for other purposes such as grazing. Current plantation forestry locations are developed from data from the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), HQPlantations Pty Ltd and Forest Enterprises Australia Holdings (FEA Holdings). Current native forestry is based on data from the Department of Agriculture, Fisheries and Forestry (Queensland) and the Department of Environment and Heritage Protection. 'High potential' = higher value commercial timber species of suitable height for sawlog production. 'Medium potential' = commercial species but trees not of sufficient height for sawlog production or no height information available. 'Low potential' = areas with tree cover but not commercially viable species or may include timber species suitable for forest products other than sawlogs.

[‡] Agricultural land-use category.

[§] MUIDs (management unit inventory data) over leasehold land and reserves generally cover the entire lot on plan, though the actual native forest production area is restricted to the forested area within the lot on plan. Therefore, this figure does not represent the actual area of production.

7.3 Data confidence

The agricultural land-class dataset that was used as the basis for most of the maps developed for the Charters Towers region was considered 'low' confidence for all areas except an area around Ingham, which was considered 'medium' confidence (see Map 7.17).

The confidence levels indicate how well the line work, soil data and soil quality information provided match reality. They are determined by how spatially accurate the lines around different soil types are on the map, how much information was available for soil data, how soil quality information was collected, what was collected and the skill of those collecting the information.

Most of the current land-use information used in the audit has been obtained through the Queensland Land Use Mapping Program (QLUMP), which is dated 2009 for this region. Land use is determined through available databases, satellite imagery and aerial photographs. As there are difficulties with differentiating land uses using imagery, local expert knowledge and some field surveys have been conducted to verify the data.[8]

The current locations of intensive animal production facilities are derived from data from the Intensive Livestock Environmental Regulation Unit, within the Department of Agriculture, Fisheries and Forestry (Queensland). The area for intensive land use is based on QLUMP data. The location of egg production is based on the Safe Food Production Queensland egg register as at October 2012.

Current plantation forestry locations are developed from data from the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), HQPlantations Pty Ltd and Forest Enterprises Australia Holdings (FEA Holdings).

Apart from forestry and intensive livestock (where more up-to-date and specific datasets are available), QLUMP data represents the best available dataset for the land uses and was used in the identification of current areas of agricultural production.

The QLUMP forestry data is based on state forest boundaries and some plantation forest information is also included. However, there is also native forestry on private land and other state land (for which state government information is available). There are also more accurate and up-to-date plantation forestry datasets available from ABARES, HQPlantations and FEA Holdings. Therefore, the forestry analysis (which is based on non-QLUMP datasets) is presented in Table 7.3.

As there will be differences between the current Intensive Livestock Environmental Regulation Unit data, forestry information and the QLUMP dataset, the current land-use information based on QLUMP data does not represent exact and current figures for land area (as it is 2009 data), but relative areas between the different land-use types.

Intensive animal operations represent a relatively small agricultural footprint. Therefore, differences in datasets for intensive livestock are not likely to significantly impact on the relative proportions of other land uses.

Grazing can be a mixed land use; therefore, the difference between the total area for forestry from QLUMP data and that derived from the other datasets will largely occur in areas where grazing and forestry are occurring on the same land.

When determining the potential for each of the different land uses, a number of assumptions had to be made (as a result of issues such as uncertainties in the mapping). The net result of these assumptions is that the area figures contained in Table 7.2 overestimate the true potential area for each agricultural land use category.

8 The methods QLUMP apply to mapping land use are described in full in the ABARES handbook *Guidelines for land use mapping in Australia: principals, procedure and definitions* (4th edition), available at ‹http://adl.brs.gov.au/data/warehouse/pe_abares99001806/GuidelinesLandUseMappingLowRes2011.pdf›.

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Peck, G, Buck, S, Hoffman, A, Holloway, C, Johnson, B, Lawrence, D & Paton, C 2011, *Review of productivity decline in sown grass pastures*, report to Meat and Livestock Australia Ltd, Sydney.

Queensland Government 2009, 'Climate change impacts on Queensland's regions', Queensland Government, viewed 10 September 2012, ‹http://www.ehp.qld.gov.au/climatechange/regional-summaries.html›.

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Safe Food Queensland 2012, S*FPQ egg register 2012*, Safe Food Queensland, ‹http://www.safefood.qld.gov.au/images/PDF/egg_egg_products/egg%20register.PDF›.

State of Queensland 2007, *Water Resource (Burdekin Basin) Plan 2007*, Office of the Queensland Parliamentary Counsel, ‹http://www.legislation.qld.gov.au/Acts_SLs/Acts_SL_W.htm›.

The University of Queensland 2009, 'Restoring brigalow landscapes: land use history', The University of Queensland, viewed 21 November 2012, ‹http://www.uq.edu.au/brigalow/land-use_history.html›.

Wingfield, M & Willett, D 2011, *Ross Lobegeiger report to farmers aquaculture production survey 2009–10*, Department of Employment, Economic Development and Innovation, Queensland.

7.4.2 Further studies

Pre-amalgamation shire handbooks

- Hinchinbrook Shire (1975)
- Ayr Shire (1973)

Studies

The references marked with an * are available to view (or download) from the Department of Environment and Heritage Protection electronic library at www.ehp.qld.gov.au (click on the 'Library catalogue' link).

Use the search function and the title of the reference to access the relevant documents in PDF format.

Note: Some of these documents are very large (up to 50 MB).

Australian Bureau of Agricultural Economics 1973, *Bowen–Broken Rivers region land capability*, Australian Bureau of Agricultural Economics, Canberra.

Abstract: This is an agricultural capability map of the Bowen–Broken Rivers region, a part of the Burdeken River watershed. Relief is shown by spot heights. It is based on a land capability map prepared by the Department of Primary Industries (Queensland) and includes a locality map and reliability diagram.

***Day, KJ 1994, *Irrigated land suitability assessment of Leichhardt Downs relift section, Burdekin River Irrigation Area*, project report QO94010, Department of Natural Resources and Mines, Queensland, 88 pp.**

Abstract: The Leichhardt Downs relift section comprises 1916 hectares of mainly sloping upland terrain with adjacent pediments and some very gently sloping alluvial plains. Current land use centres on beef cattle fattening and irrigated sugarcane. In all, 203 unique map areas (UMAs) were described within the Leichhardt Downs relift survey area, ranging in size from less than 1 hectare to 82 hectares. Some 169 UMAs were less than 15 hectares in size and the model UMA size was less than 5 hectares (108 occurrences). Such soil complexity will make many parts of the area difficult to manage for irrigated crop production.

***Department of Primary Industries 2008, *Burdekin River Irrigation Area Jardine section: soils and land suitability*, State of Queensland.**

Abstract: This is a map of the high-intensity soil survey (1:25 000 scale) of the Burdekin River Irrigation Area Jardine section. The recommended land uses are agricultural production, pasture research, forestry production, irrigation implementation, urban development, waste disposal, highway planning, mine site rehabilitation, engineering uses, management of small catchments and shire planning (agricultural areas). This document consists of digital data and one map.

Department of Science, Information Technology, Innovation and the Arts 2009, *Burdekin NRM region landuse 2009*, Department of Environment and Resource Management, Queensland, ‹http://qspatial.information.qld.gov.au/geoportal/catalog/search/resource/details.page?uuid=%7BE4D57922-D65F-40AD-8138-5391CD299CAE%7D›.

Abstract: This dataset is a digital land-use map of part of the Great Barrier Reef catchment in Queensland. It encompasses the Burdekin Natural Resource Management Region. As nearly as possible, it shows land use in 2009. The dataset is a product of the Queensland Land Use Mapping Program (QLUMP) and was produced by the Department of Environment and Resource Management. It was prepared as part of a land-use change and updated land-use mapping for the Great Barrier Reef catchment funded by the Queensland Government Reef Protection Package. The dataset comprises an ESRI vector geodatabase at a nominal scale of 1:50 000. The layer is a polygon dataset with each class having attributes describing land use. Land use is classified according to the Australian Land Use and Management Classification (ALUMC) Version 7, May 2010.

***Kent, DJ & Shields, PG 1984, *Land capability study of the northern Burdekin region, Queensland*, land resources bulletin: QV84002, Department of Natural Resources and Mines, Queensland, 103 pp.**

Abstract: The land resources of the northern Burdekin region, comprising 8.6 million hectares, were assessed for both agricultural and pastoral capability. The landforms, vegetation and soils are described briefly with particular reference to those factors influencing land capability. There are 12 soil groups based on land capability characteristics. Both present and future land use are discussed and future prospects are considered. Approximately 875 000 hectares are considered to be climatically and physically suitable for some form of agricultural use. Selected important aspects of land management are also discussed. The electronic version of the report includes maps of land capability.

***Loi, JK, McClurg, JI & Christianos, NG 1994, *Soils and land suitability of Selkirk section, Burdekin River Irrigation A*rea*, North Queensland,* land resources bulletin: QV94005, Department of Natural Resources and Mines, Queensland, 122 pp.**

Abstract: A high-intensity survey (scale 1:25 000) and land suitability assessment were undertaken in Selkirk section. The primary purpose of the survey is to provide engineers with detailed land resource information and assessment of the land suitability for irrigation farm design. Land was assessed as to its suitability for furrow irrigation of sugarcane, grain crops and small crops, low-volume irrigation of mangoes and flood irrigation of rice. This project consists of a report and two published maps.

***McClurg, J, Donnollan, TE & Tucker, RJ 1988, *Soils and land suitability of Mulgrave section, Burdekin River Irrigation Area*, land resources bulletin: QV88004, Department of Natural Resources and Mines, Queensland, 58 pp.**

Abstract: This survey was part of a series of high-intensity (scale 1:25 000) soil surveys being undertaken by the Department of Primary Industries (Queensland) in the Burdekin River Irrigation Area. These surveys were designed to provide detailed land resource information and an assessment of land suitability for irrigation. The electronic version of the report includes maps.

***Murtha, GG 2013, *Soils and land use on the southern section of the Townsville coastal plain, North Queensland*, CSIRO, 78 pp.**

Abstract: This soil survey was of 11 000 hectares of the coastal plain immediately to the south and east of Townsville, North Queensland. The soils have been mapped on a free survey basis as associations of soil series. The electronic version has PDF of the full report and maps.

***Thompson, WP 1977, *Soils of the lower Burdekin River – Elliott River area, North Queensland*, Department of Natural Resources and Mines, Queensland, 104 pp.**

Abstract: The existing information for areas in the lower Burdekin River – Elliot River area was considered inadequate for reliable assessment of irrigation suitability. This project addresses this by surveying at a realistic scale for irrigation.

***Thompson, WP 1990, *Soils of the lower Burdekin Valley, North Queensland: Redbank Creek to Bob's Creek and south to Bowen River*, Department of Primary Industries, Queensland, 82 pp.**

Abstract: This report presents the results of a soil survey undertaken in the lower Burdekin Valley to assess the suitability of the area for irrigation.

***Turner, EJ & Hughes, KK 1983, *Upper Flinders River irrigation proposal*, Department of Primary Industries, Queensland, 20 pp.**

Abstract: The irrigation potential of the Flinders River region was assessed according to the soil types found within the area. The reconnaissance survey found that the brown and grey cracking clays have some potential, but the massive red/yellow earths have limited potential.

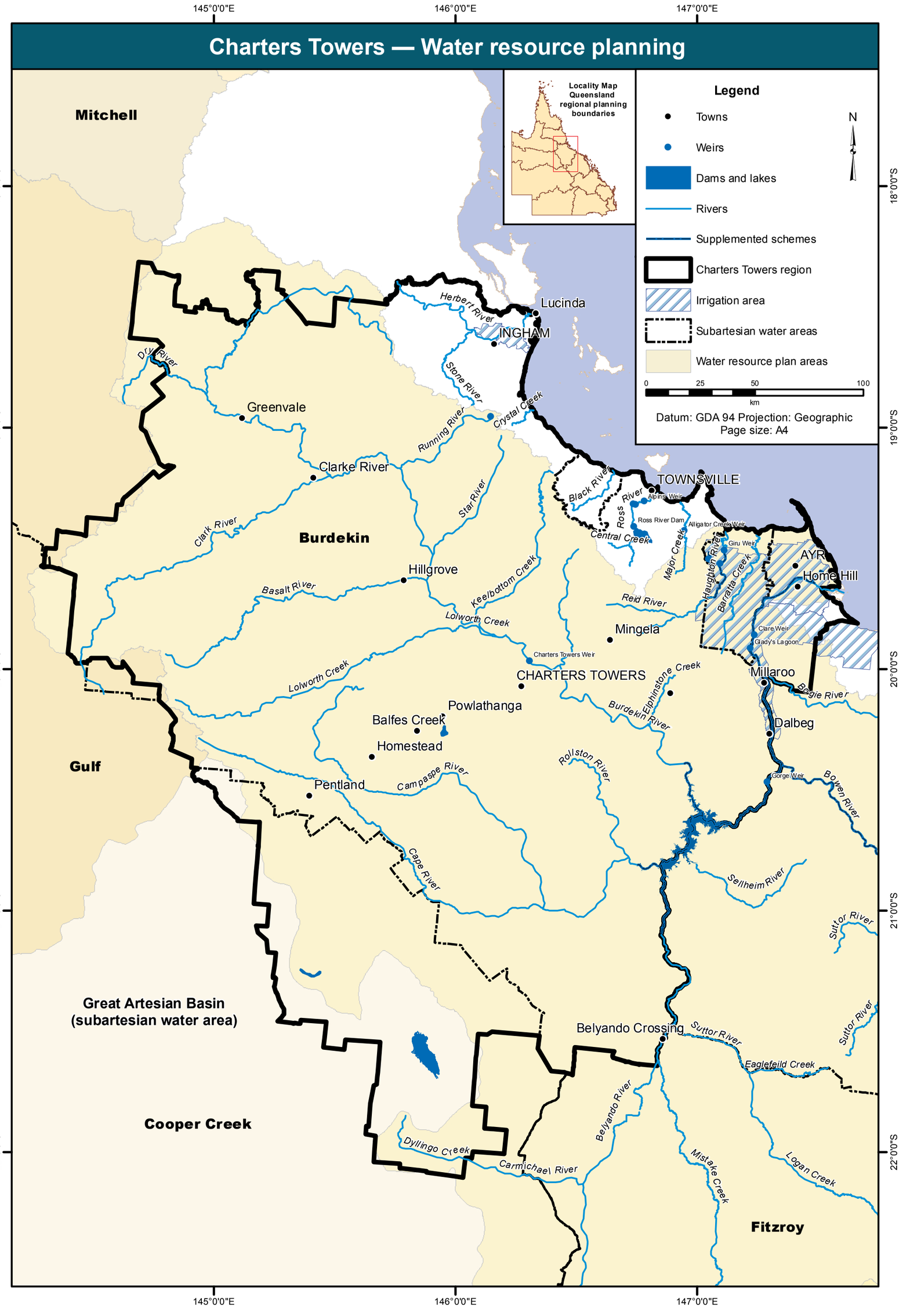
***Van den Berg, D & Jamieson, B 2006, *Land use change mapping from 1999 to 2004 for the Burdekin River catchment, Queensland*, Department of Natural Resources, Mines and Water, Queensland, 17 pp.**

Abstract: This dataset is a digital land-use map of the Burdekin River catchment in Central Queensland. It encompasses the sub-catchments of the Burdekin, Belyando, Bowen, Gregory and Cape rivers. It shows land use around the year 2004. The dataset is a product of the Queensland Land Use Mapping Program (QLUMP). It was prepared as part of a land-use change mapping project funded by the Natural Heritage Trust.

Map 7.2 Water resources

This map provides an overview of current water resources and water infrastructure.

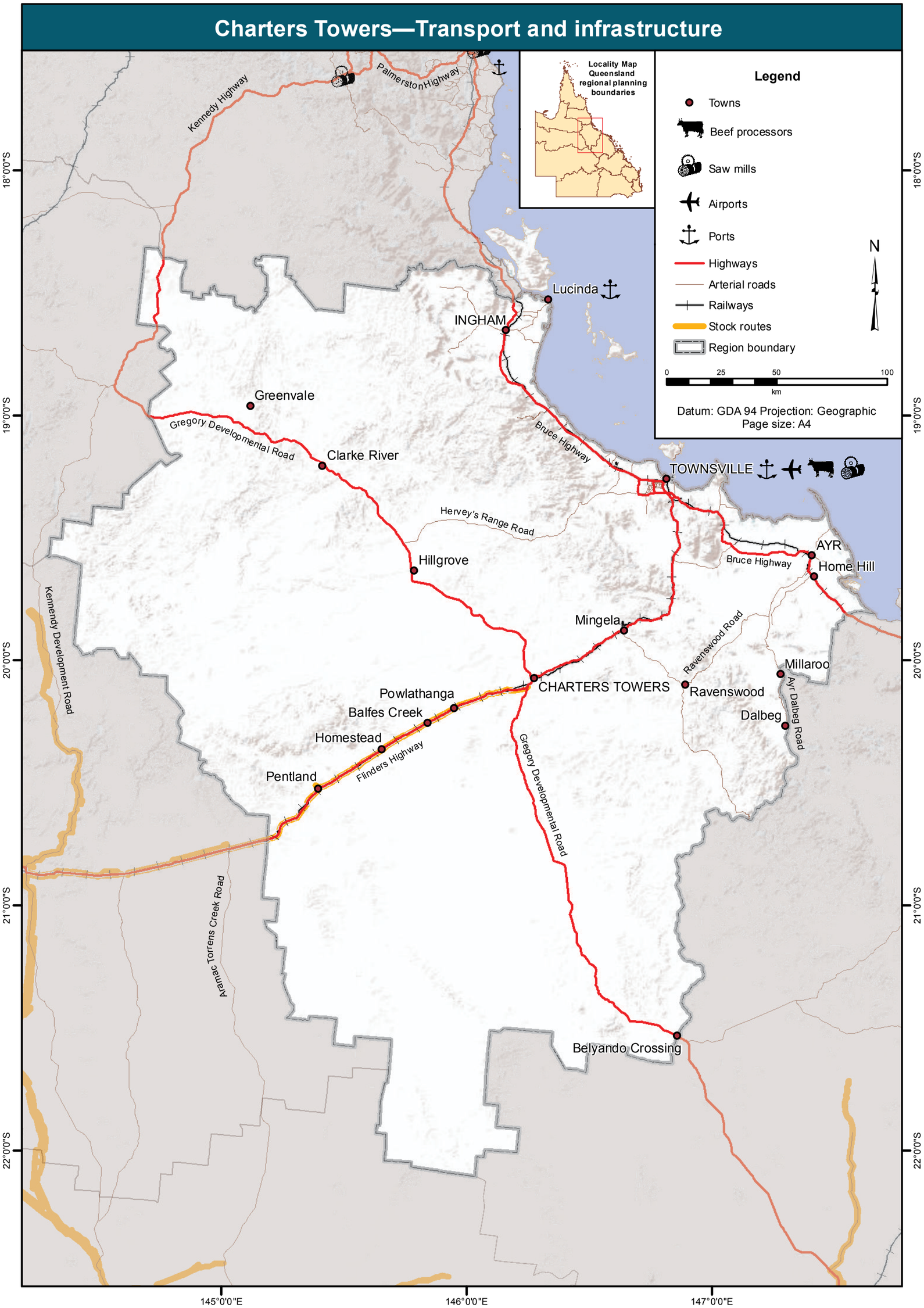
Charters Towers — Water resource planning



Map 7.3 Infrastructure

This map shows key infrastructure components, major agricultural processing plants and natural features relevant to current and future agricultural development within the region.

Charters Towers—Transport and infrastructure



Map 7.4 Vegetation management

This map shows land where, based on currently available information, agricultural use is potentially impacted by the provisions of the *Vegetation Management Act 1999* or associated Regulations protecting native vegetation. It has been compiled from information available to the audit at 28 September 2012 and reflects the legislative and policy regime in place at that time. The map shows areas where no clearing is permitted and areas where clearing requires further verification.

'Clearing requires further verification' can be split into two categories. Category A is where clearing for agriculture purposes may be constrained to varying levels under the Vegetation Management Act. These areas need further verification on the ground, depending on the types of activities taking place. Land that is category A has been denoted:

- high-value regrowth

or

- Schedule 4 Grassland regional ecosystem—homogeneous or heterogeneous polygons

or

- Schedule 5 Grasslands—heterogeneous polygons.

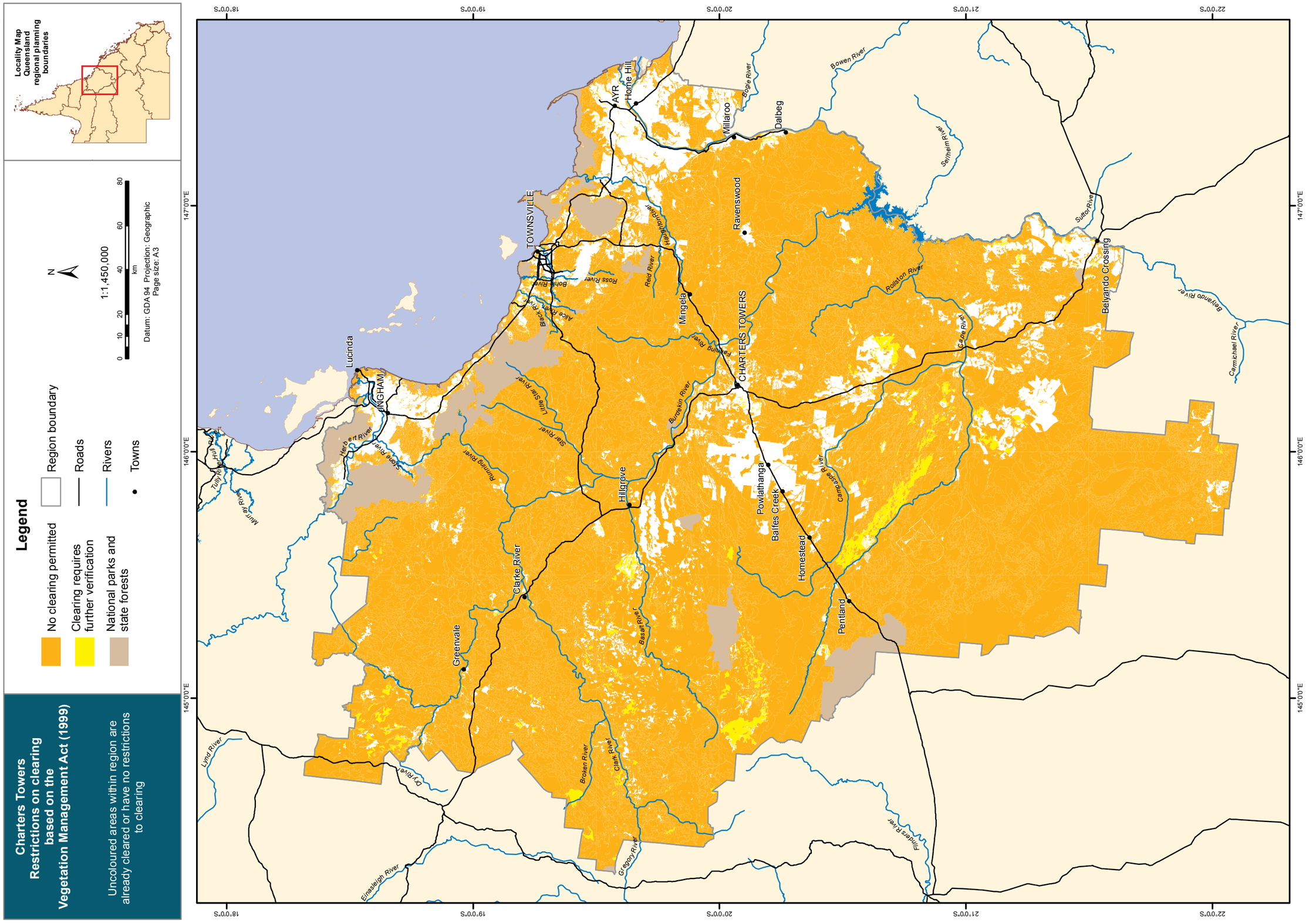
Category B indicates land for which regional ecosystems have not been reliably mapped. This land may or may not contain areas of regional ecosystems where clearing for agricultural purposes is constrained under the Vegetation Management Act. This land requires regional ecosystem mapping before its status can be confirmed. Land that is in this category has been denoted remnant vegetation on the 'remnant map' as per the description on the Department of Environment and Heritage Protection website at www.ehp.qld.gov.au (search 'remnant vegetation').

'No clearing permitted' identifies land for which clearing for agriculture purposes is constrained under the Vegetation Management Act. This land has been denoted:

- remnant vegetation other than Schedule 4 Grasslands on the regional ecosystem map

and

- category A or B on a PMAV.


Locality Map
Queensland
regional planning
boundaries
Legend
Region boundary
Roads
Rivers
Towns
No clearing permitted
Clearing requires
further verification
National parks and
state forests
Charters Towers
Restrictions on clearing
based on the
Vegetation Management Act (1999)
Uncoloured areas within region are
already cleared or have no restrictions
to clearing
N
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km
Datum: GDA 94 Projection: Geographic
Page size: A3
18°0'0"S
19°0'0"S
20°0'0"S
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22°0'0"S
145°0'0"E
146°0'0"E
147°0'0"E
TOWNSVILLE
AYR
Horse Hill
Millaroo
Dalbeg
Ravenswood
Mingela
CHARTERS TOWERS
Lucinda
INGHAM
Hillgrove
Powlathanga
Balfes Creek
Homestead
Pentland
Greenvale
Clarke River
Belyando Crossing
Bowen River
Sogie River
Suttor River
Ross River
Reid River
Haughton River
Alice River
Black River
Burdekin River
Running River
Star River
Cape River
Belyando River
Carmichael River
Broken River
Basalt River
Lynd River
Einasleigh River
Gregory River
Pitfalls River

Map 7.5 Current land use

This map shows the extent and distribution of land used for each of the agricultural land-use classes adopted by the audit. It has been produced mainly using data collected by QLUMP. QLUMP mapping has been generated using a combination of satellite image interpretation and ground validation. Its nominal scale is 1:100 000 and for this region it is current as at 2009. Visit www.derm.qld.gov.au (search 'QLUMP') for further information about QLUMP. Forestry plantations are mapped using data provided by ABARES and HQPlantations and state forest boundaries have been extracted from the Queensland Government tenure spatial layer.

Charters Towers
Current land use based on QLUMP data (2009) and other data sources for forestry (see explanatory notes)

Legend

- Current forestry plantations
- State forests
- Annual horticulture
- Perennial horticulture
- Cropping
- Irrigated cropping
- Grazing
- Intensive animal production
- Sugarcane
- Other land use
- Defence
- Nature conservation
- Mining
- Water
- Region boundary
- Roads
- Rivers
- Towns

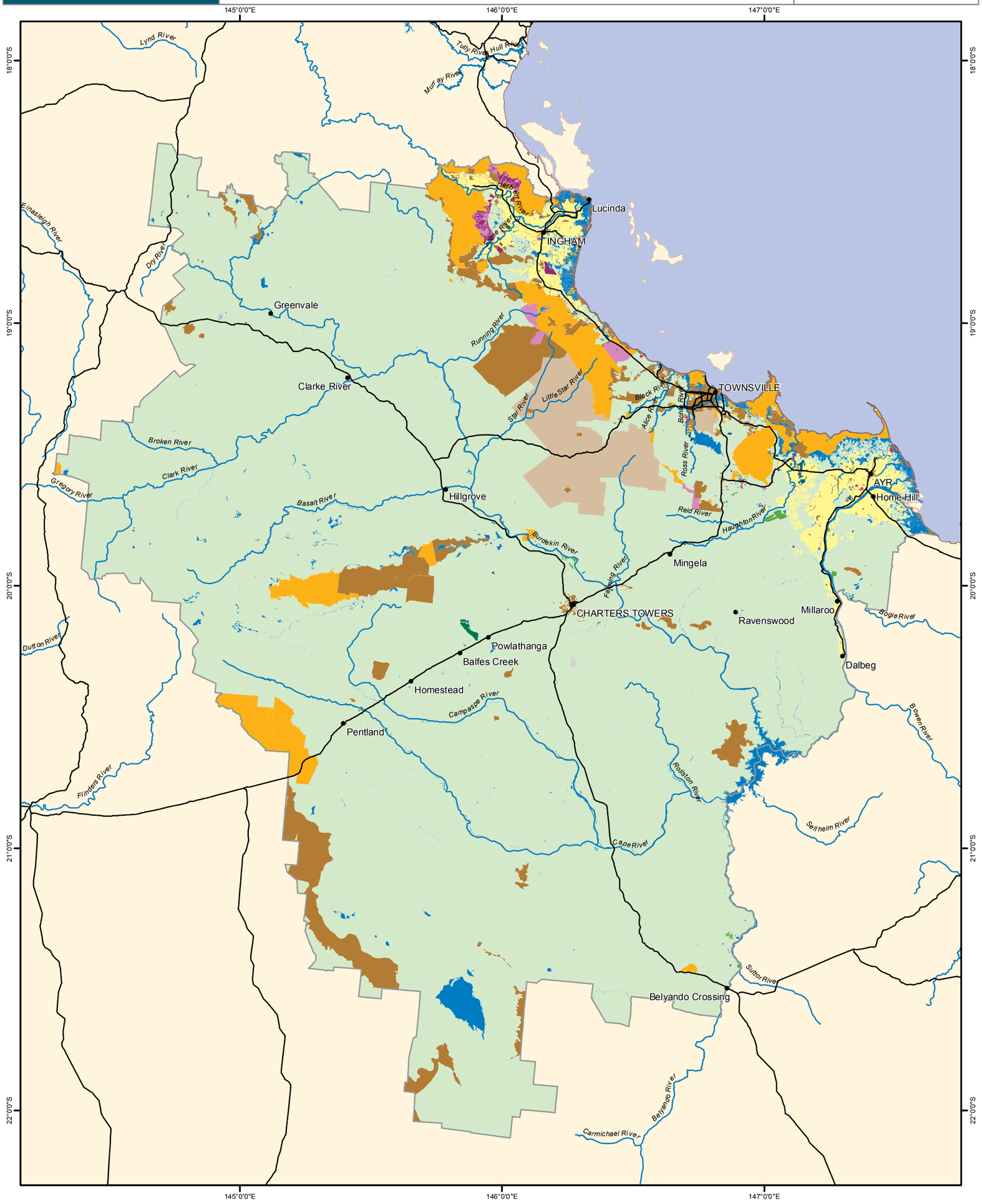
N

1:1,450,000

0 5 10 20 30 40
km

Datum: GDA 94 Projection: Geographic
Page size: A3

Locality Map
Queensland regional planning boundaries



Map 7.6 Important agricultural areas

This map shows the important agricultural areas identified by the audit within this region. An area is identified by the audit as being important for agriculture if it has all the requirements for agriculture to be successful and sustainable, is part of a critical mass of land with similar characteristics and is strategically significant to the region or the state. The areas shown on this map have been identified by the audit on the basis of advice from regional and industry experts and from synthesis of maps and information on current and potential use of land for the range of agricultural land uses considered by the audit. The information used to derive this map varies in its spatial accuracy and resolution. In recognition of these limitations, the information has been generalised for use in strategic decision-making at the regional level. It is indicative only of broad areas within which land important for agriculture is located. More detailed investigation to map the spatial extent and location of important land would be required before the information is suitable for finer scale decision-making such as in statutory land-use planning.

Charters Towers Important agricultural land areas

Legend

- Herbert River and Ingham area
- Lower Burdekin
- Areas excluded from potential (see explanatory notes)
- Region boundary
- Roads
- Rivers
- Towns

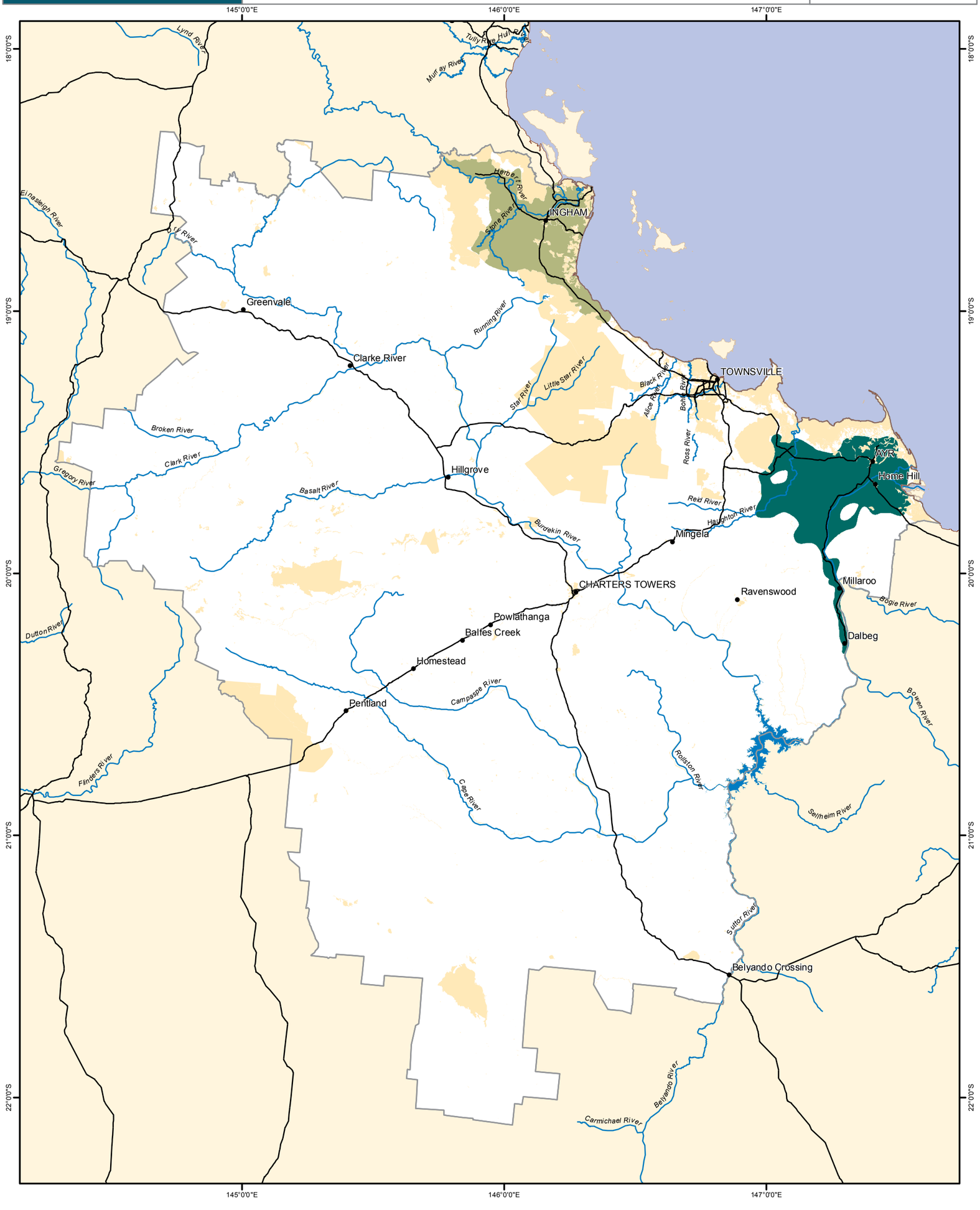
N

1:1,450,000

0 10 20 40 60 80
km

Datum: GDA 94 Projection: Geographic
Page size: A3

Locality Map
Queensland regional planning boundaries



Map 7.7 Broadacre cropping

This map shows land identified by the audit as currently being used for the agricultural land-use category 'broadacre cropping' (rain-fed or irrigated). It also shows land identified as not currently used for broadacre cropping but having potential to be used for this purpose. Land shown as currently being used for broadacre cropping has been identified on the basis that it was mapped by QLUMP as secondary class 'cropping' or 'irrigated cropping'.

Land shown as having potential for broadacre cropping:

a) **includes** land of agricultural land class (ALC) A with slope less than 8 per cent and mean annual rainfall greater than 450 mm for 7 out of 10 years

b) **excludes** land that is urban, intensive use (such as mining), national park, state forest, managed by the Department of Defence or permanently under water.

In identifying this land, the audit **did not consider** a range of business factors (such as markets, pre-existing land uses and competing potential land uses) that are important influences on management decisions made by producers who drive land use.

It should not be assumed from this study that all (or any particular portion of) land identified as having potential to be used for broadacre cropping should or will be converted to that use. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by constraints that have not been included as criteria in the mapping, for example the availability of water for irrigation (see Map 7.2). See Section 7.1 for further constraints.

Charters Towers
Biophysical potential for broadacre cropping and current broadacre cropping

Potential based on ALC 'A', slope <8%, rainfall >450mm 7 in 10 years

Legend

- Potential cropping
- Current cropping
- Current irrigated cropping
- Areas excluded from potential (see explanatory notes)
- Region boundary
- Cotton gins
- Roads
- Rivers
- Towns

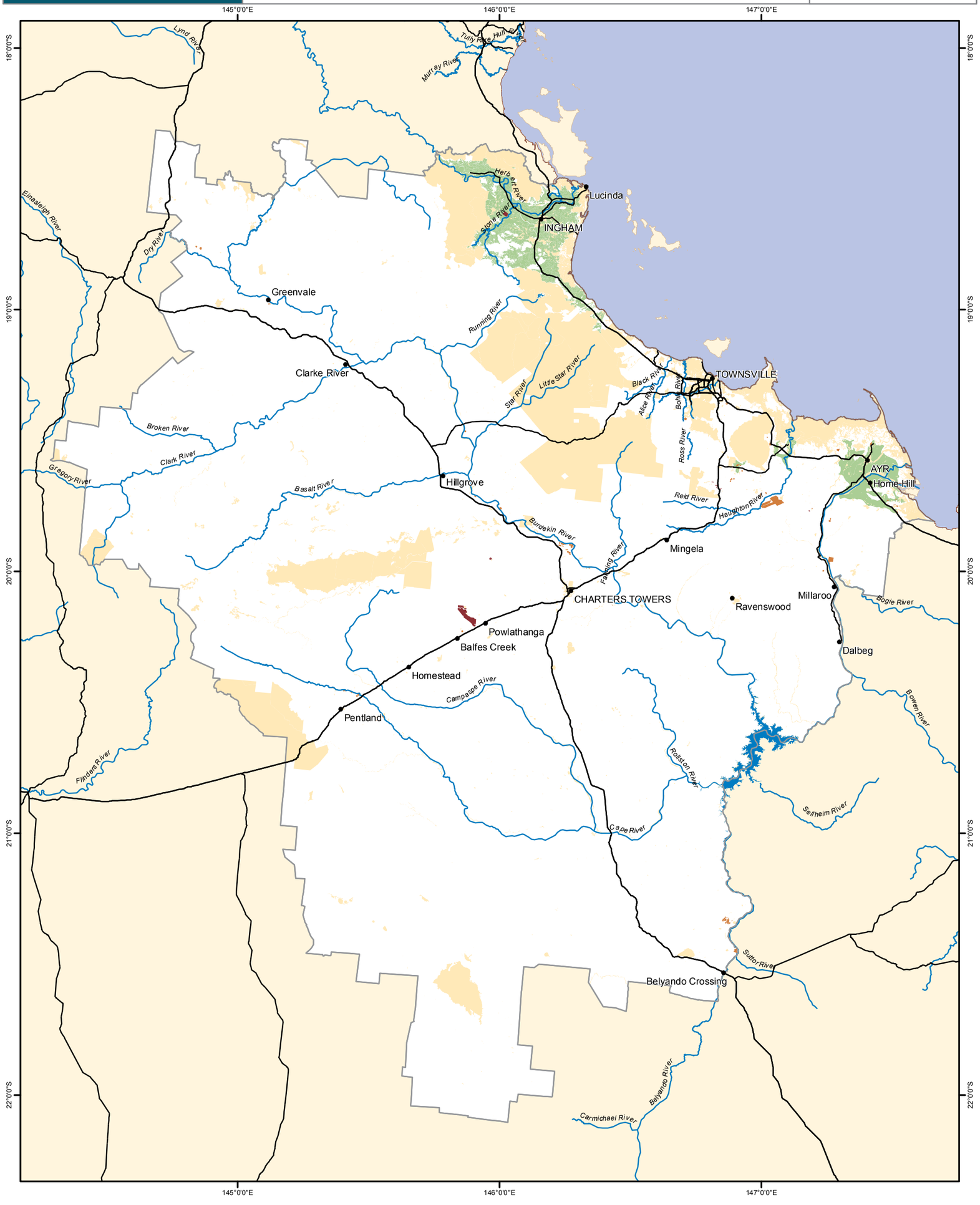
N

1:1,450,000

0 10 20 40 60 80
km

Datum: GDA 94 Projection: Geographic
Page size: A3

Locality Map
Queensland regional planning boundaries



Map 7.8 Sugarcane

This map shows land identified as not currently used for sugarcane cultivation but having potential to be used for this purpose. Land shown as currently being used for sugarcane cultivation has been identified on the basis that it was mapped by QLUMP as tertiary class 'sugarcane'.

Land shown as having potential for sugarcane cultivation:

a) **includes** land of agricultural land class A and class B with slope less than 5 per cent and fewer than 55 days per year with a minimum temperature of 9 °C or less

b) **excludes** land that is urban, intensive use (such as mining), national park, state forest, managed by the Department of Defence or permanently under water.

In identifying this land, the audit **did not consider** a range of business factors (such as markets, pre-existing land uses and competing potential land uses) that are important influences on management decisions made by producers who drive land use. These factors and how farmers respond to them are highly variable across space and through time. It was not possible to measure the effects of these factors with any confidence within the time and resources available to the audit.

Access to a sugar mill is an important consideration in determining the potential for land to be used for growing sugarcane. The locations of current mills are shown on the map for information.

It should not be assumed from this study that all (or any particular portion of) land identified as having potential to be used for sugarcane cultivation should or will be converted to that use. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by constraints that have not been included as criteria in the mapping, for example the availability of water for irrigation (see Map 7.2). See Section 7.1 for further constraints.

Charters Towers
Biophysical potential for sugarcane and current sugarcane

Potential based on ALC 'A' and 'B', slope <5%, <55 days per year where minimum temperature ≤9˚C

Legend

- Potential sugarcane
- Current sugarcane production
- Areas excluded from potential (see explanatory notes)
- Region boundary
- Sugar mills
- Sugarcane rail
- Roads
- Rivers
- Towns

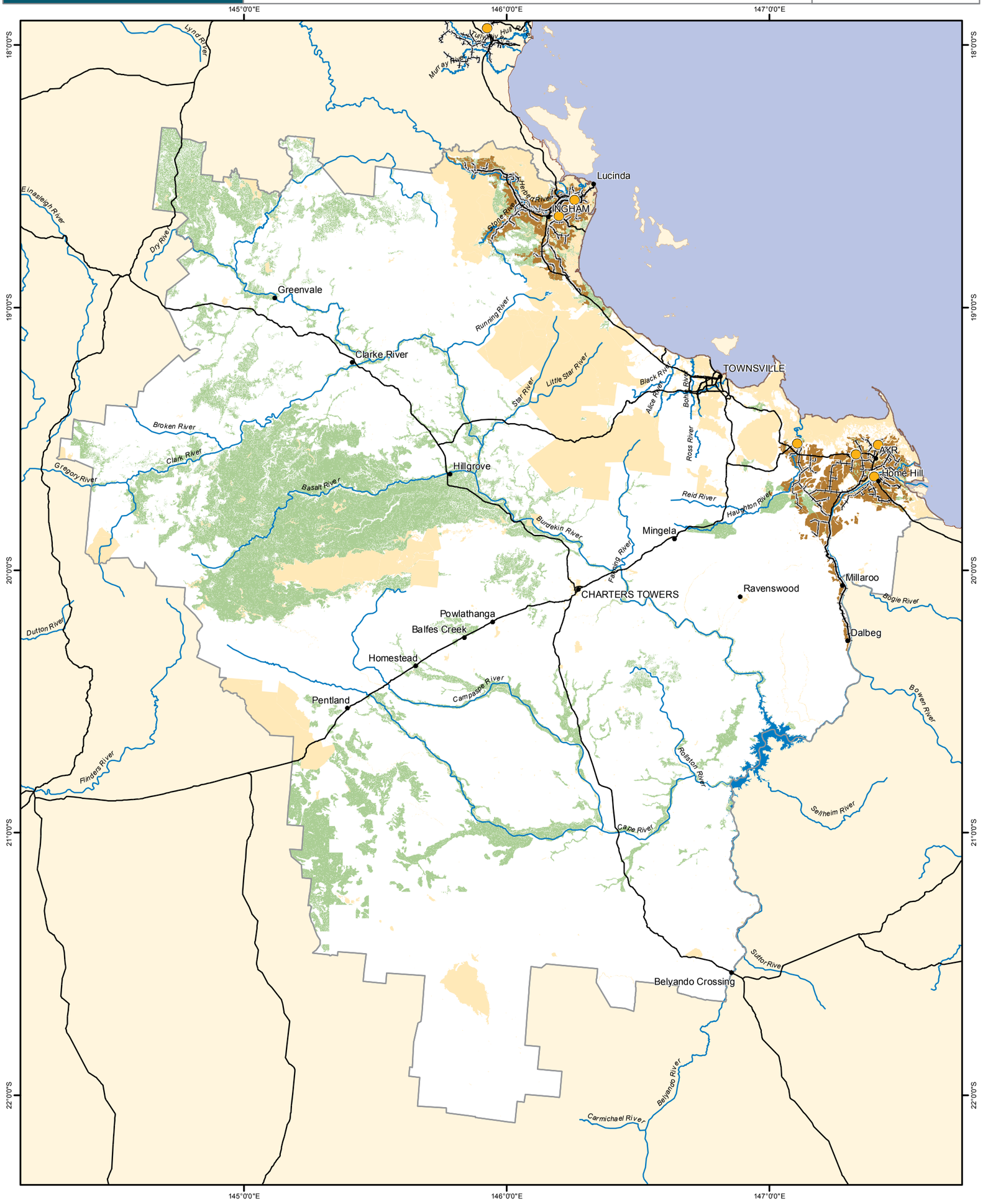
N

1:1,450,000

0 10 20 40 60 80
km

Datum: GDA 94 Projection: Geographic
Page size: A3

Locality Map
Queensland regional planning boundaries



Map 7.9 Annual horticulture

This map shows land identified by the audit as currently being used for the agricultural land-use category 'annual horticulture'. It also shows land identified as not currently used for annual horticulture but having potential to be used for this purpose. Land shown as currently being used for annual horticulture has been identified on the basis that it was mapped by QLUMP as 'seasonal horticulture', 'irrigated seasonal horticulture' or 'intensive horticulture'.

Land shown as having potential for annual horticulture:

a) **includes** land of agricultural land class A and class B with slope less than 8 per cent and April to October rainfall less than 500 mm

b) **excludes** land that is urban, intensive use (such as mining), national park, state forest, managed by the Department of Defence or permanently under water.

In identifying this land, the audit **did not consider** a range of business factors (such as markets, pre-existing land uses and competing potential land uses) that are important influences on management decisions made by producers who drive land use. These factors and how farmers respond to them are highly variable across space and through time. It was not possible to measure the effects of these factors with any confidence within the time and resources available to the audit.

Also, the audit **did not consider** temperature or flood risk. Temperature is a major determinant of suitability of land for horticulture. It affects whether a crop can grow and its performance. However, due to the large range of different horticultural crops grown in Queensland and the widely variable temperature requirements for these crops, it is not possible to determine meaningful criteria for temperature for the category 'annual horticulture'. Flood risk is similarly difficult to map. Reliable data on flood frequency and severity currently exists for comparatively few parts of the state and the extent to which agricultural land use and management are affected by flooding varies greatly from farmer to farmer depending on their individual circumstances and perceptions.

Availability of labour, especially during harvest season, is an important consideration in selecting suitable land for many forms of annual horticulture. To reflect this, areas that are within 50 km of a centre with a population of 2000 or more are highlighted on the map. However, labour is not always a critical factor (e.g. for crops that are mechanically harvested) and the size and proximity of the nearest population centre is not always the best surrogate for labour force availability (e.g. many horticultural businesses make extensive use of itinerant seasonal workers or backpackers).

It should not be assumed from this study that all (or any particular portion of) land identified as having potential to be used for annual horticulture should or will be converted to that use. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by constraints that have not been included as criteria in the mapping, for example the availability of water for irrigation (see Map 7.2). See Section 7.1 for further constraints.

Charters Towers
Biophysical potential for annual horticulture and current annual horticulture

Potential based on ALC 'A' and 'B', slope <8%,
April - October rainfall <500mm

Legend

- Potential annual horticulture
- Current annual horticulture (not to scale)
- Areas excluded from potential (see explanatory notes)
- Region boundary
- 50km from a population >2000
- Roads
- Rivers
- Towns

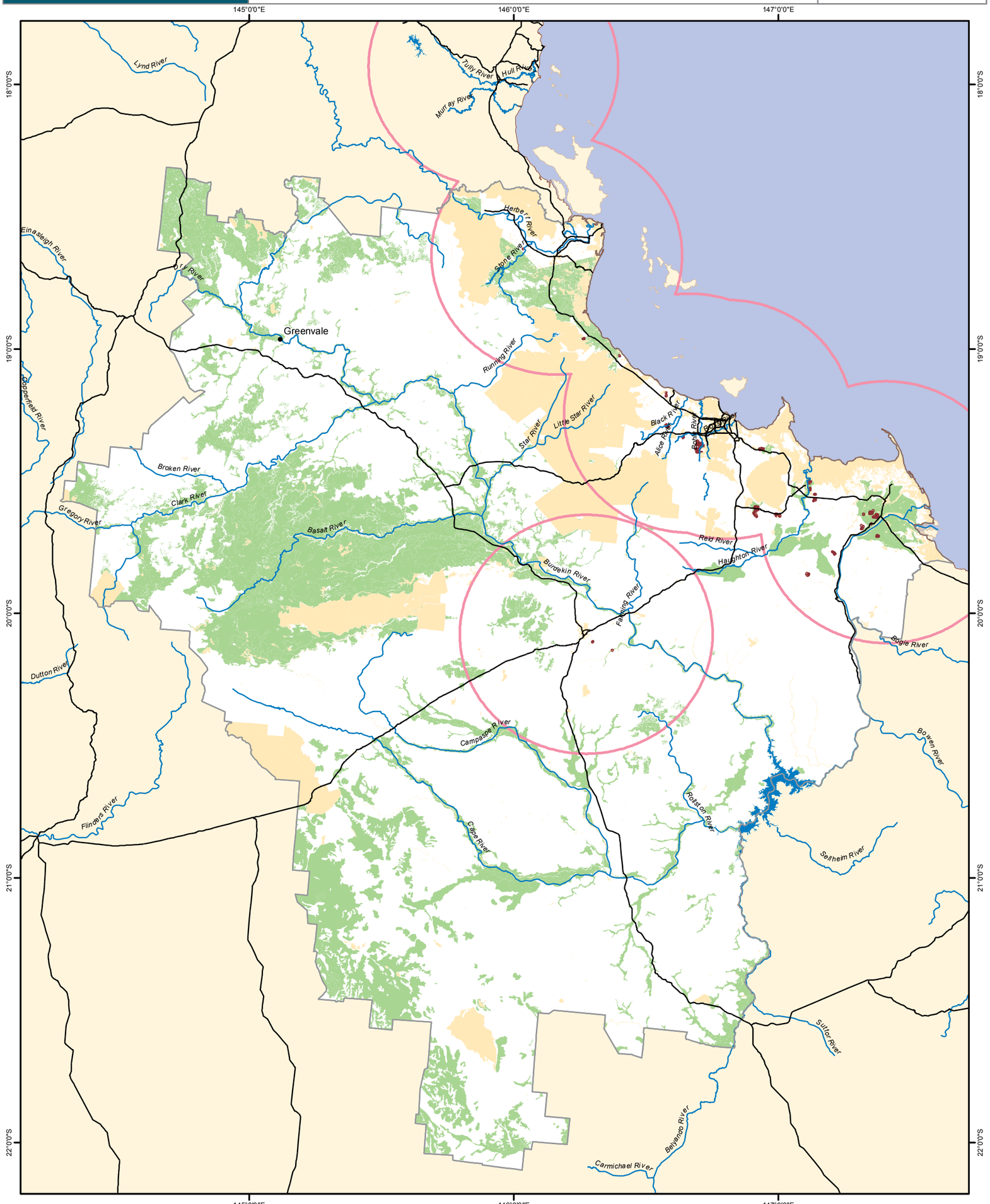
N

1:1,450,000

0 10 20 40 60 80
km

Datum: GDA 94 Projection: Geographic
Page size: A3

Locality Map
Queensland regional planning boundaries



Map 7.10 Perennial horticulture

This map shows land identified by the audit as currently being used for the agricultural land-use category 'perennial horticulture' (rain-fed or irrigated). It also shows land identified as not currently used for perennial horticulture but having potential to be used for that purpose. Land shown as currently being used for perennial horticulture has been identified on the basis that it was mapped by QLUMP as 'perennial horticulture' or 'irrigated perennial horticulture'.

Land shown as having potential for perennial horticulture:

a) **includes** land of agricultural land class A and class B with slope less than 15 per cent and April to October rainfall less than 500 mm

b) **excludes** land that is urban, intensive use (such as mining), national park, state forest, managed by the Department of Defence or permanently under water and land that has cracking clay soils.

In identifying this land, the audit **did not consider** a range of business factors (such as markets, pre-existing land uses and competing potential land uses) that are important influences on management decisions made by producers who drive land use These factors and how farmers respond to them are highly variable across space and through time. It was not possible to measure the effects of these factors with any confidence within the time and resources available to the audit.

Also, the audit **did not consider** temperature or flood risk. Temperature is a major determinant of suitability of land for horticulture. It affects whether a crop can grow and its performance. However, due to the large range of different horticultural crops grown in Queensland and the widely variable temperature requirements for these crops, it is not possible to determine meaningful criteria for temperature for the category 'perennial horticulture'. In addition, the inability to map microclimates at the appropriate scale means that temperature cannot be included in the criteria. Flood risk is similarly difficult to map. Reliable data on flood frequency and severity currently exists for comparatively few parts of the state and the extent to which agricultural land use and management are affected by flooding varies greatly from farmer to farmer depending on their individual circumstances and perceptions.

Availability of labour, especially during harvest season, is an important consideration in selecting suitable land for many forms of perennial horticulture. To reflect this, areas that are within 50 km of a centre with a population of 2000 or more are highlighted on the map. However, labour is not always a critical factor (e.g. for crops that are mechanically harvested) and the size and proximity of the nearest population centre is not always the best surrogate for labour force availability (e.g. many horticultural businesses make extensive use of itinerant seasonal workers or backpackers).

It should not be assumed from this study that all (or any particular portion of) land identified as having potential to be used for perennial horticulture will be converted to that use. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by constraints that have not been included as criteria in the mapping, for example the availability of water for irrigation (see Map 7.2). See Section 7.1 for further constraints.

Charters Towers
Biophysical potential for perennial horticulture and current perennial horticulture

Potential based on ALC 'A' and 'B', slope <15%, April - October rainfall <500mm, no cracking clays

Legend

- Potential perennial horticulture
- Current perennial horticulture (not to scale)
- Areas excluded from potential (see explanatory notes)
- Region boundary
- 50km from a population >2000
- Roads
- Rivers

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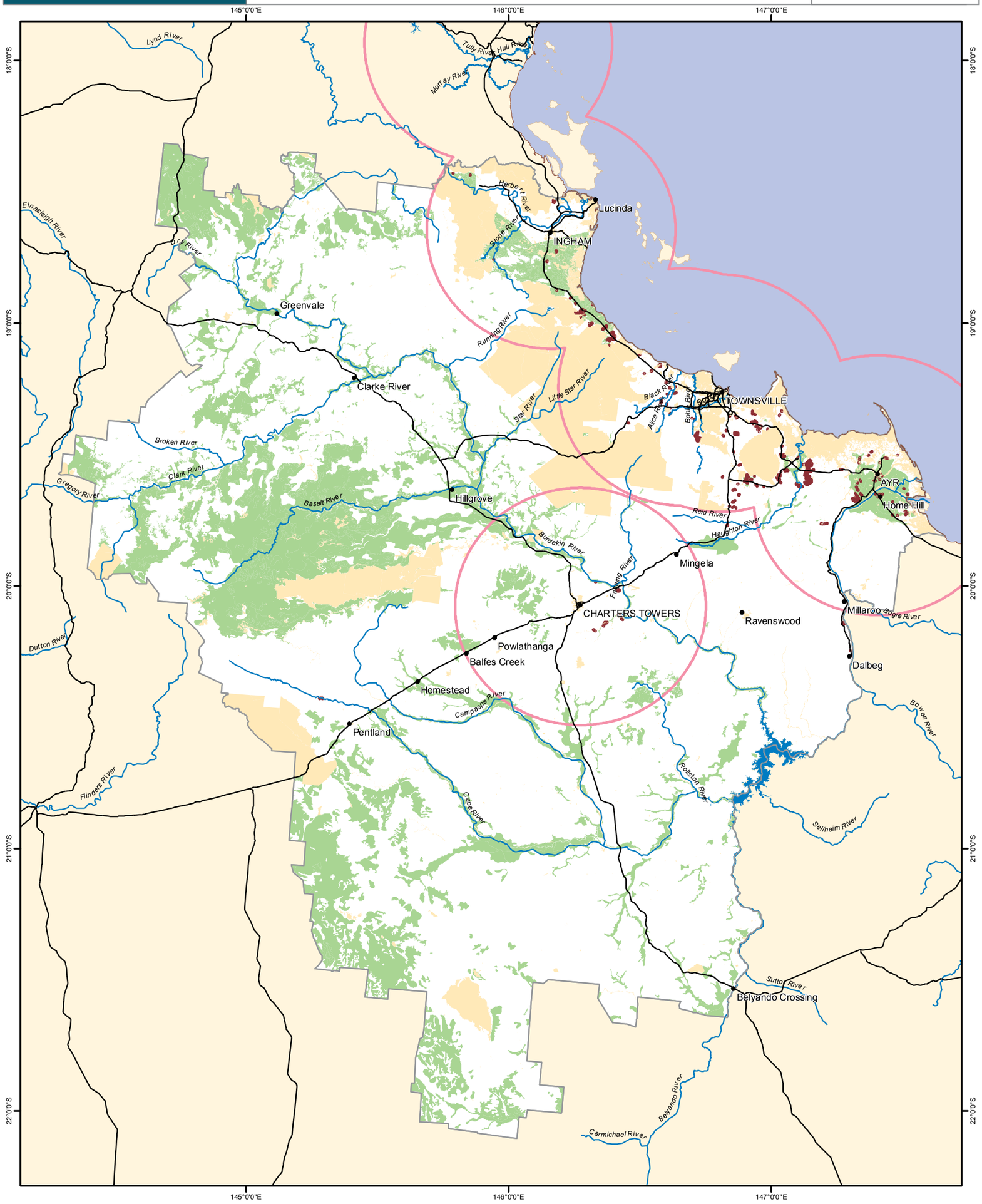
km

Datum: GDA 94 Projection: Geographic
Page size: A3

Locality Map
Queensland regional planning boundaries



Map 7.11 Intensive livestock

This map shows land identified by the audit as currently being used for the agricultural land-use category 'intensive animal industries' (feedlot cattle and pigs). It also shows land identified as not currently being used for intensive animal industries but having potential to be used for that purpose. Land shown as currently being used for intensive animal industries has been identified on the basis that it is listed in the database of the Department of Agriculture, Fisheries and Forestry (Queensland) Intensive Livestock Environmental Regulation Unit. Cattle feedlots are only included where they have a capacity greater than 150 head. Individual intensive animal enterprises are smaller in area than enterprises involved in other agricultural land-use categories and most intensive animal enterprises would not be visible when represented to scale on audit maps. Because of this, the spatial extent of each current intensive animal enterprise is not shown; instead, each enterprise is mapped using a symbol centred on the centroid of the property.

Major beef abattoirs are shown on the map for information. Their locations have not been used in the analysis to identify land with potential for intensive beef industries as the location of many other smaller-scale abattoirs or country butchers that process animals was not available and therefore it could not be determined where access to processing was a constraint on potential intensive animal production.

Land shown as having potential for intensive animal industries:

a) **includes** land of agricultural land class A and class B (and class C1 where it is within 10 km of current cropping) with slope less than or equal to 8 per cent

b) **excludes** land that is urban, intensive use (such as mining), national park, state forest, managed by the Department of Defence or permanently under water.

In identifying this land, the audit **did not consider** a range of business factors (such as markets, pre-existing land uses and competing potential land uses) that are important influences on management decisions made by producers who drive land use. These factors and how farmers respond to them are highly variable across space and through time. It was not possible to measure the effects of these factors with any confidence within the time and resources available to the audit.

It should not be assumed from this study that all (or any particular portion of) land identified as having potential to be used for intensive animal industries should or will be converted to that use. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by constraints that have not been included as criteria in the mapping, for example the availability of water (see Map 7.2) and natural resource regulations such as those for vegetation management.

Aquaculture—current and potential

This map shows land identified by the audit as currently being used for the agricultural land-use category 'aquaculture'. It also shows land identified as not currently used for aquaculture but having potential to be used for that purpose. Land shown as currently being used for aquaculture has been identified on the basis that it was mapped by QLUMP as the tertiary class 'aquaculture'. Individual aquaculture enterprises are smaller in area than enterprises involved in other agricultural land-use categories and most aquaculture enterprises would not be visible when represented to scale on audit maps. Because of this, the spatial extent of each current aquaculture enterprise is not shown; instead, each enterprise is mapped using a symbol centred on the centroid of the property.

Land shown as having potential for aquaculture:

a) **includes** land that is within 2 km of an estuarine water source, is above the highest astronomical tide and has an elevation less than 10 m, slope less than 5 per cent and clay content greater than 20 per cent

b) **excludes** land that is urban, intensive use (such as mining), national park, state forest, managed by the Department of Defence, permanently under water, fish habitat area, of high ecological significance or mapped as containing acid sulfate soils.

In identifying this land, the audit **did not consider** a range of business factors (such as markets, pre-existing land uses and competing potential land uses) that are important influences on management decisions made by producers who drive land use. These factors and how farmers respond to them are highly variable across space and through time. It was not possible to measure the effects of these factors with any confidence within the time and resources available to the audit.

The map also shows areas where there are vulnerable groundwater systems. Contamination of groundwater systems is an important consideration in selecting sites for aquaculture enterprises. However, mapping of groundwater vulnerability in Queensland is relatively coarse and a range of measures can be used to mitigate this risk. Therefore the occurrence of vulnerable groundwater is not included in the criteria for mapping potential for aquaculture but is shown on the map for information.

It should not be assumed from this study that all (or any particular portion of) land identified as having potential to be used for aquaculture should or will be converted to that use. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by constraints that have not been included as criteria in the mapping, for example the availability of water for irrigation (see Map 7.2). See Section 7.1 for further constraints.

Charters Towers
Biophysical potential for cattle feedlots, piggeries and marine aquaculture and current intensive animal production and aquaculture

Feedlots and piggeries potential: 'A' + 'B' class land + 'C1' class land within 10km of current cropping, slope ≤8%

Marine aquaculture potential: within 2km of estuarine water source, above HAT, <10m elevation, soil >20% clay content

Legend

- Potential feedlot and piggeries area
- Beef processors
- Current cattle feedlots (over 150 head)
- Current egg producers
- Current piggeries
- Current aquaculture sites
- Potential marine aquaculture area
- Areas excluded from potential (see explanatory notes)
- Region boundary
- Roads
- Rivers
- Towns

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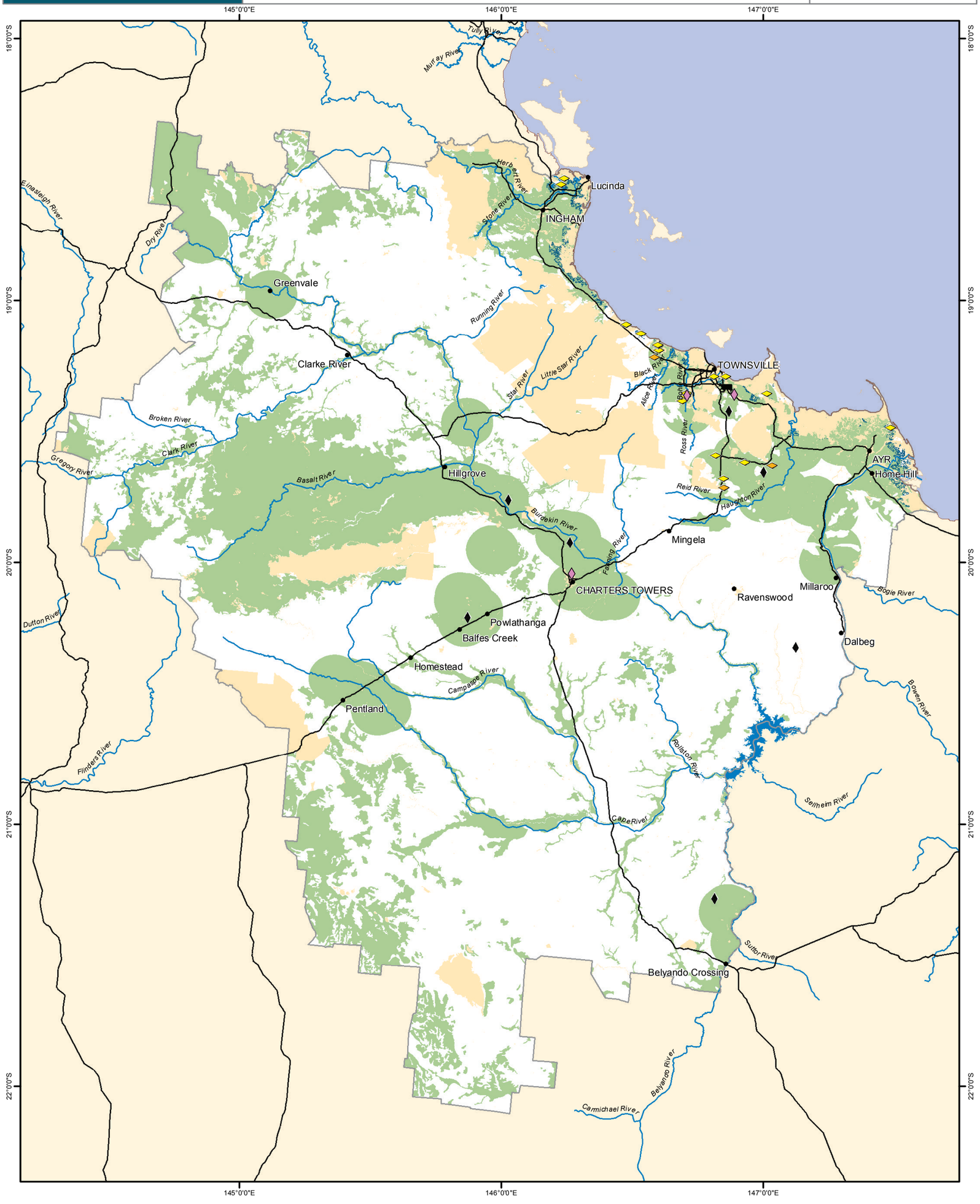
0 10 20 40 60 80
km

Datum: GDA 94 Projection: Geographic
Page size: A3

Locality Map
Queensland regional planning boundaries



Map 7.12 Current pasture production (land condition B)

This map shows the current pasture biomass production that was modelled by the audit. For the purpose of this modelling, the land was assumed to be in fair condition (grazing land management (GLM) class B).

Current modelled pasture biomass production of land:

a) is **calculated** using the GRASP model of pasture biomass production (www.longpaddock.qld.gov.au—search 'GRASP') parameterised for each GLM land type (http://futurebeef.com.au) and discounted according to the amount of existing tree basal area on the land (as mapped by SLATS) and with pasture condition set to B (http://futurebeef.com.au)

b) **excludes** production from land that is urban, intensive use (such as mining), national park, managed by the Department of Defence or permanently under water.

In modelling this production, the audit **did not consider** a range of business factors (such as markets, pre-existing land uses or competing potential land uses) that are important influences on management decisions made by producers who drive land use. These factors and how farmers respond to them are highly variable across space and through time. It was not possible to measure the effects of these factors with any confidence within the time and resources available to the audit.

It should not be assumed from this study that the current modelled pasture biomass production of all land (or any particular portion of land) will be achieved. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by natural resource regulations such as those for vegetation management.

Charters Towers
Current yearly pasture production (long term average)

GRASP model, modified by tree basal area and land condition (B)

Legend

Yearly pasture production (long term average)
(Dry matter yearly growth in kg/ha)

- High >3500
- Medium 1500-3500
- Low <1500

- Areas excluded from potential (see explanatory notes)
- Region boundary
- Roads
- Rivers
- Towns

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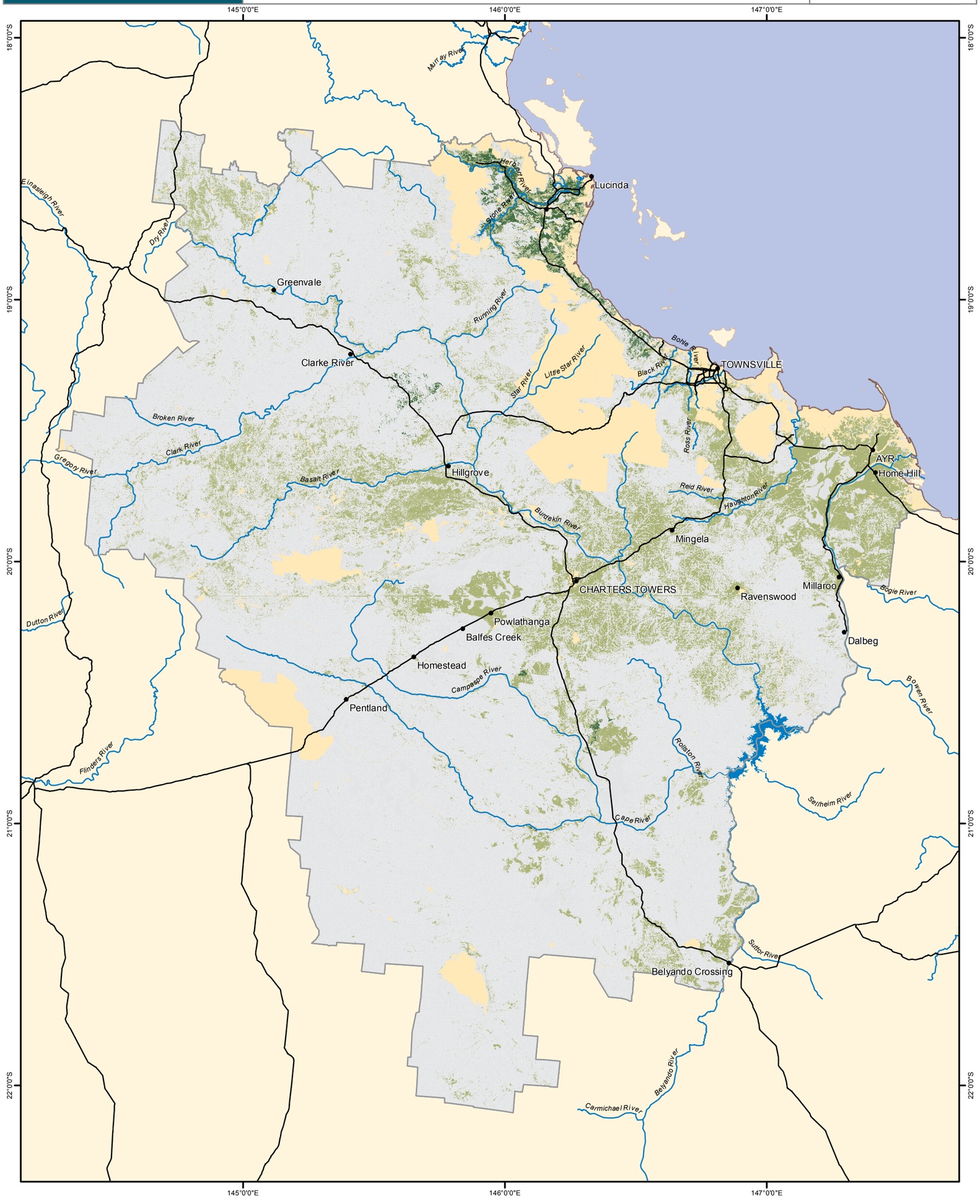
0 10 20 40 60 80
km

Datum: GDA 94 Projection: Geographic
Page size: A3

Locality Map
Queensland regional planning boundaries



Map 7.13 Potential pasture production (land condition A)

This map shows the potential pasture biomass production that was modelled by the audit. For the purpose of this modelling, the land was assumed to be in good condition (GLM class A).

Potential modelled pasture biomass production of land:

a) is **calculated** using the GRASP model of pasture biomass production (www.longpaddock.qld.gov.au—search 'GRASP') paramaterised for each GLM land type (http://futurebeef.com.au) and discounted according to the amount of existing tree basal area on the land (as mapped by SLATS) and with pasture condition set to A (http://futurebeef.com.au)

b) **excludes** production from land that is urban, intensive use (such as mining), national park, managed by the Department of Defence or permanently under water.

In modelling this production, the audit **did not consider** a range of business factors (such as markets, pre-existing land uses and competing potential land uses) that are important influences on management decisions made by producers who drive land use. These factors and how farmers respond to them are highly variable across space and through time. It was not possible to measure the effects of these factors with any confidence within the time and resources available to the audit.

It should not be assumed from this study that the potential modelled pasture biomass production of all land (or any particular portion of land) will be achieved. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by natural resource regulations such as vegetation management.

Charters Towers
Potential yearly pasture production (long term average)

GRASP model, modified by tree basal area and land condition (A)

Legend

Yearly pasture production (long term average)
(Dry matter yearly growth in kg/ha)

- High >3500
- Medium 1500-3500
- Low <1500

- Areas excluded from potential (see explanatory notes)
- Region boundary
- Roads
- Rivers
- Towns

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km

Datum: GDA 94 Projection: Geographic
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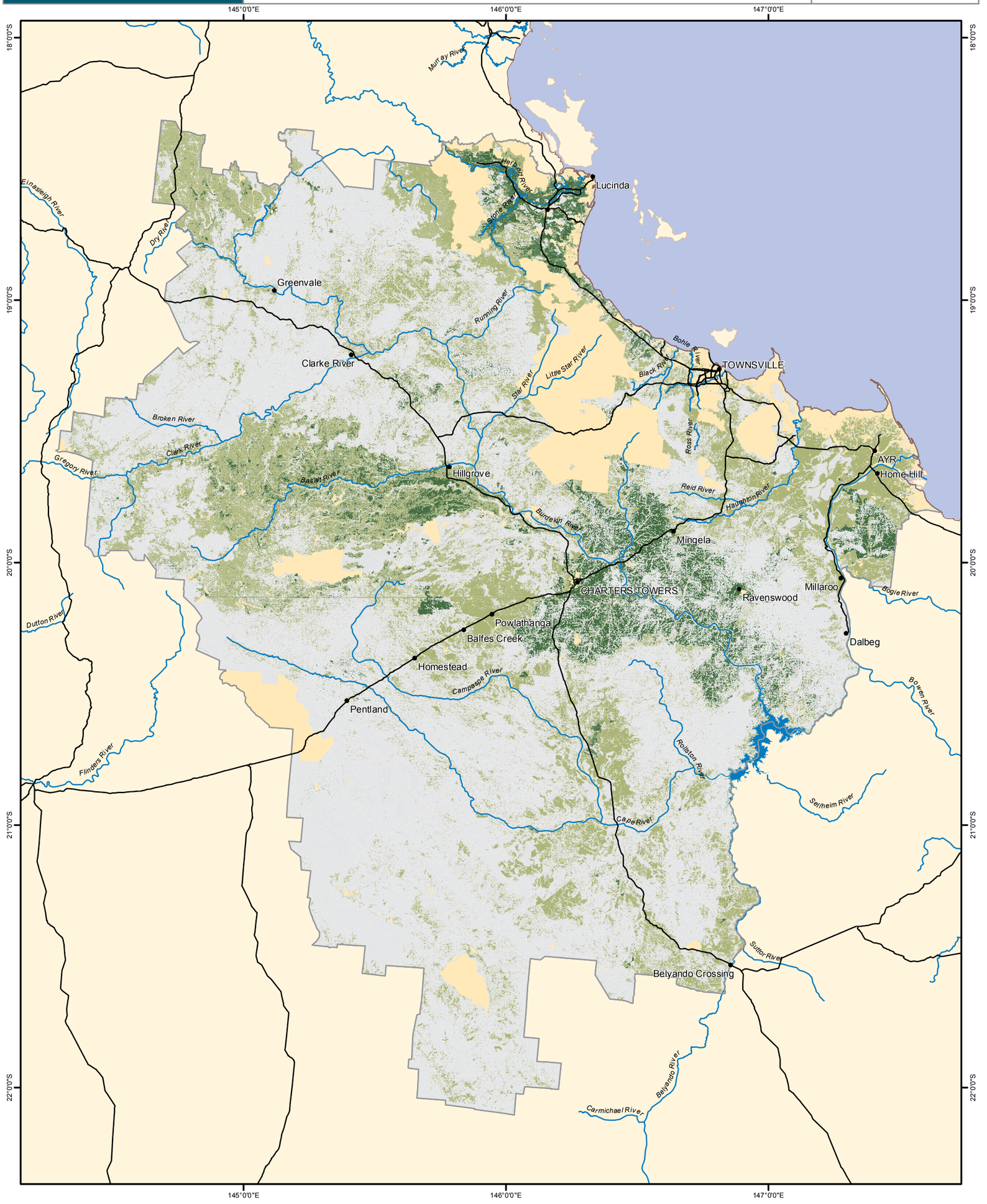
Locality Map
Queensland regional planning boundaries



Map 7.14 Sown pastures

This map shows land identified by the audit as currently sown to pasture grasses. It also shows land identified as not currently sown to pasture grasses but having potential to be used for that purpose. For the purpose of the audit, sowing of pastures is considered to be the deliberate introduction of pasture grass varieties and species. It includes distribution of pasture grass seed preceded by cultivation or other management actions (such as fire) to create conditions conducive to successful establishment of the introduced grasses. It does not include naturalised introduction of exotic grasses without deliberate management or the supplementation of native grass pastures with introduced legumes. It is not possible with the data and tools available to the audit to map the occurrence of these supplemented pastures.

Land shown as currently sown to pasture has been identified using the approach outlined by Peck et al. (2010). This is land that currently has no (or very little) tree cover, has a mean annual rainfall greater than 500 mm and is of a GLM land type (http://futurebeef.com.au) that is considered to be suitable for pasture improvement. Land that is urban, intensive use (such as mining), national park, managed by the Department of Defence, permanently under water or currently cropped is **excluded**.

Land shown as having potential to be used for sown pastures:

a) **includes** land of a GLM land type that is considered to be suitable for establishing and maintaining sown pasture but currently has trees on it

b) **excludes** land that is urban, intensive use (such as mining), national park, managed by the Department of Defence or permanently under water.

In identifying this land, the audit **did not consider** a range of business factors (such as markets, pre-existing land uses or competing potential land uses) that are important influences on management decisions made by producers who drive land use. These factors and how farmers respond to them are highly variable across space and through time. It was not possible to measure the effects of these factors with any confidence within the time and resources available to the audit.

It should not be assumed from this study that all (or any particular portion of) land identified as having potential to support improved pastures will or should be converted to that use. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by constraints that have not been included as criteria in the mapping, for example natural resource regulations relating to vegetation management.

Charters Towers
Areas suitable for sown grass species and areas predicted to have sown grass species established

Legend

- Sown grasses present in a significant density
- Potential for broadscale introduction of sown grass species
- Low potential for broadscale introduction of sown grass species
- Areas excluded from potential (see explanatory notes)
- Region boundary
- Roads
- Rivers
- Towns

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km

Datum: GDA 94 Projection: Geographic
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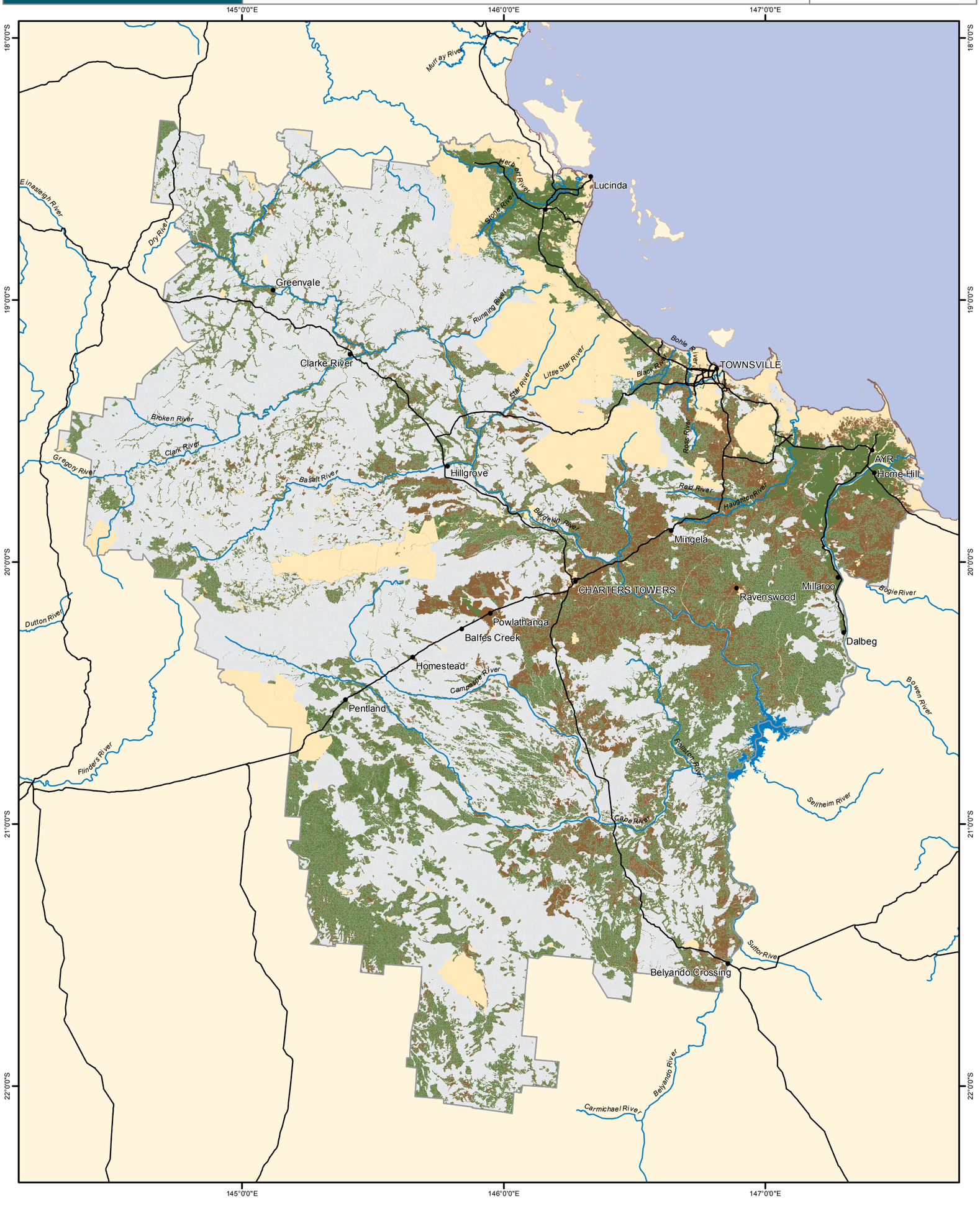
Locality Map
Queensland regional planning boundaries



Map 7.15 Native forestry

This map shows land identified by the audit as currently being used for production of sawlogs and/or other timber products from native forestry. This land has been identified on the basis that it is either freehold land that is covered by a forest practice notification under the *Vegetation Management Act 1999* or is state-owned land over which the Queensland Government has a timber interest (as indicated by it being covered by a Department of Agriculture, Fisheries and Forestry (Queensland) Forestry Division MUID).

The map also shows land identified as not currently being used for production of sawlogs and/or other timber products from native forestry but having potential to be used for that purpose.

For land to be rated by the audit as having potential for sawlog as well as non-sawlog timber production, it must also be a regional ecosystem that contains species (as listed in the REDD description) known to produce commercial sawlogs. For land to be listed as high potential for sawlog production, the canopy top height for that regional ecosystem must also exceed the threshold determined by the audit as indicating high-productivity site conditions for production of sawlogs of that type.

Land shown as having potential for native forestry:

a) **includes** land that is mapped as currently having a woody vegetation canopy of greater than 15 per cent (SLATS foliage projective cover)
b) **excludes** land that is cleared of forest, urban, intensive use (such as mining), national park, managed by the Department of Defence or permanently under water.

In identifying this land, the audit **did not consider** a range of business factors (such as markets, pre-existing land uses and competing potential land uses) that are important influences on management decisions made by producers who drive land use. These factors and how farmers respond to them are highly variable across space and through time. It was not possible to measure the effects of these factors with any confidence within the time and resources available to the audit.

Access to processing facilities can also be a major consideration in determining the potential for land to be used for native forestry. However, it was not possible in this analysis to determine with any confidence what the critical threshold distances are. Therefore, while the locations of existing sawmills are shown on the map as a general guide to those interested in considering this factor, distance from sawmills has not been included in the analysis.

It should not be assumed from this study that all (or any particular portion of) land identified as having potential to be used for native forestry should or will be converted to that use. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by natural resource regulations such as those for vegetation management.

Charters Towers Biophysical potential for native forestry and current native forestry

Potential based on commercial tree species, tree height, FPC>15%

Legend

- High potential for sawlog and non-sawlog products
- Potential for sawlog and non-sawlog timber products
- Potential for non-sawlog timber products only
- Forest practice notifications on private land (Vegetation Management Act 1999)
- State owned land timber interests (Forestry Act 1959)
- Areas excluded from potential (see explanatory notes)
- Region boundary
- Saw mills for native timber (within 100km of region)
- Roads
- Rivers
- Towns

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Datum: GDA 94 Projection: Geographic
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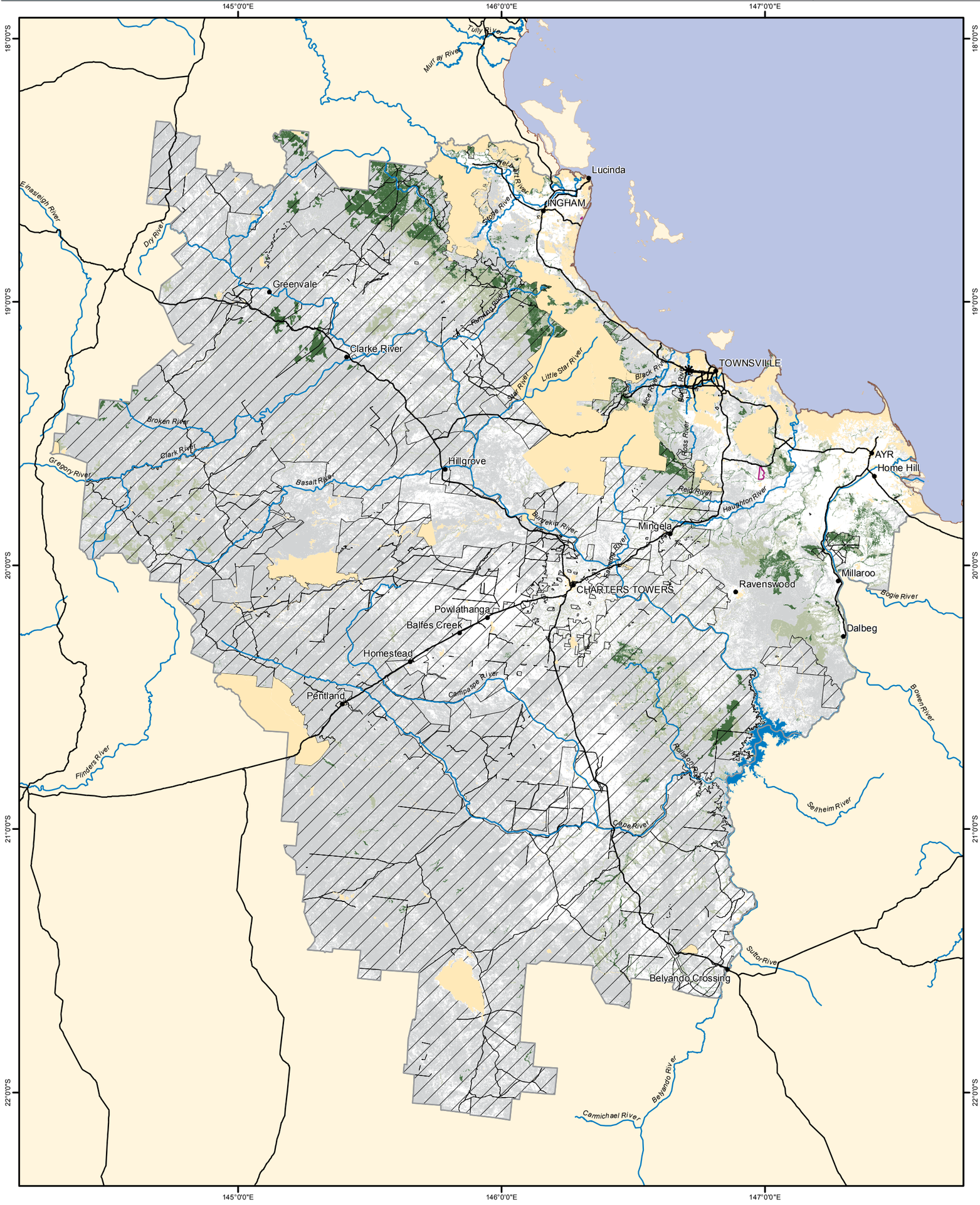
Locality Map
Queensland regional planning boundaries



Map 7.16 Plantation forestry

This map shows the land identified by the audit as currently being used for the agricultural land-use category 'plantation forestry'. It also shows land identified as not currently used for plantation forestry but having potential to be used for this purpose. Land shown as currently being used for plantation forestry has been identified from mapping provided by HQPlantations, ABARES and FEA Holdings. Areas represented in this mapping have been classified as either hardwood or softwood by experts with local knowledge.

Land shown as having potential for plantation forestry:

a) **includes** land of agricultural land class A, class B and class C1 (as well as class C2 and class C3 for softwoods) that has slope less than 25 per cent and rainfall greater than 700 mm (or 800 mm for softwood) for 7 out of 10 years

b) **excludes** land that is urban, intensive use (such as mining), national park, managed by the Department of Defence or permanently under water as well as land that has cracking clay soils.

In identifying this land, the audit **did not consider** a range of business factors (such as markets, pre-existing land uses and competing potential land uses) that are important influences on management decisions made by producers who drive land use. These factors and how farmers respond to them are highly variable across space and through time. It was not possible to measure the effects of these factors with any confidence within the time and resources available to the audit.

Access to processing facilities can also be a major consideration in determining the potential for land to be used for plantation forestry. However, it was not possible in this analysis to determine with any confidence what the critical threshold distances are. Therefore, while the locations of existing sawmills that predominantly process plantation timber are shown on the map as a general guide to those interested in considering this factor, distance from sawmills has not been included in the analysis.

It should not be assumed from this study that all (or any particular portion of) land identified as having potential to be used for plantation forestry should or will be converted to that use. Land potential has been identified by the audit using a limited number of criteria for which mapping is readily available. Also, the extent to which the potential identified on this map is realised (or realisable) is strongly influenced by constraints that have not been included as criteria in the mapping, for example the availability of water for irrigation (see Map 7.2). See Section 7.1 for further constraints.

Charters Towers Biophysical potential for rainfed plantation forestry and current plantation forestry

Hardwood potential based on ALC 'A', 'B' and 'C1', slope <25%, rainfall >700mm 7 in 10 years, no cracking clays
Softwood potential based on ALC 'A', 'B' and 'C', slope <25%, rainfall >800mm 7 in 10 years, no cracking clays

Legend

- Potential softwood plantations
- Potential hardwood plantations
- Current fallow
- Current hardwood
- Current mixed species
- Current softwood
- Areas excluded from potential (see explanatory notes)
- Region boundary
- Sawmills for plantation timber
- Roads
- Rivers
- Towns

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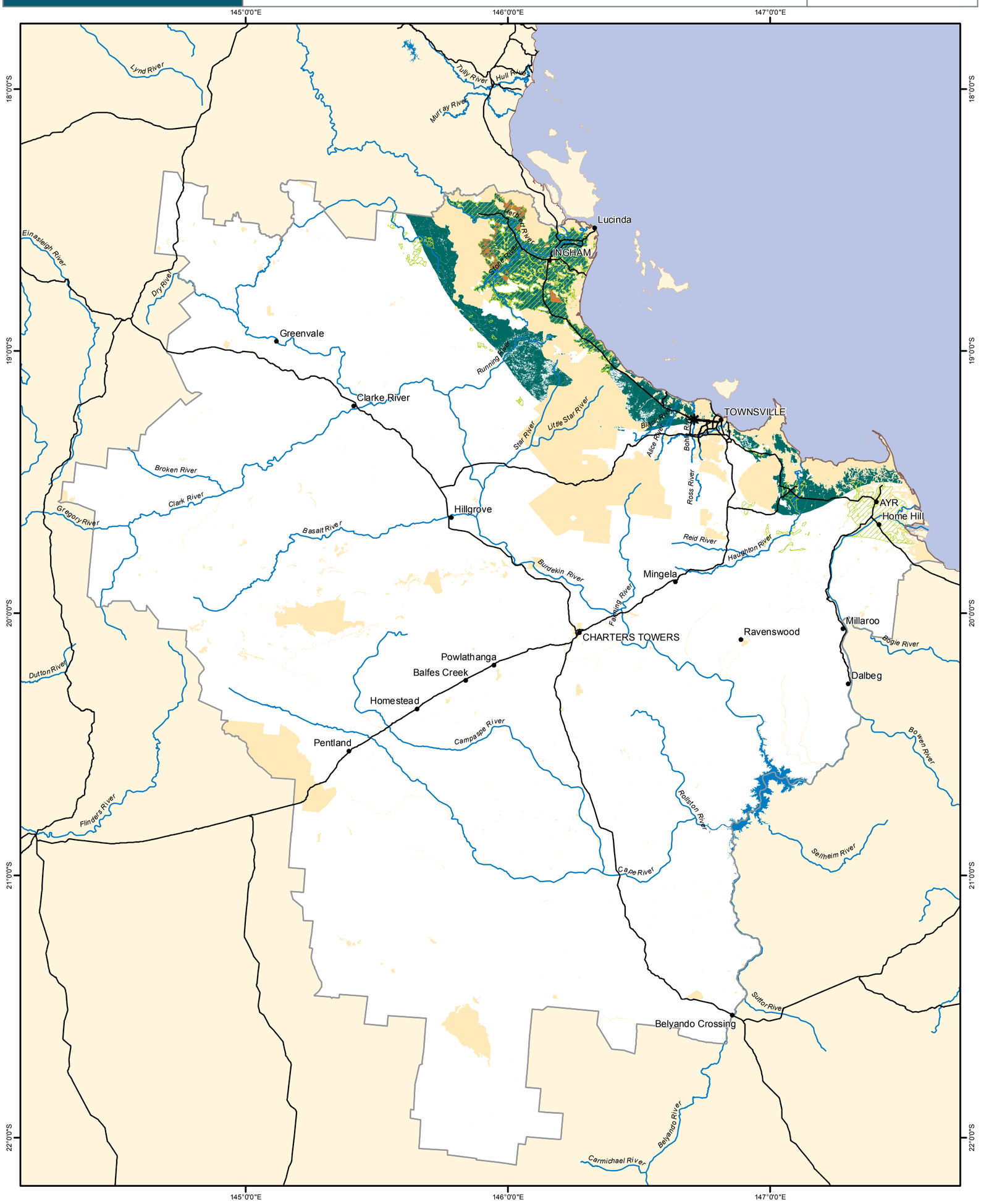
Datum: GDA 94 Projection: Geographic
Page size: A3

Locality Map
Queensland regional planning boundaries



Map 7.17 Data confidence in soil mapping

This map shows the variation in the relative confidence in the audit's mapping of land-use potential across the region. Land-use potential maps have been generated by the audit by combining a number of different datasets. The level of confidence in the final product is determined by the most limiting of the datasets used. This is generally the agricultural land class mapping, which was derived from a number of different land resource studies, each covering different parts of Queensland often at differing scales of resolution and with different standards of information reported. Confidence in land resource data ranges from high (where mapping is detailed and map units are described in terms of their suitability for a full range of relevant crop types and uses) to low (where mapping is coarse and map units are described in general terms only). For some parts of the state, the only available land resource information is from the *Atlas of Australian soils*. The quality of this information is considered inadequate for the audit; therefore, those areas are shown on this map as having no data.

Charters Towers–Confidence in ALC data