# REPORT

## Spatial land assessment and regional suitability for plantation forestry

Prepared for the North Queensland Forestry Hub
February 2025

GREENWOOD STRATEGY

NORTH QUEENSLAND REGIONAL FORESTRY HUB

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# EXECUTIVE SUMMARY

## Project overview

The North Queensland Forestry Hub engaged Greenwood Strategy to undertake spatial land assessment and regional suitability for plantation forestry across the Hub region. The project comprises three key activities:

1. Literature review, data analysis and review of foundational GIS platform.
2. Modelling financially suitable afforestation areas.
3. Policy barriers and opportunities for plantation expansion.

## Financial suitability analysis

### Development of commercial scenarios

Four commercial tree species were selected for the analysis (*Pinus caribaea*, *Eucalyptus pellita*, *E. cloeziana* (Gympie messmate) and *Corymbia citriodora* (spotted gum)). A total of seven silvicultural regimes (scenarios) were identified and four commercial regimes (timber only; timber & carbon; timber, carbon & grazing; alternative silvopastoral (alley planting)). This resulted in 28 individual regimes for analysis (refer to Table 1). Comparison was undertaken against a grazing only scenario to determine which scenarios delivered a better financial outcome than grazing by itself.

### Financial suitability findings

The analysis assumed an internal rate of return (IRR) threshold of 10% to determine whether a regime was financially viable. The findings demonstrate that timber only regimes are not financially viable. However, the inclusion of carbon and grazing substantially improves the viability of several scenarios and regimes.

All of the scenarios assessed for the project demonstrated financial suitability at the 10% IRR threshold for at least one silvicultural regime. The poorest performing scenarios were unthinned Gympie messmate and spotted gum, for which about 5,400 ha each is viable only when considered under an alternative silvo-pastoral (alley planting) regime. For the other five scenarios, material areas within the region were identified as financially suitable for each of the timber & carbon; timber, carbon & grazing; and alternative silvopastoral (alley planting) regimes.

Long rotation pine is the best performing scenario across the board but is highly sensitive to timber price. Short rotation pine performs very well in the alternative silvopastoral regime but is highly sensitive to the presence of a pulp market. The *Eucalyptus pellita* regimes demonstrate a large area of financial suitability but compete with higher IRR for grazing only because of the relatively large proportion of higher quality land. Results for thinned Gympie messmate and spotted gum are very similar regardless of the silvicultural regime, although at lower IRR thresholds (0% and 5%), there is a much greater area of potentially suitable land in the alternative silvopastoral regime for both species.

The summary findings are presented in Table 1. Financially suitable scenarios are those which exceed the 10% IRR threshold. Amber cells indicate scenarios that financially suitable but less suitable than grazing only. Green cells indicate scenarios that also perform better than the grazing only regime for that scenario.

Overall, the analysis demonstrates that in North Queensland there are large areas of land which are suited to growing financially viable plantations, when combined with carbon and/or grazing. For much of that area, a combined land use approach which incorporates grazing under full tree stocking, or in alternative silvo-pastoral regimes, perform better than if the same land was used only for grazing.

***Table 1: Summary of financial suitable areas for each scenario and silvicultural regime***

| Scenario | | | Area (ha) of financially suitable land by silvicultural regime | | | |
|---|---|---|---|---|---|---|
| Scenario | Species | Silviculture | Timber | Timber & carbon | Timber, carbon & grazing | Timber, grazing & alley planting |
| 1 | Pinus caribaea | Long rotation no thin | | 158,399 | 158,777 | 257,285 |
| 2 | Pinus caribaea | Short rotation no thin | | 27,454 | 33,431 | 201,660 |
| 3 | Eucalyptus pellita | Short rotation no thin | | 71,097 | 74,096 | 141,018 |
| 4 | Gympie messmate | Long rotation thin | | 13,796 | 13,786 | 15,365 |
| 5 | Gympie messmate | Long rotation no thin | | | | 5,429 |
| 6 | Spotted gum | Long rotation thin | | 25,877 | 27,825 | 20,411 |
| 7 | Spotted gum | Long rotation no thin | | | | 5,429 |

## Limitations

There are important limitations to the analysis which must be considered.

First, the coarseness and limited availability of data for the project is such that the results can only be applied at the regional scale. It would be inappropriate to attempt to use the results at a property level, for example. Landowners and commercial proponents that are considering establishing new plantations should rely on local conditions and professional advice to assist in decision-making.

Secondly, the analysis relies on assumptions about the future presence of markets which either don't currently exist (e.g., pulp markets and plantation hardwood sawlog markets) or are not currently large enough to cater for a significant increase in available log supply.

## Other outputs

In addition to this report, the project has generated an online spatial database which is accessible to the public, as well as a suite of map products which are available on the Hub's website.

# Opportunities and barriers

## Opportunities

The most significant opportunities relate to the potential for expansion of the softwood estate and the potential role of silvopastoral systems to support that. Supported by changes to the ACCU Scheme rules and the prospects for development of new and expanded markets, these present real commercial opportunity for the plantation-based forest and wood products sector.

The financial suitability results are strongly supported by the existing Commonwealth Government **Support Plantation Establishment** grant program. That program is currently expected to conclude in 2027. However, there are other potential sources of financial support that may be able to be applied or adjusted for use in new plantation establishment, such as the **Northern Australia Development Program**. There is an opportunity to engage with both the State and Australian Governments about regionally specific opportunities.

## Barriers

A vitally important component to future successful expansion is to attract and retain a processing industry capable of purchasing and utilising plantation wood products. This will require concerted and ongoing support from all levels of Government, facilitated by industry investment.

The current FullCAM rules do not fully recognise the role of solid wood timber production from North Queensland plantations, and this is potentially a barrier to full participation in the ACCU Scheme.

Environmental risk (cyclones, pests and diseases) and State Government regulation also present potential barriers to expansion.

# Recommendations

## Recommendation 1: Amendment to the FullCAM parameters

There is a pressing need to engage with the Clean Energy Regulator and seek amendment to the FullCAM parameters that better recognise the role of solid wood production from softwood plantations in the region and provide a greater incentive for new plantation incentive through the ACCU Scheme.

## Recommendation 2: Collaborative communication

The results demonstrate considerable plantation expansion potential with timber, carbon and grazing outcomes combined. Other work being undertaken in the region and in south-east Queensland is focussing on practical trials of silvopastoral systems aimed at quantifying these silvopastoral outcomes more accurately. There is an important and timely opportunity to use the results from this study to reinforce parallel research efforts and support communication with the agricultural industry about the benefits of combining timber, carbon and pastoral production.

## Recommendation 3: Improving biophysical data quality

There is strong rationale for developing a project to focus on developing higher quality and better resolution biophysical data to support more detailed analysis of opportunities within the target envelopes identified in this project. In particular, Cassowary Coast and Tablelands Regional Councils

could form the focus for an initial project, supported by FWPA and/or AFWI along with the State Government, for example.

## Recommendation 4: Future markets and wood products opportunities analysis

This project has identified the potential for a very significant increase in future fibre supply from plantations. A regionally specific future markets and wood products opportunities analysis undertaken in the context of the particular environmental, economic and social opportunities and barriers in the region would allow the Hub and the industry to focus expansion and development efforts towards genuine opportunities for industry growth. Importantly, this analysis could be used to improve investor confidence in future opportunities in the region.

# INTRODUCTION

## About the Hub

### Hub role

The North Queensland Forestry Hub (the Hub) is one of 11 similar organisations funded by the Australian Government to support expansion of the forest and wood products sector in key regions. The Hub encompasses about one-third of Queensland's land mass, from Mackay north to Cape York and west to the Northern Territory border (refer to Figure 1). The role of the Hub is to work with industry, the Queensland State Government and local government authorities, along with other key stakeholders to prepare and provide the Government with strategic planning, technical assessments and analyses to support growth in the forest industries in North Queensland.

The Hub has identified regional priorities for the industry including:

- Skills and workforce development.
- Plantation investment models.
- Manufacturing competitiveness.
- Indigenous forestry and native forest management.
- Bioenergy and carbon.
- Supply chains and infrastructure.

### The plantation industry in North Queensland

The forest and wood products sector in the Hub region is relatively small compared to other key forestry regions in Australia but is important in the regional context. The sector relies predominantly on the Hub's 23,600 ha plantation base, with a small but important native forest industry as well. These plantations include southern pines (16,000 ha), hoop and other pines (1,000 ha), a large area of fallow softwood (4,500 ha) and a small area of hardwood plantations (350 ha).

Plantation log production is about 50,000$m^3$/yr although it is forecast by ABARES to increase over the next 5-10 years. There are two sawmills, at Mareeba and Ravenshoe, which process about 50,000$m^3$/yr of softwood sawlogs. There is also a softwood pallet manufacturer located at Townsville. Hardwood sawmillers in the region currently process about 8,000$m^3$/yr of mainly native forest sawlogs, although capacity is estimated at about 30,000$m^3$/yr. This suggests potential processing capacity for hardwood plantation sawlogs if the resource becomes available in future.

### Regional context

The North Queensland Forestry Hub is the largest regional forestry hub at approximately 60 million ha and covers about one-third of the entire area of Queensland. A large proportion of the Hub region is considered unsuitable for commercial tree plantations because of low or strongly seasonal rainfall, high evaporation and low fertility soils. The project identified a smaller Area of Interest (AoI) based on biophysical characteristics more likely to support plantation growth. The AoI is concentrated around the coast and tablelands, from the south-east boundary of the Hub region to Cooktown in the north. The land area of the AoI is 11.9 million ha, or about 19% of the Hub area (refer to Figure 3).

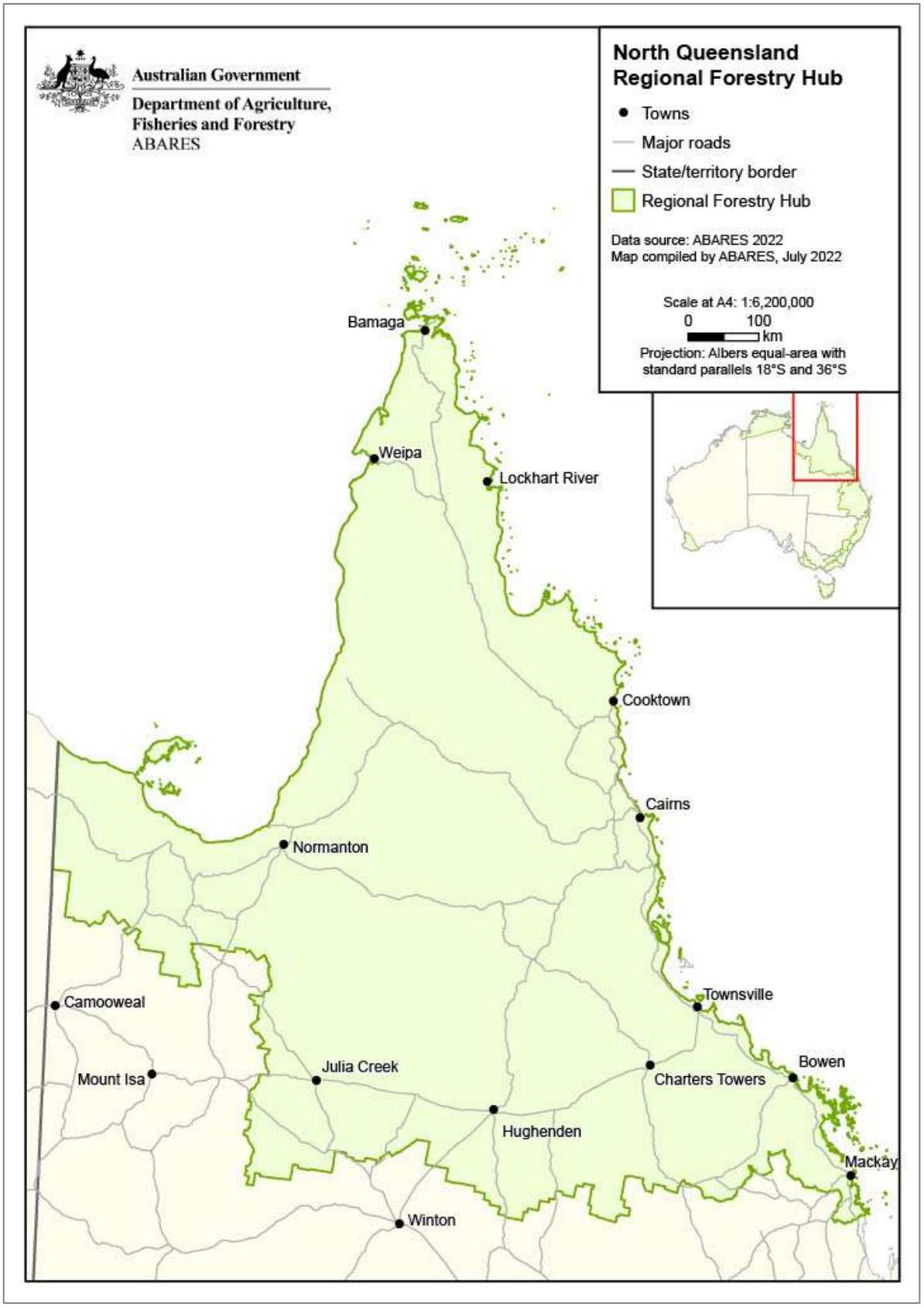



***Figure 1: North Queensland Forestry Hub extent***

# About the project

## Project rationale

North Queensland has been identified in several studies as presenting the greatest opportunity for significant expansion of the commercial plantation estate in Australia, particularly for softwoods (e.g., Whittle *et al.*, 2019; Stephens *et al.*, 2020). However, there are also well understood environmental and commercial challenges for plantation expansion, specifically seasonal water availability and cyclones. Added to that are potential regulatory barriers, limited access to markets, and infrastructure and logistics challenges.

Notwithstanding these challenges, there are specific opportunities related to land availability and suitability. In particular, there is a unique opportunity to explore the role of integrated grazing and forestry (silvo-pastoralism) to deliver improved outcomes for private landowners in the region.

Through this report, the Hub aims to better understand the biophysical suitability for plantation expansion of identified species in the region (i.e., where specific species can perform in a plantation environment at appropriate growth rates) and the financial suitability of plantation expansion with those species under a range of alternative silvicultural scenarios.

## Report structure

The report is structured in four parts:

1. **Data collation and analysis**: including literature review and assessment of available data sets, and selection of preferred species for modelling plantation suitability.
2. **Plantation suitability assessment**: including identification of appropriate silvicultural scenarios, and modelling of biophysical and financial suitability, including Australian Carbon Credit Unit (ACCU) generation.
3. **Opportunities and barriers**: review of the policy and regulatory environment for plantation expansion and assessment of opportunities and barriers for the sector.
4. **Discussion and recommendations**: collation of outputs and development of recommendations.

# DATA COLLATION AND ANALYSIS

## Literature and database review

### Literature review

A wide range of existing literature was reviewed to determine its potential application to this project. Potentially suitable literature was accessed through:

1. Existing databases, particularly the draft Forest & Wood Products Australia (FWPA) Private Forestry Guidance Materials database.
2. Joint Venture Agroforestry Program (JVAP) publications.
3. Other Hub projects (specifically the Verterra draft literature review).
4. Targeted internet searches.
5. Regionally specific reports and literature.
6. Species specific reports and literature.
7. Grey literature.

### General commentary on available literature

The historic literature in relation to plantation suitability for north Queensland, and northern Australia more generally, has quite limited application for this project. However, there has been a small body of work undertaken over the past five to ten years which is of much more use and is discussed in more detail. The review has focused on the following key areas:

1. Existing timber plantation resource.
2. Suitability of north Queensland for plantation expansion.
3. Likely species to support plantation expansion.
4. Critical limitations and barriers to plantation expansion.

### Existing timber plantation resource

#### *Plantation area*

In relation to plantation area, ABARES[1] provides data for Hub and National Plantation Inventory regions[2], as well as ABS regions[3]. All three of these data sets, from the same agency, provide different results for north Queensland. Stephens *et al.* (2020), in a report for the CRC for Northern Australia, provides a different area statement again. Data are presented in Table 2. The Hub region data seems to exclude the area of sandalwood plantations located to the south-west of Townsville at Dalberg in the Burdekin River irrigation area (refer to Figure 3). The National Plantation Inventory (NPI) data have been adjusted to exclude approximately 7,000 ha of softwood plantations north of Yepoon, which is outside the Hub boundary.

[1] Australian Bureau of Agricultural and Resources Economics

[2] Australian plantation area and log availability — National plantation inventory regions and Regional forestry hubs - DAFF (agriculture.gov.au)

[3] Regional profiles for forestry - data visualisation - DAFF (agriculture.gov.au)

***Table 2: Comparison of regional plantation area from various data sets***

| | Plantation area ('000 ha) | | | |
|---|---|---|---|---|
| **Data Set** | **Softwood** | **Hardwood** | **Other*** | **Total** |
| Regional Forestry Hub | 13.70 | 0.33 | | **14.03** |
| National Plantation Inventory** | 14.08 | 0.32 | 1.90 | **16.30** |
| ABS Regions | 14.16 | 2.26 | | **16.42** |
| Stephens *et al.* (2020) | 15.00 | 0.50 | 1.50 | **17.00** |

* This is most likely sandalwood
** Adjusted for the Hub boundary

The Queensland Department of Agriculture and Fisheries – Forestry Division (2021) states that (referring to the North Queensland NPI region):

*"The plantation estate in the North Queensland region totalled 23 195 hectares in 2019, consisting of 21 549 hectares of softwoods, 1 475 hectares of hardwoods and 171 hectares of mixed species. Plantation areas were severely impacted by cyclones in 2011 (Cyclone Yasi) and 2015 (Cyclone Marcia), which destroyed or severely affected the plantations owned by both HQP and other growers in the region. Given the adjustment to NPI regional boundaries used for this report, direct comparisons between 2016 and 2019 are not possible. However, indications are that the softwood plantation estate reduced by about 8 800 hectares, mostly due to the disposal of land and subsequent conversion to other uses."*

## *Forecast softwood log production*

Forecast future annual log production from the existing softwood plantation estate is highly variable, driven by a lumpy age class distribution (refer to Figure 2).

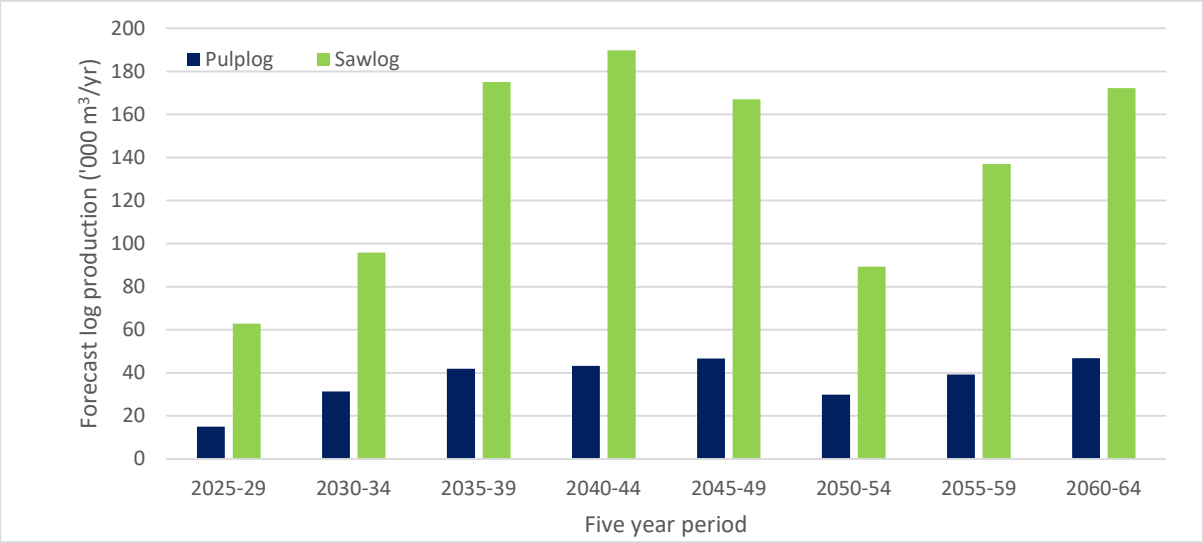



***Figure 2: Forecast log production from softwood plantations in the North Queensland Forestry Hub Region (Source: Legg et al., 2021)***


***Figure 3: Location of existing plantations within the Hub region (Source: ABARES, 2023)***

These log volume forecasts anticipate a considerable volume of pulplog (up to 40,000 $m^3$/yr) to be produced from the region. While there is some history of log exports (particularly for cyclone salvaged timber) there are currently no pulp log markets for the region which suggests this data requires further scrutiny by the industry. The sawlog volumes also assume a 25-30 year rotation length, free of significant impact from severe tropical cyclones, which is unlikely given recent history.

## Suitability of north Queensland to plantation expansion

### *Historic suitability assessment*

The Queensland Department of Natural Resources undertook a high-level analysis of forest plantation land suitability for Queensland in 1999. Suitability limitations included:

- Rainfall >800mm/yr
- Cleared freehold and land parcels (in north Queensland this was determined by forest crown density classes Non-Woody and Sparse)
- Land slope between > 10° and < 35°[4]

For the region from Mackay north (i.e., the Hub region), suitable land was generally identified within 50km of the coast and centred around Mackay, Bowen, Ingham, Cairns and Cooktown. From Cairns north, potentially suitable land was identified up to 200km inland, but only limited areas. A map was produced, which is presented in Figure 4. No report or data could be found to support the mapping.

A 2013 Regional Land Suitability Frameworks study (Queensland Government, 2013) identifies plantation forestry (specifically southern pines, Gympie messmate and flooded gum) as assessed potential land uses in southeast Queensland but not in any of the sub-regions in north Queensland that are relevant for the Hub.

### *Historic expansion*

The current plantation estate, which comprises predominantly southern pines, was mostly established by the Queensland Government during the 20th century and later acquired by Hancock Queensland Plantations. Smaller existing plantation areas are mostly owned by small independent landowners, with the exception of the existing sandalwood plantations.

North Queensland has been a serious target for plantation expansion since at least the mid-2000s. A number of managed investment scheme companies, most notably Elders-ITC, focused efforts in the region. Legg *et al.* (2021) identify the increase in both hardwood and softwood plantation area in the North Queensland NPI region (noting this region extends further south than the Hub region and includes c. 7,000 ha of current softwood plantation) between 1999 and 2015. By 2020, both the hardwood and softwood plantation area had reduced to about the original 1999 levels (refer Figure 5). There are three main reasons for this:

1. Failure of the managed investment schemes and subsequent reversion back to agricultural use.
2. The impact of severe tropical cyclones destroying plantations which have subsequently not been replanted.
3. The impact of other environmental factors such as weed competition and pests.

[4] Given the impact of recent severe cyclones, including landslip events and transport infrastructure damage on steeper slopes, planting on slopes steeper than 20) is inadvisable due to the significantly enhanced risk.

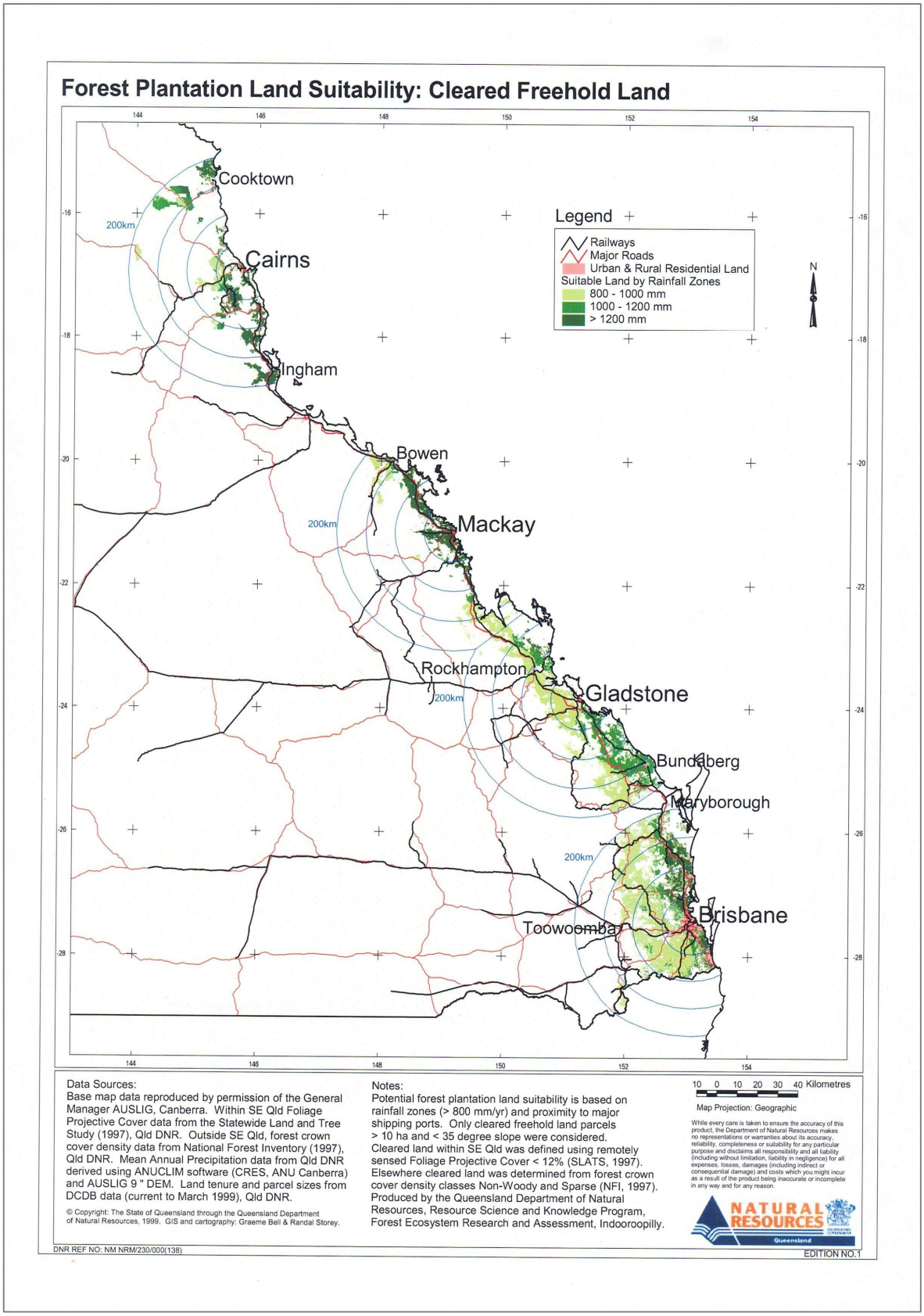



***Figure 4: Forest plantation land suitability assessment (Source: Queensland Government, 1999)***

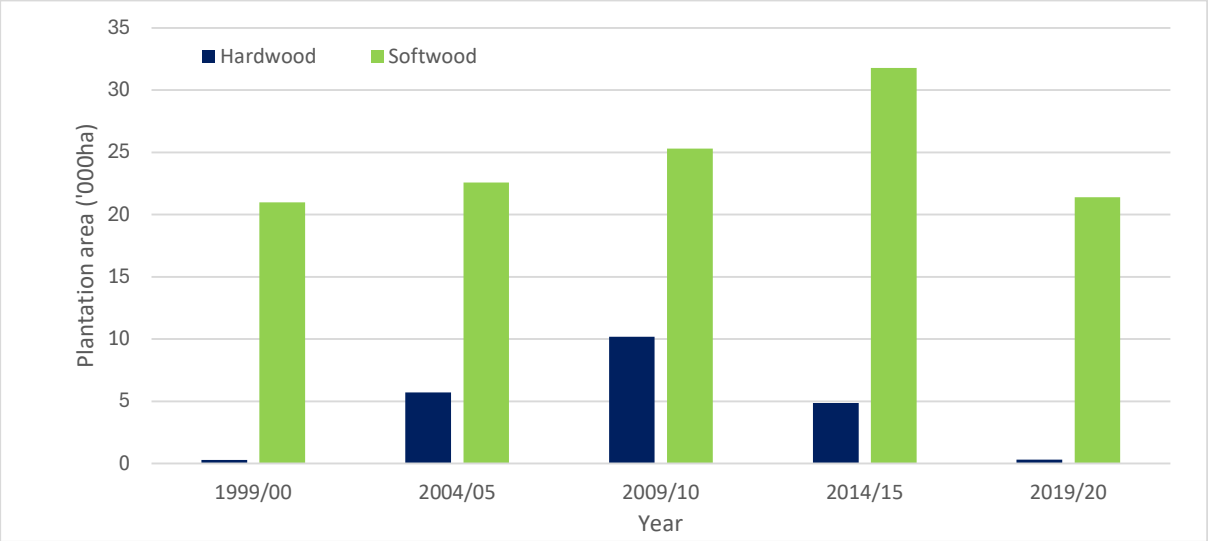



***Figure 5: Plantation area changes (1999-2020) for the North Queensland NPI region (source: Legg et al., 2021)***

## *Contemporary assessments*

### Traditional commercial plantations

In 2019, ABARES published an assessment of the economic potential for new plantation establishment in Australia to 2050 (Whittle *et al.*, 2019). The report assessed potential in seven regions, considering factors such as transport costs, land prices, plantation growth rates and market factors. It identified the potential for an additional 28,782 ha of new plantation that could be established by 2050, of which 9,471 ha (approximately one-third) was located in the North Queensland NPI region.

The main outputs from the study are presented in Table 3. There are several elements which, for north Queensland (and perhaps other regions), require further interrogation. First, the average distance to market is assessed at 100km which is likely to be quite optimistic. Second, average land price is assessed at $2,078/ha which seems highly unrealistic for land in the region located within 100km of existing processing markets.

***Table 3: Characteristics of new plantation areas by NPI region, base case (Source: Whittle et al., 2019)***

| NPI Region | Area in 2050 (ha) | Average land value ($/ha) | Average distance (km) | Average MAI (m³/ha/yr) |
|---|---|---|---|---|
| North Queensland | 9,471 | 2,078 | 100 | 25.8 |
| Southeast Queensland | 3,685 | 1,877 | 153 | 18.1 |
| Western Australia | 4,773 | 2,900 | 38 | 30.0 |
| Central Victoria | 5.872 | 3,487 | 151 | 26.1 |
| Green Triangle | 4.054 | 5,088 | 41 | 30.0 |
| East Gippsland | 926 | 2,260 | 113 | 26.0 |
| **All** | **28,782** | **2,906** | **99** | **26.2** |

## Silvopastoral systems and agroforestry

There is increasing interest at both the national and State level about the role of silvopastoral and agroforestry systems in improving long term agricultural (grazing) returns while meeting the Commonwealth's policy objectives to increase the area of commercially viable timber plantations. In Queensland, considerable work is being undertaken which is focused on both natural and planted forests, to demonstrate situations where commercial forestry and agriculture can be undertaken simultaneously to deliver improved whole of farm financial outcomes.

The North Queensland Forestry Hub is participating in a three-year trial for commercial pine systems in North Queensland[5]. The project will measure and model the returns from field trials with cattle grazed in widely spaced commercial pine forests and compare the returns from carbon sequestration and combined timber and beef production returns with traditional grazing only activities on cleared farmland. It is examining three scenarios:

1. Commercial pine plantation at full stocking (1,000 sph).
2. Silvopastoral system in pine plantation with timber and livestock production, with 30% tree thinning.
3. Silvopastoral system in pine plantation with timber and livestock production and 50% thinning.

The work builds on recommendations made in the CRC for Northern Australia's Northern Forest and forest products industry situational analysis (Stephens *et al.*, 2021), which analysed pathways for realising forest industry potential in Northern Australia and identified silvopastoral systems as a key opportunity.

Donaghy *et al.* (2010), in an assessment of strategies to improve the profitability of extensive grazing systems in central Queensland, assessed silvopastoral grazing systems with clearing followed by either: (a) retention of regrowth woody vegetation strips; or (b) planted spotted gum strips for both poles and pulp (separately). The spotted gum version delivered an outcome which would leave the grazier $209,087 better off than clearing without planting. However, the analysis also recognised sensitivity risks around long payback periods and prices received for timber products.

Lewis *et al.* (2022) note that Silvopastoral systems *"…provide the opportunity to improve the economics associated with plantation establishment and native forest management. They involve the intentional management of both livestock and trees…on a given unit of land. The aim of SPSs is to optimise land productivity by producing fodder, forage, livestock, woodfuel and timber, while conserving soil and nutrients through careful stock management."*

They identify a number of barriers, including:

- **Economic**: upfront costs, opportunity costs of foregone annual income from grazing and cropping, long payback periods, supply chain and timber product price transparency, and limited opportunities for additional income streams.
- **Risk**: sovereign risk (e.g. potential restriction on native forest harvesting in future), plantation failure or loss due to pests, disease or fire.

[5] https://www.qldforestryhubs.com.au/_files/ugd/3c7854_680b31a9e5934648b0ebd6f44b8a6b74.pdf

- **Education**: such as lack of understanding of the benefits of silvopastoral systems and timber and market carbon values, and a lack of understanding about how to implement.

It should be noted that these barriers are broadly consistent with the general barriers to participation in private forestry in all Australian jurisdictions (Greenwood Strategy, 2023c).

# Potential species

## Species short list

A broad range of potential species were considered by the consulting team. The species considered, and reasons for inclusion or exclusion, are summarised in Table 4.

***Table 4: Summary of species decisions for the project***

| Common name | Scientific name | Decision | Rationale |
|---|---|---|---|
| Southern pines | *Pinus caribaea* (and hybrids) | In | Demonstrated performance in the region. Existing markets and existing plantation scale. Clear potential in a wide range of biogeographic conditions. Potential for hybrids that have better wind firmness in relation to cyclones. |
| Red mahogany | *Eucalyptus pellita* | In | Increasingly being applied as a tropical hardwood replacement for *A. mangium* and other species (including in the Tiwi Islands). Also well established in SE Asia – e.g. Sabah and Vietnam. Increasing body of research and silvicultural practice. Potential for both pulp, solid wood and engineered (LVL) products. |
| Gympie messmate | *Eucalyptus cloeziana* | In | Strong plantation performer in Queensland. High (class 1) durability. Also suitable for poles. Bred for myrtle rust resistance. |
| Spotted gum | *Corymbia citriodora*<br>Appropriate sub species | In | Relatively good plantation performer in Queensland. High durability. Suitable for commercial markets (including poles) as well as on-farm use. |
| African mahogany | *Khaya senegalensis* | Out | Small existing area in north Queensland (300-500 ha). Larger areas in the Northern Territory but struggling to find markets that can generate a positive return. Difficult to justify in that context but if markets improve, then worth reconsidering. |
| Hoop pine | *Araucaria cunninghamii* | Out | Major challenge is rotation length which makes it unlikely to be commercially viable. Also issues with scale, as a competitive species in the market to southern pines. Is well established as an agroforestry species in the region and considerable attention on it for carbon only planting. |
| Mangium | *Acacia mangium* | Out | Pulp only species. Major issues emerging in Australia and southeast Asia related to red root rot fungus. Being replaced extensively. Second string preference as a pulp species and requires good export infrastructure close to plantations. |
| Sandalwood | *Santalum* spp | Out | Significant issues with sandalwood plantations in northern Australia at the moment. Limited access to processing facilities and markets. Expensive and difficult species to establish and manage. |

The two species which were not included but attracted the most discussion were African mahogany and hoop pine (Araucaria). In the case of African mahogany, Verterra (2023) noted that its ability to

withstand cyclone strength winds is a key positive, as is its potential as a timber species. However, there are knowledge gaps and risks including biological (termites, root and leaf diseases, crickets and other insects), and lack of market development, which is the most significant risk. Verterra (2023) identifies that Araucaria has the potential for drought resistance, which is potentially appealing in the region, although it is highly sensitive to fire. It is also susceptible to root rot in moister environments. The key risk for Araucaria is its slow growth rates and therefore limited likelihood of meeting conventional benchmarks for financial performance. However, as noted above, it is extensively planted as an agroforestry species for non-timber values in the region and is also a target species for carbon only forestry projects.

## Biophysical requirements of selected species

The biophysical requirements for the selected species are detailed in Table 5. From a practical application perspective, the water related parameters are a key driver for the preliminary plantation suitability results, with temperature and soils playing a lesser role.

***Table 5: Biophysical requirements of the selected species***

| Limiting factors | | Species | | | |
|---|---|---|---|---|---|
| **Category** | **Parameter** | ***P. caribaea*** | ***E. pellita*** | ***E. cloeziana*** | ***C. citriodora*** |
| Water | Mean annual rainfall (mm/yr) | 1200+ | 1500+ | 1300+ | 1200+ |
| | PE ratio (min)[6] | >0.60 | > 0.8 | >0.75 | >0.55 |
| | Dry months[7] | 0-6 | 2-4 | 0-5 | 0-6 |
| | Moisture deficit tolerance[8] | Moderate | Low | Moderate | Moderate |
| Temperature | Mean annual (°C) | 21-27 | 23-27 | 16-24 | 14-23 |
| | Mean monthly max (°C)[9] | 29-34 | 24-33 | 28-34 | 22-34 |
| | Mean monthly min (°C)[10] | 15-23 | 12-16 | 6-14 | 0-10 |
| | Frost tolerance | None | None | Slight | Slight |
| Soils | Min depth (cm) | >50 | >80 | >80 | >50 |
| | Preferred soil suitability class[11] | S1-S3 | S1-S2 | S1-S2 | S1-S3 |
| | Waterlogging tolerance | Moderate | Low | Low | Low |
| | Salinity tolerance | Low | Low | None | None |
| | pH | Acid-neutral | Acid | Acid-neutral | Acid-neutral |
| Other | Wind firmness | Low | Moderate | Moderate | Moderate |

## Review of spatial data

A total of 30 specific data sources were used to develop the preliminary suitability mapping. These are summarised in Appendix 1. The preliminary suitability mapping was applied to determine the practical extent of the potential growing envelope for each of the target species.

[6] PE ratio = Mean annual rainfall/mean annual pan evaporation
[7] Monthly rain <50mm
[8] Low = prefers wetter sites; High = can tolerate frier conditions
[9] Highest mean monthly maximum temperature
[10] Lowest mean minimum monthly temperature
[11] Limitations: s1 = 1; S2 = few/some; S3 = moderate; S4 = many/severe

## Analysis scenarios

For each of the four target species, silvicultural regimes were developed in consultation with the Hub. They reflect a range of rotation lengths and management interventions (e.g., thinning or no thinning). A total of seven silvicultural scenarios were described and applied to the analysis (refer to Table 6).

***Table 6: Summary of silvicultural regimes***

| Scenario | Species | Rotation length (yrs) | Thin (Y/N) | General description |
|---|---|---|---|---|
| 1 | Southern pines (*Pinus caribaea*) | 27 | N | Establish 27-30 year rotation with no thinning (mod-high MAI, tablelands and coast) |
| 2 | Southern pines (*Pinus caribaea*) | 18 | N | 18 year rotation with no thinning (mod-high MAI, tablelands and coast) |
| 3 | Red Mahogany (*Eucalyptus pellita*) | 15 | N | Establish at 1,000 sph (high stocking good for branch management but too high is too expensive) on a 15 year rotation for veneer production. High MAI. |
| 4 | Gympie messmate (*Eucalyptus cloeziana*) | 27 | Y | Establish at 850-1,000 sph on 25-30 year rotation. One or two thins to final crop of about 400 sph. Focus on poles and sawlogs. Low to moderate MAI. |
| 5 | Gympie messmate (*Eucalyptus cloeziana*) | 27 | N | Establish at 850-1,000 sph on 25-30 year rotation. No thinning. May require pruning for form and branching. Focus on poles and sawlogs. Low to moderate MAI. |
| 6 | Spotted Gum (*Corymbia citriodora subsp. variegata*) | 27 | Y | Establish at 850-1,000 sph on 25-30 year rotation. Focus on poles and sawlogs. Drier parts of the tablelands and central areas where the P/E ratio allows. Low MAI. |
| 7 | Spotted Gum (*Corymbia citriodora subsp. variegata*) | 27 | N | Establish at 850-1,000 sph on 25-30 year rotation. No thinning Drier parts of the tablelands and central areas where the P/E ratio allows. Low MAI. |

In addition to the silvicultural scenarios, four commercial regimes were developed which reflect the aim of the project to compare the potential contribution of timber, carbon and grazing (silvopastoral) activities to value and plantation suitability. Each of the commercial regimes was compared to a baseline grazing only regime. The combination of species and silvicultural and commercial regimes provided a total of 28 timber production regimes for the suitability analysis is presented in Table 7.

***Table 7: Summary of commercial regimes***

| Commercial regime | Description |
|---|---|
| Timber only | This regime assumed plantations were established only to produce timber products. |
| Timber and carbon | This regime assumed that plantations would be established under the ACCU Scheme Plantation Method (Schedule 1). |
| Timber, carbon and grazing (full crop) | This regime assumed timber and carbon, as well as grazing under a full tree crop from age 3. |
| Alternative silvopastoral (alley planting) | This regime assumed timber and carbon on a proportion of the landscape, established in alley plantings to allow full pasture over the remaining proportion of the area |
| Grazing only | A grazing only scenario was developed to provide a comparison between the other regimes and to assist in determining where the plantation options performed better than only grazing. |

# ASSESSMENT METHODOLOGY

## Overview

A cascading approach to defining the area of financially suitable land for each scenario and commercial regime was applied as follows:

1. Determine **Area of Interest** (AoI) representing the subset of the region most likely to be able to support commercial tree growth.
2. Determine **Land Capability**, which is the envelope representing the biophysical suitability of land for each of the target species.
3. Determine **Land Availability**, through exclusion of areas where commercial timber plantations cannot be established.
4. Determine **Financial Suitability** for each species, under the various silvicultural and commercial regimes.

## Area of Interest

The AoI (shown in Figure 6) was established early in the project. It reflects an agreed limit on the likely practical extent of commercial plantation opportunities in the Hub region based on a range of high level biophysical and commercial factors.

## Land capability

Land capability, defined as the biophysical suitability for growing species, was determined based on the limiting factors identified in Table 5. The result is a land envelope within the AoI for each species where it is assessed as being biophysically viable.

The analysis applied the Queensland Land Suitability Model and the Queensland Land Capability Classification to exclude areas where biophysical limiting factors of the land fell outside the acceptable growth parameters for each species, highlighting areas not capable of sustaining plantations.

### Queensland Land Suitability Model

A detailed suitability classification[12] for agricultural crops and for *Pinus caribaea* was available. However, the extent of the modelling was limited to coastal agricultural regions only, leaving much of the Hub unclassified. A significant attempt was made by the project team to extrapolate the suitability from this limited dataset based on the underlying limiting factors (i.e. mean rainfall, rockiness, salinity, soil depth, frost, water erosion, etc) from the coastal regions out to inland regions, but the quality and extent of the data for the inland areas was poor or lacking and as such the resultant correlation was poor and the attempt abandoned.

[12] Land Suitability (information.qld.gov.au)

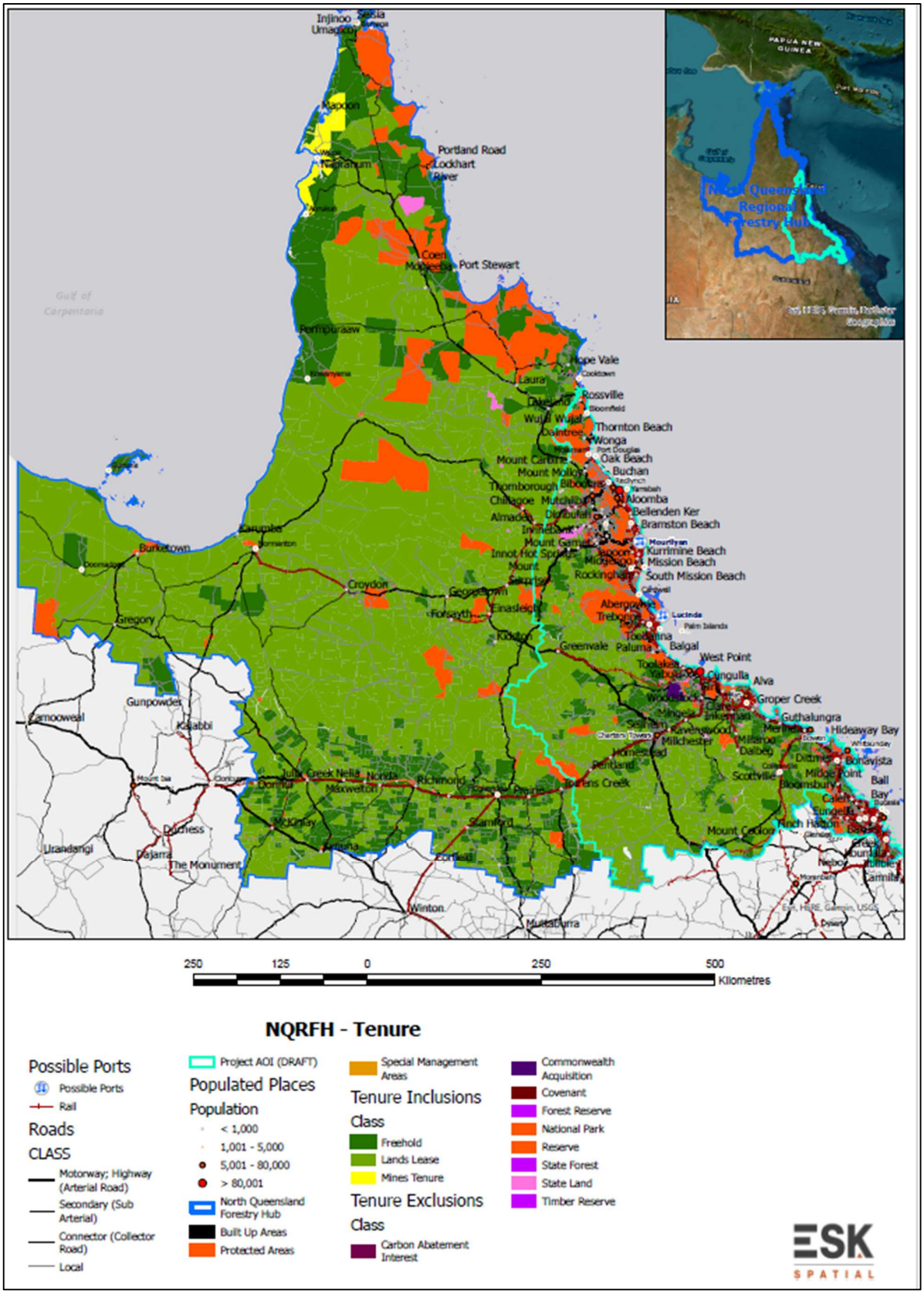



***Figure 6: Land included and excluded from the spatial land assessment modelling***

## Queensland Land Capability Classification

Given the lack of good soil modelling across the Hub, land capability classifications were used as a surrogate for land suitability. Land Classes A, B and C were assessed as being suitable for plantation establishment, whereas as areas under Land Class D were assessed as unsuitable:

- **Class A:** Crop land that is suitable for a wide range of current and potential crops with nil to moderate limitations to production.
- **Class B:** Limited crop land that is suitable for a narrow range of current and potential crops due to severe limitations but is highly suitable for pastures. Land may be suitable for cropping with engineering or agronomic improvements.
- **Class C:** Pasture land that is suitable only for improved or native pastures due to limitations which preclude continuous cultivation for crop production. Some areas may tolerate a short period of ground disturbance for pasture establishment.
- **Class D:** Non-agricultural land and land not suitable for agricultural uses due to extreme limitations. This may be undisturbed land with significant conservation or catchment values, land that may be unsuitable because of very steep slopes, shallow soils, rock outcrop, poor drainage, salinity, acidic drainage, or is an urbanised area.

# Land availability

Land use and land tenure classes not available for plantation establishment were modelled. Figure 6 shows the area within the Hub which has been excluded and included based on the criteria described below.

## Land Use exclusions

The following land use classes were excluded from the spatial assessment modelling:

- Lakes/Reservoirs/Water
- Built Up Areas – urban settlements with more than 50 residential buildings
- Protected Areas – areas protected for the conservation of natural and cultural values and those areas managed for production of forest resources, including timber and quarry material
- Special Management Areas – areas that cover parts of the protected areas of Queensland that have additional constraints on their use

## Tenure Exclusions

The following tenure classes were excluded from the spatial assessment modelling:

- Commonwealth Acquisition
- Covenant
- Forest Reserve
- National Park
- Reserve
- State Forest
- State Land
- Timber Reserve

Land tenure classed as freehold, lands lease or mine tenure were included.

## Carbon Project Exclusions

Although such areas were not excluded for plantation establishment purposes, a subset of areas are currently not available for Schedule 1 carbon project registration under the Plantation Forestry Method of the ACCU Scheme, based on current and historic land use. Specifically, areas are excluded from Schedule 1 where the land:

- Is currently forested
- Has been cleared of native vegetation or drained of a wetland within 7 years of Application to register, or 5 years of change of land ownership
- has been under plantation within 7 years of application to register

These exclusions were only applied when determining potential for ACCU generation under a carbon scheme.

# Financial suitability method and assumptions

## Overview of the modelling approach

Modelling of financial suitability was undertaken using a proprietary spatial modelling approach developed by Esk Spatial, which marries land capability and land availability with a suite of spreadsheet-based inputs, applied as lookup tables. The spatial modelling for the North Queensland project has been undertaken over a 1km grid for the area of interest. This is much coarser than similar modelling undertaken for other regions. However, the size of the AoI and the relatively coarse nature of the available biophysical assessment inputs required the approach to be undertaken at this scale.

## Plantation growth

### *Mean annual increment models*

The FullCAM software has been developed to account for carbon storage and release in the life cycle of forests but has an underlying growth model (3-PG) which can output standing and extracted tree stem volumes at any period along that life cycle. For each of the seven base scenarios (i.e. species x silvicultural regime), FullCAM was applied on a grid across all available land. The total volume of extracted stems at any thinning or clearfell event generated by 3-PG was reported across the available land within the AoI. The mean annual increment (MAI) was calculated by summing the extracted stem volumes over the life of the first rotation, and spatial output describing the estimated MAI for each plantation scenario was developed.

FullCAM modelling was applied on a 1km grid where land was modelled as eligible under Schedule 1 of the Plantation Forestry Method and on a 4km grid where land was not eligible. This was done to reduce processing time on the very large data sets, while still maintaining reasonable reliability of the MAI results across the Hub. The data was intersected with the land capability layer for each species for the purpose of assessing financial suitability.

### *Plantation yield*

Yield tables were developed for each species and each scenario. A challenge for the region is the relative lack of current markets. Assumptions were made about the future availability of markets which are presented under the relevant heading below. Based on these assumptions, yield tables were developed for each scenario. Yield tables for each scenario are presented in Appendix 2.

## Plantation cashflow

### *Timber revenue*

Timber revenue (mill door) was calculated on a per cubic metre basis for each log product type (refer Table 8).

***Table 8: Log product mill door price assumptions***

| Product | Mill door price ($/m³) | |
|---|---|---|
| | Softwood | Hardwood |
| Pulp log | 80 | 80 |
| Posts | 115 | 115 |
| Small sawlog | 110 | 130 |
| Medium sawlog | 135 | 180 |
| Large sawlog | 150 | 200 |

### *Other revenue*

It was assumed that the Commonwealth Government grant of $2,000/ha is available for all new establishment.

### *Costs*

It is important to note that operating costs, particularly in relation to weed management and control, are generally much higher for north Queensland compared to other jurisdictions. The approach developed for this analysis recognises those higher costs but may not capture all costs accurately, given the scale. They should be considered a guide and not relied on for any specific circumstances.

## Softwood costs

Softwood costs are summarised in Table 9.

***Table 9: Softwood costs***

| Management activity | Amount | Unit | Notes |
|---|---|---|---|
| Establishment | 2,805 | $/ha | Includes site preparation and supervision |
| Annual costs | 97 | $/ha | Excludes management, includes firebreaks, fences, insurance |
| Management | 70 | $/ha | Annual cost |
| Land | 3 | % land value | Land rental calculated as a percentage of land value annually |
| Harvest roading | 600 | $/ha | At clearfell |
| Harvest costs | 35 | $/m³ | MAI <13 (contractor costs CF) |
| | 30 | | MAI>13 (contractor costs CF) |

| | | | |
|---|---|---|---|
| Harvest supervision | 4 | $/m³ | Costs of harvest oversight |
| Haulage | 0.18 | $/m³/km | Calculated on the basis of distance to market |

## Hardwood costs

Hardwood costs are summarised in Table 10.

***Table 10: Hardwood costs***

| Management activity | Amount | Unit | Notes |
|---|---|---|---|
| Establishment | 2,865 | $/ha | Includes site preparation and supervision |
| Annual costs | 97 | $/ha | Excludes management, includes firebreaks, fences, insurance |
| Management | 70 | $/ha | Annual cost |
| Land | 3 | % land value | Land rental calculated as a percentage of land value annually |
| Harvest roading | 375 | $/ha | At T1 |
| | 330 | | At T2 |
| | 600 | | At clearfell |
| Harvest costs | 35 | $/m³ | MAI <13 (contractor costs CF and Thin) |
| | 30 | | MAI>13 (contractor costs CF and Thin) |
| Harvest supervision | 4 | $/m³ | Costs of harvest oversight |
| Haulage | 0.18 | $/m³/km | Calculated on the basis of distance to market |

# Markets

The following assumptions were applied to market destination for log products.

| | Destination | |
|---|---|---|
| **Product** | **Softwood** | **Hardwood** |
| Pulp log | Townsville | Townsville |
| Sawlog | Mareeba | Ravenshoe |
| | Townsville | Myrtlevale |
| | | Kuttabul |

There is currently no market for pulpwood in the region. The analysis assumes a new methanol production facility at Townsville, or a similar outlet for pulp log at a delivered price of $80/m³.

It is assumed that softwood sawlog will be transported to existing processing facilities at Mareeba (c. two thirds of production) and Townsville (refer to Figure 7). It is assumed that hardwood will be transported to processing facilities at Ravenshoe, Myrtlevale and Kuttabul, based on nearest distance (refer to Figure 8).

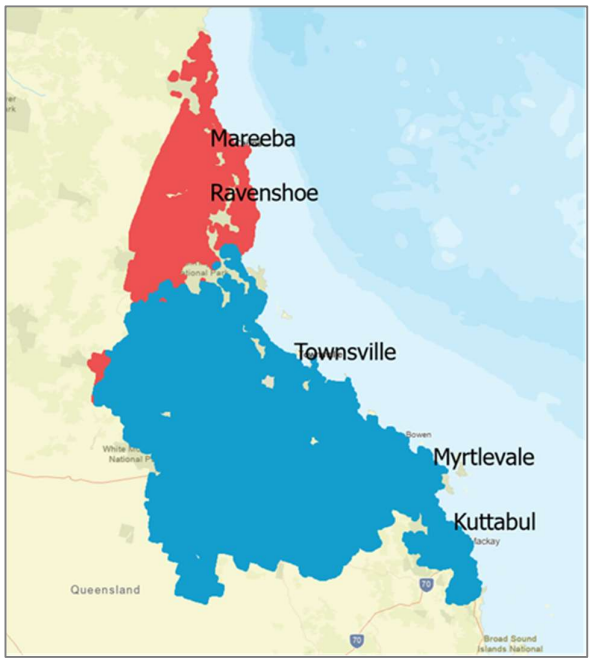



*Figure 7: Indicative supply catchments for softwood sawlog processing destinations*

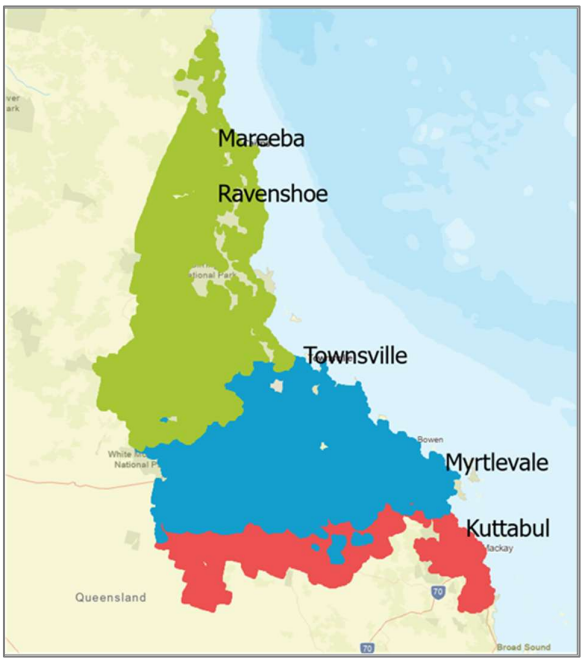



*Figure 8: Indicative supply catchments for hardwood sawlog processing destinations*

It is important to note that existing processing capacity within the region is not currently sufficient to deal with any substantial increase in log production. However, it is assumed that capacity will respond to the new increased log availability at scale.

# Carbon abatement and ACCU generation

## Total ACCU Models

All land currently eligible under Schedule 1 of the Plantation Forestry Method was modelled using FullCAM version 2023 on a 1km x 1km grid. The outputs of the FullCAM analysis were then processed to calculate ACCU yields for each location using appropriate global warming potential values, risk of reversal buffer discount and 25-year permanence discount. The result is a 'heat map' style GIS layer which presents the potential total yield of ACCUs likely to be generated for any given location

## ACCU profile models

Average annual ACCU yield profiles by ACCU Band (width of band is 50 ACCUs) were developed for use in the financial model to apportion the total ACCU yield returned by the ACCU GIS model for a scenario and location across the length of the rotation within the region.

These profiles were constructed from the outputs of randomly selected FullCAM PLO files for each scenario. For each manually run FullCAM PLO file, the profile of the annual ACCU yields was generated and the average annual values for all locations within each ACCU Band calculated to represent the profile for that ACCU Band (refer to Figure 9). The final profiles are expressed in percentage terms such that the sum of the percentages for each year across the 25-year crediting period equals 100% (refer to Figure 10). These annual percentage figures are applied to the specific total ACCU yield derived for any given individual location on the ACCU GIS Model, to calculate yield of ACCUs included in the financial analysis for that year.

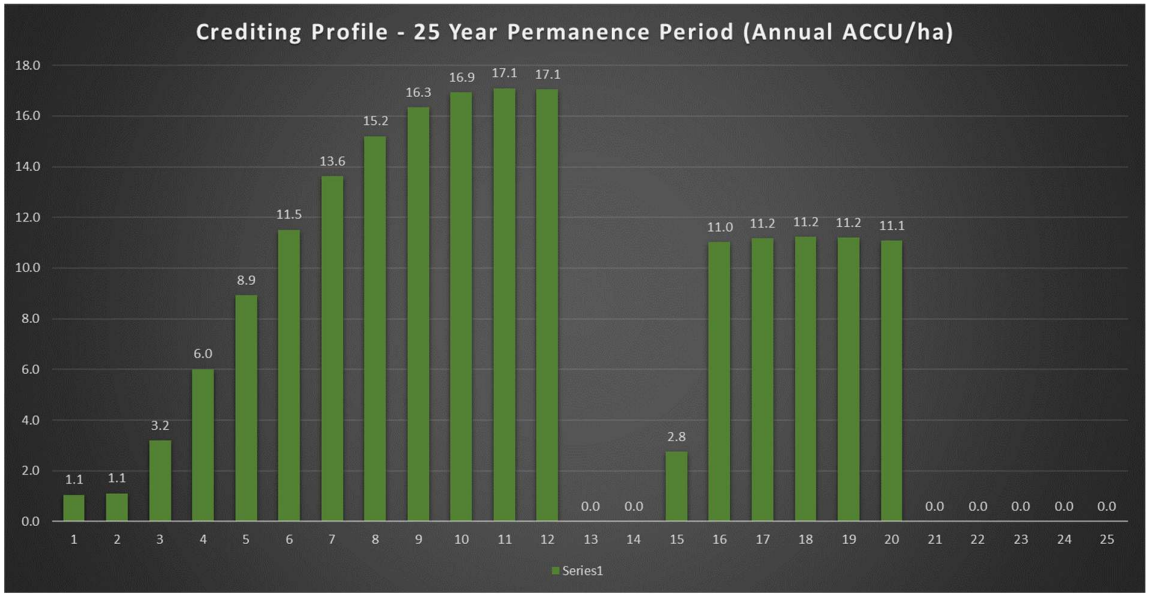



***Figure 9: Example Average Annual ACCU Profile (Total ACCU Yield = 187 ACCU/ha)***

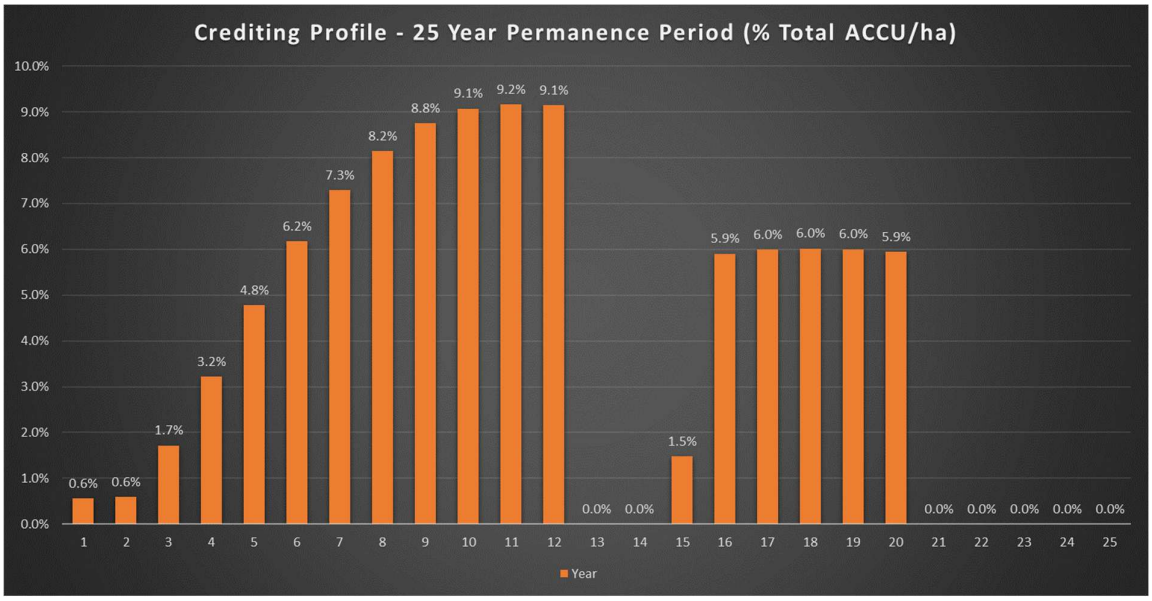



***Figure 10: Example Average Annual ACCU Profile, expressed in Percentage Terms***

## Carbon financial analysis

### *Carbon project revenue*

A price of $35/ACCU has been applied to the financial analysis.

### *Carbon project costs*

Carbon acquisition costs were modelled at $10/ACCU.

# Grazing

## Method and inputs

### *Grazing revenue formula*

Grazing financial inputs were calculated using the methodology developed by Lewis *et al.* (2022). Grazing revenue is calculated as:

$$GR = CC \times LWG \times LWP$$

Where: GR = Grazing revenue ($/ha/yr)
CC = Carrying capacity (AE/ha)
LWG = Live Weight Gain (kg/ha/yr)
LWP = Live weight price ($/kg)
AE = Adult Equivalent (450 kg *Bos taurus* steer at 2.25 yrs old)

### *Carrying capacity and live weight gain*

Carrying capacity varies widely based on a range of factors. The first consideration is site quality. As a proxy for site quality, we assigned carrying capacity variations to plantation MAI categories (Low: <7, Medium: 7-15 and High: >15 $m^3$/ha/yr). Using Lewis *et al.* (2022) as a base, we reviewed a range of grey literature about carrying capacity in Queensland and applied the range as 0.25 to 0.5 AE/ha. Similarly, we applied a range of 100-130kg/ha/yr for live weight gain.

### *Live weight price*

Live weight price was calculated as the weighted average price ($/kg) for all 2024 sales at Blackall[13], Queensland for manufacturing steers, grown heifers, vealer heifers, vealer steers, yearling steers, yearling heifers, bulls and cows. This location provided the most recent full set of sales data closest to the region. The average weighted live weight price was calculated at $3.64/kg.

### *Input summary*

| | MAI band | | |
|---|---|---|---|
| **Measure** | **<7** | **7-15** | **>15** |
| Carrying capacity (AE/ha) | 0.25 | 0.35 | 0.5 |
| Live weight gain (kg/ha/yr) | 100 | 115 | 130 |
| Live weight price ($/kg) | 3.64 | 3.64 | 3.64 |
| Grazing revenue ($/ha) | 91.00 | 146.51 | 236.60 |

### *Costs*

Husbandry costs were applied at $30/AE.

## Outputs

### *Adjustments*

Actual grazing output varies depending on the land management regime. Adjustments were made to grazing only outputs, based on the silvopastoral regime, as presented below. It should be noted

[13] https://www.mla.com.au/prices-markets/cattlephysicalreport/ (Accessed 08 January 2025)

that there are a wide range of potential agroforestry/silvopastoral designs which could be applicable. The approaches outlined below have been developed and analysed to allow comparison with other work being undertaken in northern and southern Queensland currently.

### Grazing under full tree crop

Grazing commenced in year 3. Live weight gain in year 3 was adjusted to 12.5% of live weight gain under grazing only conditions. Live weight gain was then reduced by 5% each year until year 13, to account for gradual loss in pasture availability as the trees grow.

### Grazing in alley plantings

Grazing commenced in year 3. Grazing in alley plantings was adjusted in a manner consistent with the modelling undertaken for the South-east Queensland Hub project. The alley-based system consists of a 20m row of pasture with no trees, followed by two rows of hardwood trees or three rows of softwood trees with five metres between the rows. In essence, there are concentrated rows of plantation trees with standard spacing (5m x 2m) beside alleys of regular pasture. For the hardwood silvopastoral system, a total land area of 60 hectares is required to achieve 20 hectares of plantation (i.e. 10/30, or 0.33 of every hectare is planted). For the softwood system, a total land area of 46 hectares is required (i.e. 15/35, or 0.429 of every hectare is planted) (PF Olsen Australia, 2023). Grazing revenues were adjusted on a pro-rated basis to account for this approach.

## Land value

Land value was derived from available published data (Rural Bank, 2023) and is presented in Table 11. ND refers to no data available. Presents a heat map of average land value across the AoI.

***Table 11: Average land value by local government authority***

| Local Government Authority | 2023 average land value ($/ha) |
|---|---|
| Aurukun Shire Council | ND |
| Burdekin Shire Council | $16,540 |
| Cairns Regional Council | $13,221 |
| Carpentaria Shire Council | ND |
| Cassowary Coast Regional Council | $11,726 |
| Charters Towers Regional Council | $1,896 |
| Cook Shire Council | $8,470 |
| Croydon Shire Council | ND |
| Douglas Shire Council | $11,226 |
| Etheridge Shire Council | ND |
| Flinders Shire Council | $172 |
| Hinchinbrook Shire Council | $10,316 |
| Hope Vale Aboriginal Shire Council | ND |
| Kowanyama Aboriginal Shire Council | ND |
| Lockhart River Aboriginal Shire Council | ND |
| McKinlay Shire Council | $825 |

| | |
|---|---|
| Mackay Regional Council | $12,204 |
| Mapoon Aboriginal Shire Council | ND |
| Mareeba Shire Council | $11,157 |
| Napranum Aboriginal Shire Council | ND |
| Northern Peninsula Area Regional Council | ND |
| Pormpuraaw Aboriginal Shire Council | ND |
| Richmond Shire Council | $974 |
| Tablelands Regional Council | $10,316 |
| Torres Shire Council | ND |
| Torres Strait Island Regional Council | ND |
| Townsville City Council | $14,605 |
| Whitsunday Regional Council | $8,642 |
| Wujal Wujal Aboriginal Shire Council | ND |
| Yarrabah Aboriginal Shire Council | ND |

# Calculation of financial suitability

For each of the 28 potential combinations of species/silviculture scenario and commercial regime (timber only; timber & carbon; timber, carbon & grazing; alternative silvopastoral), the internal rate of return (IRR) was calculated for each cell that was assessed as being capable of supporting plantation growth based on the financial analysis inputs described above.

Each scenario was analysed against IRR thresholds of 0%, 5%, 10% and 15% to determine which of the regimes for each scenario returned a positive IRR and what land area is capable of supporting profitable plantations. Results were only considered valid for areas greater than 1,000 ha.

In addition, each positive plantation IRR outcome was compared against the relevant IRR calculation for grazing only, to determine whether grazing by itself or a plantation-based solution delivered the best investment outcome.

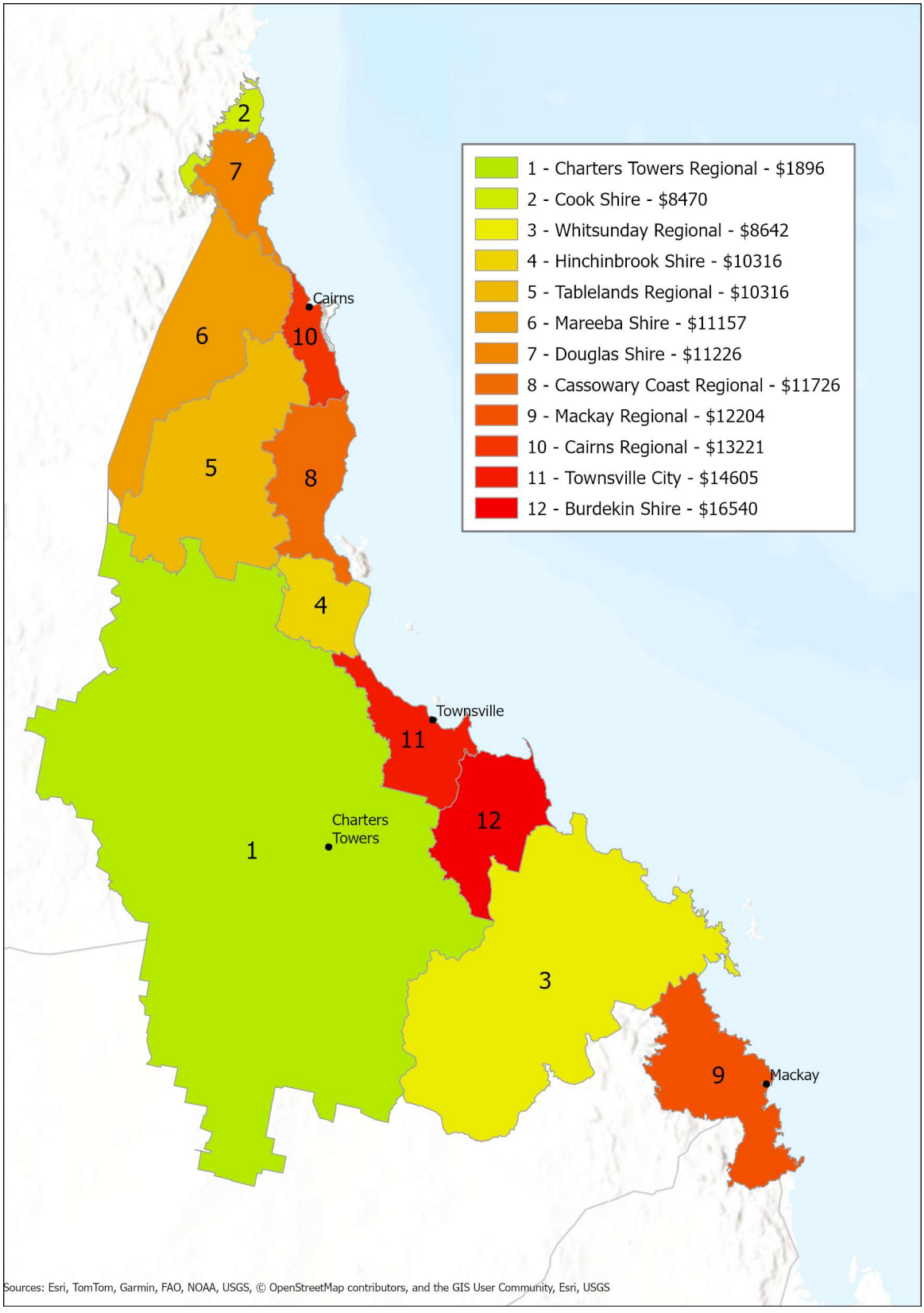



***Figure 11: Average land value ($/ha) in 2023 by LGA***

# FINANCIAL SUITABILITY RESULTS

## Overview

The suitability analysis shows that there are very large areas (540,000 to 1.2 million ha) that are capable of growing the selected species. There are also substantial areas (up to 260,000 ha) that are financially suitable for growing trees in for timber, carbon and grazing outputs, although the range of financially suitable areas varies considerably from as small as 5,400 ha for unthinned spotted gum and Gympie messmate in the alternative silvopastoral regime. Financially suitable results are strongly concentred in Cassowary Coast Regional Council and Tablelands Regional Council.

## Land capability and availability

The base case analysis indicates that a significant area within the region is available (not excluded) and has the biophysical capacity to support plantation expansion. The land area capable of supporting new plantations varies with species and is summarised in Table 12. The analysis demonstrates the more significant limitations for *E. pellita* and *E. cloeziana*, with both *P. caribaea* and *C. citriodora* capable of growing successfully across a much broader range of the challenging biophysical variables within the region (refer to Figure 12).

***Table 12: Land area available and capable of supporting new plantations***

| Species | Land area (ha) |
|---|---|
| Southern pines (*Pinus caribaea*) (Scenarios 1 and 2) | 988,176 |
| Red Mahogany (*Eucalyptus pellita*) (Scenario 3) | 644,534 |
| Gympie messmate (*Eucalyptus cloeziana*) (Scenarios 4 and 5) | 541,734 |
| Spotted Gum (*Corymbia citriodora subsp. variegata*) (Scenarios 6 and 7) | 1,107,768 |

While these are large areas that can viably support growing trees, there is also large variability in potential productivity. Table 13 shows the spread of productivity in MAI bands for each scenario within the relevant land capability envelope for the species.

***Table 13: Area capable of growing plantation trees by MAI band for each scenario***

| | MAI band ($m^3$/ha/yr) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | <5 | 5 to 7 | 7 to 9 | 9 to 11 | 11 to 13 | 13 to 15 | 15 to 17 | >17 | Total |
| Scenario 1 | - | 22,424 | 206,682 | 231,420 | 194,589 | 99,441 | 233,620 | - | 988,176 |
| Scenario 2 | - | - | 39,928 | 205,600 | 192,524 | 178,033 | 76,957 | 295,135 | 988,176 |
| Scenario 3 | 8,144 | 156,238 | 183,201 | 103,569 | 193,382 | - | - | - | 644,534 |
| Scenario 4 | 112,122 | 167,869 | 93,308 | 64,205 | 74,438 | 24,165 | 5,627 | - | 541,734 |
| Scenario 5 | 112,122 | 167,869 | 93,308 | 64,205 | 74,438 | 24,165 | 5,627 | - | 541,734 |
| Scenario 6 | 348,186 | 388,174 | 155,480 | 87,122 | 87,771 | 31,729 | 8,914 | 393 | 1,107,768 |
| Scenario 7 | 686,924 | 227,862 | 117,363 | 64,669 | 10,950 | - | - | - | 1,107,768 |

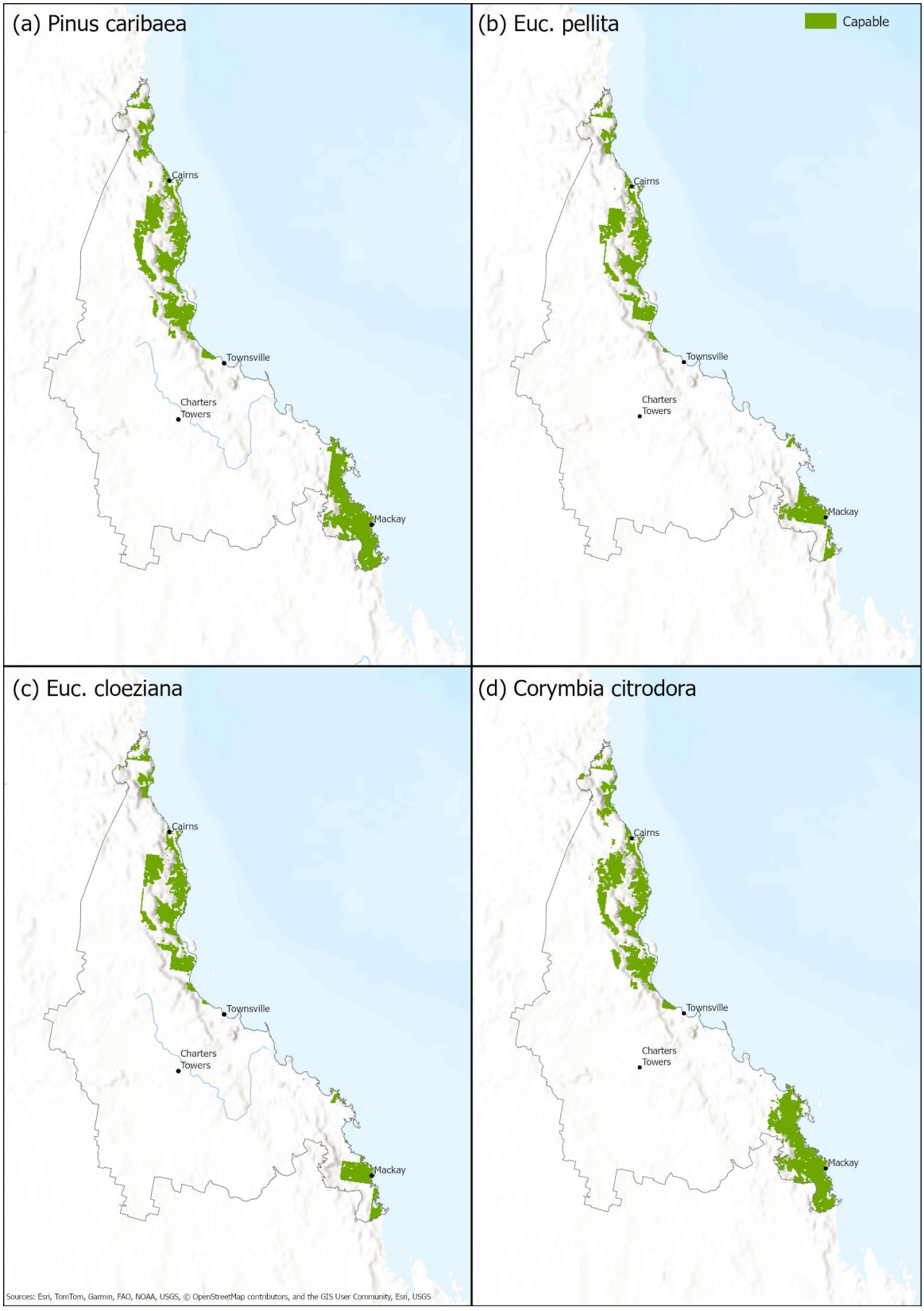



***Figure 12: Land capability by species***

# Land suitability for commercial plantations

## Summary

IRR analysis was completed for threshold returns at 0%, 5%, 10% and 15%. However, for the purpose of determining commercial suitability of plantations, the 10% threshold was applied. This is consistent with an informed investment decision, although the model permits the threshold to be tested at any preferred IRR.

***Table 14: Area of financially suitable land for plantation expansion at an IRR threshold of 10%***

| | | Timber | | Timber and carbon | | Timber carbon and grazing | | Timber, carbon and grazing (alley planting) | | Grazing only |
|---|---|---|---|---|---|---|---|---|---|---|
| Scen | Land capability area (ha) | Area | IRR | Area | IRR | Area | IRR | Area | IRR | IRR |
| 1 | 988,176 | | | 158,399 | 14% | 158,777 | 15% | 257,285 | 23% | 10% |
| 2 | 988,176 | | | 27,454 | 11% | 33,431 | 11% | 201,660 | 19% | 16% |
| 3 | 644,534 | | | 71,097 | 10% | 74,096 | 10% | 141,018 | 13% | 19% |
| 4 | 541,734 | | | 13,796 | 10% | 13,796 | 10% | 15,365 | 12% | 10% |
| 5 | 541,734 | | | | | | | 5,429 | 11% | 10% |
| 6 | 1,107,768 | | | 25,877 | 10% | 27,825% | 10% | 20,411 | 12% | 10% |
| 7 | 1,107,768 | | | | | | | 5,429 | 11% | 10% |

The analysis demonstrates that, regardless of the commercial regime, *P. caribaea* (Scenarios 1 and 2) performs considerably better than the hardwood species as measured by the area on which plantations can be grown profitably. It also demonstrates the considerable incremental value of carbon and grazing in improving the potential returns for forestry projects. Each of the target species demonstrates potential for expansion in the region at the 10% IRR threshold, although the unthinned Gympie messmate and spotted gum scenarios were only positive on a very small area (5,400 ha) under the alternative silvopastoral regime.

For most of scenarios and regimes where plantation suitability is demonstrated, the plantation returns exceed the average grazing returns. The exceptions are Eucalyptus pellita (which competes with higher grazing returns due to higher quality and) and short rotation pine. This demonstrates that plantation-based land uses can compete with grazing effectively as a preferred land use, for some species in some locations.

There are no combinations for which the timber only regime exceeds the 10% IRR threshold. This clearly demonstrates that for plantations to compete with other land uses, carbon and grazing need to be considered as part of the overall land management mix.

A summary of all IRR outputs for each combination of species, silviculture and commercial regime is presented in Appendix 3.

## Scenario 1 – Long rotation softwood, unthinned

The analysis shows that for long rotation pine to be commercially viable requires a combination of timber, carbon and/or grazing. That is due to the long rotation lengths which impact the long-term profitability of long rotation plantations in most locations. However, the incorporation of both carbon and grazing significantly improves the financial outlook, with 303,000 hectares viable at the 10% IRR threshold (refer to Figure 13). At that point, commercial plantations are also competitive with grazing only for the same land base. It relies on the presence of a pulp log market.

***Table 15: Plantation suitability analysis for Scenario 1***

| IRR Threshold | 0% | | 5% | | 10% | | 15% | |
|---|---|---|---|---|---|---|---|---|
| | Area | IRR | Area | IRR | Area | IRR | Area | IRR |
| Suitable area | 988,716 | | | | | | | |
| Timber only | | | | | | | | |
| Timber and carbon | 230,905 | 12% | 203,996 | 13% | 158,399 | 14% | 67,927 | 16% |
| Timber, carbon, grazing | 232,144 | 12% | 208,500 | 13% | 158,777 | 15% | 73,077 | 17% |
| Alternative silvopastoral | 291,872 | 21% | 276,735 | 22% | 257,285 | 23% | 225,764 | 24% |
| Grazing only | | 10% | | 10% | | 10% | | 10% |

## Scenario 2 – Short rotation softwood, unthinned

Scenario 2 does not compete with grazing only except for the alternative silvopastoral system. That is because it competes with higher grazing returns over a shorter timeframe. At the 10% IRR threshold, alternative silvopastoral significantly outperforms timber, carbon and grazing. Scenario 2 has been calculated using pulp log as the only timber output. An increase in value would be delivered if small and medium sawlog was also included in the yield outturn. It relies on the presence of a pulp log market (refer to Figure 14).

***Table 16: Plantation suitability analysis for Scenario 2***

| IRR Threshold | 0% | | 5% | | 10% | | 15% | |
|---|---|---|---|---|---|---|---|---|
| | Area | IRR | Area | IRR | Area | IRR | Area | IRR |
| Suitable area | 988,716 | | | | | | | |
| Timber only | 1,373 | 7% | | | | | | |
| Timber and carbon | 133,555 | 7% | 105,290 | 9% | 27,454 | 11% | 1,067 | 18% |
| Timber, carbon, grazing | 136,812 | 8% | 110,529 | 9% | 33,431 | 11% | 1,067 | 19% |
| Alternative silvopastoral | 205,564 | 19% | 205,448 | 9% | 201,660 | 19% | 195,381 | 20% |
| Grazing only | | 16% | | 16% | | 16% | | 16% |

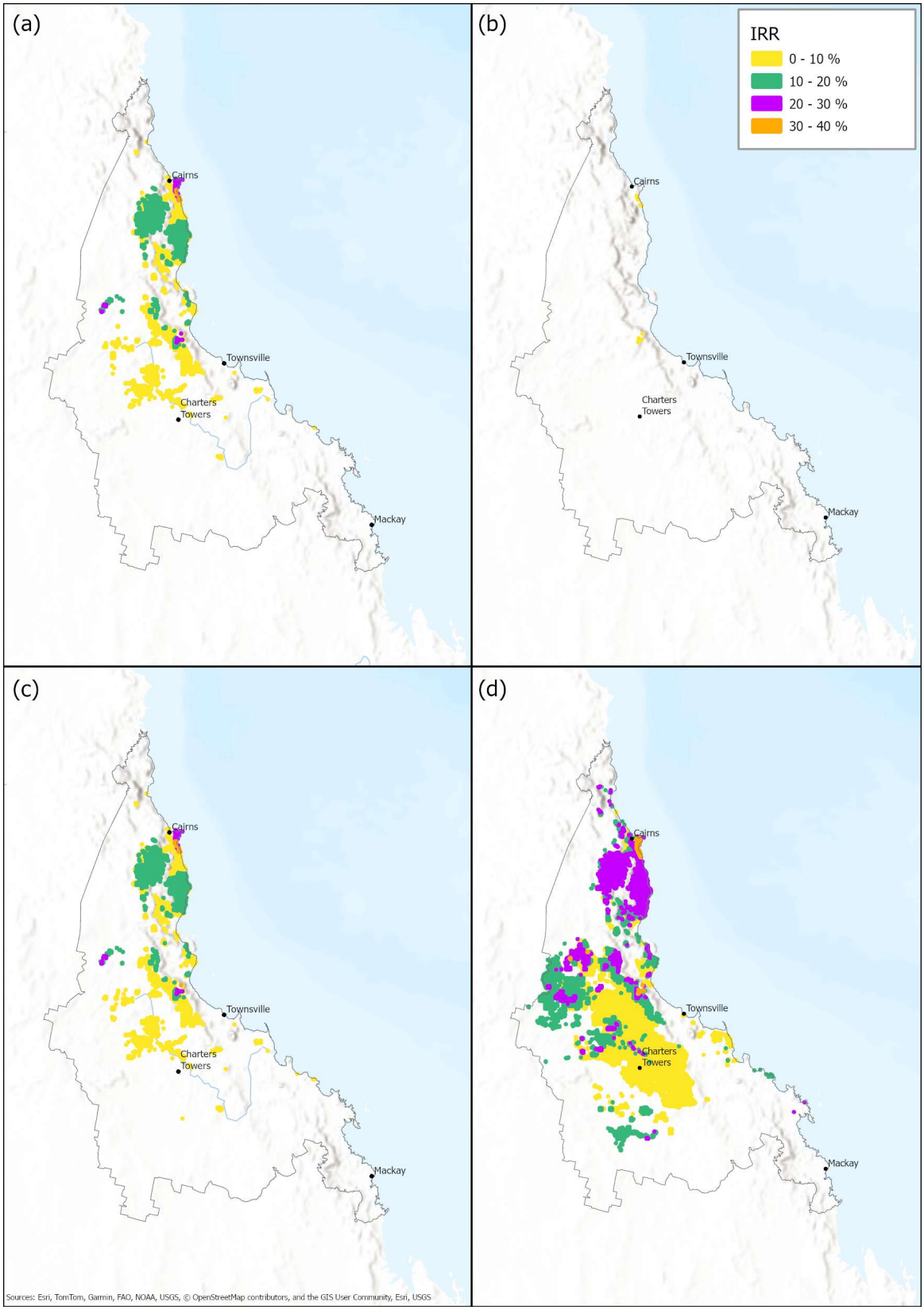



***Figure 13: Scenario 1 - Long rotation softwood financial suitability (a) timber & carbon; (b) timber only; (c) timber, carbon & grazing; (d) alternative silvopastoral***

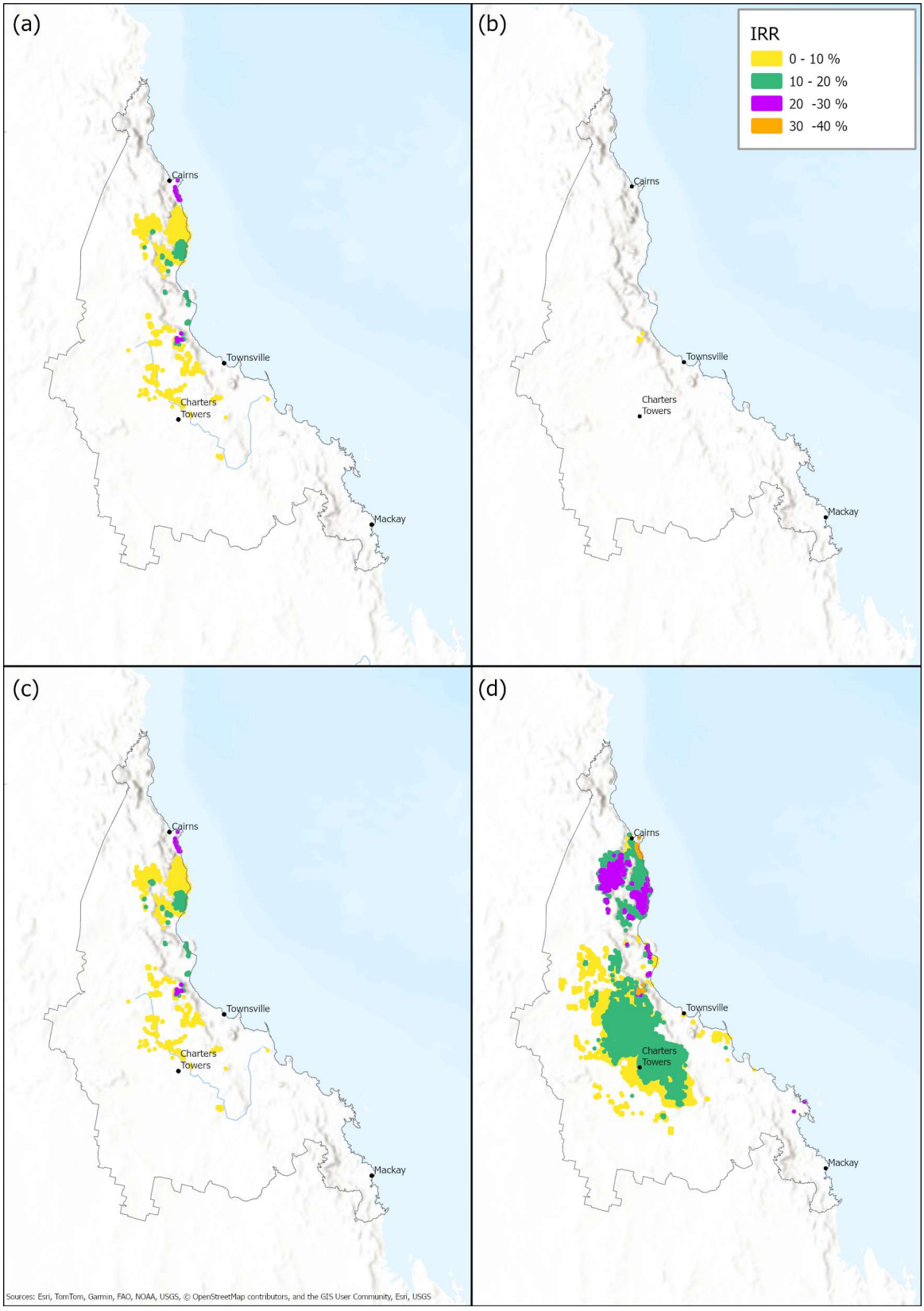



***Figure 14: Scenario 2 - Short rotation softwood financial suitability (a) timber & carbon; (b) timber only; (c) timber, carbon & grazing; (d) alternative silvopastoral***

## Scenario 3 – Short rotation *E. pellita*, unthinned

Capability for this scenario is limited to a relatively small area of high-quality land close to the coast. Therefore, it competes with a relatively higher site quality grazing option which means that it struggles to compete, even though it has a sizeable area that exceeds the 10% IRR threshold (refer to Figure 15). It is possible that higher product prices for veneer could result in significant improvement, although that is somewhat speculative.

***Table 17: Plantation suitability analysis for Scenario 3***

| IRR Threshold | 0% | | 5% | | 10% | | 15% | |
|---|---|---|---|---|---|---|---|---|
| | Area | IRR | Area | IRR | Area | IRR | Area | IRR |
| Suitable area | 644,534 | | | | | | | |
| Timber only | | | | | | | | |
| Timber and carbon | 160,138 | 8% | 156,589 | 9% | 71,097 | 10% | | |
| Timber, carbon, grazing | 160,238 | 9% | 156,894 | 9% | 74,096 | 10% | | |
| Alternative silvopastoral | 160,497 | 13% | 160,397 | 13% | 141,018 | 13% | 38,527 | 36% |
| Grazing only | | 19% | | 19% | | 19% | | 19% |

## Scenario 4 – Long rotation Gympie messmate, thinned

There is a small but material area of about 14,000 ha that presents opportunity for expansion of Gympie messmate with carbon and grazing (refer to Figure 16). It is possible that tweaking the timber prices to recognise future pole production could have a significant influence on the viability of this option.

***Table 18: Plantation suitability analysis for Scenario 4***

| IRR Threshold | 0% | | 5% | | 10% | | 15% | |
|---|---|---|---|---|---|---|---|---|
| | Area | IRR | Area | IRR | Area | IRR | Area | IRR |
| Suitable area | 541,734 | | | | | | | |
| Timber only | | | | | | | | |
| Timber and carbon | 49,151 | 6% | 23,873 | 8% | 13,796 | 10% | | |
| Timber, carbon, grazing | 50,067 | 6% | 24,867 | 8% | 13,786 | 10% | | |
| Alternative silvopastoral | 159,201 | 6% | 96,424 | 7% | 15,365 | 12% | 4,625 | 16% |
| Grazing only | | 10% | | 10% | | 10% | | 10% |

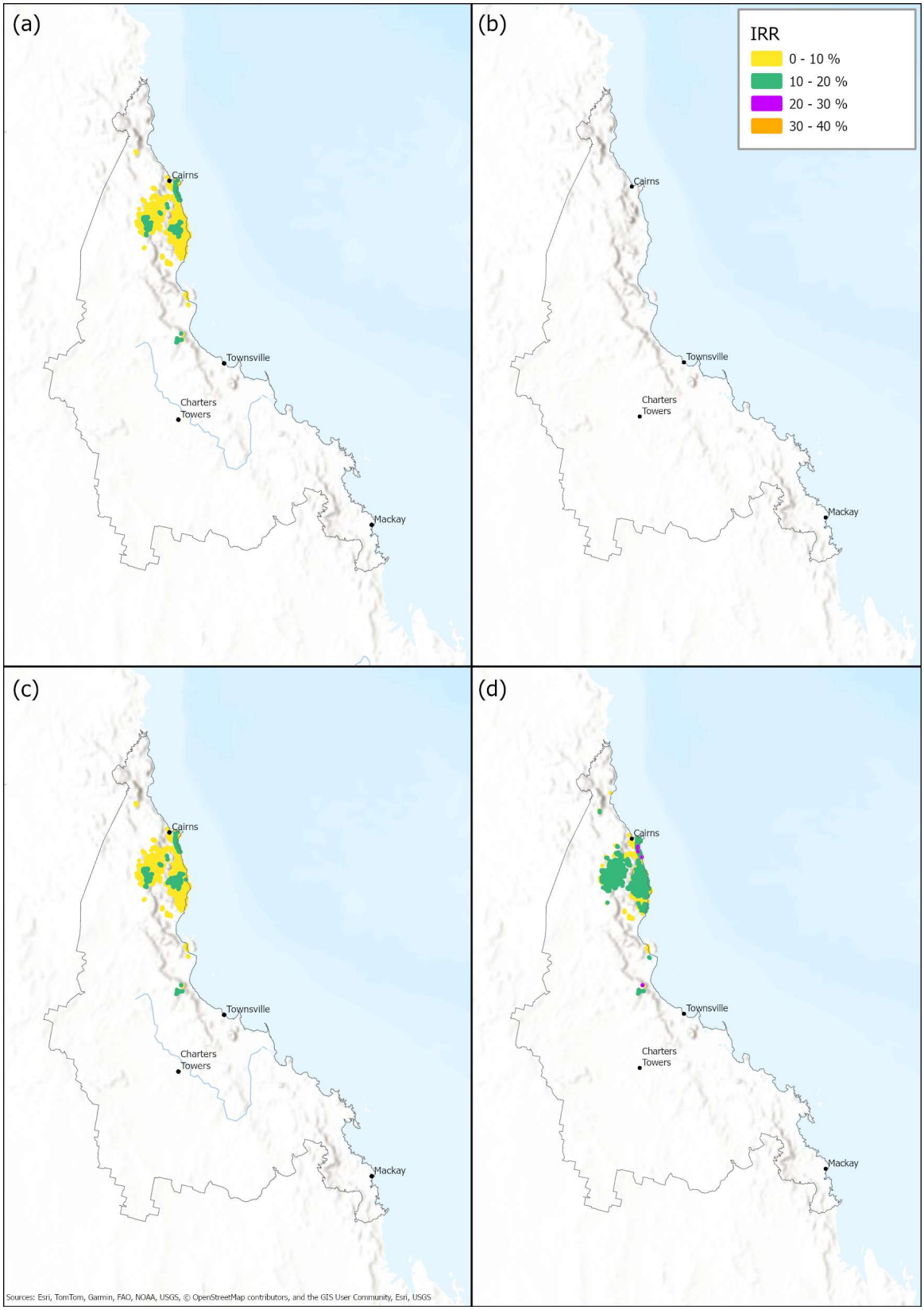



***Figure 15: Scenario 3 - Eucalyptus pellita financial suitability (a) timber & carbon; (b) timber only; (c) timber, carbon & grazing; (d) alternative silvopastoral***

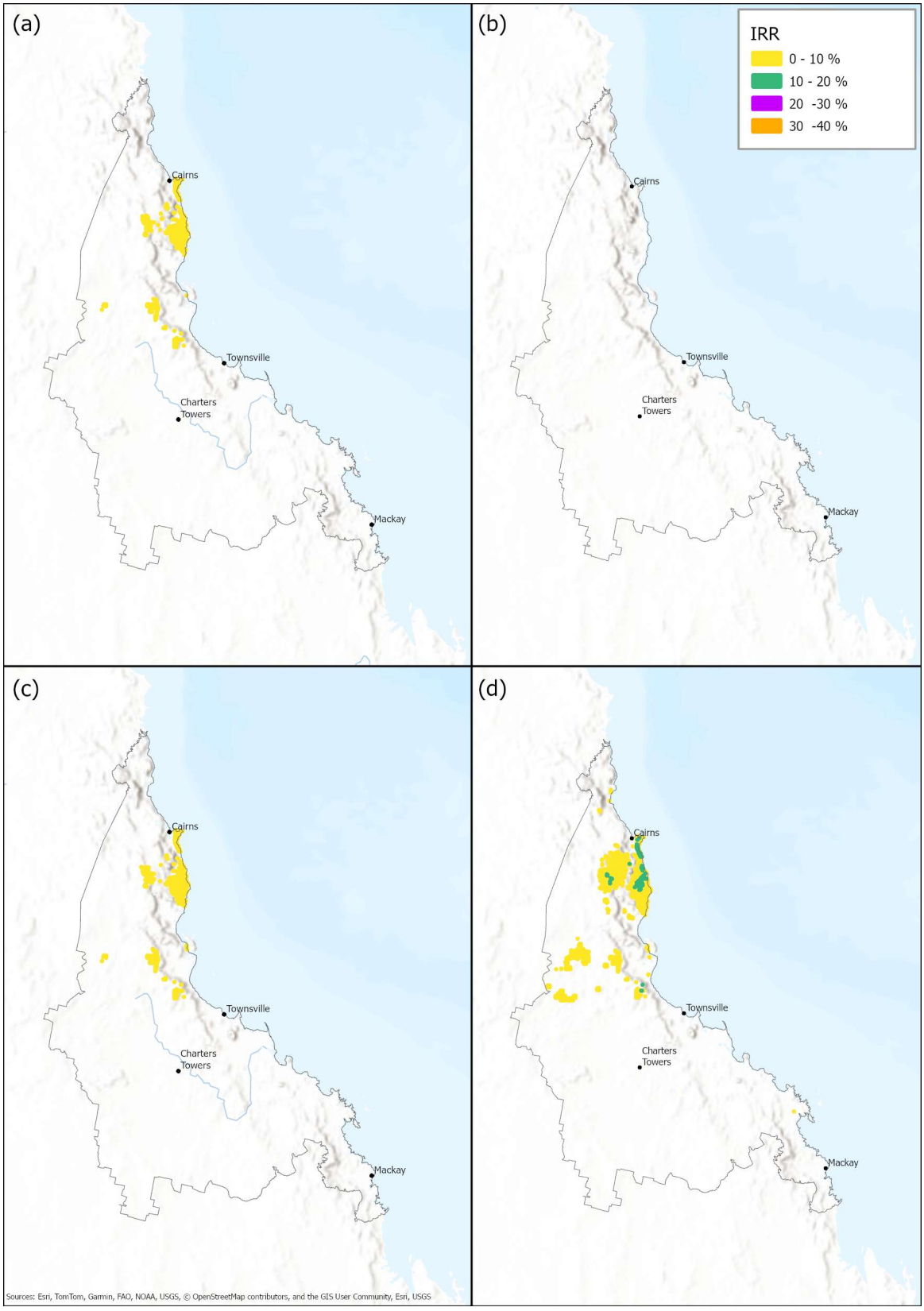



***Figure 16: Scenario 4 - Thinned Gympie messmate financial suitability (a) timber & carbon; (b) timber only; (c) timber, carbon & grazing; (d) alternative silvopastoral***

## Scenario 5 – Long rotation Gympie messmate, unthinned

This scenario is considered financially unviable under all regimes except for a small area of alternative silvopastoral regime (refer to Figure 17).

***Table 19: Plantation suitability analysis for Scenario 5***

| IRR Threshold | 0% | | 5% | | 10% | | 15% | |
|---|---|---|---|---|---|---|---|---|
| | Area | IRR | Area | IRR | Area | IRR | Area | IRR |
| Suitable area | 541,734 | | | | | | | |
| Timber only | | | | | | | | |
| Timber and carbon | | | | | | | | |
| Timber, carbon, grazing | | | | | | | | |
| Alternative silvopastoral | 19,868 | 7% | 16,084 | 9% | 5,429 | 11% | | |
| Grazing only | | 10% | | 10% | | 10% | | 10% |

## Scenario 6 – Long rotation spotted gum, thinned

As with Scenario 4, Scenario 6 presents a small but material area of more than 25,000 ha for expansion of spotted gum with carbon and grazing (refer to Figure 18). Spotted gum is recognised as a potentially important silvopastoral species, in both plantations and native forest settings. As with Gympie messmate, more aggressive pricing assumptions for higher quality log products could substantially improve the viability of this scenario, although those markets do not currently exist.

***Table 20: Plantation suitability analysis for Scenario 6***

| IRR Threshold | 0% | | 5% | | 10% | | 15% | |
|---|---|---|---|---|---|---|---|---|
| | Area | IRR | Area | IRR | Area | IRR | Area | IRR |
| Suitable area | 1,107,768 | | | | | | | |
| Timber only | | | | | | | | |
| Timber and carbon | 72,451 | 6% | 41,602 | 8% | 25,877 | 10% | | |
| Timber, carbon, grazing | 75,728 | 6% | 44,313 | 8% | 27,825 | 10% | | |
| Alternative silvopastoral | 202,999 | 6% | 116,184 | 8% | 20,411 | 12% | 7,668 | 16% |
| Grazing only | | 10% | | 10% | | 10% | | 10% |

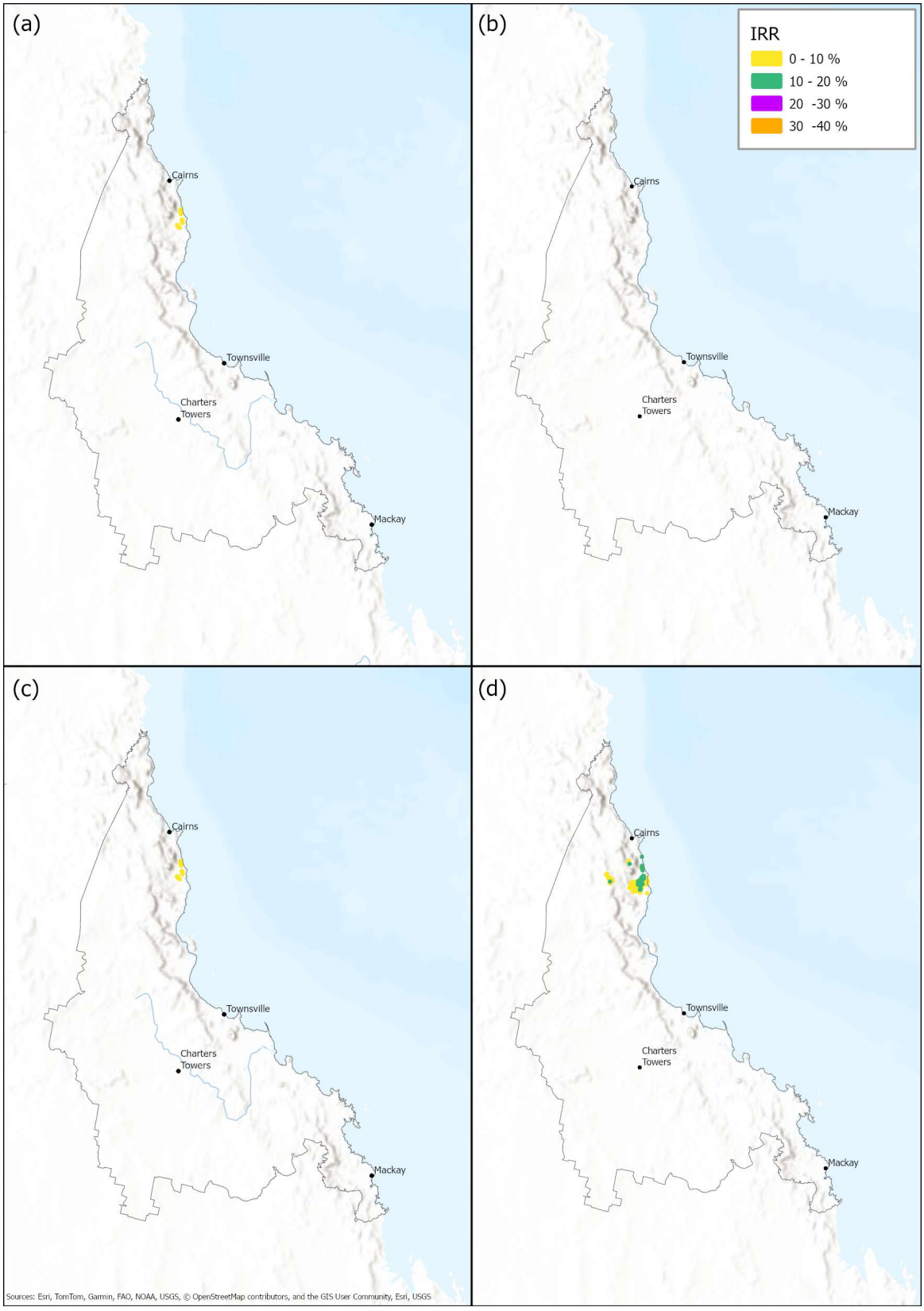



***Figure 17: Scenario 5 - Unthinned Gympie messmate financial suitability (a) timber & carbon; (b) timber only; (c) timber, carbon & grazing; (d) alternative silvopastoral***

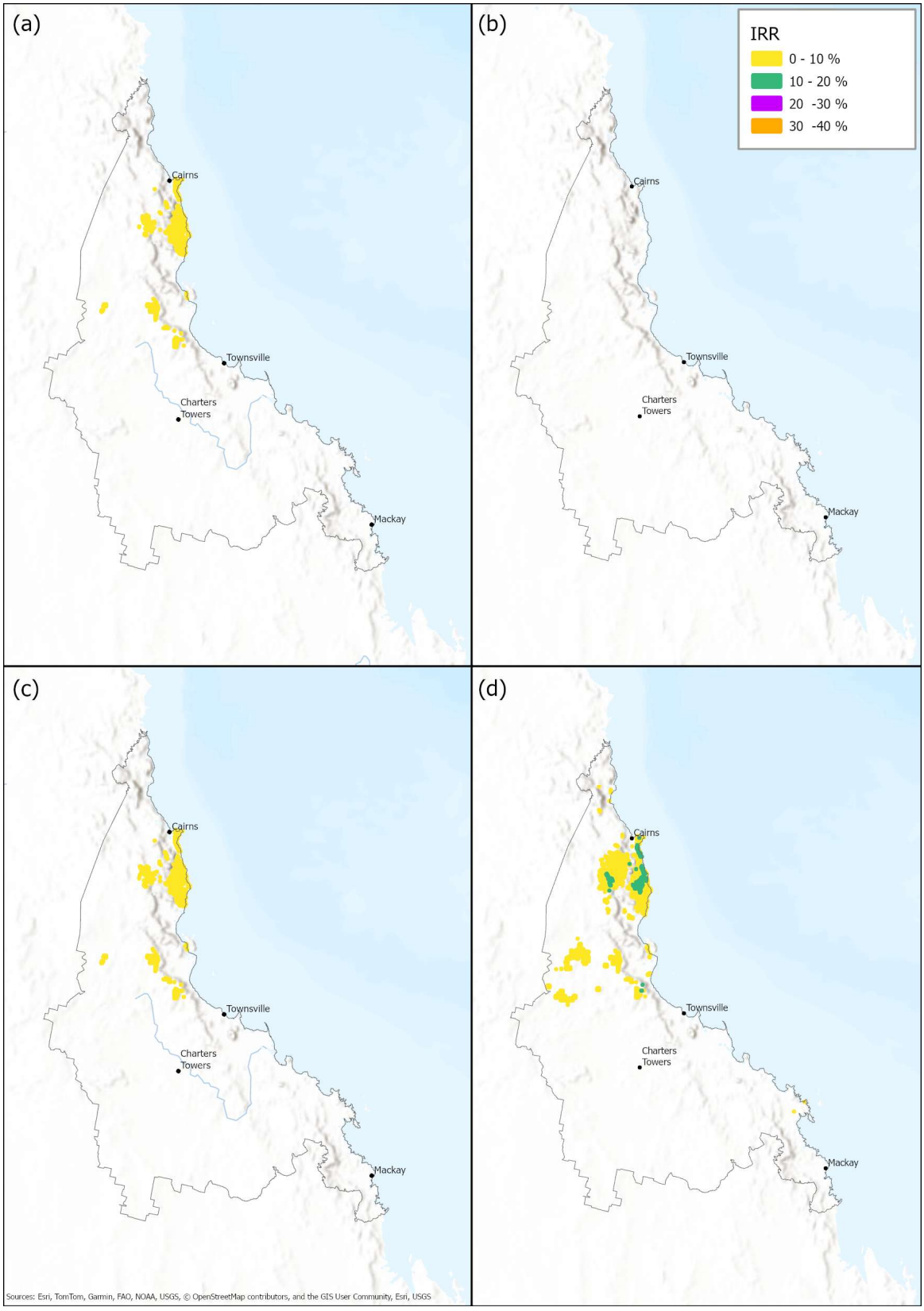



***Figure 18: Scenario 6 – Thinned spotted gum financial suitability (a) timber & carbon; (b) timber only; (c) timber, carbon & grazing; (d) alternative silvopastoral***

## Scenario 7 – Long rotation spotted gum, unthinned

This scenario is considered financially unviable under all regimes except for a small area of alternative silvopastoral regime (refer to ***Figure 19***).

***Table 21: Plantation suitability analysis for Scenario 7***

| IRR Threshold | 0% | | 5% | | 10% | | 15% | |
|---|---|---|---|---|---|---|---|---|
| | Area | IRR | Area | IRR | Area | IRR | Area | IRR |
| Suitable area | 1,107,768 | | | | | | | |
| Timber only | | | | | | | | |
| Timber and carbon | | | | | | | | |
| Timber, carbon, grazing | | | | | | | | |
| Alternative silvopastoral | 22,381 | 7% | 17,933 | 9% | 5,429 | 11% | | |
| Grazing only | | 10% | | 10% | | 10% | | 10% |

# Sensitivity analysis

## Discount rate

Internal Rate of Return (IRR) is the discount rate at which net present value (NPV) is equal to zero for a specified cashflow. In this analysis we have assessed each scenario and silvicultural regime against IRR thresholds of 0%, 5%. 10% and 15%. By analysing and comparing the results (plantation area and average IRR) it is possible to broadly assess the sensitivity of various combinations of variables.

Generally, the difference between the timber & carbon and timber, carbon & grazing regimes is minimal. Grazing generally increases the area slightly but not significantly, suggesting only minor increases in profitability.

In most of the scenarios, the alternative silvopastoral regime delivers materially larger viable areas, particularly at lower IRR thresholds but there is a slight pattern difference for scenarios 1 and 3 (high value scenarios) where the results are much closer at the lower IRR threshold and scenarios 4 and 6 (thinned hardwoods) where the results are closer at the 10% IRR threshold. The likely reason for this is that timber value influences scenarios 1 and 3 more strongly but depletes as the discount rate increases due to the timing of revenue. By contrast, with scenarios 4 and 6, timber is much less influential on the results, but the contribution of grazing revenue decreases at higher discount rates.

Scenario 1 is the least sensitive to discount rate, with less than a 50% reduction in available area for all three silvicultural regimes. Scenario 2 is the most sensitive to discount rate for the timber & carbon and timber, carbon & grazing regimes, because of the sensitivity to pulp log price. However, the alternative silvopastoral regime maintains value at all discount rates due to the higher grazing value on relatively higher quality land, and the short rotation length.

Broadly, the response to discount rate variations is typical of what should be expected for the range of scenarios analysed.

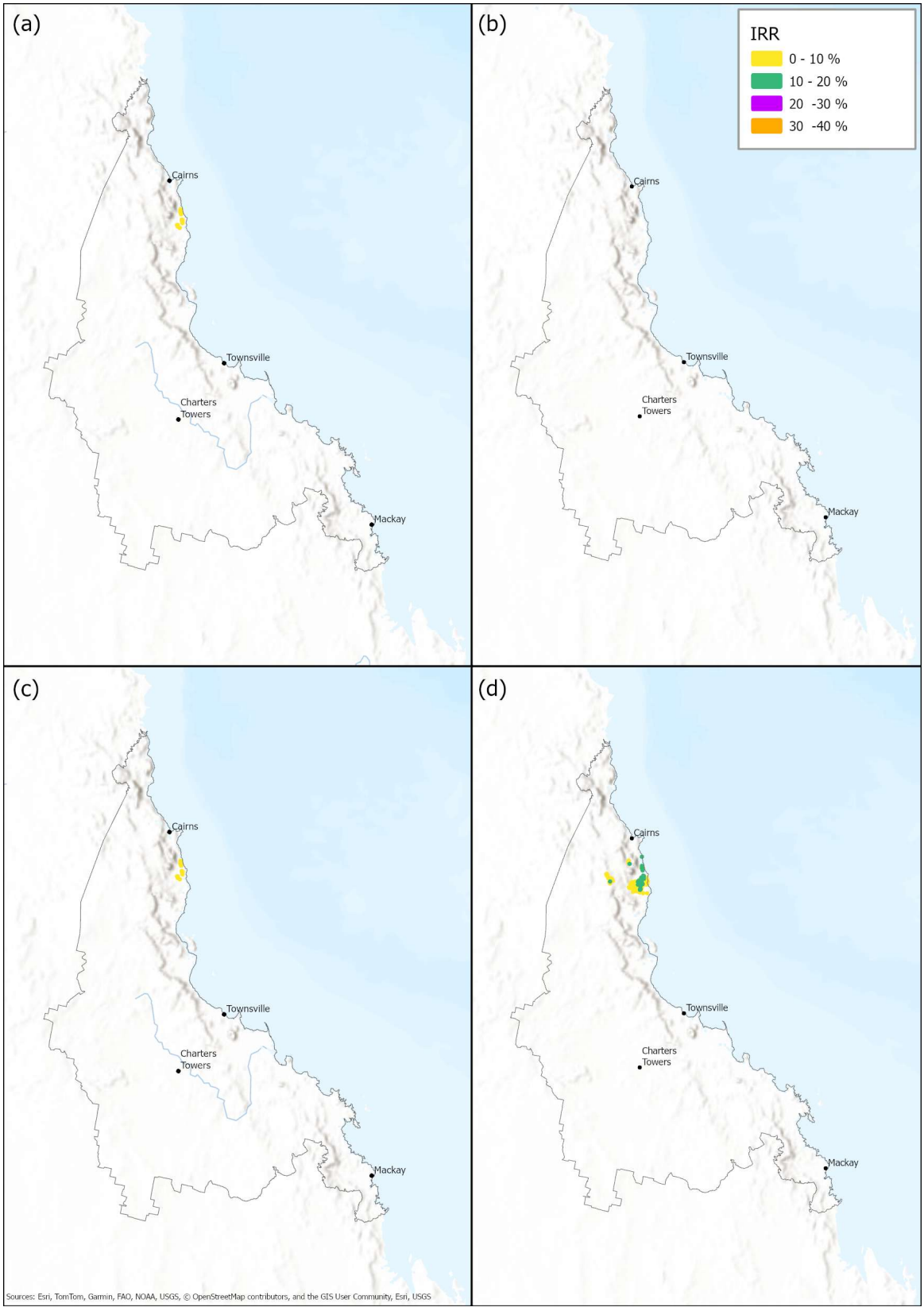



***Figure 19: Scenario 7 - Unthinned spotted gum financial suitability (a) timber & carbon; (b) timber only; (c) timber, carbon & grazing; (d) alternative silvopastoral***

## Other variables

For variables other than discount rate, nine individual 1km grid points were identified across the analysis area and cashflows generated for each scenario for the timber, carbon & grazing regime. Four variables were tested to determine their impact on value (refer to Table 22).

***Table 22: Variables considered for sensitivity analysis***

| Parameter | Low | Model | High |
|---|---|---|---|
| ACCU price ($/ACCU) | $25 | $35 | $45 |
| Timber price ($/m$^3$) | -20% | Per model | +20% |
| No pulp price | $0/m$^3$ | $80/m$^3$ | - |
| Farmgate price for beef ($/AE) | $2.50 | $3.64 | $4.00 |
| Rent (% of land value) | 2% | 3% | 5% |

Changes in net present value at 10% discount rate were compared against the base model for each scenario at each grid. The results were then averaged to determine an overall sensitivity assessment. Results were assessed as not sensitive (0-1%), moderately sensitive (2-20%), highly sensitive (20-100%) and very highly sensitive (>100%). The consolidated results are presented in Table 23

***Table 23: Results of sensitivity analysis for four variables***

| Variable | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 | Scenario 5 | Scenario 6 | Scenario 7 |
|---|---|---|---|---|---|---|---|
| ACCU price | | | | | | | |
| Timber price | | | | | | | |
| No pulp price | | | | | | | |
| Beef price | | | | | | | |
| Rent | | | | | | | |

**Legend:** Not sensitive; Moderately sensitive; Highly sensitive; Very highly sensitive

Scenario 1 is very highly sensitive to timber price and scenarios 2 and 3 are very highly sensitive to the absence of a pulp log market. All the scenarios are highly sensitive to both ACCU price and rent (as a proxy for land value). The model is generally not sensitive to beef price, except for scenario 2 where which is already sensitive to timber price and pulpwood market availability. Scenarios 4, 5, 6 and 7 are not sensitive to timber price or the presence of pulp log market, predominantly because timber revenue is less of a driver than ACCU and grazing revenue.

As with discount rate, the sensitivities identified in this analysis are consistent with the nature of the scenarios and silvicultural regimes.

## Plantation establishment grants

Since 2023, the Australian Government's **Support Plantation Establishment** program[14] has been in pace to provide grants of $2,000/ha for establishment programs of at least 20 ha. The base analysis undertaken for this project has assumed the availability of grant funds. The program is currently due to conclude in 2027. Because of the substantial contribution of the grant to plantation cashflows, it was determined that the financial suitability model should be tested without the grant funds available. Table 24 compares quantified the impact of reduced area by removing the grant at the 10% IRR threshold. While there is a significant reduction in the financially viable area, there is still a significant area of long rotation pine (Scenario 1) that is financially viable. The table does not show results for scenarios 5 and 6 (unthinned Gympie messmate and spotted gum) as these are already considered very not financially suitable.

***Table 24: Comparison of each scenario and silvicultural regime with and without grant at 10% IRR threshold***

| | Scenario 1 | | Scenario 2 | | Scenario 3 | | Scenario 4 | | Scenario 6 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Regime | Area | Change | Area | Change | Area | Change | Area | Change | Area | Change |
| 1 | - | - | - | - | - | - | - | - | - | - |
| 2 | 18,145 | -140,254 | - | -27,553 | - | -71,097 | - | -13,796 | - | -25,877 |
| 3 | 14,936 | -143,841 | - | -33,531 | - | -74,096 | - | -13,786 | - | -27,825 |
| 4 | 180,358 | -76,927 | 17,743 | -190,428 | - | -141,018 | 3,423 | -11,942 | 7,668 | -12,743 |

Regime: (1) Timber only; (2) Timber and carbon; (3) Timber, carbon & grazing; (4) Alternative silvo-pastoral

Under this analysis, Eucalyptus pellita is not viable and Gympie messmate and spotted gum demonstrate only low viability. However, reducing the IRR threshold has a significant positive impact for spotted gum in particular. At a threshold of 7%, the area of spotted gum that is viable under the alternative silvopastoral regime increases to 46,300 ha and at 5% IRR the area is 94,000, even without the grant. Importantly, much of the viable area is west of the tablelands under the lower IRR settings, which may support a push for silvopastoral regimes in drier parts of the region (refer to Figure 20).

Generally, though, the absence of the Commonwealth grant has a very significant adverse impact on the potential viability of new plantations.

# Results by local government area

The results for all scenarios are heavily concentrated in the Cassowary Coast Regional Council. Scenario 1 (long rotation pine) and Scenario 2 (Eucalyptus pellita) also have very large areas in Tablelands Regional Council. Table 25 presents the area results for each scenario under the alternative silvopastoral regime for every local government authority.

[14] https://www.agriculture.gov.au/agriculture-land/forestry/industries/support-plantation-establishment-program

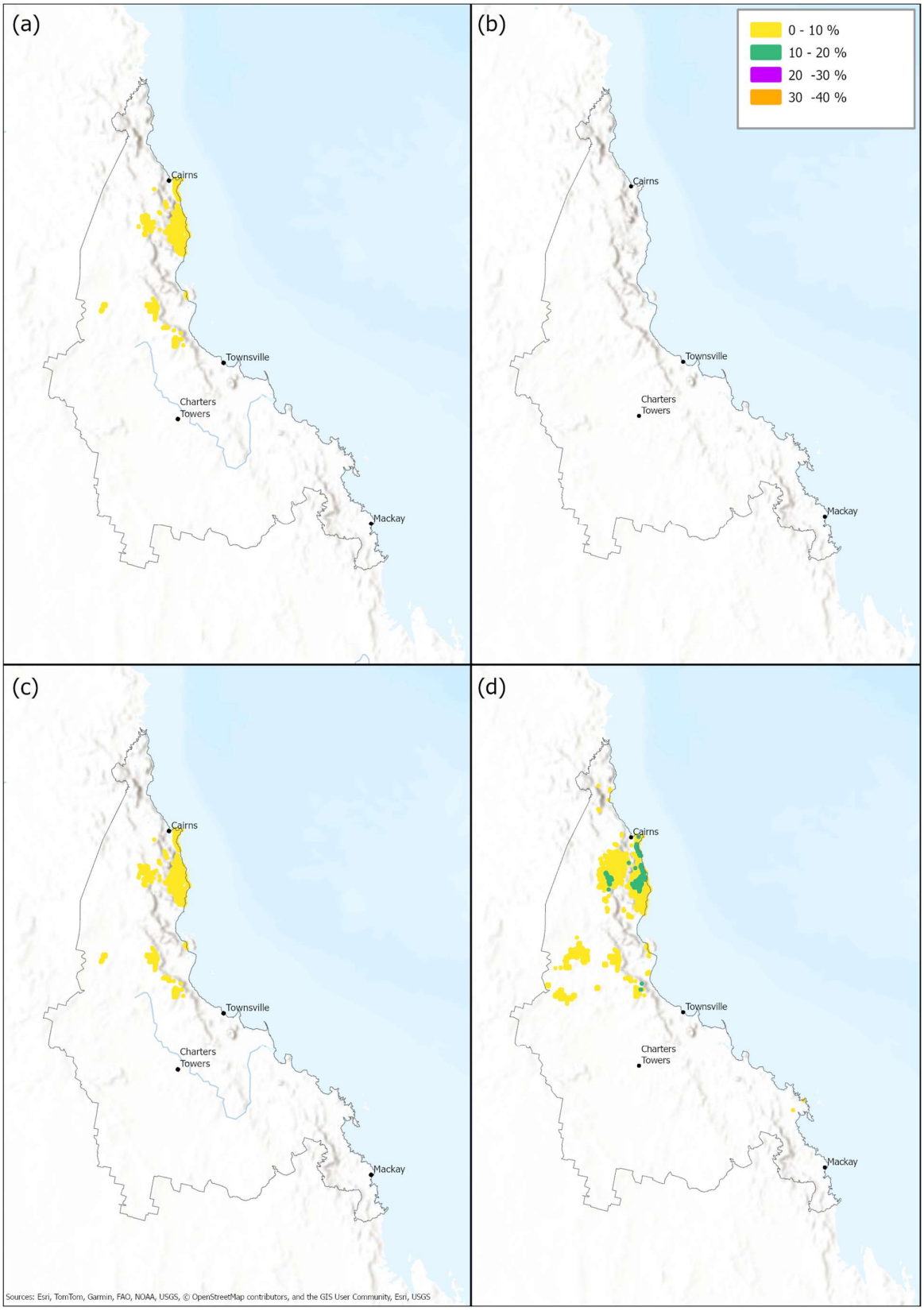



***Figure 20: Financial spotted gum financial viability without the Commonwealth grant for (a) timber and carbon; (b) timber only); 9C) timber, carbon and grazing); and (d) alternative silvopastoral***

*Table 25: Area (ha) by local government and scenario for the alternative silvopastoral regime*

| LGA | Sc 1 | Sc 2 | Sc 3 | Sc 4 | Sc 5 | Sc 6 | Sc 7 |
|---|---|---|---|---|---|---|---|
| Cairns Regional | 26,234 | 25,147 | 8,383 | 847 | 370 | 964 | 370 |
| Cassowary Coast Regional | 96,934 | 77,913 | 59,782 | 10,513 | 4,978 | 11,507 | 4,978 |
| Charters Towers Regional | 18,940 | 6,041 | - | - | - | - | - |
| Cook Shire | - | - | 131 | - | - | - | - |
| Douglas Shire | 440 | - | 1,056 | - | - | - | - |
| Hinchinbrook Shire | 5,770 | 1,253 | 197 | - | - | - | - |
| Mackay Regional | - | 3,471 | 6,445 | - | - | 1,423 | - |
| Mareeba Shire | 1,888 | 94 | - | - | - | - | - |
| Tablelands Regional | 105,132 | 93,722 | 63,351 | 2,026 | 82 | 4,857 | 82 |
| Townsville City | - | - | - | - | - | - | - |
| Whitsunday Regional | 141 | 141 | - | - | - | - | - |
| Wujal Wujal Aboriginal Shire | - | - | 268 | 776 | - | 394 | - |
| Yarrabah Aboriginal Shire | 1,807 | 388 | 1,406 | 1,203 | - | 1,265 | - |

The results for all regimes and scenarios are presented in Appendix 4.

# OPPORTUNITIES AND BARRIERS FOR PLANTATION EXPANSION

## Policy and regulatory framework

### Overview

The forest and wood products sector in the Hub region is relatively small and underdeveloped when compared to other major forestry regions in Australia. However, it is regionally important and has considerable potential for expansion, in terms of both plantation area and processing capacity and capability (Greenwood Strategy, 2023a).

Importantly, Queensland's plantation forest and wood products sector is actively supported by the State Government. For example, in 2010 the Queensland Government published its Queensland timber plantation strategy 2020, aimed at encouraging new private sector investment into the sector in Queensland to grow the sector to $34 billion (State of Queensland, 2010). In 2013 the Queensland Government responded to the industry's Forest and Timber Industry Plan, providing explicit support for each of the three strategic priorities and eight objectives outlined in that plan (State of Queensland, 2013). Similarly, in 2015, the Queensland Government committed considerable funding towards identified forest and timber research priorities (State of Queensland, 2015).

A key challenge is to identify and capitalise on opportunities for the State Government to integrate its active support with the efforts of the Hub with respect to progressing development of the sector. Additionally, despite the overt support there is little recent evidence of active work on the part of the State Government to support growth of the sector.

### Plantation policy

#### *Commonwealth policy framework*

Australia's national policy framework for forest management has six key elements (DAFF, 2024), presented in Table 26.

***Table 26: Australia's national forest policy framework***

| Policy | Description |
|---|---|
| National Forest Policy Statement (1992) | Promotes the conservation and sustainable management of forests. |
| Regional Forest Agreements | 20-year agreements between the federal and state government to support regional approaches to balancing conservation and timber production needs from native forests. |
| National Forest Industries Plan: Growing a better Australia – a billion trees for jobs and growth (2018) | Promotes the expansion of forestry and forest industries with the right trees in the right place at the right time. Delivered through:<br>• Funding of eleven Regional Forestry Hubs in strategic locations funded by the Australian Government to support the 'Growing a better Australia' policy.<br>• Establishment of the National Institute for Forest Products Innovation and Australian Forest and Wood Innovations |

| | |
|---|---|
| | (AFWI) is the national research institute, to drive smarter use of forest resources. |
| Illegal logging | The Illegal Logging Prohibition Act 2012 makes it an offence to import illegally logged timber into the Australian market and to process timber that has been illegally harvested here in Australia. |
| Plantations 2020 | The Plantations 2020 Vision, launched in 1997, which is a strategic partnership between the Australian, state and territory governments and the plantation timber growing and processing industries. |
| National Indigenous Forest Strategy | Developed in consultation with Indigenous communities and forest industry stakeholders, was published in 2005. The strategy aims to encourage Indigenous participation in the forest and wood products industry. |

### *State Government policy*

In June 2024, the State Government released Terms of Reference for consultation on the Queensland Sustainable Timber Industry Framework (State of Queensland, 2024). The Terms of Reference outline six priority areas for future development of the State's forest and wood products industry:

**Priority area 1**: Securing sustainable timber supply

**Priority area 2**: Adding value to forest and timber supply chains

**Priority area 3**: Realising the potential of forest-related markets for industry, landholders and the environment

**Priority area 4**: Future forest workforce and strong timber industry

**Priority area 5**: Growing Queensland's protected area estate

**Priority area 6**: Fostering First Nation's peoples' forestry employment and enterprise opportunities

The terms of reference is expected to deliver the new framework by the middle of 2025. Of particular relevance to this project, the framework intends to explore ways to provide incentives to establish new plantations and investment in new processing technology over a planning horizon to 2054. It aims to ensure no reduction in overall timber supply levels from 2025 to 2034 and support contractual certainty for the industry.

In relation to plantation timber supply, it specifies the following actions:

- determine economic and environmental feasibility of softwood and hardwood plantation expansion to respond to projected demands for timber resources, informed by statewide mapping of plantation potential
- identify measures to promote and expand the plantation timber industry, including through emerging markets and government investment vehicles
- engage with stakeholders and investigate plantation investment models between private industry, First Nations peoples' businesses, farm foresters and state and territory governments

- apply learnings from previous hardwood plantation ventures in Queensland to ensure plantation expansion is future focussed
- support plantation supply chain development, infrastructure and employment in plantation forest management, harvest, haulage and processing.

## Plantation regulation [15]

### *Commonwealth requirements*

There are Commonwealth Government requirements which apply although in practice they have little impact on the establishment or operation of commercial timber plantations. They include:

- Aboriginal and Torres Strait Islander Heritage Protection Act 1984
- Australian Heritage Commission Act 1975
- Environment Protection and Biodiversity Conservation Act 1999
- Export Control Act 1982
- National Environment Protection Measures (Implementation) Act 1998
- Native Title Act 1993
- Quarantine Act 1908
- Regional Forests Agreement Act 2002

### *State level requirements*

#### Code of Practice

The Timber Plantation Operations Code of Practice, although voluntary, is designed to assist plantation operators to meet the range of legislative and other requirements for sound plantation management. Application of the Code is intended to enable plantation managers to meet all legal and regulatory requirements. The Code is tenure blind and outlines voluntary standards developed for use by all parties with an interest in commercial timber plantations (landowners, plantation owners, managers, agents and employees and contractors).

#### General plantation management

There are some 20 pieces of legislation that apply directly to plantation activities on private land in Queensland. Application of the Code is intended to ensure that plantation managers meet the requirements of these laws.

#### New plantation establishment

New timber plantations that are a material change of land-use are subject to the Queensland Planning Provisions (QPPs) and local government planning requirements. The QPPs provide a universal local government regulatory framework for development the development of new plantation areas for wood production.

The Sustainable Planning Act (2009) and the QPPs allow for a local government to elect to specifically regulate “forests for wood production” separately from other forms of cropping in a rural zone. The QPPs related to forestry, when adopted by a local government, become regulatory

[15] This section is summarised from Greenwood Strategy (2021) and Greenwood Strategy (2023b)

instruments under the Act and any new plantation must comply with these regulations and other codes required by a specific local government area.

This requires proponents of new plantations to ensure direct consultation with each local government area where they intend to operate to determine the specific requirements of that local government area (refer to Figure 21).

## Assessable vegetation

In order to provide increased, long-term investment security for native species plantations, a property map of assessable vegetation (PMAV) should be obtained from the Department of Natural Resources Mines and Energy as a step in the planning process. A certified PMAV replaces regulated vegetation management maps, which are used to determine the location and extent of regulated vegetation for which permitted management activities are restricted. There is a risk with plantations of native species that they may be mapped as regulated vegetation and consequently deemed unavailable for harvest. The PMAV identifies the extent of the existing cleared areas prior to planting and ensure it is not categorised as regulated vegetation at a later date.

## Vegetation clearing

Vegetation clearing (native) in Queensland is guided by requirements of the *Vegetation Management Act 1999* and *Planning Act 2016*. The vegetation management framework covered by these two pieces of legislation provides an alternative path to the development application and assessment processes. The accepted development vegetation clearing codes offer the opportunity for landholders to remove vegetation for low-risk property management activities, while ensuring that legal objectives are achieved (State of Queensland, 2020).

There are five vegetation categories to which the framework applies, as summarised in Figure 21. The Government provides an online mapping and reporting service to assist landholders with planning. If the landowner identifies the mapping as incorrect, they can apply to have it changed. Figure 22 shows the process for determining approvals to clear native vegetation.


***Figure 21: Process for approval of new plantations in Queensland***

*Table 27: Definition of vegetation categories under Queensland's vegetation management framework*

| Vegetation Category | Description |
|---|---|
| Category A area | An area which is:<br>• a declared area<br>• an offset area, an exchange area, an area that has been subject to unlawful clearing or an enforcement notice, an area subject to clearing as a result of a clearing offence or<br>• an area that the chief executive determines to be Category A.<br>Category A areas are colour-coded red on the regulated vegetation management map. |
| Category B area | An area which is remnant vegetation or an area the chief executive determines to be Category B.<br>Category B areas are colour-coded dark blue on the regulated vegetation management map. |
| Category C area | An area which is high-value regrowth vegetation on freehold land, Indigenous land or land the subject of a lease issued under the Land Act 1994 for agriculture or grazing purposes or an occupation licence under that Act, in an area that has not been cleared in the last 15 years which is also an endangered, of concern, or least concern regional ecosystem.<br>Category C areas may also include vegetation which the chief executive decides to show as Category C.<br>Category C areas are colour-coded light blue on the regulated vegetation management map. |
| Category R area | An area which is a regrowth watercourse and drainage feature area located within 50 metres of a watercourse located in the Burdekin, Burnett–Mary, Eastern Cape York, Fitzroy, Mackay–Whitsunday or Wet Tropics catchments identified on the vegetation management watercourse and drainage feature map.<br>The vegetation management framework regulates clearing of native vegetation within this buffer area.<br>Category R areas are colour-coded yellow on the regulated vegetation management map. |
| Category X area | All areas other than Category A, B, C and R areas.<br>Category X areas are areas not generally regulated by the vegetation management laws.<br>Category X areas are coloured-coded white on the regulated vegetation management map. |

The importance of the vegetation management framework is that it may have a significant influence on where new plantations can be established, particularly where the context is silvopastoral activity and the area comprises Category C regrowth. There has also been some discussion about whether it is appropriate to establish plantations in Category X areas, where there are no restrictions under the vegetation management framework. It is likely that, in the latter case, there are no legal restrictions to establishing plantations. However, if plantation proponents are seeking forest management certification, any clearing of native vegetation (whether legal or not) is likely to be prohibited.

## Summary

Table 28 presents a summary of the State level legal and regulatory requirements for establishing and managing plantations in north Queensland (Greenwood Strategy, 2021).

*Table 28: Summary of State level legal and regulatory requirements for plantation management in Queensland*

| State legislation | |
|---|---|
| **Legislation** | Native Title (Queensland) Act 1993 |
| Aboriginal Cultural Heritage Act 2003 | Nature Conservation Act 1992Plant Protection Act 1989 |
| Agricultural and Veterinary Chemicals (Qld) Act 1994 | Queensland Heritage Act 1992 |
| Agricultural Chemicals Distribution Control Act 1966 | Soil Conservation Act 1986 |
| Biosecurity Act 2014 | Sustainable Planning Act 2009 |
| Chemical Usage (Agricultural and Veterinary) Control Act 1988 | Torres Strait Islander Cultural Heritage Act 2003 |
| Environmental Protection Act 1994 | Vegetation Management Act 1999 |
| Fire and Emergency Services Act 1990 | Water Act 2000 |
| Fisheries Act 1994 | Work Health and Safety Act 2011 |
| Forestry Act 1959 | Australian Government (visit www.comlaw.gov.au for all current legislation) |
| Land Protection (Pest and Stock Route Management) Act 2002 | Environment Protection and Biodiversity Conservation Act 1999 |
| **Local government requirements** | |
| **Planning Provisions** | • Etheridge Shire Council |
| Queensland Planning Provisions version 3.1 | • Hinchinbrook Shire Council |
| 9.2.2 Forestry for wood production code | • Mackay Regional Council |
| **Local Government Areas**[16] | • Mareeba Shire Council |
| • Burdekin Shire Council | • Tablelands Regional Council |
| • Cairns Regional Council | • Townsville City Council |
| • Cassowary Coast Regional Council | • Whitsunday Regional Council |
| • Charters Towers Regional Council | • Wujal Wujal Aboriginal Shire Council |
| • Cook Shire Council | • Yarrabah Aboriginal Shire Council |
| • Douglas Shire Council | |
| **Other instruments** | |
| Timber Plantation Operations Code of Practice for Queensland | |

[16] The full list of local government areas has been reduced to those which fall within the area of interest for this project

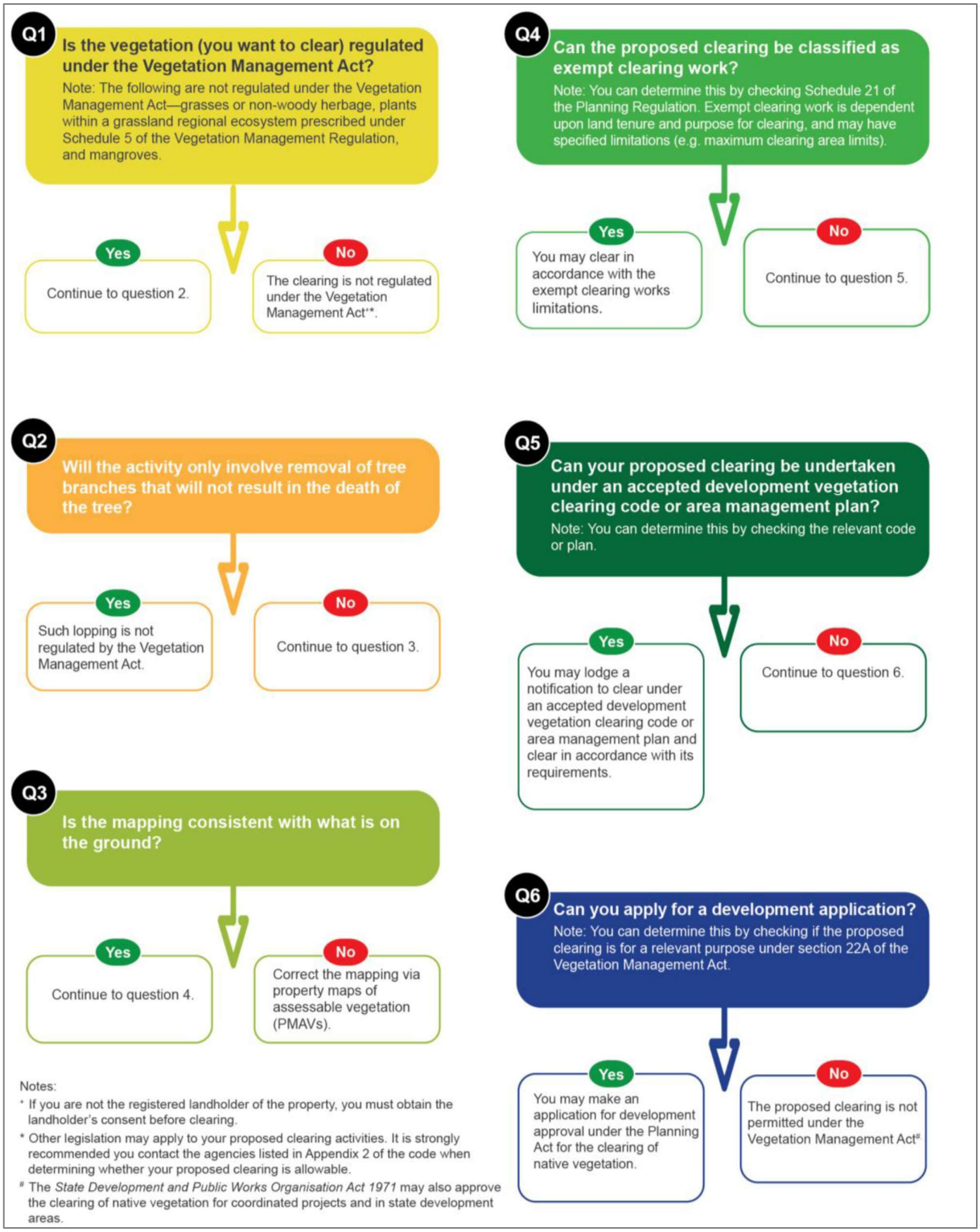



***Figure 22: Flowchart for determining approvals for clearing native vegetation (State of Queensland, 2020)***

# Analysis themes

Stephens *et al.* (2020) undertook a SWOT analysis for North Queensland, recognising it as the most likely location for expansion of softwood plantations in Australia. This analysis has been used as the starting basis for a SWOT assessment relevant to the spatial project, as presented in Figure 23.

| Strengths | Weaknesses |
|---|---|
| Established softwood plantation resource with links to downstream processing and markets.<br>Industry and government priority to increase estate size and improve productivity.<br>Strong cross-industry links between key players, supporting efforts to trial new approaches for plantation expansion. | Inconsistent and highly seasonal rainfall.<br>Processing technologies and markets for non-softwood species not fully tested.<br>High energy costs.<br>Infrastructure bottlenecks, particularly transport infrastructure.<br>Limited access to markets beyond North Queensland.<br>Poor understanding among landowners of benefits of silvopastoral systems, carbon pricing and timber value. |
| **Opportunities** | **Threats** |
| Expansion of the plantation softwood estate.<br>Application of silvopastoral regimes for plantation forests of all species.<br>Identification and development of markets for non-softwood timber species, particularly from silvopastoral regimes<br>Opportunities in emerging processing technology and markets such as biofuels, engineered wood products.<br>Changes to the ACCU Scheme that allow participation of plantations. | Availability of and competition for irrigation water in the dry tropics.<br>General competition for suitable plantation growing land.<br>Negative perceptions of plantation forestry.<br>Risk of damage from weather and other environmental factors, including severe tropical cyclones, pests and weeds.<br>Limitations of the ACCU Scheme rules that don't fully recognise softwood plantation timber use in construction.<br>Regulatory limitations to plantation expansion. |

***Figure 23: SWOT assessment for North Queensland plantation expansion***[17]

# Opportunities

## Softwood plantation expansion

Growing the softwood plantation estate is the most obvious "traditional" expansion. The southern pines (specifically *P. caribaea* and hybrids) have been successfully grown in the region for a considerable length of time and there exists a functioning supply chain and markets. Recognised issues are the same as for any species. Wind-firmness and ability to withstand severe tropical cyclones is a key issue. Another key issue is limited markets for pulpwood and lower grade log products. There is significant opportunity for the Hub and the industry more broadly to work with the Queensland and Commonwealth Government on feasible market alternatives for non-sawlog

[17] Based on Stephens et al. (2020) and updated by Greenwood Strategy for this assessment

products, as outlined below. There is also significant scope for the Hub to provide advice to Government about how to improve the ACCU Scheme to better support plantation expansion, as detailed under the Barriers section below.

### Silvopastoral systems

As outlined elsewhere in this report, there is considerable work being undertaken in the region and in Queensland more broadly, investigating and testing the suitability and viability of silvopastoral systems as a means to improve on-farm productivity and revenue generation, while contributing to expansion of the plantation estate. While trial work is still underway, there is considerable evidence that silvopastoral systems work. Key challenges include matching species to site conditions (rainfall, soil and seasonality), profitable access to log markets and improving perceptions of landowners about this approach to land management.

### ACCU Scheme changes

The removal of the "water rule", which previously limited participation of new plantations in the ACCU Scheme unless they were established in regions with less than 600mm/yr annual rainfall, is a significant positive development. The availability of a carbon price is unlikely to justify the establishment of a commercial plantation by itself. However, with other factors such as available land at a suitable price, an appropriate level of productivity and access to markets, the ability to participate in the ACCU Scheme will increase the size of the potential plantation envelope of viability.

### Emerging and potential markets

Emerging markets such biofuels present a substantial area of potential opportunity for the region's plantation industry (both growers and processors) as a price competitive market for lower quality log and residue products. In March 2024, for example, ABEL Energy announced[18] that it is fast-tracking feasibility assessment of its proposed Townsville Green Methanol facility, to complement its proposed facility at Bell Bay in Tasmania. That facility, if it progresses, will require in the order of 500,000 green tonnes of biomass input and will produce an estimated 400,000t/annum of green methanol. It is intended to capitalise on the Commonwealth Government's policy commitment to A Green and Digital; Shipping Corridor to decarbonise and digitalise shipping between Australia and Singapore.

## Barriers

### ACCU Scheme rules

While changes to the ACCU Scheme to remove the water rule is a significant positive step creating opportunity for North Queensland plantations to participate, there remains a significant ACCU Scheme barrier, as detailed below.

The attribution of ACCUs for plantations under the Plantation Method is determined through the FullCAM modelling parameters. The parameters distribute plantation forest products between various product classes, which in turn are allocated variable ACCU generation capability. For product classes with longer service life or other carbon advantages (e.g., panels, furniture, construction and mill residues) the ACCU generation is relatively higher when compared to paper and pulp, for

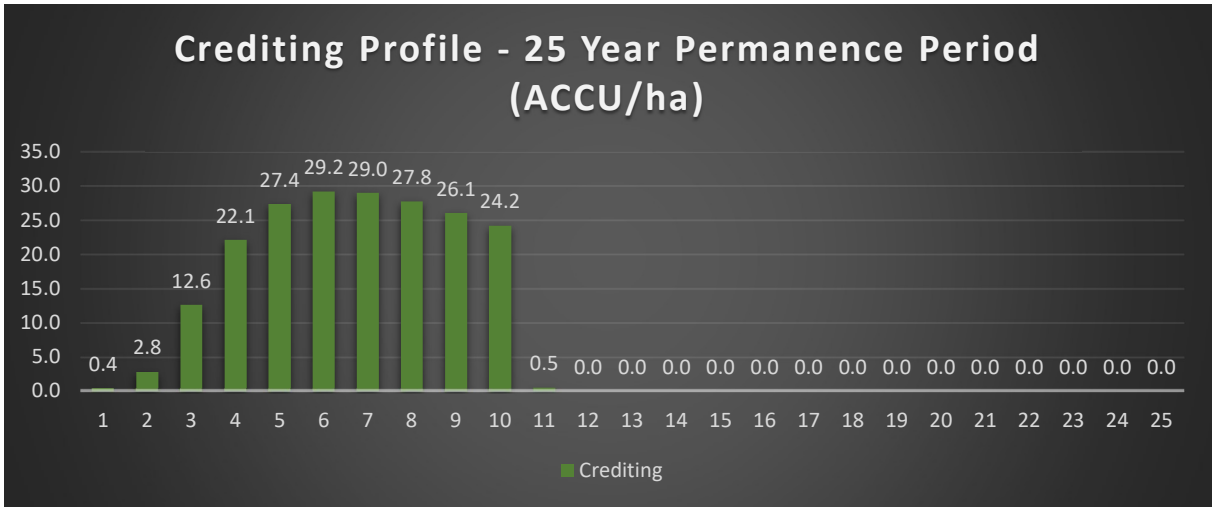
[18] https://abelenergy.com.au/volumes/documents/ABEL-Energy-Port-of-Townsille-Media-Release.pdf Accessed 05 August 2024

example. For *P. caribaea* sawlog regimes, there is a significant difference in the distribution of product classes in south-east Queensland compared to North Queensland (refer to Table 29). In north Queensland, less than 5% of clearfell production is recognised as construction or mill residue or panels. For south-east Queensland, between 50-60% of second thinning and clearfell production is recognised in these three categories, which generate more ACCUs per productive hectare.

***Table 29: FullCAM modelling parameters for P. caribaea - north and south-east Queensland***

| Region | Thin or CFL event | Deadwood | Biofuel | Paper and pulp | Packing wood | Furniture | Fibre-board | Construct'n | Mill Residue |
|---|---|---|---|---|---|---|---|---|---|
| North Qld | 1 | 15.00% | 0.00% | 82.30% | 0.00% | 0.00% | 0.20% | 1.70% | 0.80% |
| | C | 10.00% | 0.00% | 84.80% | 0.00% | 0.00% | 0.40% | 3.30% | 1.50% |
| SE Qld | 1 | 15.00% | 0.00% | 25.40% | 0.00% | 0.00% | 51.10% | 4.00% | 4.50% |
| | 2 | 15.00% | 0.00% | 28.00% | 0.00% | 0.00% | 12.90% | 30.20% | 13.90% |
| | C | 10.00% | 0.00% | 30.00% | 0.00% | 0.00% | 8.10% | 35.80% | 16.10% |

This has a very significant impact on the number of ACCUs generated per hectare. The outcomes for both regimes were compared for a no thinning regime. If all other factors are held equal, there is a difference of 68 ACCUs/ha (34%) issued over a 25-year crediting period for south-east Queensland compared to north Queensland, for the same species and same silvicultural regime. Using the current spot price of about $30/ACCU[19], that represents a difference of $2,040/ha. Using $17.35 (the last auction result) delivers a difference of $1,179/ha. Figure 24 demonstrates the considerable difference for the ACCU crediting profile under each scenario between the North Queensland and South-east Queensland modelling parameters.




[19] https://cer.gov.au/markets/reports-and-data/quarterly-carbon-market-reports/quarterly-carbon-market-report-september-quarter-2023/australian-carbon-credit-units-accus#:~:text=The%20ACCU%20price%20remained%20stable%20between%20%2430.50%20and%20%2432.00%20for%20Q3%202023. (Accessed 05 August 2024)

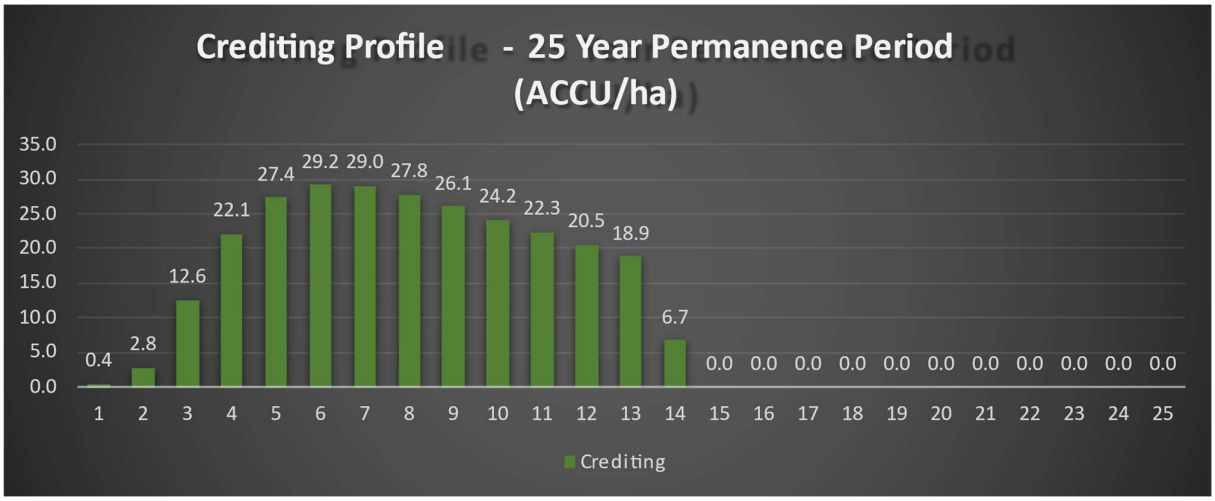



***Figure 24: Difference between ACCU crediting profiles for North Queensland (top) and South-east Queensland (bottom) for P. caribaea, using the relevant regional FullCAM parameters***

There is no obvious explanation for the difference for the same species between the two regions, particularly when there are currently no pulpwood markets for north Queensland logs and all sales are for solid wood manufacturing. However, this issue is clearly an investment barrier for plantation expansion in North Queensland, especially if there is competition between regions for the same capital pool.

## Environmental risk

Environmental risk is a significant barrier to plantation expansion in the region. The most obvious issue in recent years has been the impact of severe tropical cyclones in damaging large areas of plantation. Rainfall seasonality is an absolute barrier in large parts of the region and, at the margins, can be an issue in any part of the region if seasonal conditions are particularly adverse. Competition from weeds and regrowth, as well as insect infestation and browsing, are potentially significant hurdles to successful plantation expansion as well.

## State regulation barriers

In broad terms, the regulatory framework is problematic for new plantations. A key concern is the role of local government in approving new plantations, and the lack of certainty about how decisions to approve or reject are made by local government authorities. However, when compared to some other jurisdictions, this is a relatively minor issue. The vegetation management framework specifies limitations on clearing of native vegetation for a range of activities. However, third party, voluntary certification schemes are more limiting with respect to plantation establishment on areas subject to native vegetation clearing.

## Other barriers

The availability of suitable and affordable land and water remains a key barrier to plantation expansion in the region. Similarly, access to markets for a full range of log products is challenging. While there are not necessarily any direct policy solutions or interventions to these barriers, it is essential to be aware of them.

# DISCUSSION AND RECOMMENDATIONS

## Discussion

### Positive opportunities for plantation expansion

The analysis undertaken for this project demonstrates that there is expansion potential for arrange of commercial forestry species under a range of silvicultural and commercial regimes, particularly when combined with carbon (under Schedule 1 of the Plantation Method) and grazing.

Of the four species examined, *Pinus caribaea* (softwood) is the most promising, under long (27 year) term rotations. This species is assessed as financially suitable on up to 260,000 ha in the region, when combined with carbon and grazing. That is consistent with other studies (Stephens *et al.*, 2020; Whittle *et al.*, 2019) that have identified North Queensland as the most suitable location for substantial softwood plantation expansion in Australia.

Importantly, there are regimes for three of the four species (softwood, Gympie messmate and spotted gum) where a combination of timber, carbon and grazing delivers better returns than grazing by itself.

### Market limitations

An important limitation on the suitability analysis is the relative lack of existing market development. Assumptions have been made about future potential markets based on the existence of an expanded plantation estate. While the yield, outturn and price assumptions are quite conservative, those markets do not currently exist, so these potential returns are speculative at this point. However, the Queensland Government is strongly committed to supporting the forest and wood products sector and the broader state and national policy environment is supportive. There is also commercial interest in the potential opportunities for the sector in North Queensland, so it is not unreasonable to expect that there would be a commercial and policy response to support industry development to enable expanded processing capacity.

### ACCU Scheme limitations

The current framework of the FullCAM parameters for softwood do not adequately reflect the likely or actual distribution of post harvest wood products from plantations in the region. Addressing this will make the inclusion of carbon significantly more advantageous for softwood projects. The potential improvement is more than $2,000 at an ACCU price of $30 or more.

### Cyclones and rotation length

Cyclones are a significant risk factor. By shortening rotation length, the exposure to potential future cyclones is also reduced. The fact that short rotation softwood is the most promising scenario with respect to investment returns is therefore very positive.

### Data limitations

The analysis relies on coarse and limited data sets in relation to biophysical suitability for the four species. While the outcomes are logical in terms of the broad regional outcomes, they have limited utility at the sub-regional and property levels, where specific site conditions and professional advice

should be considered by landowners and proponents that are interested in establishing new plantations.

# Recommendations

## Recommendation 1: Amendment to the FullCAM parameters

There is a pressing need to engage with the Clean Energy Regulator and seek amendment to the FullCAM parameters that better recognise the role of solid wood production from softwood plantations in the region and provide a greater incentive for new plantation incentive through the ACCU Scheme.

## Recommendation 2: Collaborative communication

The results demonstrate considerable plantation expansion potential with timber, carbon and grazing outcomes combined. Other work being undertaken in the region and in south-east Queensland is focussing on practical trials of silvopastoral systems aimed at quantifying these silvopastoral outcomes more accurately. There is an important and timely opportunity to use the results from this study to reinforce parallel research efforts and support communication with the agricultural industry about the benefits of combining timber, carbon and pastoral production.

## Recommendation 3: Improving biophysical data quality

There is strong rationale for developing a project to focus on developing higher quality and better resolution biophysical data to support more detailed analysis of opportunities within the target envelopes identified in this project. In particular, Cassowary Coast and Tablelands Regional Councils could form the focus for an initial project, supported by FWPA and/or AFWI along with the State Government, for example.

## Recommendation 4: Future markets and wood products opportunities analysis

This project has identified the potential for a very significant increase in future fibre supply from plantations. A regionally specific future markets and wood products opportunities analysis undertaken in the context of the particular environmental, economic and social opportunities and barriers in the region would allow the Hub and the industry to focus expansion and development efforts towards genuine opportunities for industry growth. Importsantly, this analysis could be used to improve investor confidence in future opportunities in the region.

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# APPENDICES

# Appendix 1: Data sources applied to plantation suitability mapping

| Layer name | Feature | Data use | Data description | Data source | Attribution |
|---|---|---|---|---|---|
| Populated places | populated_places | mapping, transport | This dataset contains point features representing the centre of named towns and cities. | https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={36DBF62A-76E4-4BFA-A04A-E747401C4C09} | © State of Queensland (Department of Resources) 2023 |
| Rail | rail_network | mapping, transport | This dataset shows the position, name and ownership of Railway centrelines within the State of Queensland. | https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid=%7b8C0F5D96-96C0-4510-8D67-445A0E92893A%7d | © State of Queensland (Department of Resources) 2023. |
| Roads | Queensland_roads_and_tracks | mapping, transport | Queensland Roads and Tracks (QRT) is the Department of Resources' foundation dataset of roads data. It is a vector (line segment) dataset depicting the approximal centreline location and attributes of roads and tracks across Queensland. It does not replicate a navigable product.<br><br>The Data Dictionary is published here https://www.resources.qld.gov.au/__data/assets/pdf_file/0003/1592310/roads-tracks-data-dictionary.pdf | https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={CE66D3D5-8740-41A7-8B42-30F5F1691B36} | © State of Queensland (Department of Resources) 2023. Updated data available at http://qldspatial.information.qld.gov.au/catalogue// . |
| Built up areas | Built_up_areas | mapping, exclusions | This dataset contains the extents of urban settlements with more than 50 residential buildings and where the areas have a cadastral parcel size of less than 2 hectares. Note that the following are cut out of the built-up area polygons:<br>- Educational institutions<br>- Hospitals<br>- Caravan parks<br>- Cemeteries<br>- Aircraft landing areas<br>- Sewage and water treament plants<br>- Sports and recreational areas<br>- Parks and gardens. | https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={063A413F-7910-4E6B-8389-24E06AF4508C} | © State of Queensland (Department of Resources) 2023 |
| Protected Areas | Protected_areas | mapping, exclusions | Protected areas of Queensland represent those areas protected for the conservation of natural and cultural values and those areas managed for production of forest resources, including timber and quarry material. These areas are defined spatially using cadastral parcels | https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={07E360E3-A191-4C24-9671-1471362F0B1B} | © State of Queensland (Department of Environment and Science) 2023. Updated data available at |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | http://qldspatial.information.qld.gov.au/catalogue// |
| Protected Areas | Protected_areas___boundaries | mapping, exclusions | Protected areas of Queensland represent those areas protected for the conservation of natural and cultural values and those areas managed for production of forest resources, including timber and quarry material. These areas are defined spatially using cadastral parcels. This representation of the protected areas contains a single record for each protected area with multiple spatial parts for those protected areas where not all of the cadastral parcels are adjacent. | https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={6C180042-2B50-4018-8B29-E245818B1B8A} | © State of Queensland (Department of Environment and Science) 2023. Updated data available at http://qldspatial.information.qld.gov.au/catalogue//. |
| Special management areas | Special_management_areas | mapping, exclusions | Special Management Areas (SMA) are areas that cover parts of the protected areas of Queensland that have additional constraints on their use. In many places the boundaries of the SMAs are aligned with the Digital Cadastre Database (DCDB) land parcel while in other locations the boundaries of the SMAs follow the lines of topographic features such as streams, forestry tracks and ridges. | https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={230C2287-141B-4DA1-A07B-F057925D0A2A} | © State of Queensland (Department of Environment and Science) 2023. Updated data available at http://qldspatial.information.qld.gov.au/catalogue//. |
| Cadastral data - Queensland - by area of interest | QLD_CADASTRE_DCDB_Clip_NQRFH | mapping, exclusions | QLD cadastre clipped to NQRFH | https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={A07975CC-FE78-408F-959F-B0CDEC1C6EDA} | © State of Queensland (Department of Resources) 2023. |
| Statewide Landcover and Trees Study (SLATS) Sentinel-2 - 2019 woody vegetation extent - Queensland - Whole of state | DP_QLD_WOODY_EXTENT_2019_ Clip_NQRFH | mapping, exclusions | Statewide Landcover and Trees Study (SLATS) Sentinel-2 - 2019 woody vegetation extent - Queensland - Whole of state<br>The SLATS 2019 Woody extent dataset shows the presence/absence of woody vegetation throughout Queensland. The scale of the woody extent dataset is intended to capture features visible at a nominal map scale of 1:10,000: stands of woody vegetation greater than 0.5 ha with a canopy density greater than 10% crown cover will be classified as woody. A minimum width of 20 metres applies to linear features. | https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={CF89E7AC-FFD9-4295-AC6C-98DD553ACE7D} | © State of Queensland (Department of Environment and Science) 2023 |
| Seasonal rainfall | BOM_Climate_Seasonal Rain | mapping, suitability | Seasonal rainfall classification (base climate related classification datasets)<br>The grid shows Seasonal Rainfall Classification indices across Australia in the form of two-dimensional array data.<br>The classification is based on 100-year period (1900-1999) | http://www.bom.gov.au/climate/data/index.shtml | ? |
| PE_Ratio | PE_Ratio | mapping, suitability | | Generated by Esk Spatial using BOM data | |

| | | | | | |
|---|---|---|---|---|---|
| BOM Pan Evaporation Grid | BOM_PanEvarporation_ Grid | mapping, suitability | Average monthly and average annual evaporation data (base climatological datasets). Mean monthly and mean annual evaporation grids. The grids show evaporation values across Australia in the form of two dimensional array data. The mean data are based on all available stations with at least ten years of records between 1975 and 2005. | http://www.bom.gov.au/climate/data/index.shtml | ? |
| Long term Average Rainfall | LTA_rainfall.tif | mapping, suitability | The Long-term average rainfall map layer - CFI rainfall map shows the long-term average annual rainfall (mm) across continental Australia, calculated for the period 1921-2010.<br><br>For the purposes of the regulations, legislative rules and methodology determinations under the Carbon Credits (Carbon Farming Initiative) Act 2011, including: | https://data.gov.au/data/dataset/emissions-reduction-fund-environmental-data/resource/beb93add-1f5b-42a0-9a7e-d174d0139435?view_id=d12502b6-f0f8-464a-b74d-89461b31b357 | ? |
| Forest of Australia 2023 | Forest of Australia 2023 | mapping, exclusions | Forests of Australia (2023) is a continental spatial dataset of forest extent, by national forest categories and types, assembled for Australia's State of the Forests Report - 2023 update. It was developed from multiple forest, vegetation and land cover data inputs, including contributions from Australian, state and territory government agencies and external sources. | https://www.agriculture.gov.au/abares/forestsaustralia/forest-data-maps-and-tools/spatial-data/forest-cover | Australian Bureau of Agricultural and Resource Economics and Sciences, Forests of Australia (2023), Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra, December. CC BY 4.0 |
| Biogeographic regions - Queensland | Biogeographic region | mapping | Bioregions of Queensland, version 5.0 - 2010. Queensland has been divided into 13 bioregions. Bioregions represent broad landscape patterns that are the result of the interplay between factors including geology, climate and biota. | https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={D66120B3-B705-4BEC-B22C-E9AD6674F776} | © State of Queensland (Department of Environment and Science) 2023 |
| Landuse | landuse | mapping, exclusions | Indicates the most current primary use or management objective of the land for Queensland. Last updated June 2019. | https://gisservices.information.qld.gov.au/arcgis/rest/services/PlanningCadastre/LandUse/WFSServer?request=GetCapabilities&service=WFS | © State of Queensland (Department of Environment and Science) 2023 |
| Lakes | lakes | mapping, exclusions | This dataset displays lakes (naturally occurring bodies of mainly static water that are surrounded by land and are greater than 625 sq metres at full supply level) within the State of Queensland. | https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={DA4AC311-8643-477B-BD7E-FD41A3496C18} | © State of Queensland (Department of Resources) 2023 |
| Reservoirs | resevoirs | mapping, exclusions | This dataset displays reservoirs (man-made water bodies surrounded by land where the water is used for drinking, irrigation or watering of stock and or horticulture and are greater than 625 sq metres at full supply level) within the State of Queensland | https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={15C6CEA5- | © State of Queensland (Department of Resources) 2023 |

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|---|---|---|---|---|---|
| | | | | DF96-4D7E-9F3C-266AB09B24A0} | |
| Soils - agricultural land suitability of the wet tropical coast, Far North Queensland - MJA | Soils_agricultural_land_suitability_of_the_wet_tropical_coast_MJA | mapping, suitability | This dataset is a Soil Profile Class and land suitability survey of the Mossman-Julatten area in the Wet Tropics, Far North Queensland. The mapping covers parts of the Mossman, Rumula and Thornton Peak 1: 50,000 map sheets (7965-2, 7964-1, 7965-1) and was completed in 1991. The mapping is at a scale of 1: 50,000 and 49 Soil Profile Classes were identified. Sites were assessed using the free survey method. | https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={D9A77F70-53F5-4675-B4D3-E55D9D3032A0} | © State of Queensland (Department of Resources) 2023 |
| Watercourse areas | watercourse_areas | mapping, exclusions | This dataset displays the watercourse areas (A natural water channel along which water may flow from time to time) covering the State of Queensland. | https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={F6456070-7123-47EA-B990-910673D7BE42} | © State of Queensland (Department of Resources) 2023 |
| Forestry - Current Sawmills | Forestry___current_sawmills | mapping, transport | This dataset shows the location of sawmills in Queensland. Mills included were open at the time of publication, coordinate location could be confirmed, and the mill information is available in the public domain. | https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={84834481-05FB-425B-9F9D-8D646C6754C8} | © State of Queensland (Department of Agriculture and Fisheries) 2023. |
| Soils Project polygons best available polygon mapping | Project_polygons_best_available_polygon_mapping | mapping, suitability | This map service contains all soil and land resource mapping currently available for Queensland, which is maintained by the Department of Natural Resource Mines and Energy and the Department of Environment and Science. The service contains soil site data and soil polygon mapping data which is represented as four main types: soil, land management manual, land system and land degradation mapping (including acid sulfate soil mapping). Links to site description data and land suitability reports are also available via this service. | https://spatial-gis.information.qld.gov.au/arcgis/services/GeoscientificInformation/SoilsAndLandResource/MapServer/WMSServer?request=GetCapabilities&service=WMS | © State of Queensland (Department of Environment and Science) 2023 |
| Australian soil classification [ASC] | Australian soil classification [ASC] | mapping, suitability | This map service contains all soil and land resource mapping currently available for Queensland, which is maintained by the Department of Natural Resource Mines and Energy and the Department of Environment and Science. The service contains soil site data and soil polygon mapping data which is represented as four main types: soil, land management manual, land system and land degradation mapping (including acid sulfate soil mapping). Links to site description data and land suitability reports are also available via this service. | https://spatial-gis.information.qld.gov.au/arcgis/services/GeoscientificInformation/SoilsAndLandResource/MapServer/WMSServer?request=GetCapabilities&service=WMS | © State of Queensland (Department of Environment and Science) 2023 |
| Agricultural land class: A; B; C; D | Agricultural land class: A; B; C; D | mapping, suitability | This map service contains all soil and land resource mapping currently available for Queensland, which is maintained by the Department of Natural Resource Mines and Energy and the Department of Environment and Science. The service contains soil site data and soil polygon mapping data which is | https://spatial-gis.information.qld.gov.au/arcgis/services/GeoscientificInformation/SoilsAndLandResou | © State of Queensland (Department of Environment and Science) 2023 |

| | | | | | |
|---|---|---|---|---|---|
| | | | represented as four main types: soil, land management manual, land system and land degradation mapping (including acid sulfate soil mapping). Links to site description data and land suitability reports are also available via this service. | rce/MapServer/WMSServer?request=GetCapabilities&service=WMS | |
| Agricultural Land Audit - Important Agricultural Areas | Agricultural_land_audit___important_agricultural_areas | mapping | This dataset shows areas of Queensland identified by the DAFF Qld Agricultural Land Audit (2013) as being Important Agricultural Areas for the region or at a Statewide level. 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 agricultre is located. It is recommended that 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. This dataset can be viewed in the web map AgTrends Spatial: https://qldspatial.information.qld.gov.au/AGTrendsSpatial/ | https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={A99EC761-C888-486C-9DA2-74B789346A2E} | © State of Queensland (Department of Agriculture and Fisheries) 2023 |
| Local Government Areas | Local_Government_Areas | mapping | The spatial representation of local government areas in Queensland. | https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={3F3DBD69-647B-4833-B0A5-CC43D5E70699} | © State of Queensland (Department of Resources) 2023 |
| Moratorium Area for Minerals | Moratorium_areas_for_minerals | mapping | Identifies future land release areas.<br>Purpose: Expired or surrendered mineral exploration permit areas are held under moratorium for a period of time to allow competitive applications to be lodged for this land. | https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={71006923-557E-4931-AE71-F89A30954E23} | © State of Queensland (Department of Resources) 2021 |
| Rural Properties | Rural_Properties | mapping | This dataset has been compiled from numerous sources to produce to the best of our knowledge a dataset that displays the extent of named rural properties (horticultural or agricultural properties) in Queensland. There is no legislative requirement for any landholder to advise us of a property name or a change to a property name. Property names are recorded for administrative and mapping purposes only and the reliability of the information is not guaranteed by the Queensland Government. | https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={056BC8D6-A24C-423E-9C05-AA6952C5F0D4} | © State of Queensland (Department of Resources) 2023 |

| | | | | | |
|---|---|---|---|---|---|
| Valuation Property Boundaries | QLD_VALN_PROP_QSPATIAL | mapping | The layer is a property spatial representation of the valuation roll contained in the Queensland Valuation and Sales System (QVAS). A property polygon is formedby dissolving lot plan polygonsfrom the cadastre based on a propertyid field linkage to lot plan descriptions in QVAS. A property has a common owner name and local proximity based on its land use | https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={C3AEBA1F-E102-47B1-8E1C-6BCBC42F1E36} | © State of Queensland (Department of Resources) 2021 |
| Project polygons soils - 1:1 000 000 scale | Project polygons soils - 1:1 000 000 scale | mapping, suitability | This map service contains all soil and land resource mapping currently available for Queensland, which is maintained by the Department of Natural Resource Mines and Energy and the Department of Environment and Science. The service contains soil site data and soil polygon mapping data which is represented as four main types: soil, land management manual, land system and land degradation mapping (including acid sulfate soil mapping). Links to site description data and land suitability reports are also available via this service. | https://spatial-gis.information.qld.gov.au/arcgis/services/GeoscientificInformation/SoilsAndLandResource/MapServer/WMSServer?request=GetCapabilities&service=WMS | © State of Queensland (Department of Environment and Science) 2023 |

# Appendix 2: Plantation yield tables

| Scenario | MAI ($m^3$/ha) | Age T1 | Age T2 | Age CF | Products ($m^3$) T1 | | | | Products ($m^3$) T2 | | | | Products ($m^3$) CF | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Pulp | Small sawlog | Med sawlog | Large sawlog | Pulp | Small sawlog | Med sawlog | Large sawlog | Pulp | Small sawlog | Med sawlog | Large sawlog |
| 1 | 9 | | | 27 | | | | | | | | | 170 | 51 | 22 | 0 |
| | 11 | | | 27 | | | | | | | | | 193 | 63 | 31 | 10 |
| | 13 | | | 27 | | | | | | | | | 193 | 63 | 63 | 32 |
| | 15 | | | 27 | | | | | | | | | 202 | 61 | 81 | 61 |
| | 17 | | | 27 | | | | | | | | | 274 | 55 | 110 | 110 |
| 2 | 9 | | | 18 | | | | | | | | | 162 | | | |
| | 11 | | | 18 | | | | | | | | | 198 | | | |
| | 13 | | | 18 | | | | | | | | | 234 | | | |
| | 15 | | | 18 | | | | | | | | | 270 | | | |
| | 17 | | | 18 | | | | | | | | | 306 | | | |
| 3 | 3 | | | 15 | | | | | | | | | 45 | | | |
| | 5 | | | 15 | | | | | | | | | 75 | | | |
| | 7 | | | 15 | | | | | | | | | 105 | | | |
| | 9 | | | 15 | | | | | | | | | 100 | 35 | | |

| Age | | | | | Products ($m^3$) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 11 | | | 15 | | | | 90 | 75 | |
| | 13 | | | 15 | | | | 95 | 100 | |
| 4 | 4 | | | 27 | | | | 108 | | |
| | 6 | | | 27 | | | | 162 | | |
| | 8 | 20 | | 27 | 65 | | | 76 | 40 | 35 |
| | 10 | 20 | | 27 | 81 | | | 95 | 50 | 44 |
| | 12 | 14 | 20 | 27 | 94 | 60 | 22 | 40 | 43 | 43 | 22 |
| | 14 | 14 | 20 | 27 | 109 | 70 | 26 | 47 | 50 | 50 | 26 |
| | 16 | 14 | 20 | 27 | 125 | 80 | 29 | 53 | 58 | 58 | 29 |
| 5 | 3 | | | 27 | | | | 81 | | |
| | 5 | | | 27 | | | | 135 | | |
| | 7 | | | 27 | | | | 179 | 10 | 24 | |
| | 9 | | | 27 | | | | 176 | 72 | 30 | 15 |
| | 11 | | | 27 | | | | 148 | 104 | 70 | 35 |
| | 13 | | | 27 | | | | 140 | 105 | 70 | 35 |
| 6 | 4 | | | 27 | | | | 108 | | |
| | 6 | | | 27 | | | | 162 | | |
| | 8 | | 20 | 27 | 65 | | | 76 | 40 | 35 |

| Age | | | | | Products ($m^3$) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | | 20 | 27 | 81 | | | 95 | 50 | 44 | |
| | 12 | 14 | 20 | 27 | 94 | 60 | 22 | 40 | 43 | 43 | 22 |
| | 14 | 14 | 20 | 27 | 109 | 70 | 26 | 47 | 50 | 50 | 26 |
| | 16 | 14 | 20 | 27 | 125 | 80 | 29 | 53 | 58 | 58 | 29 |
| | 18 | 14 | 20 | 27 | 141 | 90 | 33 | 60 | 65 | 65 | 33 |
| 7 | 3 | | | 27 | | | | 81 | | | |
| | 5 | | | 27 | | | | 135 | | | |
| | 7 | | | 27 | | | | 179 | 10 | 24 | |
| | 9 | | | 27 | | | | 176 | 72 | 30 | 15 |
| | 11 | | | 27 | | | | 148 | 104 | 70 | 35 |
| | 13 | | | 27 | | | | 140 | 105 | 70 | 35 |

# Appendix 3: Summary of IRR analysis

| | | IRR Threshold | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | >0% | | | | | | 5% | | | | | | 10% | | | | | | 15% | | | | | |
| | | Areas (ha) | | | Metrics | | | Areas (ha) | | | Metrics | | | Areas (ha) | | | Metrics | | | Areas (ha) | | | Metrics | | |
| | | Suitable | Capable | % Suitable | Av IRR | Av ACCU | Av MAI | Suitable | Capable | % Suitable | Av IRR | Av ACCU | Av MAI | Suitable | Capable | % Suitable | Av IRR | Av ACCU | Av MAI | Suitable | Capable | % Suitable | Av IRR | Av ACCU | Av MAI |
| **Scenario 1** | Timber only | - | 988,176 | 0% | | | | - | 988,176 | 0% | | | | - | 988,176 | 0% | | | | - | 988,176 | 0% | | | |
| Pine | Timber and carbon | 230,905 | 988,176 | 23% | 12% | 425 | 16 | 203,996 | 988,176 | 21% | 13% | 432 | 16 | 158,399 | 988,176 | 16% | 14% | 437 | 16 | 67,927 | 988,176 | 7% | 16% | 441 | 17 |
| 27 yrs | Timber, carbon, grazing | 232,144 | 988,176 | 23% | 12% | 425 | 16 | 208,500 | 988,176 | 21% | 13% | 430 | 16 | 158,777 | 988,176 | 16% | 15% | 437 | 16 | 73,077 | 988,176 | 7% | 17% | 442 | 17 |
| No thin | Timber, carbon, alternative grazing | 291,872 | 988,176 | 30% | 21% | 404 | 15 | 276,735 | 988,176 | 28% | 22% | 409 | 15 | 257,285 | 988,176 | 26% | 23% | 414 | 16 | 225,764 | 988,176 | 23% | 24% | 421 | 16 |
| | Grazing only | 988,176 | 988,176 | 100% | 10% | | | 988,176 | 988,176 | 100% | 10% | | | 988,176 | 988,176 | 100% | 10% | | | 988,176 | 988,176 | 100% | 10% | | |
| **Scenario 2** | Timber only | 1,373 | 988,176 | 0% | 7% | 278 | 20 | 841 | 988,176 | 0% | 9% | 282 | 20 | 693 | 988,176 | 0% | 10% | 282 | 20 | - | 988,176 | 0% | | | |
| Pine | Timber and carbon | 133,555 | 988,176 | 14% | 7% | 278 | 20 | 105290 | 988,176 | 11% | 9% | 279 | 20 | 27,454 | 988,176 | 3% | 11% | 280 | 20 | 1,067 | 988,176 | 0% | 18% | 273 | 19 |
| 18 yrs | Timber, carbon, grazing | 136,812 | 988,176 | 14% | 8% | 279 | 20 | 110529 | 988,176 | 11% | 9% | 279 | 20 | 33,431 | 988,176 | 3% | 11% | 281 | 20 | 1,067 | 988,176 | 0% | 19% | 273 | 19 |
| No thin | Timber, carbon, alternative grazing | 205,564 | 988,176 | 21% | 19% | 274 | 20 | 205448 | 988,176 | 21% | 19% | 201 | 14 | 201,660 | 988,176 | 20% | 19% | 277 | 20 | 195,381 | 988,176 | 20% | 20% | 279 | 20 |
| | Grazing only | 988,176 | 988,176 | 100% | 16% | | | 988,176 | 988,176 | 100% | 16% | | | 988,176 | 988,176 | 100% | 16% | | | 988,176 | 988,176 | 100% | 16% | | |
| **Scenario 3** | Timber only | - | 644,534 | 0% | 0% | 0 | 0 | - | 644,534 | 0% | | | | - | 644,534 | 0% | | | | - | 644,534 | 0% | | | |
| Pellita | Timber and carbon | 160,138 | 644,534 | 25% | 8% | 341 | 13 | 156,589 | 644,534 | 24% | 9% | 342 | 13 | 71,097 | 644,534 | 11% | 10% | 358 | 13 | 191 | 644,534 | 0% | 18% | 273 | 19 |
| 15 yrs | Timber, carbon, grazing | 160,238 | 644,534 | 25% | 9% | 341 | 13 | 156,894 | 644,534 | 24% | 9% | 342 | 13 | 74,096 | 644,534 | 11% | 10% | 357 | 13 | 291 | 644,534 | 0% | 19% | 273 | 19 |
| No thin | Timber, carbon, alternative grazing | 160,497 | 644,534 | 25% | 13% | 326 | 12 | 160,397 | 644,534 | 25% | 13% | 326 | 12 | 141,018 | 644,534 | 22% | 13% | 329 | 12 | 38,527 | 644,534 | 6% | 36% | 268 | 19 |
| | Grazing only | 644,534 | 644,534 | 100% | 19% | | | 644,534 | 644,534 | 100% | 19% | | | 644,534 | 644,534 | 100% | 19% | | | - | 644,534 | 0% | 19% | | |
| **Scenario 4** | Timber only | - | 541734 | 0 | 0% | 0 | 0 | - | 541,734 | 0% | | | | - | 541,734 | 0% | | | | - | 541,734 | 0% | | | |
| Gympie messmate | Timber and carbon | 49,151 | 541734 | 0 | 6% | 373 | 13 | 23,873 | 541,734 | 4% | 8% | 377 | 13 | 13,796 | 541,734 | 3% | 10% | 345 | 12 | - | 541,734 | 0% | | | |
| 27 yrs | Timber, carbon, grazing | 50,067 | 541734 | 0 | 6% | 372 | 13 | 24,867 | 541,734 | 5% | 8% | 376 | 13 | 13,786 | 541,734 | 3% | 10% | 342 | 12 | - | 541,734 | 0% | | | |
| Two thins | Timber, carbon, alternative grazing | 159,201 | 541734 | 0 | 6% | 334 | 12 | 96,424 | 541,734 | 18% | 7% | 357 | 12 | 15,365 | 541,734 | 3% | 12% | 399 | 14 | 4,625 | 541,734 | 1% | 16% | 445 | 16 |
| | Grazing only | 541,734 | 541,734 | 100% | 10% | | | 541,734 | 541,734 | 100% | 10% | | | 541,734 | 541,734 | 100% | 10% | | | 541,734 | 541,734 | 100% | 10% | | |
| **Scenario 5** | Timber only | - | 541,734 | 0% | | | | - | 541,734 | 0% | | | | - | 541,734 | 0% | | | | - | 541,734 | 0% | | | |
| Gypmie messmate | Timber and carbon | 907 | 541,734 | 0% | 7% | 497 | 16 | 907 | 541,734 | 0% | 7% | 497 | 16 | - | 541,734 | 0% | | | | - | 541,734 | 0% | | | |
| 27 yrs | Timber, carbon, grazing | 907 | 541,734 | 0% | 8% | 497 | 16 | 907 | 541,734 | 0% | 8% | 497 | 16 | - | 541,734 | 0% | | | | - | 541,734 | 0% | | | |
| No thins | Timber, carbon, alternative grazing | 19,868 | 541,734 | 4% | 7% | 443 | 14 | 16,084 | 541,734 | 3% | 9% | 449 | 15 | 5,429 | 541,734 | 1% | 11% | 474 | 16 | 287 | 541,734 | 0% | 15% | 504 | 17 |
| | Grazing only | 541,734 | 541,734 | 100% | 10% | | | 541,734 | | | | | | 541,734 | 541,734 | 100% | 10% | | | - | 541,734 | 0% | 10% | | |
| Scenario 6 | Timber only | 100 | 1,107,768 | 0% | 10% | 485.87 | 17.10 | 100 | 1,107,768 | 0% | 10% | 486 | 17 | 100 | 1,107,768 | 0% | 10% | 486 | 17 | - | 1,107,768 | 0% | | | |
| Spotted gum | Timber and carbon | 72,451 | 1,107,768 | 7% | 6% | 365.89 | 12.65 | 41,602 | 1,107,768 | 4% | 8% | 357 | 12 | 25,877 | 1,107,768 | 2% | 10% | 316 | 11 | - | 1,107,768 | 0% | | | |
| 27 yrs | Timber, carbon, grazing | 75,728 | 1,107,768 | 7% | 6% | 191.83 | 12.57 | 44,313 | 1,107,768 | 4% | 8% | 189 | 12 | 27,825 | 1,107,768 | 3% | 10% | 168 | 11 | - | 1,107,768 | 0% | | | |
| Two thins | Timber, carbon, alternative grazing | 202,999 | 1,107,768 | 18% | 6% | 334.18 | 11.49 | 116,184 | 1,107,768 | 10% | 8% | 366 | 13 | 20,411 | 1,107,768 | 2% | 12% | 414 | 14 | 7,668 | 1,107,768 | 1% | 16% | 451 | 16 |
| | Grazing only | 1,107,768 | 1,107,768 | 100% | 10% | | | 1,107,768 | 1,107,768 | 100% | 10% | | | 1,107,768 | 1,107,768 | 100% | 10% | | | - | 1,107,768 | 0% | 10% | | |
| Scenario 7 | Timber only | - | 1,107,768 | 0% | | | | - | 1,107,768 | 0% | | | | - | 1,107,768 | 0% | | | | - | 1,107,768 | 0% | | | |
| Spotted gum | Timber and carbon | 907 | 1,107,768 | 0% | 7% | 498 | 12 | 907 | 1,107,768 | 0% | 7% | 498 | 12 | - | 1,107,768 | 0% | | | | - | 1,107,768 | 0% | | | |
| 27 yrs | Timber, carbon, grazing | 907 | 1,107,768 | 0% | 8% | 255 | 12 | 907 | 1,107,768 | 0% | 8% | 255 | 12 | - | 1,107,768 | 0% | | | | - | 1,107,768 | 0% | | | |
| No thins | Timber, carbon, alternative grazing | 22,381 | 1,107,768 | 2% | 7% | 442 | 11 | 17,933 | 1,107,768 | 2% | 9% | 449 | 11 | 5,429 | 1,107,768 | 0% | 11% | 475 | 12 | 287 | 1,107,768 | 0% | 15% | 505 | 13 |
| | Grazing only | 1,107,768 | 1,107,768 | 100% | 9% | | | 1,107,768 | 1,107,768 | 100% | 9% | | | 1,107,768 | 1,107,768 | 100% | 9% | | | - | 1,107,768 | 0% | 10% | | |

# Appendix 4: Area of each scenario and regime by local government authority

| | Scenario 1 | | | | | Scenario2 | | | | | Scenario 3 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LGA | Timber only | Timber and carbon | Timber, carbon, grazing | Timber, carbon, alternative grazing | Suitable area | Timber only | Timber and carbon | Timber, carbon, grazing | Timber, carbon, alternative grazing | Suitable area | Timber only | Timber and carbon | Timber, carbon, grazing | Timber, carbon, alternative grazing | Suitable area |
| Cairns Regional | - | - | - | 26,234 | 37,888 | - | - | - | 25,147 | 37,888 | 0 | - | - | 8,383 | 36,217 |
| Cassowary Coast Regional | - | 66,211 | 66,111 | 96,934 | 135,749 | 693 | 25,050 | 29,574 | 77,913 | 135,749 | 0 | 23,287 | 24,693 | 59,782 | 142,065 |
| Charters Towers Regional | - | 3,212 | 3,272 | 18,940 | 19,448 | - | 100 | 100 | 6,041 | 19,448 | 0 | - | - | - | - |
| Cook Shire | - | - | - | - | 11,323 | - | - | - | - | 11,323 | 0 | - | - | 131 | 11,985 |
| Douglas Shire | - | - | - | 440 | 41,927 | - | - | - | - | 41,927 | 0 | - | - | 1,056 | 40,338 |
| Hinchinbrook Shire | - | 784 | 784 | 5,770 | 108,203 | - | 679 | 679 | 1,253 | 108,203 | 0 | - | - | 197 | 74,006 |
| Mackay Regional | - | - | - | - | 355,698 | - | - | - | 3,471 | 355,698 | 0 | 1,839 | 1,839 | 6,445 | 191,177 |
| Mareeba Shire | - | 94 | 193 | 1,888 | 18,882 | - | - | - | 94 | 18,882 | 0 | - | - | - | 160 |
| Tablelands Regional | - | 86,290 | 86,609 | 105,132 | 163,048 | - | 1,336 | 2,791 | 93,722 | 163,048 | 0 | 44,760 | 46,354 | 63,351 | 114,595 |
| Townsville City | - | - | - | - | 15,033 | - | - | - | - | 15,033 | 0 | - | - | - | 6,726 |
| Whitsunday Regional | - | - | - | 141 | 77,521 | - | - | - | 141 | 77,521 | 0 | - | - | - | 9,972 |
| Wujal Wujal Aboriginal Shire | - | - | - | - | 908 | - | - | - | - | 908 | 0 | 272 | 272 | 268 | 844 |
| Yarrabah Aboriginal Shire | - | 1,807 | 1,807 | 1,807 | 2,547 | - | 388 | 388 | 388 | 2,547 | 0 | 938 | 938 | 1,406 | 2,642 |
| Total | - | 158,399 | 158,777 | 257,285 | 988,176 | 693 | 27,553 | 33,531 | 208,171 | 988,176 | - | 71,097 | 74,096 | 141,018 | 630,727 |

| | Scenario 4 | | | | | Scenario 5 | | | | | Scenario 6 | | | | | Scenario 7 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Timber only | Timber and carbon | Timber, carbon, grazing | Timber, carbon, alternative grazing | Suitable area | Timber only | Timber and carbon | Timber, carbon, grazing | Timber, carbon, alternative grazing | Suitable area | Timber only | Timber and carbon | Timber, carbon, grazing | Timber, carbon, alternative grazing | Suitable area | Timber only | Timber and carbon | Timber, carbon, grazing | Timber, carbon, alternative grazing | Suitable area |
| Cairns Regional | - | 53 | 221 | 847 | 32,983 | - | - | - | 370 | 32,983 | - | 786 | 1,384 | 964 | 37,888 | - | - | - | 370 | 37,888 |
| Cassowary Coast Regional | - | 13,447 | 13,565 | 10,513 | 135,749 | - | - | - | 4,978 | 135,749 | 100 | 17,112 | 17,076 | 11,507 | 135,749 | - | - | - | 4,978 | 135,749 |
| Charters Towers Regional | - | - | - | - | - | - | - | - | - | - | - | 4,412 | 4,821 | - | 28,147 | - | - | - | - | 28,147 |
| Cook Shire | - | - | - | - | 11,323 | - | - | - | - | 11,323 | - | 270 | 334 | - | 15,363 | - | - | - | - | 15,363 |
| Douglas Shire | - | - | - | - | 39,076 | - | - | - | - | 39,076 | - | - | - | - | 41,927 | - | - | - | - | 41,927 |
| Hinchinbrook Shire | - | - | - | - | 74,787 | - | - | - | - | 74,787 | - | - | - | - | 108,203 | - | - | - | - | 108,203 |
| Mackay Regional | - | - | - | - | 127,771 | - | - | - | - | 127,771 | - | 2,997 | 3,241 | 1,423 | 361,633 | - | - | - | - | 361,633 |
| Mareeba Shire | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 25,277 | - | - | - | - | 25,277 |
| Tablelands Regional | - | 296 | - | 2,026 | 100,144 | - | - | - | 82 | 100,144 | - | 200 | 771 | 4,857 | 176,158 | - | - | - | 82 | 176,158 |
| Townsville City | - | - | - | - | 6,581 | - | - | - | - | 6,581 | - | - | - | - | 15,033 | - | - | - | - | 15,033 |
| Whitsunday Regional | - | - | - | - | 9,864 | - | - | - | - | 9,864 | - | 99 | 199 | - | 158,935 | - | - | - | - | 158,935 |
| Wujal Wujal Aboriginal Shire | - | - | - | 776 | 908 | - | - | - | - | 908 | - | - | - | 394 | 908 | - | - | - | - | 908 |
| Yarrabah Aboriginal Shire | - | - | - | 1,203 | 2,547 | - | - | - | - | 2,547 | - | - | - | 1,265 | 2,547 | - | - | - | - | 2,547 |
| Total | - | 13,796 | 13,786 | 15,365 | 541,734 | - | - | - | 5,429 | 541,734 | 100 | 25,877 | 27,825 | 20,411 | 1,107,768 | - | - | - | 5,429 | ####### |