



SUSTAINABLE FORESTRY PRACTICES

Guidelines for the Northern Territory



Sustainable Forestry Practices: Guidelines for the Northern Territory.
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Acronyms

| | |
|-------|--|
| AAPA | Aboriginal Areas Protection Authority |
| CSIRO | Commonwealth Scientific and Industrial Research Organisation |
| DENR | Department of Environment and Natural Resources |
| DEPWS | Department of Environment, Parks and Water Security |
| DIPL | Department of Infrastructure, Planning and Logistics |
| DPIR | Department of Primary Industry and Resources |
| EPA | Environment Protection Authority |
| EPBC | Environment Protection and Biodiversity Conservation |
| ESCP | Erosion and Sediment Control Plan |
| ESD | Ecologically Sustainable Development |
| FIANT | Forestry Industry Association Northern Territory |
| FSC | Forest Stewardship Council |
| GIS | Geographic Information System |
| NLC | Northern Land Council |
| NT | Northern Territory |
| PAMA | Pest Animal Management Authorisation |
| PEFC | Programme for the Endorsement of Forest Certification |
| PLB | Pastoral Land Board |
| TNRM | Territory Natural Resource Management |
| WA | Western Australia |
| WAP | Water Allocation Plan |

Introduction

The forestry industry within the Northern Territory (NT) is considered to be in its early stages, with potential for expansion in the coming decades. The existing operators have identified a need for a set of guidelines for forestry practices.

These Sustainable Forestry Practices Guidelines have been prepared for foresters or those interested in the industry to gain an understanding of the requirements necessary to undertake plantation forestry operations sustainably. They have been developed with special reference to the NT environment and conditions, and reflect NT legislation, information and existing guidelines where relevant. The Guidelines outline best management practices and have been developed in consultation with industry leaders who formed the working group, the NT Department of Primary Industry and Resources (DPIR), and other interested parties.

A relatively large area of land is used for forestry purposes and the industry is likely to expand in the future, hence it is imperative that this land and associated natural resources are managed sustainably. There is continuing interest in growing timber trees in the Top End of the NT and an increasing recognition of the associated economic and social benefits. There is a need for the NT industry to have evidence and guiding documents when demonstrating to the public that the industry is applying appropriate standards for sustainability.

While there is an existing NT Codes of Practice for Forestry Plantations (NT Government, 2004; Appendix 2), the Code is somewhat dated and resources from interstate are being used by forestry operators in the NT. The NT Code stipulates broad requirements relating to biodiversity, soil conservation, habitat protection, control of chemicals and hazardous substances, cultural heritage protection, and weed, pest and disease prevention. In relation to the goal statements in the NT Code, Raison et al. (2012) found that the Code 'does not provide guidance on how these goals effectively link to and trigger supporting legislation, or how they can be translated into plans and on-ground practices that will allow the goals to be achieved.' The Code currently has no status under relevant environmental or planning laws, and as such is a draft voluntary code with no formal status.

This document aims to promote sustainable forestry practices. It is intended as a guide for appropriate management practices in forestry activities, and provides guidelines to plantation managers so that operations in plantations in the northern portion of the NT are economically competitive and sustainable and are consistent with other resource management objectives. These guidelines allow land managers to assess where they currently stand in regard to their management techniques. Compliance with the Guidelines will serve to advance the formation of a professional, credible and sustainable industry by establishing the framework within which growers can apply best practice.

This set of guidelines has a particular focus on sustainable practices, with the intention of encouraging sustainable management of the natural resources of the NT. Development of guidelines for forestry is a listed Priority (Priority 4.7) in the Northern Territory Natural Resource Management Plan for the Top End region, as part of Program 4 Industry adoption of sustainable practices (TNRM, 2016).

Scope

As part of the preparation of the guidelines, information was collated and analysed from a range of sources, both from the NT and interstate. The working group of partners in the NT provided expert guidance and scope for the development of the guidelines.

Documents referred to in compiling the Guidelines were:

- *Mackay Whitsunday Region Planted Forests Management Practices*
- *Timber Plantation Operations Code of Practice for Queensland*
- *Land Clearing Guidelines (NT)*
- *Assessment of Code of Practice for Plantation Forestry: Northern Territory*
- *Northern Territory Codes of Practice for Forestry Plantations* (refer to Appendix 2)
- *Forest Practices Code (Tasmania)*
- *Code of Practice for Timber Plantations in Western Australia*
- *Mackay Whitsunday Region Native Forestry Management Practices*
- *Code of Practice for Native Forest Timber Production on the QPWS Forest Estate*
- *Forest Practices Related to Wood Production in Plantations: National Principles*

The Guidelines explore a range of different themes associated with forestry. They are not overly prescriptive as prescriptions vary between growers and are contingent on individual plantation characteristics, these being the responsibility of individual plantation managers.

Establishing and maintaining a plantation forestry operation in the NT involves a range of matters that must be considered. These are summarised in the flow diagram on the next page. More detail on these considerations is provided in the Guidelines sections.

The Guidelines comprise three associated documents:

1. Sustainable Forestry Practices for the NT (this document), which outlines Best Management Forestry Practices;
2. NT Sustainable Forestry Practices Field Guide which provides a summary listing of the practices for use in the field; and
3. NT Forestry Ready Reckoner, which compiles information on legislative requirements for forestry in the NT. This is provided as Appendix 1.

Territory Natural Resource Management (TNRM) has prepared these Guidelines in consultation with the industry and government, as an independent not for profit organisation working to ensure sustainable management of NT natural resources.

This document is intended to be a working document. As such it is planned to be updated following a review in 18-24 months, once users have provided feedback.

Structure

The document is structured to firstly provide background information about the NT physical environment as the setting for forestry operations and provides a summary of the industry as currently practiced in the NT. References are provided for those seeking additional information. The concept of sustainability as a guiding principle in relation to forestry is introduced next, along with the legislative framework as it relates to forestry in the NT.

These introductory sections are followed by the Guidelines themselves, which form the main part of the document. An introduction to the format, purpose and practices outlined in the Guidelines is provided in the first part of the Guidelines section.

CONSIDERATIONS FOR FORESTRY PLANNING AND OPERATIONS *in the Northern Territory*

Forestry is not just about planting trees and waiting for them to grow – there are a variety of matters to consider in establishing and maintaining a forestry operation. Starting up takes several years and detailed planning is necessary. Forestry is a long-term undertaking.



The Territory Context

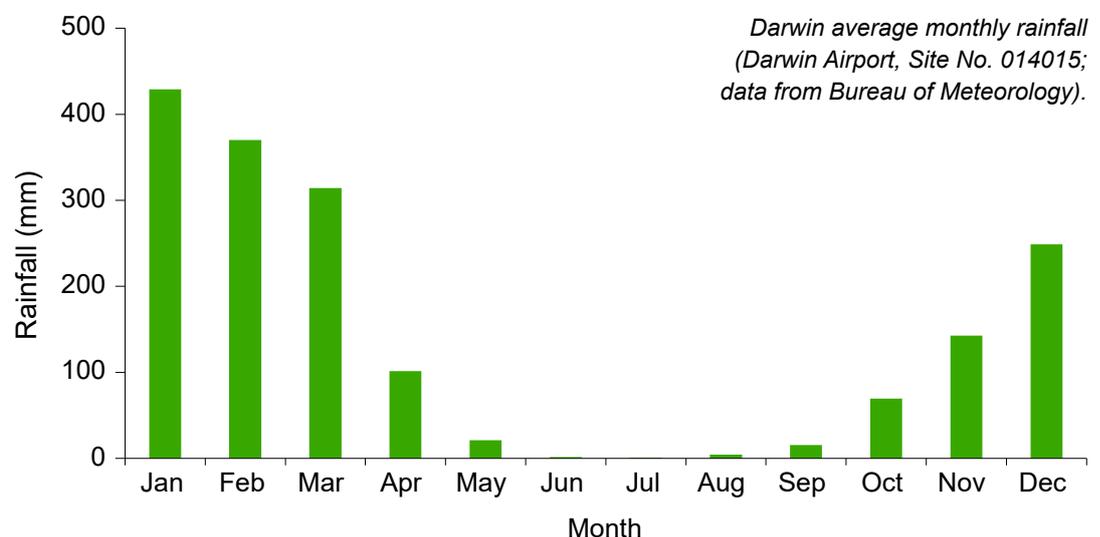
The conditions of the Top End of the Northern Territory are distinctive, being most similar to the northern parts of Queensland and the Kimberley region of Western Australia. Similar seasonal climates with a prolonged dry season also occur in parts of south-east Asia and in Africa. The combination of land and climate suited to growing particular tree species is a key factor in establishing forestry operations in the Top End (Evans, 1982).

Environment

Climate and moisture availability

The Top End has a highly seasonal climate, denoted as a tropical savanna climate (Aw) under the Koppen classification. The majority of rain falls in the wet season months of October to April (91% of annual rainfall at Darwin). The period May to September receives little or no rainfall in most years; the median rainfall at Darwin for the months June, July and August is zero (data from Bureau of Meteorology). The hottest months are October and November (during the 'build-up'), and humidity is high for over half the year. December to March are the wettest months with rainfall associated with convective thunderstorms, the seasonal monsoon as the intertropical convergence zone passes south of the equator, and rain derived from tropical cyclones that form in the Arafura Sea or from further east. Tropical cyclones are generally slow-moving, very low pressure systems that generate severe winds and widespread and often heavy rainfall.

In relation to forestry activities, it has been suggested that species should be selected that can withstand high winds, and ideally plantations should be situated away from the coast, where destructive winds from tropical cyclones are most intense. Select Carbon (2012) provide a review of cyclones and their effects on trees and plantations in cyclone-prone areas of Queensland.



Moisture in the soil profile fluctuates considerably between the wet and the dry seasons. Many savanna plant species access this moisture without any significant reliance on groundwater. Transpired water during the wet season is sourced from the upper 50 cm of soil, whereas dry season water requirements are sourced from between 2 and 8 m depth with little reliance on groundwater. In the case of African Mahogany, plantation canopy transpiration rates are more than double that of native eucalypt trees of the savanna, however, the Mahogany trees are not utilising groundwater to maintain this high rate, and are able to meet transpirational requirements from soil moisture alone (Hutley et al., 2012). In land units most appropriate for plantations, water table depth is typically well beyond the anticipated rooting depth. Near watercourses, groundwater is closer to the surface and mature trees in these habitats generally access groundwater throughout the year; riparian vegetation in particular is highly groundwater dependent (O'Grady et al., 2006).

The growing period is mainly during the wet season and early dry season, but trees may grow for longer where soil moisture is available. Trees grow actively in the hot and wet months as there is plentiful sunlight and water, as well as high levels of atmospheric moisture (humidity). In native tree and shrub species, a rise in humidity may induce production of new leaves in the build-up, prior to substantial rainfall. Insect activity is greater in the wet season and the early part of the dry season, with peaks in numbers following rain.

Soils and landforms

Major soil types across the Top End are kandosols (red and yellow earths), hydrosols (seasonally inundated soils), rudosols (shallow soils on rugged terrain), vertosols (cracking clays or black soils), chromosols (on alluvial plains) and calcarosols (calcium carbonate often on limestone). Red and yellow earths (kandosols) are characteristically deep soils which grade from a sandy surface to a more clayey subsoil (Fogarty et al., 1984), and are important for agricultural and horticultural production.

Land unit and land system mapping is available in a series of reports that describe the landforms, vegetation and soils of various parts of the NT. A land unit is defined as a reasonably homogenous part of the landscape, distinct from the surrounding terrain with relatively uniform properties in landform, soils and vegetation (DENR, 2018). Land systems are at a larger scale and are recognised as being an assemblage of land units. Land, soil and vegetation information across the NT in the form of maps and reports is available online and through the land catalogue (DENR, 2018).

Vegetation

The Top End region naturally supports eucalypt-dominated savanna vegetation with a grassy understorey, with patches of monsoon forest distributed across the landscape particularly near the coast and in sheltered positions inland (monsoon vine thickets) and where water (wet soils) is available throughout the year (wet monsoon forests). Waterways, wetlands and sheltered coasts support distinctive vegetation types, as do the sandstone habitats of Arnhem Land. For further information about native vegetation communities refer to Brock (1993) *Native Plants of Northern Australia* and references therein, and the NT Government factsheet *Native Vegetation in the NT*, available at: https://denr.nt.gov.au/_data/assets/pdf_file/0017/261062/vegetation-types-in-nt-factsheet.pdf.

The Territory Forestry Industry

Forestry is the establishment, growing, maintenance, and harvesting of trees as a resource for human and environmental benefits. These resources can be commercial such as construction timber, paper, or woodchips, or in some instances can be used for special products such as oil. Forestry can be practiced in both human created plantations, or by cultivating select trees in a natural area. Naturally forested land (savanna woodlands and open forests in the Top End) may also be utilised.

Importantly, forestry is a long-term enterprise, requiring investment of time and energy over many years, from the time of establishment and planting until the time at which harvest is practicable. Although growth rates may be high under tropical conditions, time to harvest for plantation trees in northern Australia is of the order of 10-40 years.

Forestry is the second largest production land use in the NT, after extensive beef grazing on pastoral properties. Forestry currently incorporates an area of approximately 49 000 hectares, and provides an estimated \$23 million to the NT economy annually. Forestry in the NT provides employment opportunities for several hundred people. There is strong demand for wood and a range of economic and social benefits.

The forestry industry in northern Australia is still relatively small-scale, geographically fragmented and diverse. There is good underlying demand for forest products and it is projected to grow. In the NT, interest in establishing hardwood plantations has increased due to predicted increasing demands for hardwood timbers, and diminishing supply from native forests. The Top End has considerable potential for agroforestry, if species can be identified that can thrive in the extreme climatic conditions and poor soil conditions of the region (Reilly et al., 2007). Proximity to Asian markets is also considered a factor in its favour.

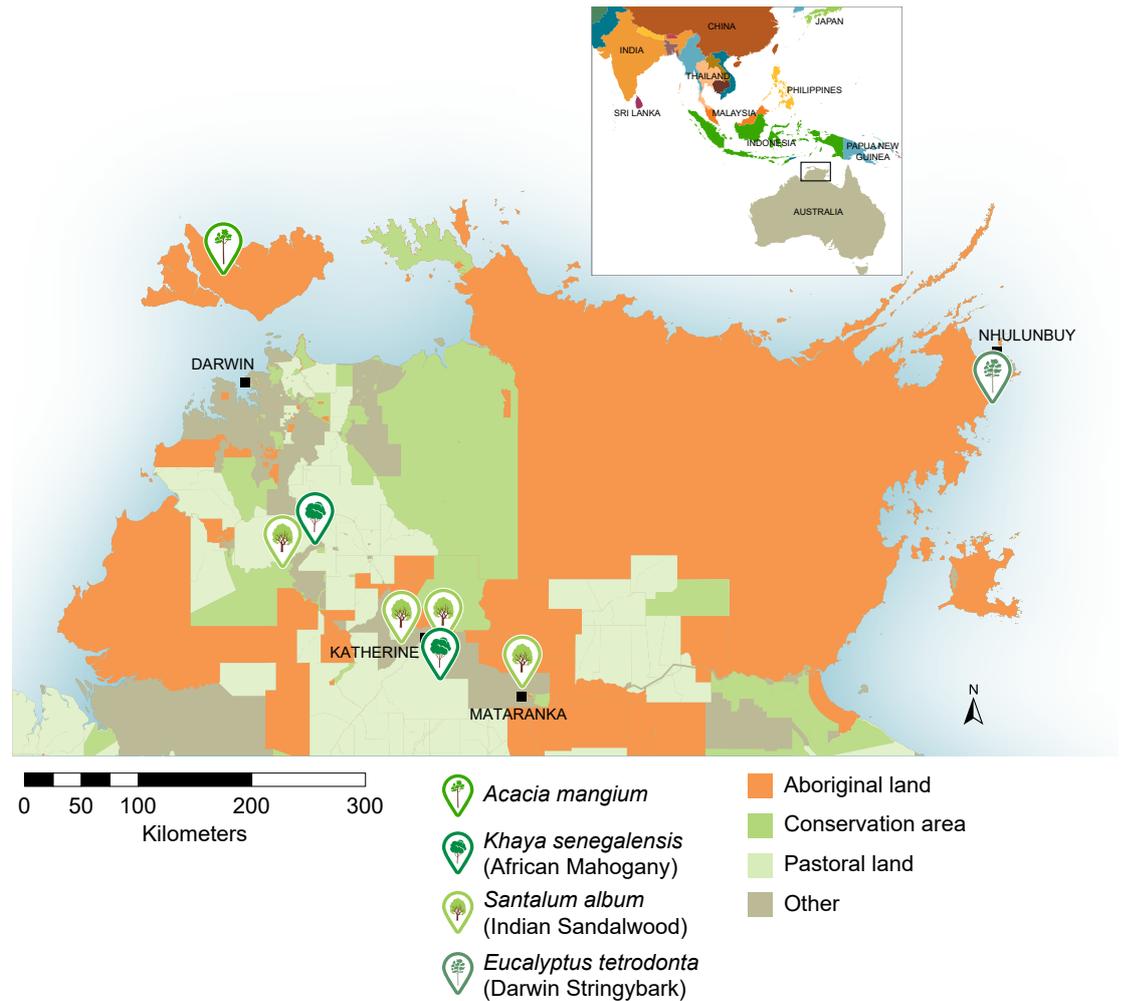
The Cooperative Research Centre for Developing Northern Australia (CRCNA) have recently completed a Northern Australia forest and forest products industry situational analysis (Stephens et al., 2020). In their analysis they noted the following points relevant to the NT that are common to forestry in northern Australia:

- Specific areas of land are available for expansion of plantations in northern Australia, dependent upon suitable soils, rainfall and access to markets.
- Broad areas of native forest exist, but there is a need for improved forest inventory and assessment of commercial potential.
- Silvicultural understanding needs to be improved and supported through expertise and training for private native forestry (particularly among traditional owners and to support expansion of Indigenous forestry opportunities).
- Silvopastoral systems (particularly beef cattle and timber) are likely to be important.
- Infrastructure needs are significant across northern Australia, linking resource with processing for local markets and export (port) opportunities.

Despite the potential of an extensive land mass, and large forest areas, remoteness and extremes of climate as well as regular fires and termites have limited the potential of the region, including the forestry and forest products industry (Lacey, 1978; Stephens et al., 2020). The northern Australian forestry and forest products industry, at least in terms of wood product processing and value chain activity currently is small scale and fragmented (Stephens et al., 2020). Access to plantations can be an issue in the wet season when soils are waterlogged and access to markets can fluctuate and in some cases are still being developed.

The three major plantation projects in the NT are Acacia wood chip for pulp, mahogany timber (logs) for furniture and other uses, and sandalwood for oil, pharmaceuticals and carving timber. Materials for artwork and yidaki (didgeridoo) are obtained from native forests. Products are mainly for international pulp markets and local building products. Plantation forestry occurs currently across the Tiwi Islands, Douglas-Daly and Katherine regions. There are also extensive areas of savanna woodland and open forest that could be important for sustainable forestry production.

Top End region indicating plantation areas, native forest project and land tenure.



Acacia mangium

There are extensive plantations of *Acacia mangium* on Melville Island as part of the Tiwi Islands forestry operations. Tiwi Plantations is a major Indigenous business development in northern Australia.

The first forestry plantation started on Melville Island in the 1960s. When the NT Government ended its involvement in forestry on the islands in 1986, over 4900 ha of plantations were handed over to the Tiwi Land Council. This was mainly *Pinus caribaea* (Caribbean Pine) and *Callitris intratropica* (Northern Cypress), with some mixed plantings including the first trials of *Acacia mangium* (Tiwi Plantations Corporation, 2020). This fast-growing tropical hardwood is native to northern Queensland and Papua New Guinea.

Acacia mangium plantations on Melville Island were significantly expanded in 2001 when hundreds of thousands of seedlings were provided by external growers. Ownership of the plantation was transferred to new managers, who invested millions in the plantations and supported the broader community through land rental and ranger programs. Growing of nursery stock and plantings of *A. mangium* were carried out regularly in the period 2003-2008. The current forest estate consists of approximately 26 000 hectares of *Acacia mangium* plantations.

Tiwi leaders formed their own Tiwi forestry company, Tiwi Plantations Corporation Trust (TPC) in 2009. The driving consideration behind this undertaking was the leaders' vision of creating sustainable employment and livelihoods for their people. The first harvest of *A. mangium* and export for woodchip occurred in 2015, and harvesting has continued each year since. As of 2019, 16 shipments of Tiwi woodchip had been exported from the deep-water port that has been established at Port Melville.

Harvesting of *A. mangium* takes place when the trees are 10-17 years old, with yields varying considerably depending on site conditions. Some legacy *P. caribaea* has also been harvested and exported to Asian markets through Port Melville. The managers provide the staff and technical skills to plant, grow, harvest, process and market trees for TPC. A considerable workforce (100+ personnel) is required during periods of active harvest and ship loading.

Fire management is a major part of forestry operations on the Tiwi Islands, with extensive controlled burns conducted each dry season to protect plantation areas from uncontrolled wildfires that can damage *A. mangium* plantations.

Wildling *A. mangium* are becoming naturalised in the vicinity of plantations on Melville Island. There is ongoing monitoring of areas around and downstream of plantations for incursions and the managers coordinate an ongoing control program.

There are plans to start re-planting harvested areas in the near future. A eucalypt species or a hybrid will be the crop as its wood properties are more desired by processing plants.

***Khaya senegalensis* (African Mahogany)**

Khaya senegalensis (African Mahogany) is grown in plantations in the Douglas-Daly region, occupying an area of approximately 14 000 ha. Planting has occurred since 2006, and the industry supports up to 10 regional jobs. Mid-rotation silviculture is carried out and integrated grazing occurs on most properties.

The non-irrigated *K. senegalensis* plantations were developed predominantly on freehold lands previously cleared for improved pastures (Hutley et al., 2012). It is anticipated that there will be an expansion of plantations within the Daly River region, potentially up to a total of 50 000 ha. Much of the existing cleared land and mahogany plantation development occurs within the Douglas and Stray Creek sub-catchments.

The species grows naturally in West Africa and was planted for the first time in the NT near Darwin in the 1950s (NT Government, 2012). During the 1960s its potential as a plantation species began to be recognised and trials aimed at domesticating and improving the species were established near Darwin and on Melville Island. *Khaya senegalensis* prefers well-drained, sandy loams but will grow in a wide range of soil types (NT Government, 2012). Proper spacing of trees is important, a common spacing being 5 m between rows and 5 m along the row (400 stems/ha). Fertiliser should be applied at the time of planting to ensure successful establishment. The plantations are generally non-irrigated and stand maturity is anticipated to occur at 18-25 years.

African Mahogany is well known for its capacity to produce high value timber. The heartwood is pale pink-brown when freshly cut, darkening to a deep red-brown colour (NT Government, 2012). It is moderately hard and heavy and is used for furniture and interior decoration. It has been used and continues to be used at a small scale in the Top End for making furniture and for bench tops. The quality of wood sourced from older trial plantations in the NT and potential uses of the timber is discussed by Armstrong et al. (2007).



*African Mahogany
plantation, Douglas-
Daly*

Santalum album (Indian Sandalwood)

There are currently 6 000 ha of *Santalum album* (Indian Sandalwood) plantations in the Douglas-Daly region of the NT. This forms part of the largest sandalwood plantations in the world. Initial trials and experiments were conducted in the 1980s and 1990s in the Ord River area of Western Australia, followed by establishment of plantations (Bristow, 2004).

The species *S. album* occurs naturally from India through to the South Pacific and also on the northern coast of Australia. There are several other *Santalum* species native to Australia. The height of the evergreen tree is between 4 and 9 metres. The tree is hemi-parasitic, parasitising the roots of other tree species.

Sandalwood plantation establishment commenced in the NT in 2010 near Katherine and Mataranka. Planting and management has been ongoing, providing up to 80 regional jobs. Plantations near Katherine occupy an area of approximately 3 000 ha in the Florina area. Water for irrigation is derived from the relatively high-yielding Tindall Limestone Aquifer and the Ooloo Dolostone Aquifer within the Daly Basin. Irrigation for plantations near Mataranka is sourced from the Tindall Aquifer. The total area currently under *S. album* is over 5 000 ha.

Sandalwood trees are planted together with one or more host species. Their first host (the pot host, generally *Alternanthera*) is a herbaceous plant introduced to the container-grown sandalwood prior to field planting. The short-term or primary host (e.g. *Sesbania formosa*) aims to produce rapid sandalwood growth and will die 2-4 years after establishment, leaving the long-term host to grow and support the sandalwood over its production life (Barbour, 2008). *Acacia trachycarpa* (also *A. simsii*) is often used as a primary host and *Cathormion umbellatum* has been a dominant secondary host (Barbour, 2008). *Dalbergia latifolia* (Indian Rosewood) and *Pongamia pinnata* can also provide continued sandalwood growth. Each sandalwood tree requires at least four host trees over its lifespan with sufficient spacing so that the sandalwood is not overly shaded.

Santalum album flourishes during the wet season with the warm and humid conditions stimulating growth of the Sandalwood and host trees. Except during parts of the wet season, irrigation is required to maintain adequate soil moisture. By harvesting and replanting each year, the plantations create a sustainable supply of sandalwood. Sandalwood in northern Australia is on a rotation of 15-20 years, with potentially better yields at 17+ years.

Indian Sandalwood
and host plants



Sandalwood derives its value from the heartwood which is contained within the trunk, butt and major branches. It is yellow-brown to red in colour and it contains the oil, which gives the tree its value either as timber or as oil. There is relatively high demand for sandalwood products, particularly sandalwood oil in international markets such as India and China. The first shipment of sandalwood from northern Australia was exported to China in 2016. A variety of sandalwood products are sold locally in Kununurra and Broome and through suppliers in Darwin and Katherine.

Other potential species

Callitris intratropica (Northern Cypress) was planted extensively in the past in the Howard Springs area and Gunn Point, and on Melville Island since 1955. Plantings on the mainland ceased in 1973/74. In the early days of settlement, *C. intratropica* was considered the most valuable native timber in the Territory, as it saws and dresses well, and is termite resistant (Bateman, 1955). It was used extensively for building in Darwin and Katherine, however, most accessible stands were severely depleted and the trees suffered from repeated fires (Anon., 1967). Plantations of *C. intratropica* were considered unsuccessful due to slow growth rates and sensitivity to fire, and the forestry program was abandoned in the late 1970s. In 1978 the House of Representatives Standing Committee on Expenditure (Commonwealth) recommended that 'the Howard Springs and Gunn Point plantations be written off as production areas'.

The company Blue Cypress currently obtain essential oils from the bark, cambium, sapwood and heartwood of Northern Cypress Pine. Timber is sourced from plantations near Darwin and from Melville Island, and oils are distilled in Darwin.

Historic Northern
Cypress plantation,
Howard Springs

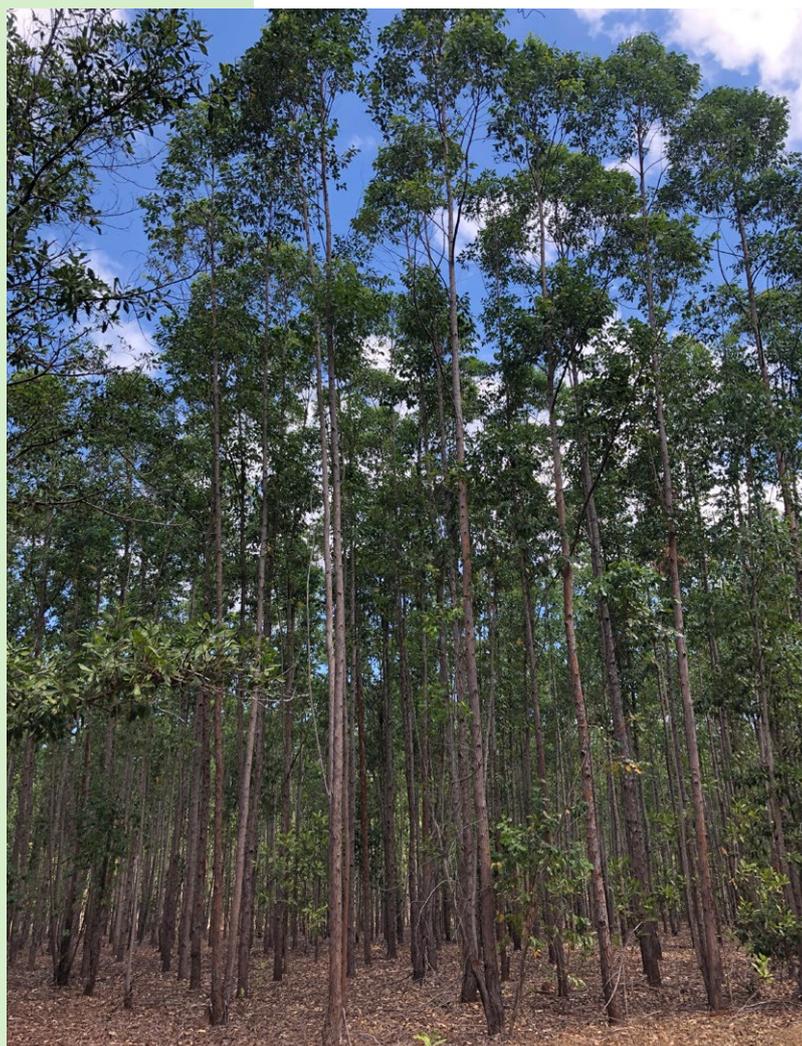


Pinus caribaea was trialled on Melville Island and to a lesser extent in the Darwin region, but this was discontinued by the NT Government in the 1970s and was not managed. Its perceived potential for growth was not achieved. In the past few years it has been managed and the last of the *P. caribaea* was harvested in late 2020.

Several eucalypt species have been trialled on the Tiwi Islands since the 1980s. The most promising trials consist of *Eucalyptus pellita* (Red Mahogany), *E. urophylla* (Timor Mountain Gum) and *E. brassiana* (Cape York Red Gum) and hybrids thereof. These species are showing good growth and relatively high tolerance of fire and wind/storms (ABC Rural, 2015). Eucalypts are likely to replace the *Acacia mangium* plantations once they are harvested.

Species that could potentially be grown for timber in rural woodlots include *Tectona grandis* (Teak), *Eucalyptus pellita*, *Pterocarpus macrocarpus* (Burma Paduak), *Pterocarpus indicus* (New Guinea Rosewood) and *Eucalyptus camaldulensis* (River Red Gum; NT Government, 2002). Other than trial plantings, these species are currently not grown to any great extent in the Top End. Clark et al. (2009) describe a series of farm forestry trials in the Top End from 1998 to 2003. Four preferred species were indicated for further silvicultural management trialling; *K. senegalensis*, *T. grandis*, *E. camaldulensis* and *E. pellita*. Climatically suitable plantation species including *E. pellita* are currently grown in plantations in north Queensland, although much of the resource was destroyed by Cyclone Yasi in 2011.

From 1969 to 1979 the Commonwealth Scientific and Industrial Research Organisation (CSIRO) established four test plantations at sites receiving greater than 1 600 mm annual rainfall at Humpty Doo, Howard Springs, Gunn Point and Melville Island. The sites were used to test over 190 high value exotic tree species to identify viable, commercial species suitable for plantation forestry. Species included the well-known and valuable Teak and African Mahogany as well as *Pterocarpus indicus*, *Corymbia nesophila* (Melville Island Bloodwood), *E. pellita* and *E. brassiana*. The management of the sites after 1979 was erratic, but assessment of the plantings in 1983 and 2002 provided some information on survival and performance of key species (Bristow 2004).



Eucalyptus pellita
trial on the Tiwi
Islands

Other small-scale trials have been undertaken since 2001 with *E. pellita*, *E. camaldulensis*, *Acacia crassicaarpa*, *E. tetradonta*, *C. nesophila*, eucalypt hybrids, *K. senegalensis* and exotic hardwoods including *P. macrocarpus*. These trials were conducted at Berry Springs, Howard Springs and Berrimah (Reilly et al., 2007). Some species showed good potential, however, issues were encountered with fire damage to some plots and weed incursion.

Special native tree crops may be established as an alternative source of native forest products, for example native food plants or trees that supply the materials for Aboriginal artefacts (NT Government, 2002).

Native forests

A natural or native forest is defined as a forest area with many of the principal characteristics and key elements of native ecosystems, such as complexity, structure and biological diversity, including soil characteristics, flora and fauna, in which all or almost all the trees are native species. A plantation, by contrast, is defined as a forest area established by planting or sowing with either non-native or native species, often with one or few species, regular spacing and even ages, and which lacks most of the principal characteristics and key elements of natural forests (FSC, 2015). Both timber and non-timber forest products have been obtained from native forests in northern Australia.

Indigenous use of natural forest products has been ongoing for millennia, with traditional bush foods and medicines derived from a range of native plant species. These uses have been documented in a series of publications by the biocultural knowledge section (NT Government). There is local native forest management in parts of the Top End and in particular East Arnhem Land where trees are utilised for ornaments, bark paintings, etc. There have been some studies of traditional harvest (Griffiths et al., 2003; Koenig et al., 2011). Other non-timber forest products include plant parts with medicinal properties and didgeridoos (yidaki).

The National Indigenous Forestry Strategy (Australian Government, 2005) aims to encourage Indigenous participation in the forest industry. An ecologically sustainable forest industry could provide economic and social opportunities. However, at present, there are very few Indigenous communities involved in the forest and wood products industry.

It is estimated that in the northern part of the NT there is approximately 17.2 million hectares of native forest that could be important for sustainable forestry production (M. Bristow, NT News March 13, 2019). Much of this is on indigenous land, and Meadows et al. (2020) discuss the potential for commercial forestry on indigenous land in northern Australia, pointing to key opportunities, challenges and needs for further development of the industry.

Gumatj Corporation based at Nhulunbuy in East Arnhem Land provide training and jobs in their forest works, timber harvesting, timber mill, sawmill, and woodwork factory. These enterprises manufacture building materials such as roof trusses for local use and some timber is supplied for a range of quality furniture and hand-crafted homeware items (Gumatj Corporation, 2016). This salvage logging project was established in 2011 and is still active, using mostly *Eucalyptus tetradonta* (Darwin Stringybark). The timber is harvested prior to land clearing associated with bauxite mining (the remaining trees are burnt). The sawmill has been operating since 2014. In May 2017 sixteen Indigenous people were employed at the mill. In recent times Gumatj supplied timber for the Cavenagh Street shade structure in Darwin as part of the city centre revitalisation plan (ABC Rural, 2018).

A similar enterprise, Wik Timber on western Cape York (north Queensland) harvests *Eucalyptus tetradonta* for timber and wood chipping. Timber is harvested ahead of land clearing for mining operations.

Erythrophleum chlorostachys (Ironwood) is a favoured native timber species in the NT due to its termite resistance, high density and its appearance (a mixture of pale yellow and dark red-brown). It was used for sleepers for the North Australian Railway (now abandoned) and is also used for fence posts, furniture and other uses where strength and durability are prime requisites (Woinarski et al., 2002). It is widely distributed across the savannas of the Top End, but is rarely dominant. Details of the ecology, biomass, local distribution and harvest of Ironwood in the NT are provided by Woinarski et al. (2002) and Taylor et al. (2002).

Additional species harvested to some extent for native timber (based on permits; Taylor et al., 2002) include *Corymbia bleeseri*, *C. polycarpa*, *C. foelscheana*, *E. miniata* in addition to *Callitris intratropica*, *Eucalyptus tetrodonta* and *Erythrophleum chlorostachys*.

A report on native timber from Cape York Peninsula in Queensland (Hopewell, 2001) includes a number of species that are native to the Top End of the NT. The report provides detailed descriptions of timber species, characteristics of the wood and utilisation.

Potential native timber species listed by Hopewell (2001) and their occurrence in the Top End of the NT.

| Species | Occurrence in NT |
|---|--|
| <i>Eucalyptus tetrodonta</i> (Darwin Stringybark) | widespread across the Top End |
| <i>Erythrophleum chlorostachys</i> (Ironwood) | widespread across the Top End |
| <i>Corymbia nesophila</i> (Melville Island Bloodwood) | restricted to Melville Island and Cobourg Peninsula |
| <i>Acacia mangium</i> (Brown Salwood) | not native to Top End; planted on Tiwi Islands; native to north Queensland and Papua New Guinea |
| <i>Acacia shirleyi</i> (Lancewood) | occurs in stands inland, generally south of Katherine |
| <i>Santalum</i> spp. (Sandalwood) | <i>Santalum album</i> generally near coastal and Northern Sandalwood <i>S. lanceolatum</i> extending inland |
| <i>Grevillea striata</i> (Beefwood) | scattered, generally inland, south of Mataranka |
| <i>Avicennia marina</i> (Grey Mangrove) | common coastal and estuarine species |
| <i>Rhizophora</i> spp. (Red Mangrove) | <i>R. stylosa</i> is widespread and common along the Top End coast, <i>R. apiculata</i> is sparsely distributed across the Top End coast |
| <i>Xylocarpus</i> spp. (Cedar Mangrove) | <i>X. granatum</i> occurs rarely and <i>X. moluccensis</i> (=australasicus) is relatively common at the rear of mangroves |
| <i>Bruguiera</i> spp. (Black Mangrove) | <i>B. gymnorhiza</i> and <i>B. parviflora</i> occur in the Top End; other <i>Bruguiera</i> spp. also occur |
| <i>Heritiera littoralis</i> (Tulip Mangrove) | not native to Top End; occurs in north Queensland and PNG |

Sustainability

Sustainability is a widely used term in relation to environmental matters, and there are a range of definitions. Sustainable development is usually taken to mean that enterprises meet the needs of the present without compromising the ability of future generations to meet their own needs. From an environmental perspective, this means that development meets these needs without damaging the environment and biological diversity. A definition of sustainable is 'using methods that do not harm the environment so that natural resources are still available in the future'.

Sustainable management of natural resources is an identified goal of governments and industries that rely on environmental products. The Australian Government has developed the National Strategy for Ecologically Sustainable Development. The Commonwealth Government suggested the following definition for Ecologically Sustainable Development (ESD) in Australia:

'using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased'.

Put more simply, ESD is development which aims to meet the needs of Australians today, while conserving ecosystems for the benefit of future generations. To do this, ways need to be developed to use those environmental resources which form the basis of our economy in a way which maintains and, where possible, improves their range, variety and quality. At the same time resources need to be utilised to develop industry and generate employment (ESD Steering Committee, 1992).

Sustainability can be viewed as the processes by which something is maintained at a certain level (i.e. sustained), hence it can be defined as the processes and actions through which humankind avoids the depletion of natural resources. This incorporates environmental values, but also economics and society. Sustainability relies on the interdependence of healthy social, economic and ecological systems. It requires a long-term approach with a vision to the future, involving actions designed to preserve the quality of the environment.

An important part of sustainability is to maintain ecosystem services. Ecosystem services are the benefits people obtain from ecosystems. These include:

1. provisioning services such as food, forest products and water;
2. regulating services such as regulation of floods, drought, land degradation, air quality, climate and disease;
3. supporting services such as soil formation and nutrient cycling;
4. cultural services and cultural values such as recreational, spiritual, religious and other non-material benefits (FSC, 2015)

Exploitation of the land and water resources of northern Australia has not always been implemented in a sustainable manner, and there are a number of examples of poor management in the past, as well as in the present day. For example, practices in the past have led to over exploitation and loss of stands of native Cypress Pine and depletion of Ironwood in areas near Darwin and Katherine. Timber was used for building construction in Darwin and Katherine and for camp construction during the war. These types of activities have not sustained the resource.

New industries based on timber plantations, tree crops, grazing systems and sustainable management of native forests could provide ecologically sustainable development, long-term employment and wider benefits to regional economies (Bristow, 2004). Such a development is envisaged for forestry in the Top End of the NT.

Sustainability is becoming a major priority for primary producers, as local and global markets increase their requirements for sustainably produced goods. Environmentally appropriate forest management ensures that the production of timber, non-timber products and ecosystem services maintains biodiversity, productivity, and ecological processes. For the purposes of forestry activities, the objective of sustainable production is to ensure management of land and yield of forest products, guaranteeing a sustainable resource for economic development. Additionally, forestry projects should have an emphasis on achieving 'triple bottom line' returns – delivering financial, social and environmental benefits.

The Forest Stewardship Council (FSC) and Programme for the Endorsement of Forest Certification (PEFC) have certification schemes to provide an assurance that forest products are derived from responsible forestry that employs appropriate management practices and that is sustainable. Timber from cleared land cannot be certified under the FSC or PEFC schemes.

In practical terms, adoption of sustainable practices means that an area with clearly defined boundaries is managed to a set of explicit long-term management objectives. Sustainability from a forestry perspective would entail the following types of actions:

- not clearing or minimising the clearing of native vegetation, i.e. establishing plantations on already-cleared land, as natural woodlands and forests support ecosystems and biodiversity values;
- replanting after harvest to ensure ongoing production of forest products over the long-term – the second and following rotations are generally more profitable as they are established on land with an existing management infrastructure;
- use of water resources to ensure minimisation of adverse effects on aquifers and stream flow; and
- ensuring no loss of soil due to erosion, in particular retaining topsoil and its physical and biological components.

Sustainability thus forms the overarching basis of the principles and practices for the Guidelines.

Legislative Framework for Establishing Plantations

There are a range of Acts in the NT that are relevant to the establishment and ongoing activities associated with forestry operations. Refer to the flow charts outlining the process for establishing forestry on cleared land and uncleared land in the NT, and relevant NT government departments and Acts. Zoning of the land will affect the way in which a permit to clear on freehold land is assessed.

Land tenure

Land tenure in the NT is mostly pastoral lease, Aboriginal freehold land under the Aboriginal Land Rights Act (NT), or vacant Crown land. There are smaller areas of leasehold land (for a variety of development purposes) and non-Aboriginal freehold (largely the residential and surrounding areas of Darwin). There are differences in the legislation that regulates the development and management activities across these tenures. Subject to the resolution of native title issues, there is ongoing conversion between different forms of leasehold, and from Crown land to freehold land.

Developments on Aboriginal Land require approval by the Northern Land Council (NLC) or Tiwi Land Council and traditional owners. This is generally achieved through a Section 19 application process which requires a Land Use Agreement expression of interest to be submitted, followed by consultation with traditional Aboriginal owners arranged through the land councils.

Forestry on pastoral and freehold land

The passing of the Pastoral Land Legislation Amendment Bill 2017, provides allowance for those operating under the Pastoral Land Act to diversify their agricultural activities. This allows for a portion of pastoral leases to be developed for other commercial purposes such as agriculture, horticulture, forestry, aquaculture or tourism ventures. The amendment specifically allows a non-pastoral use permit to be issued for forestry activities on pastoral land. These permits are approved for up to 30 years, and are registered to the land rather than the lessee, providing long term security for industries such as forestry. These changes help to increase the resilience and agility of the pastoral industry.

Developments on Pastoral Lease land require approval from the Pastoral Land Board (PLB) for non-pastoral use. Land Development Coordination within the Department of Environment, Parks and Water Security (DEPWS; previously DENR) coordinates the assessment process on behalf of the PLB. As noted in the *Northern Territory Non-Pastoral Use Guidelines*, under the Act 'A pastoral lessee who wishes to use all or part of the land the subject of a pastoral lease for a non-pastoral purpose may, in the form the Board requires, apply to the Board for a permit.' Under the Pastoral Land Act, the PLB, as the consent authority, has the powers to approve non-pastoral use permits and extend permits but also suspend, cancel or vary a permit for failure to comply with the conditions. Forestry is a listed activity on a pastoral lease which will require formal approval from the Board (Pastoral Land Board, 2018).

An application for a non-pastoral use permit requires information about land clearing (where required), details of intended non-pastoral use, details of the applicant and the lease, the purpose of the non-pastoral use, water requirements, sacred sites, sites of conservation significance, a comprehensive description of the intended non-pastoral use (e.g. number of trees and species type for forestry), duration of use (up to 30 years) and anticipated costs.

Plantations established on previously cleared freehold land may not require formal assessment under the Planning Act or Environmental Assessment Act. Areas of land that were cleared prior to the introduction of controls and have been continuously maintained free of native vegetation to date, are not considered to be in breach of controls. However, if the previously cleared land has not been maintained and regrowth has been allowed to establish, consent to re-clear that area of land will be required (DENR, 2019). Operations that are not irrigated may not require licencing under the Water Act.

The clearing of native vegetation is currently controlled by and assessed under the Planning Act, and a clearing permit is required, with applications lodged with DIPL for zoned land, DEPWS (previously DENR) for unzoned land and the Pastoral Land Board for pastoral land (refer to flowcharts). Land clearing guidelines for the NT outline the process and requirements including environmental matters to be considered, and are available here: <https://nt.gov.au/property/land-clearing/freehold-land/apply-to-clear-freehold-land>
<https://nt.gov.au/property/land-clearing/pastoral-land/clearing-native-vegetation-on-pastoral-land>

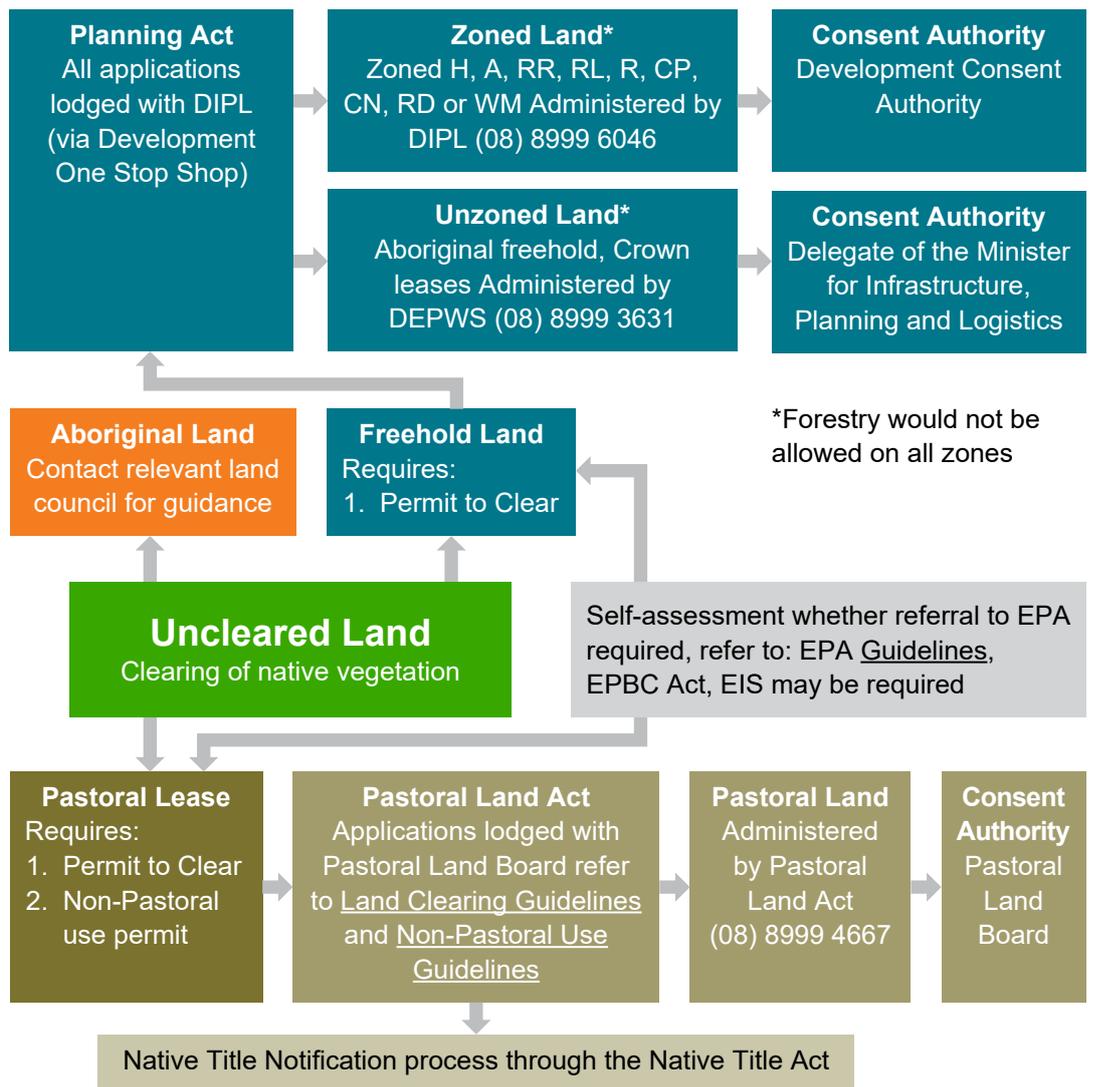
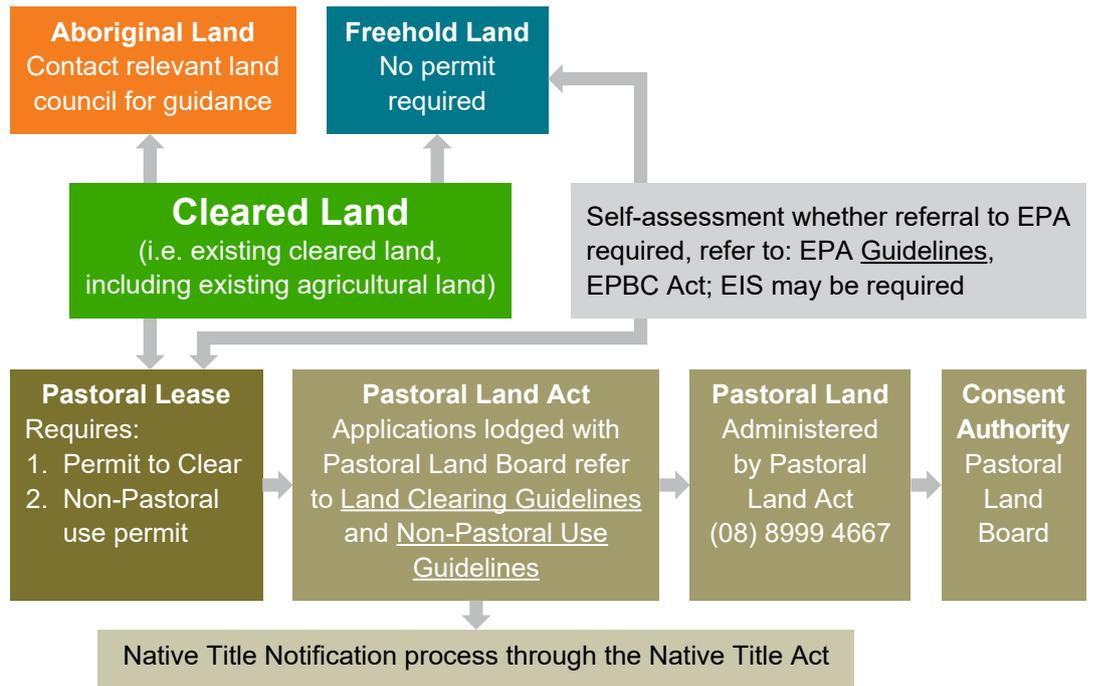
Where an extensive area of native vegetation is to be cleared, the application is referred to DEPWS as a Notice of Intent under the Environmental Assessment Act and may be assessed by the NT Environment Protection Authority (EPA). The Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act is only triggered where there are considered to be potential impacts on matters of national environmental significance, for example listed threatened flora and fauna species. Under the bilateral agreement between the NT and Australian Government, the assessment undertaken by the NT is taken to fulfill the requirements of the EPBC Act.

The NT Government is committed to the long-term management of natural resources while encouraging continued sustainable development. Proposals to clear native vegetation are assessed during the application process to ensure they demonstrate good land management principles, particularly in relation to protecting soil, water and biodiversity values. Information about clearing freehold and pastoral land in the NT is given here: <https://nt.gov.au/property/land-clearing>

Appendix 1 provides a listing of Acts relating to environmental management of forestry plantations. Complete NT Acts and Regulations can be found at: <https://legislation.nt.gov.au/>

Levies

The forest growers levy is an Australian Government levy applied to logs that are produced in Australia. It is for logs that have not undergone any form of processing other than debarking. The levy is calculated per cubic metre. For further details refer to: <https://www.agriculture.gov.au/ag-farm-food/levies/rates/forest-growers>



Forestry Guidelines

The forestry guidelines are presented below. Each section comprises a short introductory statement with relevance to the NT and an outline of guiding principles, followed by a listing of practices in relation to the theme. Also included is reference to relevant documents and other sources of information, where applicable, and legislation that relates to the theme under consideration.

The guidelines explore different themes, with each aiming to lead to the adoption of best practice. The sections have been categorised as most applicable to planning and establishment, plantation operations, resources management, or harvest and post-harvest (refer to diagram). The sequence is from planning and establishment, through the operational phase and then harvest and post-harvest.

As explained in the introduction, each theme includes practices that are associated with the NT setting and conditions. The practices outlined are not intended to be overly prescriptive, as each forestry type will have its own peculiarities.



As an overarching document, the *National Principles in Forest Practices Related to Wood Production in Plantations* provide a framework that serves to guide sustainable management of plantations. As described in the *National Principles*, Principles of Environmental Care are as follows:

1. Native forest should not be cleared for plantation establishment where this would compromise regional conservation and catchment management objectives. In some circumstances it may be appropriate to clear forests that have been severely degraded by impacts such as disease, weed invasion, wind and fire so as to enable rehabilitation through replanting.
2. Values such as intensive recreation, high scenic quality, significant geomorphic, biological, or cultural heritage sites, should be recognised in the planning of plantation forest operations.
3. Plantation management should comply with State and regional conservation and catchment management objectives, relevant planning schemes and legislation.
4. Water quality (physical, chemical, or biological) should be protected by measures controlling change resulting from plantation activities.
5. Water yield should be managed as required by careful planning of operations.
6. Soil stability should be protected by measures, which regulate site disturbance.
7. Soil, water catchment, cultural and landscape values should be protected by the careful location, construction, and maintenance of roads and tracks, and regulation of their use.
8. Fauna, floristic, and landscape values should be protected by the careful planning of plantation layout, establishment operations and the reservation and protection of appropriate areas of native vegetation; such values should be recognised in subsequent plantation management.
9. Plantations and adjacent native forests should be protected from the adverse effects of fire and from the introduction and spread of plant, insect and animal pests and plant diseases.
10. Operators will be trained in the principles of environmental care.

Other overarching documents and codes of practice for other Australian states are noted in the introduction.

Safety is important in all phases of forestry, through establishment and during all aspects of operations. It is a general consideration that must be taken into account in all sections of the Guidelines, although specific reference is made to safety in some sections only. Training and induction of staff in occupational health and safety is paramount.

A. Plantation Planning

Site selection is critical to success in growing plantation species. Planning prior to plantation establishment includes examining and understanding site productivity, and consideration of cultural heritage, biodiversity, and water allocations and licences where relevant.

Principles/goals

Forest practices will be planned to provide due care for the environment in accordance with the Land Clearing Guidelines and to maintain forest productivity.

Property planning assists in the process of matching land-use to land capability, overall economic return, consideration of on-site and off-site environmental influences, ecosystem benefits and capacity to maintain an appropriate level of management and resource inputs.

Selection of tree species is fundamental to the survival and success of the plantation in a seasonal tropical climate. Periodic severe winds and intense rainfall are features of the weather, and soil conditions may vary seasonally from very wet to extremely dry.

Practices

Where possible, plantations established on already cleared land. Community consultation carried out before any land clearing etc. takes place.

Site suitability addressed including aspects such as topography, drainage, water retaining capacity of soil, soil fertility, pH and other physico-chemical properties of soils.

Soil types and depth, landforms and watercourses mapped and site capability assessed. Area mapped using Geographic Information System (GIS).

Species selected that are suited to the climatic conditions of monsoonal northern Australia, and that have been shown to grow successfully in the Top End. Species selected that can be contained to plantation area.

Species selected that can withstand high winds, and ideally plantations situated away from the coast (where destructive winds from tropical cyclones are most intense).

Depending on land tenure and zoning, non-pastoral use guidelines addressed or appropriate application lodged. In the case of Aboriginal land, the relevant land council contacted and a section 19 Land Use Agreement expression of interest submitted. Refer to the Legislative Framework for Establishing Plantations section of this document for information regarding land clearing.

Plantation Operation Plan for at least one full crop cycle developed for the site prior to initiation of plantation establishment process.

Location of nursery, availability of seedlings and operations facilities considered in plantation planning, including access to a main road and source/s of water.

Track drainage and watercourse crossings considered in placement of roads and tracks. Soil disturbance and cut and fill minimised. Also refer to Site Tracks section of these Guidelines.

Access track layout pre-planned prior to forest establishment works. Layout takes into account location of roading materials and access for harvest.



Location of nursery facilities needs to be considered in plantation planning

Watercourses and buffer widths identified on plan and marked in the field.

Fire protection planning undertaken in coordination with relevant agencies and local bush fires groups.

As a minimum, allowance made for firebreaks of 4 m width along (or as close as practicable to) all property boundaries as designated in the NT Land Clearing Guidelines. Also refer to Fire Management section of these Guidelines.

Where possible, roads and firebreaks combined.

Where possible, Indigenous communities involved.

Cultural heritage in the proposed plantation area protected. Also refer to Cultural Heritage section of these Guidelines.

Biodiversity (flora and fauna) values, particularly sensitive vegetation types and threatened flora and fauna, assessed in the proposed plantation area. Also refer to Biodiversity section of these Guidelines.

Where irrigation is planned, applications submitted for water allocations and licences.

Consideration given to obtaining industry certification for the plantation, as required by certain markets. Many aspects of plantation planning, establishment and management are influenced by certification schemes.

Costed plan developed for establishment and maintenance of plantation.

Forestry Industry Association Northern Territory (FIANT) contacted for advice.

Relevant legislation

Planning Act

Environment Protection Act (replaces Environmental Assessment Act)

Pastoral Land Act

Aboriginal Land Rights (Northern Territory) Act 1976

Sources of information

NR Maps - Land, soil and vegetation information for the NT <https://nrmaps.nt.gov.au/nrmaps.html>

NR Maps - Land units and land systems of the northern NT <https://nrmaps.nt.gov.au/nrmaps.html> Set active layer: Map Products – Land All

NT EPA <https://ntepa.nt.gov.au/>

NT EPA – Environmental Impact Assessment <https://ntepa.nt.gov.au/your-business/environment-impact-assessment>

Northern Territory Non-Pastoral Use Guidelines <https://nt.gov.au/industry/agriculture/farm-management/diversify-your-land-non-pastoral-use-permits>

Section 19 Land Use Agreements <https://www.nlc.org.au/our-land-sea/aboriginal-land-legislation>

Forest Stewardship Council <https://au.fsc.org/en-au>

Australian Forestry Standard (Responsible Wood) <https://www.pefc.org/discover-pefc/our-pefc-members/national-members/responsible-wood>

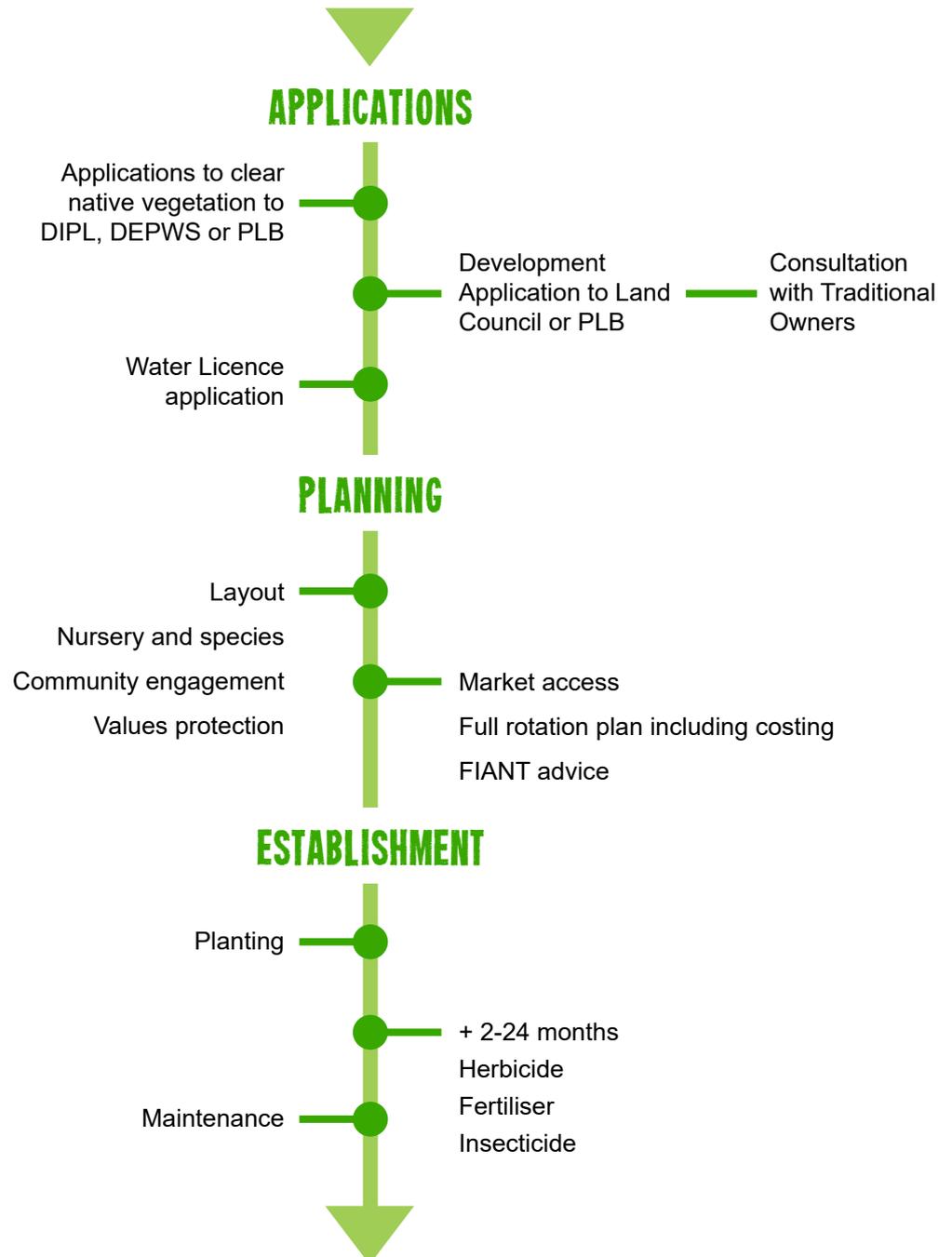
FIANT

NT Pastoral Land Clearing Guidelines <https://nt.gov.au/property/land-clearing/pastoral-land/clearing-native-vegetation-on-pastoral-land>

Land Clearing Guidelines (DENR, 2019) <https://nt.gov.au/property/land-clearing/freehold-land/apply-to-clear-freehold-land> section 2.2 - clearing permit section 3.1.2 - soil, vegetation and land section 3.2.5 - firebreaks



TIMELINE FOR ESTABLISHING A PLANTATION





B. Plantation Establishment

Establishment is the period of plantation development during which site preparation, weed control, planting, fertilising, infill planting and seedling protection takes place. The establishment phase of a forest plantation is critical to achieving high survival and rapid early growth. In turn, this is critical to a site transitioning from a field of individual trees to a plantation formation. The establishment period takes several years.

Principles/goals

Plantation establishment methods to be economically and environmentally appropriate for the particular requirements of the species to be planted and the specific site conditions.

Site preparation is a key point of soil disturbance in the cycle of a forest plantation. Management practices that balance the requirements of soil cultivation and suppressing grass and weed competition with soil conservation are critical to preserving both productive potential and environmental values.

Sourcing of stock with suitable genetics is a fundamental consideration. Appropriate spacing is important as it affects the patterns of growth of the trees, as well as weed suppression, water requirements and the economics of planting and tending of the plantation.

Practices

Seed or plant sourcing considered early to allow for significant lead times.

Nursery hygiene adequate to ensure healthy stock.

Site preparation takes site attributes into consideration.

Soil cultivated to fracture profile and encourage rapid early root growth and tree establishment while minimising bare soil exposure.

Planting timed taking into account seasonal aspects of a tropical wet/dry climate.

Seedlings planted when soil moisture is at field capacity (the window for planting in the Top End is limited).

Plantations designed to constrain or prevent the spread of wildlings into surrounding areas.

Plantation specific initial spacing determined to ensure ultimate stand density allows for efficient plantation growth, management and harvest.

Record keeping system established for planting date, rainfall records, chemical use, pests and diseases and other relevant information.

Requirement for fertiliser application at planting considered. Also refer to Water Management (nutrient) section of these Guidelines.

Area of grass control around planted seedlings minimised (taking into consideration fire risk).

Weeds controlled regularly in the first few years to facilitate tree vigour and plantation establishment.

Application of herbicides appropriately targeted to weed species being controlled.

Roads and tracks constructed in the dry season to avoid excessive erosion and delays due to inundation and boggy conditions.

Fire protection burns carried out annually (or as required) in early dry season.

Firebreaks established in compliance with the Land Clearing Guidelines. Firebreaks regularly maintained. Also refer to Fire Management section of these Guidelines.

Processes and procedures in Plantation Operation Plan adopted.

Plantation establishment works conducted in a manner that does not compromise the safety of workers.

Sites with significant cultural heritage values avoided.

Areas that support significant biodiversity values retained.

Water allocations and licences obtained.

*Newly established
plantation*



Sources of information

FIANT

Land Clearing Guidelines (DENR, 2019)

Relevant legislation

*Environment Protection Act (replaces
Environmental Assessment Act)*

NT Bushfires Management Act

Pastoral Land Act

Heritage Act

*Territory Parks and Wildlife
Conservation Act*

Water Act



C. Cultural Heritage

Principles/goals

Plantation forest practices will be conducted in a manner that respects and manages Aboriginal and historic cultural heritage through prescription or reservation in accordance with legislative requirements.

Aboriginal people have occupied areas across northern Australia for thousands of years and traditional owners associated with the various estates maintain links to the land including important cultural sites. In the Northern Territory Aboriginal people have largely retained these associations. Post-colonial heritage sites also exist in parts of the NT, particularly from early exploration and the Second World War.

Practices

Request lodged for information from Aboriginal Areas Protection Authority (AAPA) concerning any known sacred site records that may exist over an area of interest.

Authority Certificate from AAPA obtained where required.

Traditional owners consulted where necessary. The Northern Land Council (NLC) or Tiwi Land Council contacted to determine the traditional owners with connection to the land under consideration.

Conference with custodians of the relevant sacred sites requested where necessary to discuss the terms and conditions of an Authority Certificate.

Any sites on the NT Heritage Register identified.

Sources of information

Aboriginal Areas Protection Authority (AAPA) <https://www.aapant.org.au/our-services/authority-certificates>

NT Heritage Register
<https://nt.gov.au/property/land/heritage-listings/heritage-register-search-for-places-or-objects>

Relevant legislation

*Northern Territory
Aboriginal Sacred Sites
Act*

*Aboriginal Land Rights
(Northern Territory) Act*

Heritage Act

*Aboriginal and Torres
Strait Islander Heritage
Protection Act 1984*

D. Biodiversity

Principles/goals

Plantation forest practices will be conducted in a manner that results in the maintenance of biological diversity and ecological function, including viable populations and habitat for native flora and fauna.

Significant environmental values, including threatened plants, sensitive native vegetation and breeding sites of threatened animals will be protected.

Plantation practices will ensure the retention and protection of riparian, wetland and other sensitive vegetation types.

Biological diversity entails the sum of species and their genetic heritage, including populations of species and the biological communities of which they are a part. Northern Australia encompasses a range of habitats that support a diverse array of fauna and flora. Ecological relationships and processes within ecosystems sustain biodiversity. Endemic species (those that only occur in northern Australia or parts of it, e.g. sandstone communities) and threatened flora and fauna are considered significant. Threatened species are listed under Territory and Commonwealth legislation.

Active management of areas within and surrounding planted forests to maintain, expand and extend native vegetation communities, and to create corridors connecting remnant vegetation will encourage retention of biodiversity values. These management actions may provide an indirect benefit to forest health, for example by supporting natural predators (particularly insectivores) that reduce predation in planted forests from insects.

Retention of vegetation, particularly buffers along watercourses and avoidance of soil disturbance within watercourses, offers significant environmental benefits in terms of reduced sediment transfer. Large, old growth trees and tree hollows are an important resource for declining mammals and other fauna species in the Top End.

Practices

Depending on the enterprise and requirements for clearing vegetation (if necessary), the presence of significant biodiversity values assessed for the property. Refer to the Legislative Framework for Establishing Plantations section of this document for further information regarding land clearing.

Significant environmental values protected, including local populations of threatened (i.e. listed as Critically Endangered, Endangered or Vulnerable) plants, sensitive or significant native vegetation and breeding habitat of threatened animals.

Native old growth trees (>40 cm DBH) protected and tree hollows retained.

Impacts on environmental values of conservation areas or other important biodiversity areas adjacent to the property or plantation minimised.

Riparian vegetation (i.e. native vegetation within and immediately surrounding waterways) retained. Buffers between riparian areas and plantations preserved.

Disturbance to waterways and wetlands, including flow regimes, minimised.

Where possible, native habitats retained. Habitat degradation as a result of changed hydrology, fire regimes or spread of invasive (weed) species avoided.

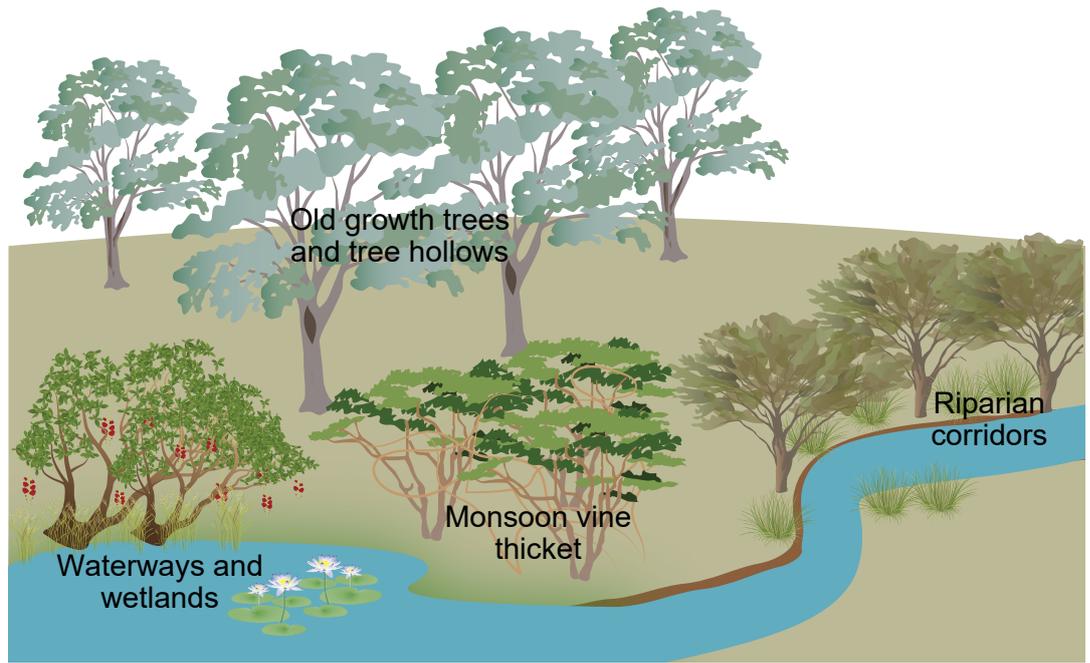
Habitat trees and biodiversity corridors retained.

Plantation tree species (e.g. African Mahogany, *Acacia mangium*) confined to plantation area. Spread into surrounding habitats and native vegetation communities avoided.



Sensitive vegetation types

(Graphics courtesy of the NESP Northern Australia Hub).



Native woodland retained as buffer between plantation and riparian vegetation

Sources of information

List of threatened animals (frogs, birds, invertebrates, mammals and reptiles) in the NT.
<https://nt.gov.au/environment/animals/threatened-animals>

List of threatened plants in the NT.
<https://nt.gov.au/environment/native-plants/threatened-plants>

EPBC Act list of threatened flora.
<http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=flora>

EPBC Act list of threatened fauna.
<http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=fauna>

Land Clearing Guidelines (DENR, 2019) <https://nt.gov.au/property/land-clearing/freehold-land/apply-to-clear-freehold-land>
 section 3.3.3 - threatened and significant species
 section 3.3.4 - conservation areas, natural land features and regional biodiversity
 section 3.3.5 - sensitive or significant vegetation types
 section 3.3.6 - riparian areas

Additional information

Sensitive vegetation as defined in the *Land Clearing Guidelines* includes rainforest, monsoon vine forest or vine thicket, sandsheet heath, riparian vegetation, mangroves, and vegetation

containing large trees with hollows suitable for fauna.

Threatened flora and fauna are listed under Territory and Commonwealth legislation using the IUCN categorisation according to level of threat of extinction, i.e. Extinct, Critically Endangered, Endangered, Vulnerable, Near Threatened, Least Concern.

Relevant legislation

Environmental Protection and Biodiversity Conservation Act 1999

Territory Parks and Wildlife Conservation Act

E. Fire Management

Principles/goals

Plantation forest practices will be conducted in a manner that meets legislative requirements and actively manages fuels in and surrounding plantations to reduce the risk and severity of damage from unplanned fires.

Fire is a regular part of the seasonal cycle in northern Australia. Control of fire risk in a forest plantation will maintain its productive potential, and fire protection is vital for the growth of forestry trees. Fire management including firebreaks is required under the *Bushfires Management Act*.

Practices

Fire management compliant with local/shire and Territory regulations including development of a Fire Management Plan.

Fire protection planning conducted in coordination with relevant land management agencies, Bushfires NT, and local bush fires groups.

Planted forest areas partitioned by access tracks which act as firebreaks.

Firebreaks constructed and regularly maintained, including slashing where necessary to remove ground layer fuels.

Firebreak maintained in early dry season once ground conditions ensure minimal disturbance and wet season growth can be cleared away to create mineral earth break.

Spraying of firebreaks during the wet season considered as it can reduce the need to remove large amounts of growth in the early dry season.

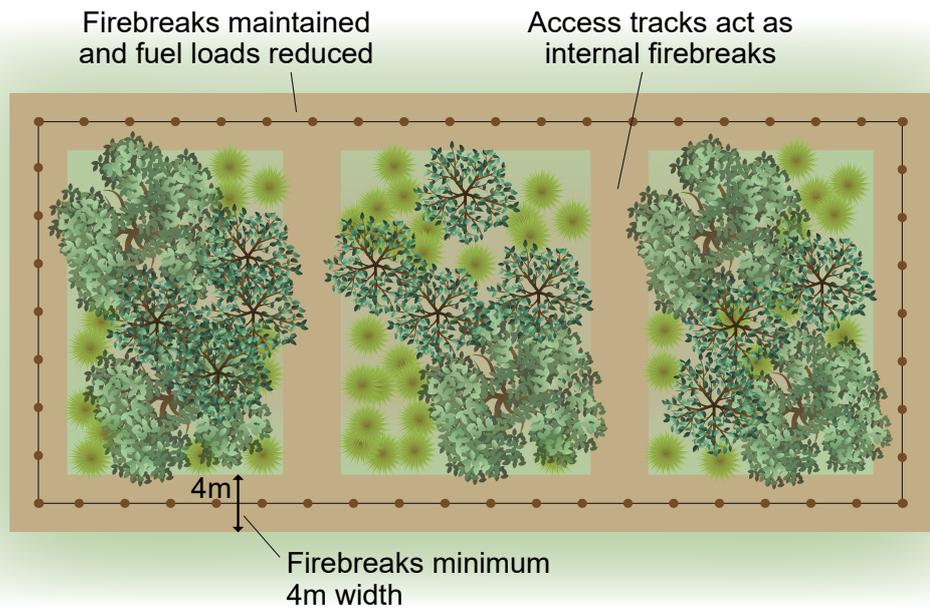
Fire Management Plan developed that considers site factors, species and seasonal conditions.

Controlled burning takes into consideration fuel loads, fire severity index, prevailing wind direction and predicted fire behaviour.

Controlled burns conducted in early dry season or during dry spells in the wet season. Burns undertaken only in suitable weather conditions; burns postponed on windy, low humidity days.

Expert advice incorporated in Fire Management Plan.

Firebreaks of minimum 4 m width installed along (or as close as practicable to) all property boundaries, in accordance with the NT *Bushfires Management Act*. Larger breaks may be required where invasive grasses (e.g. Gamba Grass) or native grasses create high fuel loads.



Fire protection combined with access track



Sources of information

Fire management – Bushfires NT
<https://depws.nt.gov.au/bushfire-information-and-management/about-bushfires-nt/fire-management>

Land Clearing Guidelines (DENR, 2019)
<https://nt.gov.au/property/land-clearing/freehold-land/apply-to-clear-freehold-land>
section 3.2.5 - firebreaks

Relevant legislation

NT Bushfires Management Act

F. Water Management

Principles/goals

Plantation forest practices will be conducted in a manner that does not cause significant deviations from natural ranges for water flow and quality, including natural disturbance events such as wildfire and extreme weather, and meets water management and water quality standards by minimising the risk of sedimentation and pollution from forestry activities.

Appropriate management will supply adequate nutrients to meet planted forest demands, minimise cost of supply and application, and minimise potential for leaching and runoff that could lead to negative environmental impacts.

Extremes of climate in northern Australia can result in intense rainfall events and periodic localised and broad-scale flooding. Low lying areas of the landscape are prone to inundation in the wet season, and most tree species are unable to survive in such areas. Maintaining natural flow regimes and water quality in drainage systems will sustain environmental values.

In general, soils in the Top End are very poor. Nutrient management in plantation forests is necessary to ensure establishment success, realise growth potential and maximise economic return and/or environmental benefits.

Practices

Drainage areas, wetlands and waterways protected.

Disturbance to waterways minimised.

Site characterised to understand soil chemical impacts from drainage, mounding and other soil disturbance activities.

Hydrological impacts of drainage, mounding and other soil disturbance activities investigated. Appropriate management actions undertaken to minimise disruption of water flows and sediment movement.

Mounding designed to improve drainage and minimise disruption to overland flow paths.

Sites selected and managed to avoid exposure to seasonal waterlogging, loss of production and excessive wind-throw.

Variation in soil type, soil nutrient fertility and organic matter characterised through soil sampling and mapping.

Standardised fertiliser application at planting considered and supplementary fertiliser provided as necessary over the growth cycle based on visual characteristics and soil and/or foliar analysis.

Type and amount of fertiliser matched to site attributes, species requirements and seasonal conditions. Soil testing considered prior to fertilising.

Records retained of location, date, type, quantity and method of fertiliser application.

Runoff water quality monitored and records maintained.

Sources of information

Land Clearing Guidelines (DENR, 2019) section 3.4.1 - Impacts on water resources

Relevant legislation

Water Act

G. Soil Conservation



Principles/goals

Plantation forest practices will be conducted in a manner that maintains soil fertility and does not cause significant deviations from natural rates of erosion.

Most NT soils are highly erodible if disturbed, have poor natural fertility and relatively low water holding capacity. In the Top End soils that support forestry are generally earthy (kandosols) and light-textured, hence susceptible to erosion if there is no vegetation cover. Rainfall erosivity is high in tropical areas where high-intensity storms result in rapid runoff.

To protect the productivity and sustainability of land use in the NT, land development needs to be managed to control soil loss. Erosion and Sediment Control Plans (ESCPs) are an essential tool for this purpose.

Retention of vegetation, particularly buffers along watercourses and avoidance of soil disturbance within watercourses, serves to reduce loss of sediment.

Practices

Erodibility of soil surface considered when planning plantation infrastructure, layout and machine operations.

Erosion and Sediment Control Plan (ESCP) developed for each site/plantation.

Disturbance minimised by retaining as much of the existing vegetation as possible, especially adjacent to drainage lines.

Sources of information

Soil management, erosion and sediment control (NT Government) <https://nt.gov.au/environment/soil-land-vegetation/soil-management-erosion-sediment-control>

Erosion and sediment control for rural development and clearing (NT Government) <https://nt.gov.au/environment/soil-land-vegetation/erosion-and-sediment-control-for-rural-development-and-clearing>

Supporting Sustainable Development - Risks and Impacts of Plant Industries on Soil Condition (NT Government, 2011) https://dpir.nt.gov.au/_data/assets/pdf_file/0005/233258/tb340.pdf

Land Clearing Guidelines (DENR, 2019) section 3.2.1 - erosion risk

Erosion potential minimised by avoiding timber production on steep slopes, and retaining native vegetation or establishing environmental plantings on slopes.

Erosion and sediment control works planned to control the potential build-up of volume and velocity of surface water flows, and to limit the formation of concentrated flows.

Erosion and sediment control measures (e.g. regrassing, mulching, gravel or rock lining, etc.) installed to protect soil surfaces to prevent or reduce erosion caused by raindrop impact and storm water flows.

Erosion and sediment control works planned to intercept runoff and retain sediment to prevent excess sediment spreading into waterways, wetlands, or neighbouring properties.

Roads located and designed to minimise run-off. Also refer to Site Tracks section of these Guidelines.

Off-track driving avoided to reduce incidence of soil compaction.

Fertiliser application managed to minimise off-target nutrient movement. Also refer to Water Management section of these Guidelines.

Relevant legislation

Soil Conservation and Land Utilisation Act

H. Weeds and Pests

Principles/goals

Plantation forest practices will be conducted in a manner that meets legislative requirements and minimises the risk of introduction or spread of weeds, pests and diseases through effective control measures that have the least risk of adverse environmental impact.

Minimisation of damaging agents (pests and diseases) to a forest plantation will maintain its productive potential, vigour and economic value and capacity to deliver environmental services. Some elements of weed management, such as control of declared weeds, are required under legislation.

Declared weeds in the NT (Class A - to be eradicated; Class B - growth and spread to be controlled) have been identified under the *Weeds Management Act*. Weeds and pests flourish in the hot and humid conditions of the northern summer and plantations can have significant weed loads by the end of the wet season. This needs to be promptly managed as the weeds (and accompanying pests)

pose a threat to the health of the plantation trees, and are a significant fire risk in the dry season. Feral vertebrate pests are also an issue in many areas of the northern NT, and some pest risks have been identified.

Practices

Weed, pest and disease impacts monitored regularly.

Weed infestations, particularly of declared weeds, eradicated or controlled.

Regional weed priorities recognised, as detailed in regional weed management plans for the Darwin and Katherine regions.

An integrated weed control approach adopted, using a variety of techniques including physical, chemical and biological control.

Integrated weed and pest management plan developed. Weed occurrences surveyed and mapped to enable targeted control and follow-up.

Use of chemicals to control pests and diseases minimised.

Where possible, herbicide use restricted to close proximity to plantation trees.

In some instances weeds between tree rows controlled by slashing or shrouded sprays of broad-spectrum herbicides.

Herbicide use restricted to plantation areas using application methods that minimise off-target spray.

Roadsides etc. treated with herbicides to prevent spread of weeds by haulage and other traffic.

Registered herbicides applied according to label specifications or off-label permitted use.

Adverse effects on the environment minimised by appropriate selection of chemicals, application rates and methods.

Handling, use and application of chemicals conducted by suitably trained and licenced personnel.



Records of herbicide and pesticide use (date, rate, location, weed species, application method, weather, etc.) maintained.

Chemical handling and storage conducted to minimise risks to human health, site contamination and off-site pollution.

Empty chemical containers, unused chemicals and other plantation and machinery waste handled in accordance with legal requirements.

Weed control undertaken as required, particularly during the establishment phase.

Introduction and spread of new weeds prevented – this is the best and cheapest form of weed management.

Weeds, pests and diseases prevented from spreading into adjacent lands and vegetation communities.

Vehicles and machinery washed down in a designated area. Washdown area maintained weed free.

Management prioritised along pathways for weed spread, such as road and track networks, areas of ground disturbance and river corridors.

Weed management undertaken in cooperation with adjacent landholders, other land users, and NT Government Weed Management Branch.

Control of wild dogs compliant with regional wild dog management. Where 1080 baits are to be used, application completed for a 1080 Pest Animal Management Authorisation and baiting done under a Permit to Take Protected Wildlife (1080 PAMA and Permit).

Where present, feral pigs controlled on-ground and by exclusion fencing of sensitive areas.

Potential insect and disease problems managed proactively by undertaking regular plant health surveillance and monitoring. Disease may affect foliage, stems and branches, roots and/or heartwood.

A designated wash down area should drain into a single point and be maintained free of weeds



Termite traps and spraying used to control termite infestations.

Hygiene thinning or clearing considered to contain pest and disease outbreaks.

Where weeds, pests or diseases cause significant damage, decline, or death of trees, prompt specialist advice sought to address the problem.



Gamba Grass – a major invasive weed in northern Australia



Effective weed control in Sandalwood plantation

Sources of information

List of Declared Weeds in the Northern Territory

<https://nt.gov.au/environment/weeds/weeds-in-the-nt/A-Z-list-of-weeds-in-the-NT>

Northern Territory Weed Management Handbook

<https://nt.gov.au/environment/weeds/how-to-manage-weeds/weed-management-handbook>

Regional Weed Management Plans

<https://nt.gov.au/environment/weeds/weeds-in-the-nt/weed-management-in-your-region>

Weeds of National Significance (WoNS) <https://weeds.org.au/weeds-profiles/>

Managing risks of storing chemicals in the workplace

<https://www.safeworkaustralia.gov.au/doc/managing-risks-storing-chemicals-workplace>

Forestry pests and diseases (Qld.)

<https://www.business.qld.gov.au/industries/farms-fishing-forestry/forests-wood/pests-diseases/overview>

Land Clearing Guidelines (DENR, 2019) <https://nt.gov.au/property/land-clearing/freehold-land/apply-to-clear-freehold-land>

section 3.5.3 - preventing weed spread

section 3.5.4 - grassy weeds

Additional information

Under the *Weeds Management Act*, if you own, manage or live on land you must:

- take reasonable measures to prevent the land becoming infested with a declared weed,
- take reasonable measures to prevent a declared weed spreading to other land, and
- follow a statutory weed management plan for any weeds on your land.

Priority weed species for the Darwin region are Gamba Grass, Bellyache Bush, Mimosa, Olive Hymenachne, Parkinsonia, Mission Grass and Grader Grass (Weed Management Branch, 2015a). Priority weed species for the Katherine region are Prickly Acacia, Parkinsonia, Chinese Apple, Gamba Grass, Bellyache Bush, Neem and Grader Grass (Weed Management Branch, 2015b).

Darwin termite *Mastotermes darwiniensis* may preclude the growing of particular susceptible tree species in some areas (NT Government, 2002).

To date the current pest issues for NT forestry include:

Termites (*Mastotermes darwiniensis* and *Microcerotermes* spp.) are pests of *Acacia mangium*, African Mahogany and sandalwood including its host trees.

Spike disease (of Sandalwood)

Soft rot of Sandalwood heartwood in flood irrigated blocks

Fig Leaf Beetle

Wood borers in general

Root pathogen causing dieback and death in Cassia (*Lasiodiplodia* sp., *Curvularia* sp. and *Nigrospora* sp.)

Information supplied by Plant Biosecurity Branch, DPIR.

Relevant legislation

Weed Management Act

Waste Management and Pollution Control Act

I. Stock Management



Principles/goals

Stock grazing in plantation forests will be managed appropriately to assist in the control of weed growth, improve access, reduce fuel loads, and enhance returns from cattle grazing, while meeting requirements of land use on pastoral properties.

Farm forestry is the integration of timber trees into agricultural systems. There are potential financial benefits to landholders of adopting silvopastoral systems. Pastoral activities involving beef cattle may benefit from forestry as a non-pastoral use.

Practices

Stock excluded until trees are large enough to withstand grazing activity.

Grazing managed to avoid selective browsing, minimise damage to trees and optimise tree growth.

Stock excluded from sensitive riparian creek lines and steep slopes through fencing.

Watering points provided away from creeks and steep slopes through the use of piped water and troughs.

Cattle grazing on Mahogany plantation



Sources of information

Northern Territory Non-Pastoral Use Guidelines

Relevant legislation

Pastoral Land Act

J. Irrigation

Principles/goals

Irrigation of plantation forests (where required) will be conducted in a manner that reduces requirements for water while ensuring adequate soil moisture for tree growth. Water is to be used in a sustainable manner that ensures maintenance of environmental values and in accordance with water allocations.

Irrigation is required for some forms of plantation forestry (particularly Sandalwood) in the NT. Irrigation requirements are less in the wet season when there are adequate levels of soil moisture. Soil characteristics will affect water infiltration rates and the ability of the soil to retain moisture.

Practices

Irrigated forest established on deep soils (>2m) with moderate permeability and medium to high water holding capacity.

Water extraction licence obtained.

Irrigation rate matched to the limiting consideration of tree water use.

Water application rate calculated and employed that does not exceed soil permeability infiltration rate.

Soil profile characterised and soil types mapped to match site capability with water chemistry, forestry type and irrigation practice.

Irrigation water tested and monitored to match water chemistry with soil type, forestry type and irrigation practice.

Irrigation scheduled based on estimated soil moisture content, taking into account seasonal rainfall, evaporation and local weather conditions (may involve monitoring of soil moisture using probes).

Irrigation reduced or stopped where wet season conditions supply adequate soil moisture.

*Irrigation lines
in Sandalwood
plantation*



All irrigation records maintained.

Water usage compliant with allocation and reported each month.

Groundwater monitored for depth and quality.



Sources of information

Water Allocation Plans
Ooloo Dolostone Aquifer Water Allocation Plan (NT Government, 2019)

Katherine Tindall Limestone Aquifer Water Allocation Plan (NT Government, 2019)

Water allocation planning – DEPWS
<https://depws.nt.gov.au/water/water-management/water-allocation-plans/about-water-allocation-planning>

Water Extraction Licences, Frequently Asked Questions
 Non-Urban Water Metering Code of Practice for Water Extraction Licences
<https://depws.nt.gov.au/water/water-publications/fact-sheets>

Agnote. An Introduction to Irrigation of Horticultural Crops. (NT Government, 1999) https://dpir.nt.gov.au/_data/assets/pdf_file/0011/233768/558.pdf

Relevant legislation

Water Act

Sandalwood plantation and flood irrigation



Additional information

The NT Government is committed to the long-term sustainable management of its water resources. The NT Water Act 1992 allows for effective water resource management through the development and implementation of Water Allocation Plans (WAPs) which cover specific regions within designated Water Control Districts. Water Allocation Plans are developed through technical and scientific assessments, and extensive community participation and consultation.

Water Allocation Plans aim to protect the environment and equitably share the available water between users, to ensure the long-term sustainability of the water resource. Plans are developed in regions where there are competing demands for water, there is risk from water use on significant environmental or cultural values, or a need to manage the whole system (surface water and groundwater reserves) due to their significant inter-connection.

Water allocation planning is currently undertaken in three regions in the Top End, namely Katherine, Douglas-Daly and Mataranka. The Ooloo Dolostone Aquifer WAP was declared in 2019. It pertains to the Ooloo Dolostone Aquifer area in the Daly groundwater basin (NT Government, 2019a). The Katherine Tindall Limestone Aquifer WAP, also declared in 2019, provides water management arrangements for the Tindall Limestone Aquifer within the Katherine River catchment boundary (NT Government, 2019b).

The Ooloo Dolostone Aquifer maintains environmental flow in the Daly and Katherine Rivers through the dry season as well as providing water resources for consumptive use (NT Government, 2019a). The Katherine Tindall Limestone Aquifer is overlain by other aquifer systems in places, including the Ooloo Dolostone Aquifer. Groundwater discharge to surface water occurs through springs and seepages along the Katherine River and the Tindall Limestone Aquifer formation also discharges to the Roper, Flora and Douglas Rivers (NT Government, 2019b).

Granting of a new water extraction licence is based on a decision by the Controller of Water Resources under the Water Act. The Controller must consider a number of factors when assessing a water licence application, such as:

- availability of water in the area,
- existing water licence entitlements,
- water allocation plan rules,
- potential effects of water extraction and the integrity of the water resource, and
- Planning Act provisions related to development and land use in the area.

Water extraction licences specify the rights to take water and the conditions under which that take is permitted. Water taken under a licence is metered and usage is reported each month.

With regard to plantations that do not require irrigation, it is noted that Hutley et al. (2012) recommended that non-irrigated African Mahogany plantations should not require a water allocation licence under the NT Water Act, as annual water use was similar to that in native savanna vegetation.

K. Site Tracks



Principles/goals

Plantation forest roads and access tracks will provide safe access for routine forest management activities, and for heavy equipment required for specific operations. Access track design standards and location should aim to minimise overall construction cost and be suitable for use in key operational activities (particularly harvesting) while preserving environmental values.



Track layout in Sandalwood plantation

Access tracks and fence line in Mahogany plantation



As hard exposed surfaces, access tracks lead to the concentration of water and may carry high volumes of fast overland flow resulting in serious erosion issues. Appropriate track design, construction and maintenance will minimise erosion and environmental impacts and preserve the asset value. The network of access tracks within a plantation is a very important part of the design of the site.

Practices

Access track layout planned prior to plantation establishment works. Roads located and designed to minimise disturbance and run-off.

Whoa boys, turn-outs, filter strips, buffer zones, and sediment detention basins used to divert runoff and reduce loss of topsoil.

Tracks regularly maintained and managed to minimise deterioration due to erosion by heavy wet season rainfall events.

Tracks constructed and maintained when soil moisture is optimal to avoid excessive disturbance and minimise cost of watering.

Site tracks considered as part of the Erosion and Sediment Control Plan (ESCP) for the site. Also refer to Soil Conservation section of these Guidelines.

Tracks designed to minimise cut and fill, avoid steep gradients, and prevent disturbance to the environment, particularly watercourses.

Tracks designed with appropriate drainage structures. Culverts and crossings installed on watercourses to minimise disturbance and ensure maintenance of seasonal flows.

Tracks decommissioned and rehabilitated when not required.

Weed-free road base materials used.

Weeds along access tracks controlled or eradicated.

Roads/tracks closed in wet conditions (primarily prolonged wet weather during monsoonal conditions or from cyclonic systems during the wet season) when unacceptable damage would occur or when other conditions warrant closure.

Access during the wet season restricted to designated areas where tracks are suitably constructed. This will be plantation specific.

Relevant legislation

Soil Conservation and Land Utilisation Act

Weed Management Act

L. Silviculture

Principles/goals

Appropriate silvicultural management will be conducted throughout the forest cycle to preserve the asset value and optimise economic return and/or environmental service benefit.

Silvicultural regime will vary depending on tree species, site conditions and final product/s. As the planted forest develops, thinning may be necessary to remove poorly formed trees and maximise stem volume growth on crop trees. Removing poorer quality trees will maintain overall stand health and vigour and reduce potential pest and disease attack.

Pruning may be required to enhance quality.

Rapid early growth and establishment of a canopy that shades out excessive grass and weed competition will reduce the need for herbicide application.

Practices

Control of competition from grasses and weeds maintained until saplings capture control of site.

Stand progressively thinned where necessary to maximise stem volume growth, maintain optimal stocking and canopy cover, and maximise vigour.

Thinning undertaken either manually or mechanically.

Where required, stand progressively pruned to minimise knotty core, remove ladder fuels, and improve timber quality.

Pruning, if required, carried out during the dry season in periods of low sap flow (to reduce the risk of infection) and prior to onset of active growth (to achieve rapid wound occlusion).

Type and amount of fertiliser matched to site attributes, species requirements, seasonal conditions and projected economic returns.

Plantation following thinning



Integrated weed and pest management principles applied. Pesticide and herbicide use planned to minimise adverse effects on the environment. Also refer to Weeds and Pests section of these Guidelines.

Silvicultural activities conducted in a manner that does not compromise the safety of workers.

Rotation length commensurate with forest product being grown.

M. Harvesting and Haulage



Principles/goals

Timber harvesting will be planned and carried out to minimise long-term impact on the environment and protect productivity of the site. Plantation forest practices will apply harvesting regimes that are appropriate for the forest type and that are planned and managed to ensure soil disturbance is minimised.



Log harvest forwarder

Harvesting operations necessarily remove vegetation cover, cause soil disturbance and require active use of access tracks. Operations can be managed to minimise soil disturbance by careful planning. Economic considerations are also important in harvest and haulage. Planning should aim to optimise extraction routes, minimise unnecessary disturbance to vegetation, install appropriate erosion control structures, and maintain a high level of harvesting residue. In most plantation situations, trees will be clearfelled and the area replanted.

Practices

Harvest protocol developed prior to commencement of harvest.

Harvest Plan prepared and timber harvest carried out according to the Plan.

Harvest Plan includes timing, method, area selection, access tracks, extraction routes, log or chipper landings, internal and external haulage routes, equipment, products, soil types, environmental hazards and values, and cultural values.

Soil, water and biodiversity values considered in Harvest Plan.

Safety management included in Harvest Plan.

Harvest boundaries clearly demarcated in the field.

Soil disturbance for harvest access infrastructure minimised and appropriately drained onto undisturbed areas.

Harvesting avoided on wet ground and during prolonged heavy rainfall.

Harvesting operations conducted in a manner that does not compromise the safety of workers.

Vehicle and machinery wash-down area established to prevent spread of weeds and pathogens off-site and to other locations on-site. Haulage hygiene maintained so that weed seeds or material containing weeds is not spread off-site.

Landings located on well-drained areas as far as practicable from watercourses.

Haulage tracks planned to optimise extraction routes. Also refer to Site Tracks section and Plantation Planning section of these Guidelines.

Post-harvest management plan developed for rehabilitation or replanting or coppicing, and monitoring.

Sources of information

Safety in forestry operations: Harvesting and haulage <https://www.worksafe.vic.gov.au/resources/safety-forestry-operations-harvesting-and-haulage>

Preventing weed spread (NT Government) <https://nt.gov.au/environment/weeds/how-to-manage-weeds/prevent-weed-spread-industry-and-recreation>

N. Post-Harvest

Principles/goals

Landscapes, soils, waterways and environmental values will be maintained using appropriate management objectives and approaches.

At the end of a growth cycle of the plantation crop, the land can either be replanted or utilised for other purposes. Decision on post-harvest land use will guide the work required. With any option, sustainable use requires retention of soil layers and maintenance of fertility.

The second and following plantation rotations are economically more profitable than the first as they are established on land with an existing management infrastructure, and with appropriate plans in place.

If land use is modified, the area must be rehabilitated or otherwise prepared for an alternate purpose.

Practices

Post-harvest management plan developed; either rehabilitation, other land use or subsequent rotation plantation establishment.

Adaptive management applied to establish best practice based on experience gained during first rotation.

Soil and water values protected.

Declared weeds controlled or eradicated.

Spread of exotic plantation species controlled.

Post-harvest objectives and end use defined on the basis of proposed future land use.

Site factors considered including topography, watercourses, soil types, erodibility and preservation of natural values.

Harvest residues managed and utilised.

Fire management regime maintained.

If area to be rehabilitated, land revegetated with native plant species sourced locally.



POST-HARVEST

Regardless of proposed land use, in a post-harvest situation consideration needs to be given to soils, water quality and retention of environmental values to ensure sustainability into the future.

Post-harvest land use will guide the options available.

| PLANTATION | OTHER LAND USE |
|--|--|
| <p>Environmental factors</p> <ul style="list-style-type: none"> • soil types / slope / sensitive areas <p>Physical factors</p> <ul style="list-style-type: none"> • debris distribution • plantation layout <p>Social</p> <ul style="list-style-type: none"> • neighbours / community <p>Economic</p> <ul style="list-style-type: none"> • crop objectives / owners / markets | <ul style="list-style-type: none"> • soil and water quality • fire management including firebreaks • neighbours / community • biodiversity values • weed management |
| <p>Burn harvest residue or Mulch harvest residue</p> | <p>Mulch harvest residue or Burn, clear and de-stump</p> |
| <p>Spot cultivation or clear and plough or No cultivation and spade plant</p> | <ul style="list-style-type: none"> • habitat restoration • cropping • other use |

CONSIDERATIONS

OPTIONS

ONGOING LANDUSE

Monitoring Sustainability

In order to assess the effectiveness of sustainable measures in plantation forestry, criteria need to be established to determine whether the sustainability of the system is being maintained. The implementation and effectiveness of sustainable forestry practices should be assessed and reported. Following on from these Guidelines, further consideration should be given to the form of measures and indicators that can be used to track performance.

Attributes that could be assessed include the following:

Physical and biological

- physical and chemical state of the soil
- soil fertility – nutrient levels
- nutrient recycling
- vegetation cover – ground layer
- leaf litter accumulation
- biodiversity components – flora and fauna
- weed cover/levels of weediness
- presence of declared weeds
- presence of wildlings
- numbers/density of feral animals
- area burnt – mild (early dry season) burns
- surface water flows
- runoff water quality
- soil erosion (by water)
- sediment in drainage systems
- groundwater recharge
- forest condition
- canopy cover
- timber outputs/yield
- capacity to provide environmental services

Social

- community perceptions of forestry activities
- impact of plantation on communities
- recreational use
- changes in level of skills available
- labour force availability
- land tenure

Economic

- benchmarking growth against expected productivity
- labour productivity
- income or profitability over the long-term
- number of rotations
- markets for products

Adoption of the practices outlined in these Guidelines will ensure sustainability of forestry activities into the future.

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Australian Government

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Appendix 1. Legislation relevant to forestry

Northern Territory

NT legislation relating to environmental management of forestry plantations.
(Sourced largely from Hutley et al., 2012, and updated according to NT Legislation online and recent NT Government publications)

| NT legislation | Details |
|--|--|
| <i>Bushfires Management Act 2016</i> | Includes the legal framework and responsibilities for bushfire management. The fundamental principle established by the Act is that the responsibility for bushfire management rests with the landholder. Replaces <i>Bushfires Act 1980</i> . |
| <i>Environmental Assessment Act 1982</i> | Replaced by the <i>Environment Protection Act 2019</i> (see below) Proposed actions that have the potential to have a <i>significant effect</i> on the environment require environmental impact assessment (EIA) under the Act. Applications for clearing of extensive areas of native vegetation are referred to the NT Environment Protection Authority (EPA) as a Notice of Intent under this legislation. If environmentally significant a Public Environmental Report or Environmental Impact Statement (EIS) is required, depending on the significance and extent of potential impacts. |
| <i>Environment Protection Act 2019</i> | Assessment for environmental approval is required under this Act, which commenced on 29 June 2020. The requirement for an approval will be triggered if a proposed action or strategic proposal is likely to have potential for significant impact on the environment; or meets a referral trigger. |
| <i>Heritage Act 2011</i> | The principle object of this Act is to provide a system for the identification, assessment, recording, conservation and protection of heritage places and objects. |
| <i>Aboriginal Land Act 1978</i> | This Act relates to entry onto Aboriginal land and the issue of permits. |
| <i>Northern Territory Aboriginal Sacred Sites Act 1989</i> | Established the Aboriginal Areas Protection Authority (AAPA) which is responsible for overseeing the protection of sacred sites across the whole of the NT. |
| <i>Pastoral Land Act 1992</i> | Controls the clearing of native vegetation on pastoral land. <i>Pastoral Land Legislation Amendment Bill 2017</i> - allows those operating under the <i>Pastoral Land Act</i> to diversify their agricultural activities. |

| NT legislation | Details |
|---|---|
| <i>Planning Act 1999</i> | <p>This Act provides for the planning and control of the use and development of land across the Territory, establishes the NT Planning Scheme and Development Consent Authority and provides for a development approval process.</p> <p>This Act controls the clearing of native vegetation (section 75).</p> |
| <i>Plant Health Act 2008</i> | <p>Details obligations about plants and plant-related materials that are affected by a pest, i.e. an organism that feeds on a plant or that causes an abnormal or unhealthy condition in a plant. This includes prevention of infestation and spread, and treatment or disposal.</p> |
| <i>Soil Conservation and Land Utilisation Act 1969</i> | <p>An Act to make provision for the prevention of soil erosion and for the conservation and reclamation of soil. Establishes a Commissioner for soil conservation and a Soil Conservation Advisory Council.</p> |
| <i>Territory Parks and Wildlife Conservation Act 1976</i> | <p>Provides for the establishment of parks and reserves and the study, protection, conservation and sustainable utilisation of wildlife.</p> <p>Under this act development proposals are assessed in terms of flora and fauna harvest and utilisation, the import and use of non-native wildlife, and the impact of development on the environment and threatened species.</p> |
| <i>Waste Management and Pollution Control Act 1998</i> | <p>Regulatory Act to provide for effective waste management and pollution control.</p> |
| <i>Water Act 1992</i> | <p>The Water Act provides for investigation, allocation, use, control, protection, management and administration of water resources, including water extraction and waste discharge licenses.</p> <p>Section 90 details factors to be considered by the Controller in deciding whether to grant a licence.</p> |
| <i>Weeds Management Act 2001</i> | <p>Owners and occupiers of land are required to take all reasonable measures to prevent their land being infested with a declared weed.</p> <p>Declared weeds in the NT (Class A - to be eradicated; Class B - growth and spread to be controlled) have been identified under the Act.</p> <p>If a proponent wishes to grow a plant declared under the <i>Weeds Management Act</i> as a crop, then a 'Permit to Use a Declared Weed' is required.</p> |

Note: Complete NT Acts and Regulations can be found at <https://legislation.nt.gov.au/>

Commonwealth legislation

Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is the Australian Government's main piece of environmental legislation. It relates to matters of national environmental significance, with threatened species (flora and fauna), migratory species, wetlands of international importance (Ramsar wetlands) and national heritage places potentially relevant to forestry operations, depending on location. Under the environmental assessment process, the EPBC Act may be triggered where there is likelihood of a proposed project having a significant impact on a matter or matters of national environmental significance. The EPBC Act aims to conserve biodiversity, provide for the protection of the environment and promote ecologically sustainable development.

Aboriginal Land Rights (Northern Territory) Act 1976

Provides the basis for Aboriginal Australian people in the Northern Territory to claim rights to land based on traditional occupation. Aboriginal land is granted as freehold title to Aboriginal Land Trusts. The Act also mandated the establishment of land councils. Applications must be made to the appropriate land council to conduct activities on an Aboriginal Land Trust.

Aboriginal and Torres Strait Islander Heritage Protection Act 1984

The purposes of this Act are the preservation and protection from injury or desecration of areas and objects in Australia that are of particular significance to Aboriginals in accordance with Aboriginal tradition. Heritage places are listed under the National Heritage List. Information about listed places is provided in the Australian Heritage Database.

Export Control Act 1982

The Export Control (Unprocessed Wood) Regulations 1986 under the Export Control Act 1982 allow plantation-sourced timber to be exported without a licence if the minister finds that the relevant state or territory's plantation forestry code of practice satisfactorily protects environmental and heritage values.

Appendix 2. Northern Territory codes of practice for forestry plantations

1. All clearing of vegetation in the NT, irrespective of land tenure, is now subject to approval under legislation. For all freehold and crown land this approval is provided under the Planning Act initially through an Interim Development Control Order and eventually through amendments to the NT Planning Scheme. For the remaining 47% of land which exists as Pastoral estate, the approval is provided under provisions of the Pastoral Land Act. All vegetation clearing applications are assessed according to statutory processes and for plantation forestry proposals both the NT Clearing Guidelines and the NT Code of Practice for Forestry Operations would be used in the assessment process.
2. Clearing proposals are assessed by a range of government agencies including the Office of Environment and Heritage. The referral of a plantation forestry proposal to this Office of Environment and Heritage would trigger the environmental assessment of the proposal under the NT Environmental Assessment Act and relevant Commonwealth legislation. The referral of a plantation forestry proposal is a requirement of the Environmental Assessment Act and would be made by the agency responsible for approving clearing either under the Planning Act or the Pastoral Land Act.
3. A plan of management will be prepared by the developer setting out work prescriptions that address the requirements of this Code of Practice. Any plan would need to take into account recommendations as specified under an approval granted under the Planning Act and would be subject to the approval of the Minister for the Environment.
4. The plan of management will detail procedures for monitoring compliance with work prescriptions that address the requirements of this Code of Practice. A committee comprising representatives of Departments of Business, Industry and Resource Development, and Infrastructure, Planning and Environment, together with a representative of the proponent will review and oversight compliance.
5. There will be no net loss of biodiversity values associated with new plantation development. Losses caused by development activities essential for the viability of the plantation enterprise will be compensated by expanded conservation activity in other areas. The plan of management will detail mechanisms to protect endangered or threatened species.
6. Soil quality will be protected by preventing erosion and mitigating processes which could lead to chemical and structural change. The risk of water pollution caused by soil erosion will be minimised.
7. Water quality, stream stability and habitat values will be maintained in the forest environment including the development area and adjoining lands.
8. A high standard of operational planning, clear work instructions, and adequately trained workforce will ensure effective and reliable implementation of complying management operations. Inspection of operations, keeping of adequate records, and periodic auditing of the system's performance will ensure the maintenance of standards and their continuous improvement.

9. The threat to water quality will be minimised by controlling the extent of road construction, and the number of stream crossings to that required for efficient plantation operations. Roads will be located and designed to minimise run-off and to facilitate effective construction and maintenance.
10. Permanent watercourse crossings will be located, designed, constructed and maintained so as to minimise disturbance during construction and to ensure stability in the long-term in order to minimise risks of degrading water quality and aquatic habitat. Temporary crossings will be sited, prepared and used so as to avoid exposure of dispersible soils and minimise the disturbance of banks. Temporary crossings will be rehabilitated to the satisfaction of the Commissioner for Soil Conservation.
11. Roads will be constructed to provide long-term stable traffic surfaces. Control measures will be implemented during the construction phase to protect against soil erosion and water quality degradation. Culverts and crossings will be installed to ensure long-term effective performance and to meet the needs of aquatic fauna.
12. Roads and their associated drainage systems will be maintained in effective functioning order to minimise risk of degradation of water quality.
13. Adverse impacts on soil, such as compaction, soil erosion and fertility loss, and degradation of water quality will be minimised during site preparation.
14. Forestry and associated operations will be conducted in such a fashion that they caused minimal disturbance of soil in buffers, in order to allow their effective and continuing functioning in filtering water pollution and preventing damage to aquatic habitat.
15. Chemical selection, rates and method of applications will assure healthy plantations, minimise risk to human health, and minimise adverse impacts on the environment.
16. Handling and storage of hazardous substances will be conducted to minimise risks to human health, site contamination, and off-site pollution, including adverse impact on flora and fauna.
17. Oils, fertiliser bags, empty chemical containers, unused chemicals, and other plantation and machinery waste will be removed off-site and disposed of by authorised disposal methods only in order to minimise risks to human health, site contamination, and adverse impacts on the environment.
18. Risks to life, property and the environment from wildfire will be minimised through adequate precautionary measures.
19. Sites with heritage and archaeological significance will be protected from disturbance by plantation activities.
20. Harmful pest outbreaks will be minimised by monitoring of plantation health and by timely implementation of control measures. Adjacent lands and forests will be prevented from degradation caused by the spread of weeds, pests and diseases.
21. Environmental disturbance associated with harvesting will be minimised by ensuring that operations are adequately planned, that clear work instructions are provided, and that supervision is effective.
22. The risk of water pollution caused by run-off from areas disturbed by harvesting machinery traffic, will be minimised during and after operations. The extent of adverse impacts on soils such as compaction caused by machinery traffic during wet weather will be minimised.
23. Turbid run-off from roads causing water pollution will be minimised.

24. Areas reserved for the protection of soil, water quality and maintenance of biodiversity will be protected and managed so that these environmental attributes remain functional in perpetuity.
25. Adverse impacts on neighbours and members of the public caused by employees, dust or safety hazards will be minimised.
26. The plan of management will provide for periodic reporting of compliance against the requirements of the plan and this Code and for ongoing monitoring. Breaches may result in action being taken under relevant legislation including the Water Act, the Weeds Act, the Bushfires Act, the Soil Conservation and Land Utilisation Act, the Parks and Wildlife Conservation Act and the Work Health Act.





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