

Land Management Plan Summary

3.2.1 Production Land

The initial area planted on the concession is 4,822ha. There was an approximate area of 1,151 ha of development that has failed and will be redeveloped. Another 1,590 is anticipated to be planted in the next 4 years.

Grandis Timber Ltd. nursery propagates mainly clonal plant material to ensure higher productivity and survival. The only seedlings cultivated are the indigenous trees cultivated in the nursery for the restoration of conservation areas.

The remaining production of land and redevelopment land will be treated as follows:

3.2.1.1 Tree plantation preparation

The development plan changed radically from what was initially envisaged due to poorer soils in the south. Grandis Timber Ltd. had to widen its scope to incorporate the planting of Eucalyptus, Acacia and other species and crops on poorer soils. Grandis Timber Ltd. opted to plant Mahogany next to natural watercourses to prevent the spread of seed. Planting of alternative species and crops is to prevent encroachment and to utilize all land given to Grandis Timber Ltd.

a. Nutrient Management Plan

The Grandis Timber Ltd. concession soils are of a relatively low level of fertility due to the disruption of the plant to soil nutrient cycle due to the removal of the indigenous trees over the last decades and the yearly native burning practices.

Ideal soils for Teak are in fact also the soils prone to leaching. Soil type, texture, and structure must be considered in the context of topography, drainage, rainfall patterns, and water table levels during various stages of the annual weather patterns. Additionally, analysis needs to be kept in the context of the constraints placed on-site selection resulting from the social and environmental objectives.

These objectives (specifically FSC Principle 10, Criteria 9, Prohibition of Conversion of Natural Forests to Plantations) effectively ensure that the project must be a reforestation/afforestation project, with the likely associated soil conditions. As such, a soil/plant nutrient cycle management system specifically designed for a given site, sector and compartment is required.

From discussions in Section 1, heading 3.6 it is evident that leaching of nutrients is a definite problem in these soil types.

b. Land Preparation

The methods, process, and techniques used to prepare the land for planting are key to the management and retention of soil nutrients. Grandis Timber Ltd. has implemented a clearance regime that is designed to retain maximum natural site nutrition and improve soil structure as below:

a. Minimization of Burning

During land preparation, Grandis Timber Ltd. aims to minimize burning and rather incorporate the maximum amount of organic matter (in the form of plant biomass) back into the soil. Burning of existing vegetation releases a portion of the key nutrient nitrogen into the atmosphere. The nitrogen remaining in the soil is in a highly soluble state and is easily leached from the sandy soils found on this site.

As most plant nutrients are found in the leaves and bark of the scrub type vegetation on our site it is most important to burn as little as possible of this material. A significant curing period between clearing and cultivation allows small material such as twigs and leaves to desiccate, fall and be incorporated back into the soil. Larger woody material can be collected by locals for charcoal production leaving only a small component requiring burning in isolated heaps.

Soil tillage speeds up the decomposition of organic matter, exposing the soil to oxygen, and increases the surface temperature. In turn, these processes release nutrients and lead to a reduction in soil organic matter. A soil with less organic matter dries out faster, has less water holding capacity and a poorer structure.

b. Clearing

As previously identified the soils on the Grandis Timber Ltd. concession have very limited organic matter and are thus very susceptible to over-cultivation. The site preparation techniques at Grandis Timber Ltd. are designed to minimize repeated tillage while at the same time doing enough to achieve a high level of weed control and adequate soil cultivation to achieve strong early growth in the teak plantations and secondary crops. Clearing

c. Disc Cultivation

Except for small diameter wood for charcoal production, there are very few remaining large trees in the areas to be planted. A specially designed bulldozer will remove small-diameter wood and brush in each planting compartment. Efforts will be made to leave all large high-value trees in place to influence the biodiversity of the site. Heaps of material cleared will left to begin decomposition and allow the collection of small wood for local charcoal production. After a few months, the piles will be bulldozer raked to spread fine decomposing material and leaves. This material will be plowed into the soil while any remaining coarse roots and branches will be burnt.

d. Root Picking

Initial cultivation will take place with a three-disc, followed by 7 discs and then a 24 disc. If not clear or level enough a follow-up operation will be done. Large discs are used to incorporate organic matter into the soil and begin cultivation. Areas to be first established in agricultural crops will require a more intensive full cultivation. This includes additional disking and multiple passes of root picking to ensure a clean cultivated area. Root picking

This process is to remove all wood waste from the area to make the planting and weeding process possible. Most of the root picking is done by local communities through a permit system.

e. Ripping

Cleared cultivated areas are ripped up to 80cm deep in rows 3m apart for planting teak. This is done to break up compacted and cemented soil layers to increase the effective rooting depth when the trees are established.

c. Secondary crop utilization

The primary objective of Grandis Timber Ltd. is the establishment of a teak plantation and the production of high-value timber. Agricultural crops (including cashew, sugarcane, soya, poormans lucern and others)

and grazing will in some cases be used to support the primary objective and achieve maximum productive land utilization. Agricultural crops will enhance the project benefits by;

- a. Improving the area of utilizable land and reducing weeds,
- b. Funding of the initial high cultivation costs,
- c. Allow the development of poor soils by the addition of organic matter to improve the soil structure
- d. Allow for the staggering of the planting of Teak to get a fully regulated stand in rotation.

[HTTPS://WWW.SARE.ORG/LEARNING-CENTER/BOOKS/MANAGING-COVER-CROPS-PROFITABLY-3RD-EDITION/TEXT-VERSION/BUILDING-SOIL-FERTILITY](https://www.sare.org/learning-center/books/managing-cover-crops-profitably-3rd-edition/text-version/building-soil-fertility)

3.2.1.2 Tree Planting

Tree planting is conducted between June and September.

a. Teak Planting

Experience to date indicates the ideal period to establish forestry crops on this site is with the first significant and reliable monsoon rains. On this site, this is generally somewhere in May or June. Planting conditions can usually persist until around September. Our focus is to maximize establishment in the early part of the wet season. This is to ensure root development and enough time in the rainy period to apply fertilizer and do proper weeding and restocking.

Clones will be planted on a 3.2 m by 3m spacing to maximize the utilization of the space available. This results in an initial planting density of 1040 clones per hectare.

b. Other tree plantings

Other crops like Mahogany, Acacia, Eucalyptus, cashews, and others will be planted according to the best industry practice.

3.2.1.3 Plantation Maintenance and Protection

Post planting management of the areas will be done as follows:

a. Restocking

Each compartment will be monitored for clone mortality after planting. Clone mortality is primarily an issue in the first year after planting. After the clones are established, a mortality count will be done to establish the survival rate. Restocking will take place within the first 3 months after planting.

b. Weed control measures

Weeds will be kept under control with a combination of different measures:

i. Mechanical measures

Removal of weeds in the inter-row is achieved with the use of mechanical means such as slashing, rotovating or plowing. Plowing is not a good method between mature trees, but can still be done between new plantings.

ii. Manual measures

Removal of weeds through hand pull manual slashing or manual hoeing of weeds on the row or inter-row to compliment the mechanical operations.

iii. Chemical measures

These operations are followed by chemical weeding although it is a minor component of the Grandis Timber Ltd. program and is only done in cases where other manual and mechanical weed control methods have proven too time-consuming and costly. We have found using non-residual chemicals on a very limited basis, has greatly enhanced our ability to control tough grass weeds. FSC compliant herbicides will continue to be applied with consideration of environmental safety.

iv. Biological measures

Livestock is used in many forestry projects to reduce fire risk and control weeds. The use of livestock to control particularly grass weeds has many benefits. On a site with low inherent nutrition such as the Grandis Timber Ltd. concession, livestock can play a positive role in eating grass and legumes and recycling nutrients into the soil. The grazing of cattle is common surrounding and on the Southern portion of the concession.

c. Fertilizing

Fertilizing is an expensive operation and is done once a year for the first two to three years according to the need of the specific compartment. Fertilizer is applied at planting, in the first year and in the second year at a rate of 40g (NPK chemical fertilizer 15:15:15) per tree. This is done in two places 5-15cm from the stem on the rip line and closed with soil. Fertilizer is only applied during the rainy season.

d. Pest Control

The trees must be monitored for signs of pest infestation. The most common pests in Cambodia are defoliants, skeletonizers, and occasionally stem bores. All field staff has fundamental training in the identification of pest infestation so that they are able to bring it to the attention of the QC and Training Department.

e. Disease monitoring

While Teak is very strong and not very susceptible to disease, still, the trees must be monitored for signs of disease. The most common diseases are fungal and if identified early can be controlled. All field staff will have fundamental training in the identification of signs of disease so that they are able to bring it to the attention of the QC and Training Department.

f. Pruning

The reason for pruning teak is to yield high-value clear lumber without knots. Typically, teak does not branch until its third year. Double stems, premature branching, and leaves on the stem need to be pruned to give good stem form. The branches will be pruned up to a target height of 6.2m. Pruning will be done in multiple variable lifts defined by the growth rates in each compartment. As general guide trees are pruned in 2m increments with three main operations to achieve a 6.2m pruned stem. The timing of pruning is done to always leave the tree with 30% of its green crown thus maintaining growth rates and not stunting growth. Pruning is generally done as soon as a 2m increment can be achieved to restrict the diameter of the “knotty core” of the tree. Once the trees achieve canopy closure, the shading works to suppress branches and the need to continue pruning diminishes. These general guidelines will be used to set a series of site-specific pruning regimes where trees are pruned up to a set diameter in each operation.

g. Thinning

The thinning strategy employed is designed to maximize total growth increment and at the same time manage individual log diameter. Teak log prices are strongly correlated with the diameter and increase significantly with diameters over 30cm. Thinning is managed with a general prescription and then varied depending on-site quality and resulting growth rates. In general, stands will be managed on a compartment basis and thinned using the following prescription.

- T1 Thin to Waste to 850 stems per hectare at age 5
- T2 Thin for production to 650 stems per hectare at age 10
- T3 Thin for production to 400 stems per hectare at age 16

The strategy requires regular monitoring of diameter and height growth rates, in correlation to site quality. If volume growth begins to slow due to overstocking in some compartments, thinning timing will be bought forward or thinning intensity increased.

3.2.1.4 Harvesting

Final clear-fell harvesting will occur on or around age 25 depending on growth rates. The optimal harvest age will be decided mid-rotation using growth rates and current log market prices at that time.

3.2.2 Preservation Land

Areas of cultural and conservation value are removed from the productive areas and managed separately as areas of biodiversity conservation. This includes riparian zones (1019.19 ha), wetlands(155.38ha), mountainous(84.37ha), rocky areas(42.91ha) and spirit area (2.02). These areas are not productive areas but will stay the responsibility of Grandis Timber Ltd. (Map 6).

TABLE 6: PRESERVATION LAND

Description	Area
Riparian zones	1019.19
Mountains	84.37
Rocky areas	42.91
Wetlands	155.38
Spiritual places	2.02
total	1303.87

a. Riparian zones

Riparian areas will be protected in their natural state to ensure water quality protection and wildlife corridors running through the concession area. These areas are delineated from the middle of the stream according to their size, condition, and water-bearing capacity:

- Perennial stream 50m on both sides
- Non- perennial streams 30m on both sides
- Preferential drainage systems 15m on both sides

The preferential drainage areas are the areas where water will accumulate during heavy storms to form runoff to rivers. By not exploiting these areas Grandis Timber Ltd is trying to prevent erosion through the preservation of local grasses and shrubs. Areas that were damaged will be repaired through the implanting of local natural species.

b. Wetland area

Wetland areas will be treated in the same way as the riparian zones leaving a natural buffer around the water body. In this instance, however, the area will be left open from the side of the water body and not from the middle.

c. Mountainous and rocky areas

Mountainous areas with biodiversity value or which could not be developed in an economically viable method, will be excised to be kept as a natural restoration area. These areas could be utilized for natural species in planting or testing.

d. Spiritual areas

These are areas with a spiritual significance for the local communities. The identified area, as well as a 30m buffer around the area, will be left untouched.

3.2.3 Infrastructure and Civil-engineering

In the development of the infrastructure (Map6) plan certain elements had to be included in the plan:

a. Nursery

Nursery(16.94ha) was developed to produce the high-quality seedlings required for land development. Based upon the area developed to date and future development schedule presented, below is a summary of actual and forecast planting material requirements for the project

TABLE 7: SEEDLING PRODUCTION

Year	Hectares to be Planted	Actual Seedling/Cutting Production
2020	554	0.634million
2021	575	0.658million
2022	529	0.605million
2023	561	0.642million
2024	522	0.597million
Total area	2741	

b. Main Camp

Most buildings to support the establishment phase of the project was completed at the main camp area (2.04ha). The buildings have been constructed on-site to meet the needs of the staff

and operations. The buildings are of a basic design, varied depending on the permanence of the building and its specific needs.

TABLE 8: CIVIL CONSTRUCTION

No	Building Use	Area (ha)	UTM
1	Field Office	2,04 hectares	X: 404503 Y: 1269861
2	Perm. Staff Housing		X: 404479 Y: 1269858
3	Temporary Staff Housing		X: 404479 Y: 1269858
4	Senior staff Mess		X: 404425 Y: 1269881
5	Daycare centre		X: 404441 Y: 1269895
6	Generator room		X: 404684 Y: 1269864
7	Recreation Centre		X: 404513 Y: 1269904
8	Training Centre		X: 404513 Y: 1269915
9	Health Centre Infirmary		X: 404492 Y: 1269915
10	Equipment Storage / Stores		X: 404530 Y: 1269864
11	Fuel storage		X: 404530 Y: 1269864
12	Workshop	X: 404539 Y: 1269816	
13	Factory	6,23	X: 404538 Y: 1269616
	Total	8.27	

Electricity is produced by Grandis Timber Ltd. owned generators. No commercial production of electricity or distribution network is available.

Clean water is harvested from a nearby stream and provided via a company treatment system. Rainwater is also harvested from buildings and used at the site. Wastewater and sewage are processed through a septic tank, with a seepage bed and sand filter system.

Grandis Timber Ltd. constructs buildings with its own labor and equipment.

c. Road Network

Roads on the concession (Map6) will be constructed in such a way as the environment dictates. The following are the classification of the roads that will be maintained on the site:

TABLE 9: ROAD TYPE IN THE CONCESSION

No	Road Type	Width (m)	Length (m)	Area (ha)
1	Road A	8	42212	33.77

2	Road B	5	71580	35.79
3	Road C	3	134200	40.26
	Total			109.82

i. Class A

The class A roads(33.77ha) are at least 8m wide, graveled and year-round passible with 2WD vehicles at high speed (30-40km/h), providing:

- Access to the Concession Area from the main entrance points to the Concession Area
- Fast traveling to the different areas of the concession in the case of emergencies.
- Connection between:
 - Nurseries and Clone Staging Areas;
 - Field Offices;
 - Equipment Depot and Storage;
 - On-Site Employee Housing;
 - On-Site Infirmary / Health Center;
 - Other Central / Critical Facilities and
 - Main planted areas.

ii. Class B

The Class B roads(35.79ha) are at least 5m wide, slightly graveled, and year-round passable with 4WD and dry season passible by 2WD vehicle and tractors at medium speed (20-30km/h), providing access to:

- Planting compartments currently under initial planting, restocking, weeding, secondary crop planting, pruning, or other silviculture maintenance;
- Fire Watch Towers
- Farms of local residents within the Concession Area boundaries

iii. Class C

The class C roads(40.26ha) should be at least 3m wide and not graveled at all. They will be dry season passible with 4WD vehicles and tractors, mainly constructed for fire-fighting and extraction purposes providing:

- Firebreaks at regular intervals based upon the final fire prevention, control and fighting plan as outlined in Section 5.5 of this document.
- Access for:
 - Firefighters and necessary equipment;
 - Security patrol;
 - Silviculture QC inspections / enumeration and inventory / permanent sample plots
 - Transport of logs removed during thinning and final harvest to staging areas and yards on Class A and B roads.

d. Factory

The factory area will be constructed in the concession area by using 6.23 hectares (UTM: 404538-1269616). This factory is in planning to be constructed in 2025 in accordance with the timber productivity from the plantation. In fact, the factory project is in a long period in (xx years) then the company can't figure out the investment cost for the factory yet. The company will inform the investment cost after the factory had constructed.

e. Gravelpit

The gravel pits have been developed to ensure good quality material for road construction.

f. Other infrastructure

This includes the contractor camps, fire lookouts and the security checkpoints around the concession. The below table defines the infrastructure and other civil construction:

#	Infrastructure	Area	UTM
1	Nursery area	16.94	Map6
2	Main Camp	2.04	
3	Road network	109.82	
4	Factory	6.23	
5	Gravel pits	20	
6	Other	25	
	Total	180	

4. Equipment and Tools

4.1. Fire Equipment

Fire equipment will include several vehicles with hand tools:

- Fast Attack- Multiple Pickups fitted with 600l high volume fire pump, rake hoes, and fire beaters
- Firetruck- Hyundai truck with 2000l high volume pump, rake hoes, and fire beaters
- Bulk tanker- Tractor with 4000l pump for water supply
- Tractor unit- Tractor with 500l high-pressure pump
- Bulldozer
- Tractor and plow/ discs

4.2 Other equipment

- Roding Equipment
- Grandis Timber Ltd. has all equipment to construct roads of high standards. Excavators, bulldozers, compactors, graders and dump trucks are available for this purpose. The company also invested in equipment to make their own pipes for drainage. The company will continue to build and maintain their own roads and fire breaks.
- Clearing equipment
- All bulldozers and heavy equipment employed for clearing will be done through a third-party contractor of Cambodian nationality.
- Silviculture Equipment

- All silvicultural heavy equipment will be employed through a third-party contractor of Cambodian nationality.
- Harvesting Equipment

All heavy equipment for harvesting operations will be sourced in through external contractors

4.3 Office equipment

Basic office equipment will be needed in the form of computers, desks, seats and filing cabinets. All senior management will link to a central server through the internet.