



Australian Government
Director of National Parks

Annual Report on the DOTARS-DNP Christmas Island Minesite to Forest Rehabilitation (CIMFR) Program

April 2004 - June 2005



Earthworks underway at mine field 20E in October 2004



Five month old native trees in mine field 20E in August 2005



Introduction

Over the last 120 years, phosphate mining and the construction of associated infrastructure have damaged approximately 25% of Christmas Island's natural landscape. To address this damage the Australian Government has initiated various restoration programs over the last twenty years aimed at restoring forest to these devastated areas. The latest is the DOTARS-DNP Christmas Island Minesite to Forest Rehabilitation Program (CIMFR), which became operational in April 2004 after the Director of National Parks from DNP, and the Assistant Secretary of DOTARS signed a MOU in February 2004. Prior to this program the Christmas Island Rainforest Rehabilitation Program (CIRRP), and other earlier programs and agencies undertook minesite rehabilitation in the National Park and on current mine leases.

The aim of this program is to rehabilitate certain mine fields within the Christmas Island National Park. DNP is the custodian of the land where the current rehabilitation has been proposed, and will in the future take custody of many of the other abandoned mine fields as their leases expire. The department has more than a decade's experience in the rehabilitation of mine fields to forest on Christmas Island, and together with its existing rehabilitation infrastructure, field equipment, and skilled personnel it has been delegated the responsibility for the operational management of the CIMFR program.

Over the years a variety of rehabilitation methodologies recommended by CSIRO, the Forestry Institute, and consultants and have been tried and exchanged after results were analysed, and new techniques and equipment have been developed. The current program is using a modified methodology provided by the current leaders in minesite rehabilitation research in tropical forests in Australia, the Centre for Mined Land Rehabilitation (CMLR/UQ 2000).

Minesites on Christmas Island to be rehabilitated with forest have been ranked by the Christmas Island National Park (CINP) and are primarily weighted on the proximity of occurrence and density of Abbott's Booby nests, an endangered species of seabird endemic to the island. Funds for the program come directly from the DOTARS, Canberra. A mining company, Phosphate Resources Limited (PRL) on Christmas Island currently pays several levies to DOTARS, one of which is used to assist this program. Payment of this levy is one of the major conditions (clause 4.1) of the company's existing mine lease with the Australian Government, which allows it to continue to mine phosphate on the island.

The Current Cycle: April 2004 - June 2005: Mine Field 20

Approximately 30,000 tree seedlings, comprising sixteen native forest species, were propagated for the CIMFR program in the CINP Nursery between April and December 2004 (Figure 1 & 2).

Rehabilitation earthworks and fieldwork took place throughout 2004 and 2005 in the abandoned mine field 20, which is adjacent to the existing mine leases 109 and 110 (Figure 3). Within mine field 20, there were three main rehabilitation sites that were targeted by the CIMFR program, coded as 20E, 20Cn, and 20Cs.

This mine field was a mixture of pinnacles and flat ground both covered with fern and weeds, and pockets of remnant soil with some natural regeneration (Figure 4). Extensive areas were also infested with weeds and required suppression. Some of these invasive weeds were from earlier rehabilitation programs that used exotic species.

Several earth stockpiles exist on this mine field, some on a current mine lease held by PRL, and the remainder in the National Park. PRL was approached by the CINP and asked to release some of these stockpiles near the sites where the CIMFR program's earthworks were to be carried out. A major condition (clause 12.1) of their mine lease with the Australian Government is that the Lessee, "retain within the Leased Land at all times during the Lease at no charge to the Commonwealth, sufficient backfill material for the next two years to be used by the Commonwealth for its environment levy purposes ...". In response, the company released one stockpile. Four other stockpiles on the mine lease near the earthwork's site were not released, which attributed to substantial earth transfer haulage times and costs.

In May 2004, a rehabilitation earthworks plan was created and a call for tenders for the provision of earthwork machinery hire rates was announced. After reviewing hire rates, and machinery specifications and condition, two local companies, Christmas Island Enterprises, and Mining & Marine, were asked to provide the machinery and operators.

Rehabilitation earthworks in mine field 20 were undertaken from August to December 2004. Extensive earthworks, road formation, and earth haulage were required over much of area due to the pinnacled nature of the site and the lack of topsoil (Figure 5). Only a few small areas on this minesite had remnants of existing topsoil and showed positive natural regeneration. Local contractors who provided the earthmoving machine operators were schooled in the particular style of earthworks required for tropic rainforest rehabilitation throughout August to December 2004 (Figure 6, 7, 8, & 9).

From January to March 2005, 28,000 of the seedlings raised in the CINP Nursery were planted into prepared rehabilitation beds (Figure 10 & 11). The rainfall for the wet season during planting was disappointing as it was well below average in quantity, number of rain days, and length. The wet was late to start, inconsistent, and early to finish. Fertilisation and weed suppression took place from January to June 2005, and will continue in these new plantings until the forest becomes established in approximately four to five years time (Figure 12).

The CIMFR program currently employs four full-time and one half-time staff throughout the year, and another seven full-time casual staff during peak operational periods. During the last fifteen months the Program has provided employment for twenty-five Christmas Island residents in its Field and Nursery operations, and a further seven island residents in the Earthmoving operations. No serious OH&S incidents occurred over the last year, and an environmental impact audit of the CINP Nursery was completed by an independent agency.

Major infrastructure acquisitions included the construction of CINP nursery plant tables to replace those tables that had rusted out, a replacement 4WD vehicle, and a replacement herbicide spray unit. Shipping costs to the island have increased and water charge rates have been doubled by Watercorp in the last year adding extra costs to that budgeted for in the initial projected costs submitted in 2004.

During this cycle, approximately nineteen hectares of abandoned mine field 20 were rehabilitated by the program (Figure 13). A further two hectares scheduled for rehabilitation

during this cycle were suspended after a field assessment at the end of 2004 found that vehicular access has been lost to the site due to a lack of road maintenance and good forest regrowth around the outside of the site. This site will be reassessed if the PRL reopen the access road on their neighbouring mine lease. Rehabilitation monitoring by CINP took place in June 2005, and involved the sampling of native flora, fauna, and soil characteristics in the newly rehabilitated site (Figure 14, Table 1).

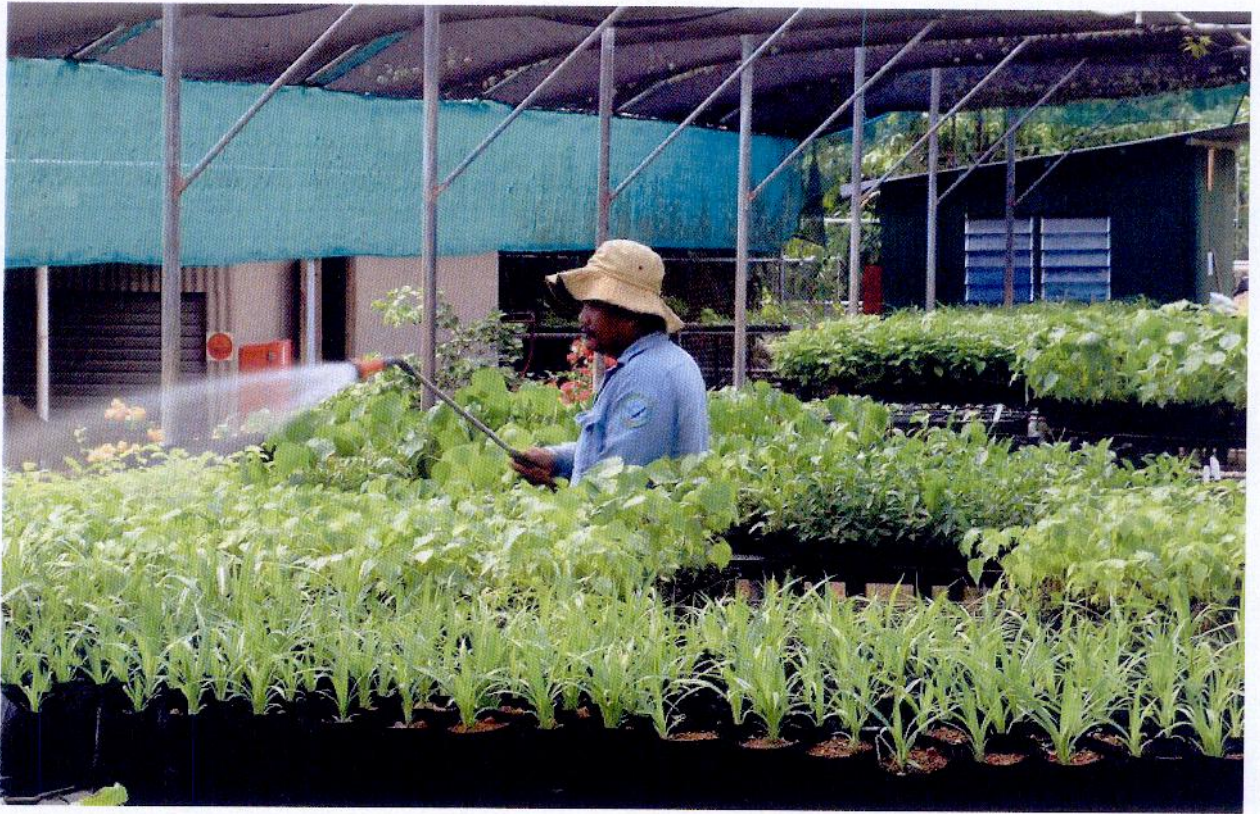


Figure 1: Nursery personnel maintaining young native tree seedlings in the CINP Nursery



Figure 2: Native tree seedlings being hardened off in the CINP Nursery before planting.

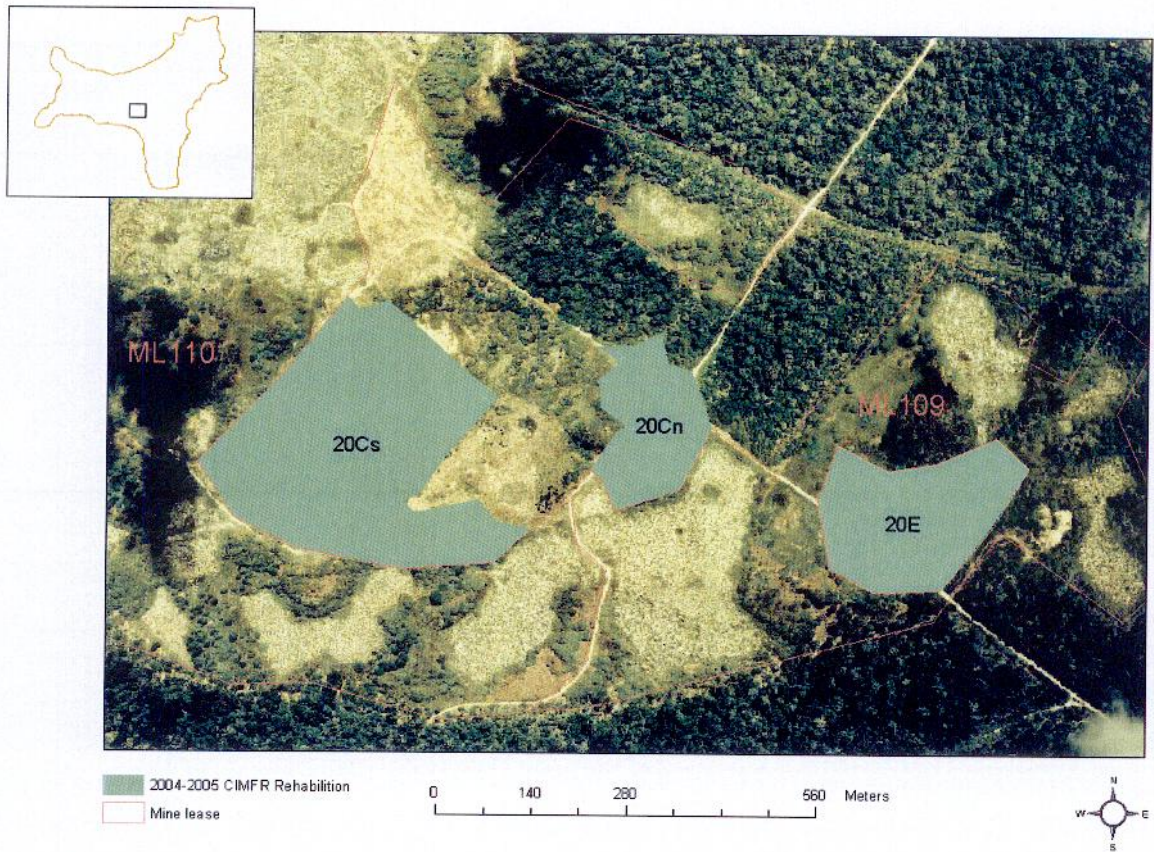


Figure 3: Areas in mine field 20 targeted for rehabilitation by the CIMFR program in 2004-2005.



Figure 4: Abandoned mine field 20E covered in fern and rimmed with exotic trees prior to the commencement of rehabilitation earthworks.



Figure 5: Mine field 20E cleared, pinnacles flattened, and the stockpile face cleared ready for soil loading and haulage.



Figure 6: Earthmoving contractors slotting stockpiles to build up the soil profile in the adjacent abandoned section of mine field 20E.



Figure 7: Earthmoving contractors loading 30 tonne dump trucks from a stockpile at mine field 20C.



Figure 8: D8 dozer doing a final rip of planting beds in mine field 20C before planting.



Figure 9: Rehabilitation planting beds formed up in mine field 20C ready for planting.



Figure 10: Four months after rehabilitation planting was completed in mine field 20C in March 2005.



Figure 11: Four months after rehabilitation planting was completed in an eastern section of mine field 20C.



Figure 12: CINP field personnel suppressing weeds in mine field 20E rehabilitation plantings.



Figure 13: Mine field 20E four months after earthworks, planting, and the suppression of the majority of weeds.

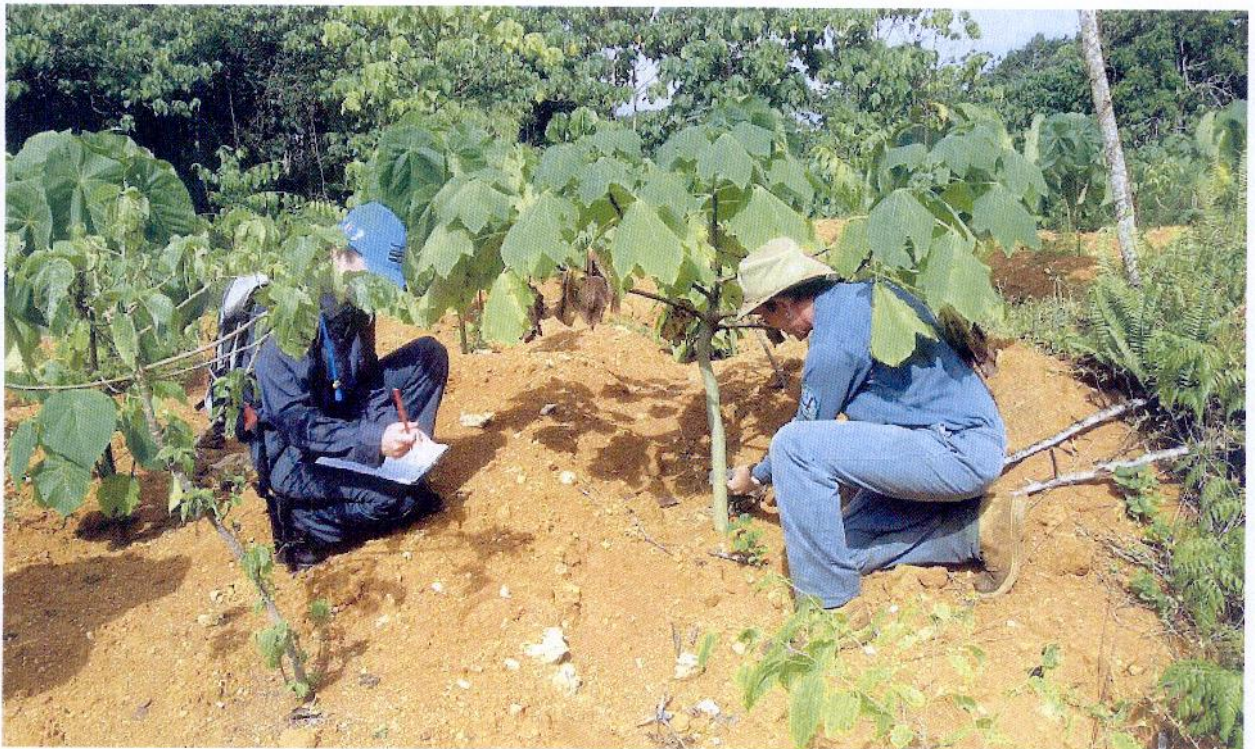


Figure 14: CINP field personnel collecting biological and edaphic data in the rehabilitation site at mine field 20C four months after planting.

Rehabilitation Site Monitoring Data for 2005 Plantings

In June 2005, data were collected from ten random sites in the rehabilitation areas in mine field 20 (Table 1). These sites were planted approximately four months before the census data were collected.

Table 1: Biological and edaphic data collected in June 2005 from newly rehabilitated sites by the CIMFR program in mine field 20.

FLORA	Mine field 20E	Mine field 20C	2005 plantings pooled
Total native plant species richness	15	21	22
Native plant species richness	10 ±0.45	13.2 ±1.56	11.6 ±0.93
Native plant species evenness	0.725 ±0.025	0.683 ±0.016	0.703 ±0.016
Simpson dominance index for native plant species	0.292 ±0.027	0.281 ±0.022	0.286 ±0.017
Native plant species diversity: - Species (Ind./species)			
- Shannon-Wiener Index	5.80 ±0.38	9.71 ±3.06	7.75 ±1.59
- Mod. Shannon-Wiener Index	1.67 ±0.071	1.74 ±0.058	1.70 ±0.045
- Mod. Simpson Index	3.19 ±0.155	3.35 ±0.139	3.27 ±0.101
	0.708 ±0.027	0.719 ±0.022	0.714 ±0.017
Native plant density (Ind./ha)	2 880 ±102	6 610 ±2 298	4 740 ±1 251
Native plant recruitment (Ind./ha)	290 ±119	3 560 ±2309	1 925 ±1 218
Native plant height (m)	0.97 ±0.03	1.08 ±0.03	1.02 ±0.02
Native plant diameter (cm)	1.73 ±0.07	1.87 ±0.08	1.8 ±0.05
Native plant basal area (m ² /ha)	0.27 ±0.03	0.32 ±0.05	0.30 ±0.03
Native canopy cover (%)	14.64 ±0.99	25.29 ±1.45	19.13 ±1.12
FAUNA			
Total native crab species richness (max. of 2)	0	1	1
Native crab species richness (Species/0.02 ha)	0	0.4 ±0.4	0.2 ±0.2
Native red crab density (Ind./ha)	0	20 ±20	10 ±10
Native red crab burrow density (burrows/ha)	0	0	0
Total native reptile species richness (max. of 2)	0	0	0
Native reptile species richness (Species/0.02 ha)	0	0	0
Native reptile density (Ind./ha)	0	0	0
Total native land bird species richness (max. of 7)	3	5	5
Native land bird species richness (Species/0.1 ha/10 min)	0.48 ±0.18	0.88 ±0.25	0.68 ±0.16
Native land bird density (Ind./0.1 ha/10 min)	1.19 ±0.7	3.18 ±1.83	2.19 ±0.98
SOIL			
Litter layer levels (g/m ²)	19.93 ±5.22	70.53 ±15.46	45.23 ±9.29
Soil organic matter levels (%)	20.3 ±0.5	22.1 ±1.0	21.2 ±0.4
Soil water holding capacity (%)	41.9 ±2.14	40.5 ±2.3	41.2 ±1.5
Soil pH level	6.6 ±0.1	7.3 ±0.1	6.9 ±0.1
Soil Conductivity (µS/cm)	51 ±8	79 ±14	65 ±8



(a) mine field 20C



(b) mine field 20E

Figure 15: Photographs from each monitoring transect in mine field 20E and 20C taken four months after planting.

The Next Cycle: July 2005 – June 2006: Mine Field 23

The next mine field to be rehabilitated is field 23, a large area abandoned in the center of the island. In January 2005, CINP nursery staff began propagating approximately 45,000 tree seedlings, comprising fourteen native forest species, for the next forest rehabilitation planting in this mine field (Figure 16). A further 6,000 tree seedlings, comprising late successional native forest species are also being propagated for the secondary planting that will take place in the rehab sites in mine field 20 in 2007.

Approximately thirty hectares in this field have been earmarked for rehabilitation by the CIMFR program in this next cycle (Figure 17). Rudimentary access roads have been pushed into mine field 23 to more closely assess the condition of the landscape for the upcoming rehabilitation earthworks in 2005 (Figure 18). Unlike mine field 20 which was relatively flat, phosphate mining has left behind extensive rocky ridges, cliffs, steep slopes, gully ravines, terraces on several different levels, and the usual fields of rocky pinnacles at mine field 23 (Figure 19 & 20). As a consequence, rehabilitation earthworks in 2005 will require different strategies used in 2004, and earthwork contractors will have to be retrained in new techniques to flatten and resoil this site.

Eleven earth stockpiles exist in mine field 23, and all except one are on a current mine lease held by the local mine company. Only seven of these stockpiles are near the proposed CIMFR earthworks site. PRL was approached by CINP and asked to release the nearby stockpiles for the CIMFR program's earthworks. In response, the company released four stockpiles in mine field 23. Two of these are those that are some distance from the earthworks site and will probably not be used. Five of the seven stockpiles nearest to the site have not been released, which will attribute to substantial earth transfer haulage times and costs.

A rehabilitation earthworks plan has been created and a call for tenders for the provision of earthwork machinery hire rates was announced in May 2005. All earthmoving companies used in last year's project have expressed an interest to be involved once again. A third, new company has also expressed a willingness to participate.



Figure 16: Native tree seedlings being raised in the CINP Nursery for the 2006 plantings in mine field 23

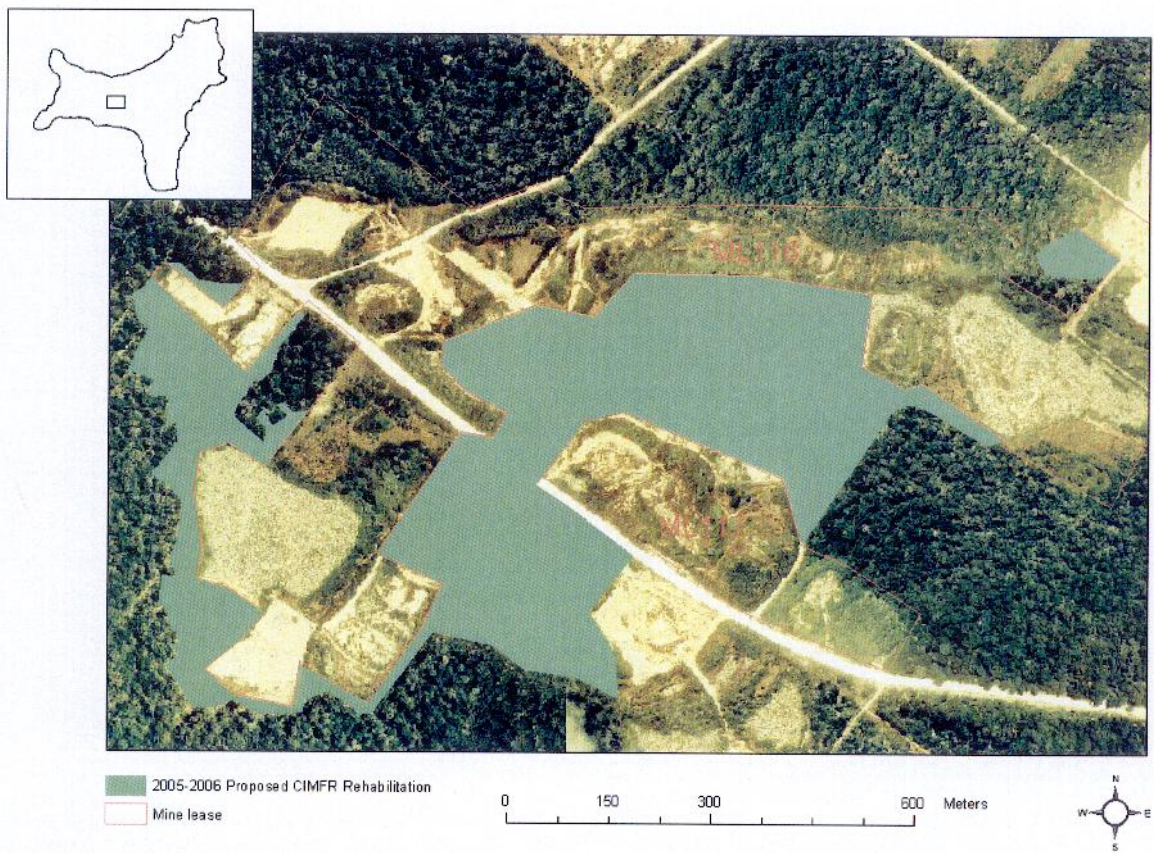


Figure 17: Areas in mine field 23 targeted for rehabilitation by the CIMFR program in 2005-2006.



Figure 18: Site of 2005-2006 CIMFR rehabilitation at mine field 23, adjacent to ML116 and 117.



Figure 19: High rocky ridges (~20 m) cliff edges (~30 m) typically left behind after mining at mine field 23.



Figure 20: Rocky pinnacles (~2 m) typically found at mine field 23.

References:

CMLR and UQ (2000). Christmas Island Minesite Rehabilitation Plans. Centre for Mined land Rehabilitation and the University of Queensland. Technical Report for the DNP.

Friday, August 12, 2005