Plate 2.9

Landscape view of a gap of approximately 80 m diameter crown-to-crown, created in the Year 2 experimental plot. The ground surface has been cleared to bare earth and woody debris has been piled in the gap's centre. A cluster occupies the background and riparian zones flank each side of the gap.

the four plots. These were slope, ground stratum cover, lower stratum cover, upper stratum cover, ground stratum height, lower stratum height, and mid stratum height (Table 2.3). I considered the number of juvenile stems to have also differed significantly ($P=0.052$) between the plots (Table 2.3). I obtained a result that approached significance ($P=0.085$) for variation in the number of pole stems between the plots (Table 2.3). The variables that were not significantly different between plots were mid stratum height, upper stratum height, distance to gully, and number of mature stems.

I used stepwise discriminant function analysis (DFA) to identify the variables that were most important in distinguishing between the plots on the basis of the measured vegetation structure variables (BMDP 7M: Dixon 1992). DFA reclassifies variables *a posteriori* into groups that were assigned *a priori* (Klecka 1980) and is both an exploratory and confirmatory technique (Corti *et al.* 1995). The discriminating variables or *a priori* groups were slope, ground stratum cover, lower stratum cover, and mid stratum height. The DFA revealed considerable overlap between the plots on the basis of these variables (Fig. 2.20). This indicated that each pair of experimental and control plots were more closely matched than all plots combined.

I performed a jackknife classification (BMDP 7M: Dixon 1992) to reduce any possible bias in the reclassification of sampled net stations. This involved the allocation of each station to its most similar group without using that station to help determine the group centre (Manly 1986, 1992). This resulted in 58.7% of replicate net stations within plots being correctly classified on the basis of *a priori* groupings (Table 2.4). In Year 1, a total of 23 net stations were correctly classified and 17 were incorrectly classified (10 into E1 or C1 Plots and 7 into Year 2 plots). In Year 2, 24 net stations were correctly classified and 16 were incorrectly classified (8 into E2 or C2 Plots and 8 into Year 1 plots).

These results may have reflected site-specific variation in several of the sampled vegetation structure variables. In the Year 1 plots these included slope, mid stratum cover, mid stratum height, and distance to nearest gully. C1 Plot had steeper slopes, denser and taller mid stratum cover, and shorter distances to gullies than E1 Plot (Table 2.2). The higher (75%) number of net stations that were correctly classified by plot in C1 Plot compared with E1 Plot (40%) may be indicative of these differences. In the Year 2 plots, C2 Plot had higher numbers of juvenile and pole stems than E2 Plot but less ground stratum cover and mid stratum cover, and shorter distances to gullies (Table 2.2). Only 55% of net stations were correctly classified by plot in C2 Plot compared with 65% in E2 Plot.

However, the fact that the DFA did not clearly separate net stations from different plots and that many net stations were incorrectly classified by plot indicates that there was a great overall similarity in sampled vegetation structure among plots. Therefore, I do not consider that my interpretation of bird responses to the experimental logging trials was impaired by pre-logging differences in vegetation structure among the research plots.

The floristic composition of Australian eucalypt forests can also influence the use of space by insectivorous birds (see Abbott & Van Heurck 1985; Recher 1985; Recher *et al.* 1996; Majer *et al.* 2000). In a comparative study of eastern and western Australian eucalypt forest, Recher *et al.* (1996) showed that some carbohydrate-dependent insectivores such as White-throated Gerygones *Gergyone olivacea* and Western Thornbills *Acanthiza inornata* forage selectively on tree species with a high diversity and abundance of canopy arthropods present in the foliage. The highly fertile, productive and floristically complex east coast site supported a richer and more abundant arthropod and insectivorous bird fauna than its drier western counterpart (see also Recher *et al.* 1991; Majer *et al.* 2000). Recher *et al.* (1996) also contended that the biological diversity of moist temperate eucalypt forests developed on very productive soils will be highly sensitive to changes in floristic composition and forest structure associated with logging and burning.

In my study, I characterised the floristic composition of the research plots by sampling vegetation at selected net stations prior to logging (see Appendix 2). The dominant tree species in the plots are Blackbutt, Flooded Gum, Tallowwood, Sydney Blue Gum and Turpentine in the moist, sheltered gullies, interspersed with dense vine tangles and rainforest species such as Bangalow Palm and Brush Box (see Appendix 2). The dominant shrub species along these gullies and lower slopes are Murrogun *Cryptocarya microneura*, Rose Maple *C. rigida*, Scentless Rosewood *Synoum glandulosum*, Prickly Supplejack *Ripogonum brevifolium*, Narrow-leafed Palm-lily *Cordyline stricta* and Tree Heath *Trochocarpa laurina*. On the drier upper slopes and ridges, Blackbutt, White Mahogany, Northern Grey Ironbark, Small-fruited Grey Gum and Forest Oak predominate. The main shrubs include *Acacia* *floribunda*, Scrub Turpentine *Rhodamnia rubescens*, Orange Thorn *Citriobatus pauciflorus* and *Dodonea triquetra*. Various grasses and forbs comprise the ground cover of these sites.

2.6 Microhabitat assessment

Previous studies have demonstrated the value of specific components of ground and understorey strata as sites of foraging, breeding and social interaction for insectivorous forest birds (see Crome 1978; Marchant 1985, 1992; Holmes & Recher 1986; Sieving *et al.* 1996; Ashton & Bassett 1997; Laven & Mac Nally 1998; Martin 1998). I term these fine-scale components of the living space of birds *microhabitats* (see Hall *et al.* 1997).

I defined seven classes of microhabitat of the study species (Chapters 5-7). I recorded the use of these classes by birds of each resident species before and after logging in each plot. I also obtained this data for monitored birds of the migratory species, but only after logging in the Year 2 plots. I calculated the microhabitat content of the home ranges of selected individuals of each study species using the software package RANGES V. I also described each species' use of woody debris piles and willingness to cross newly created gaps in the logged plots.

Table 2.1 Previous investigations of forest and woodland birds in Coffs Harbour and Urunga Management Areas and environs. SF=State Forest. FR=Flora Reserve. MA=Management Area. EIS=Environmental Impact Statement. FIS=Fauna Impact Statement.

Investigation	Type	Subject	Source
Observations in Bruxner Park Flora Reserve (FR), Orara East SF	species list	rainforest birds	Roberts unpubl. data
Birds of Woolgoolga Creek FR, Wedding Bells SF	species list	rainforest birds	Holland unpubl. data
Birds of Waihou Trig, Conglomerate SF	species list	rainforest, heath & woodland birds	Holland unpubl. data
Birds of Waihou FR, Conglomerate SF	species list	dry woodland/forest birds	Wallace unpubl. data
Bird movements and habitat use, Moonee, Red Rock, Woolgoolga Creek FR	long-term bird-banding projects	mainly moist forest & coastal heathland birds	Lane unpubl. data
Birds of Woolgoolga Creek FR	species list	rainforest/moist forest birds	Wallace unpubl. data
Bird survey of Orara East SF	survey results	rainforest/moist forest birds	Phipps unpubl. data
Flora & fauna of Waihou FR	resource surveys	dry & moist forest birds	Tweedie unpubl. data
Proposed Coffs Harbour Water Supply Headworks Augmentation Scheme	impact assessment	terrestrial vertebrates	Smith & Williams (1989)
Avifauna survey, 1260 FR, Kangaroo River SF	species list	moist & dry forest birds	Tweedie unpubl. data
Flora & fauna of Orara & Bucca Valleys	land capability assessment	all taxa	Smith *et al.* (1990)
North Boambee Valley flora & fauna	land use investigation	all taxa	Clancy (1990)
Proposed Bellbird Quarry, Bucca: fauna & flora	land use investigation	all taxa	Clancy (1990)
Fauna survey, Wedding Bells SF	mistnetting & spotlighting	birds, bats & mammals	Phillips unpubl. data
Mistake SF EIS	proposed logging operations	all taxa	FCNSW (1991)
Draft Interim Management Plan, Urunga MA	proposed & ongoing forest management operations	all taxa	SFNSW (1993a)
Bellinger River Water Supply Scheme: flora & fauna impact	impact assessment	all taxa	Austeco Pty. Ltd. (1993)

Bird movements & habitat use, Madmans Creek FR, Conglomerate SF	bird-banding project	moist & dry forest/woodland birds	Thomson unpubl. data
North-East Forests Biodiversity Study (NEFBS) Report No. 3	regional conservation study	all taxa	NSW NPWS (1994a)
NEFBS Report No. 3a	as above	all taxa	NSW NPWS (1994b)
NEFBS Report No. 3e	as above	taxa of special concern	Gilmore & Parnaby (1994)
NRAC Vertebrates of Upper North East NSW	natural resources audit	specific taxa	NSW NPWS (1995)
NRAC validation survey, Finberg Ck,Lower Bucca SF	transect survey	moist & dry forest birds	NSW NPWS unpubl. data
CHUMA EIS/FIS - Volume A: Main Report	proposed forest management operations	all taxa	SFNSW (1995a)
CHUMA EIS/FIS Fauna Report	proposed forest management operations	all terrestrial vertebrates	Smith *et al.* (1995)
An Information Base for Regional Conservation Planning	regional conservation planning	priority taxa	NSW NPWS (1996a)
RACAC Vertebrate Fauna of the Northern Study Area	interim assessment process planning	priority taxa	NSW NPWS (1996b)
Coffs Harbour Sewerage Strategy: Proposed Moonee Water Reclamation Plant EIS	proposed sewerage scheme	terrestrial vertebrates, other taxa	Coffs Harbour City Council (2000)

Table 2.2 Means and standard deviations for 13 vegetation structure variables in the experimental (E) and control (C) plots in Years 1 and 2 of the study

Variable[1] & statistic[2]	Plot[3]			
	E1	C1	E2	C2
Slope				
mean	7.35	10.80	4.15	6.47
SD	3.26	4.39	3.65	3.86
Ground stratum cover				
mean	31.13	31.54	35.40	24.80
SD	8.6	5.4	10.5	11.7
Lower stratum cover				
mean	39.85	40.53	24.55	21.79
SD	9.39	10.83	10.26	12.35
Mid stratum cover				
mean	41.25	45.78	47.27	43.71
SD	10.73	8.57	11.81	14.28
Upper stratum cover				
mean	33.18	30.30	29.90	23.38
SD	8.33	6.21	12.82	13.34
Ground stratum height				
mean	0.86	0.94	0.75	0.66
SD	0.22	0.13	0.26	0.25
Lower stratum height				
mean	3.83	4.60	4.52	4.55
SD	0.96	0.6	1.07	0.76
Mid stratum height				
mean	11.42	14.12	13.10	13.20
SD	3.12	1.23	1.92	2.07
Upper stratum height				
mean	29.60	31.20	27.70	26.80
SD	4.1	4.62	8.16	9.81
Distance to nearest gully				
Mean	47.80	34.45	46.60	32.10
SD	31.2	25.37	36.66	27.89
Number of juvenile stems				
mean	1.40	1.21	0.84	0.98
SD	0.75	0.59	0.6	0.75
Number of pole stems				
mean	0.91	0.93	0.52	0.86
SD	0.57	0.6	0.54	0.56
Number of mature stems				
Mean	0.10	0.15	0.10	0.15
SD	0.31	0.37	0.31	0.37

[1]Slope (degrees)
Stratum cover (% projective foliage cover)
Stratum height (metres)
Distance to nearest gully (metres)

[2]SD=Standard deviation
[3]Plots: E1 (Year 1 experimental) C1 (Year 1 control)
E2 (Year 2 experimental) C2 (Year 2 control)

Table 2.3 Results of a MANOVA performed on 13 vegetation structure variables to identify significant differences among plots. Significant ($P<0.05$) results and results that approach significance ($P=0.05$-0.10) are shown in bold.

Variable[1]	df[2]	Sum of squares	Mean of squares	*F*	*P*
Slope	3	641.66	213.89	9.72	**0.000**
Ground stratum cover	3	1155.73	385.24	4.41	**0.006**
Lower stratum cover	3	5876.6	1958.9	16.91	**0.000**
Mid stratum cover	3	410.5	136.8	1.03	0.385
Upper stratum cover	3	1027.2	342.4	3.04	**0.034**
Ground stratum height	3	0.8890	0.2963	5.94	**0.001**
Lower stratum height	3	7.9065	2.6355	3.51	**0.019**
Mid stratum height	3	75.813	25.271	5.25	**0.002**
Upper stratum height	3	232.15	77.38	1.54	0.211
Distance to nearest gully	3	3947.7	1315.9	1.41	0.247
Number of juvenile stems	3	3.7178	1.2393	2.69	**0.052**
Number of pole stems	3	2.2287	0.7429	2.29	**0.085**
Number of mature stems	3	0.0500	0.0167	0.15	0.932

[1]based on plot factor. Slope (degrees), stratum cover (%), stratum height (m), distance to nearest gully (m)
[2]error degrees of freedom (df)=76; total df=79

Table 2.4 Results of a jackknife classification of sampled net stations in plots

Group	% correctly classified	Number of cases classified into group (plot)			
		E1	C1	E2	C2
E1	40.0	8	8	1	3
C1	75.0	2	15	1	2
E2	65.0	2	2	13	3
C2	55.0	3	1	5	11
Total	58.7 (mean)	15	26	20	19

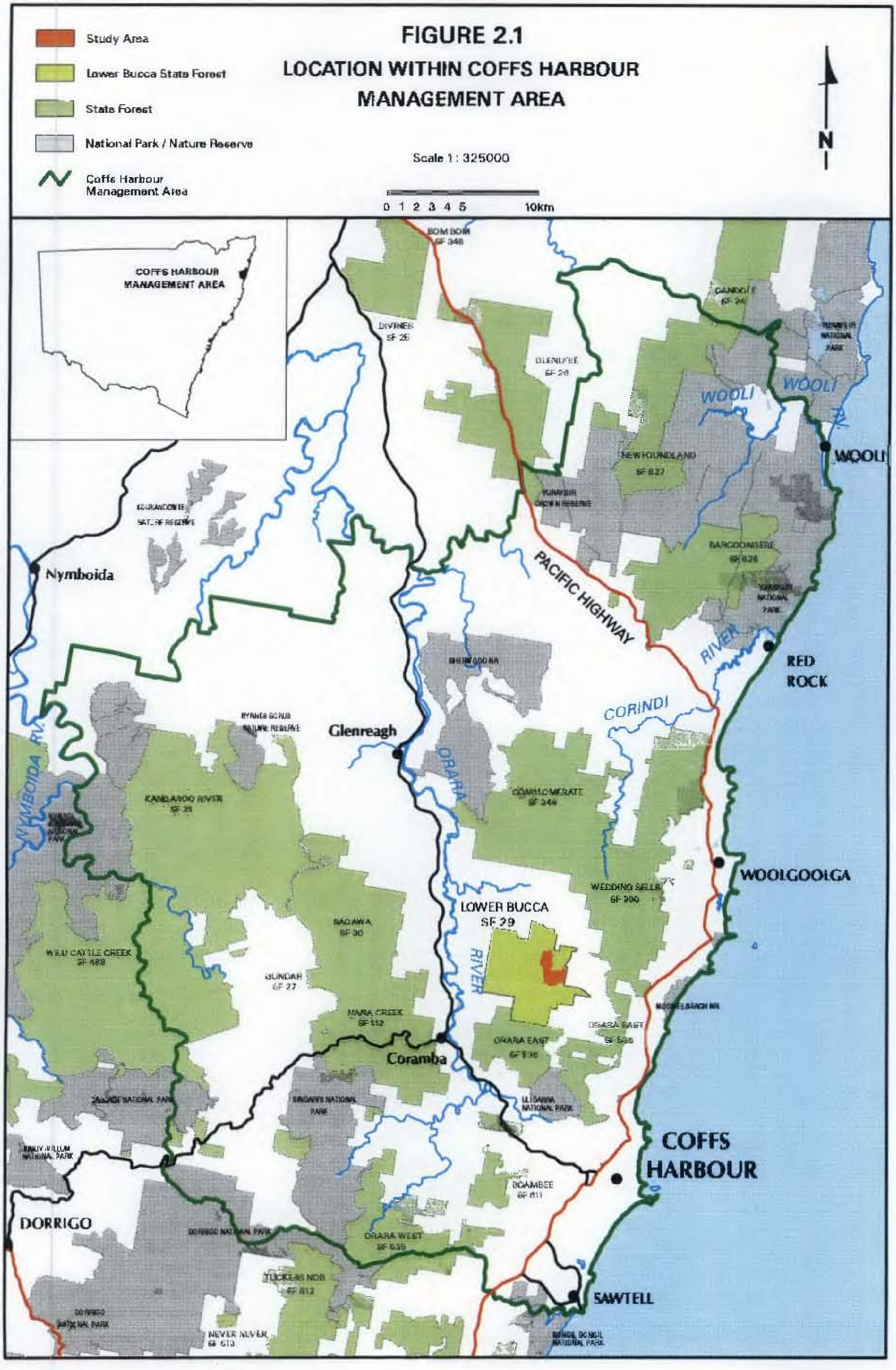

FIGURE 2.1
LOCATION WITHIN COFFS HARBOUR MANAGEMENT AREA

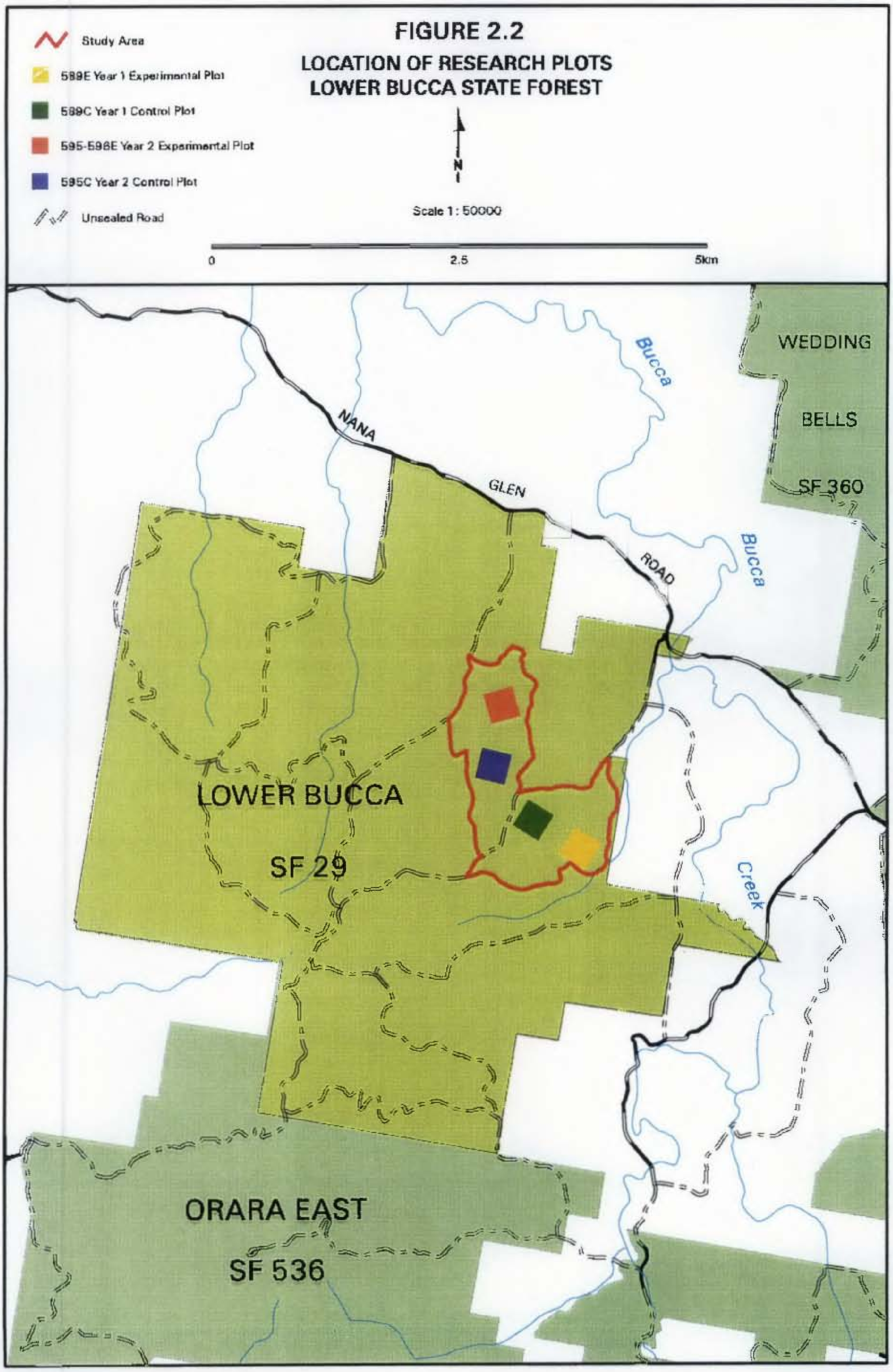

FIGURE 2.2
LOCATION OF RESEARCH PLOTS
LOWER BUCCA STATE FOREST

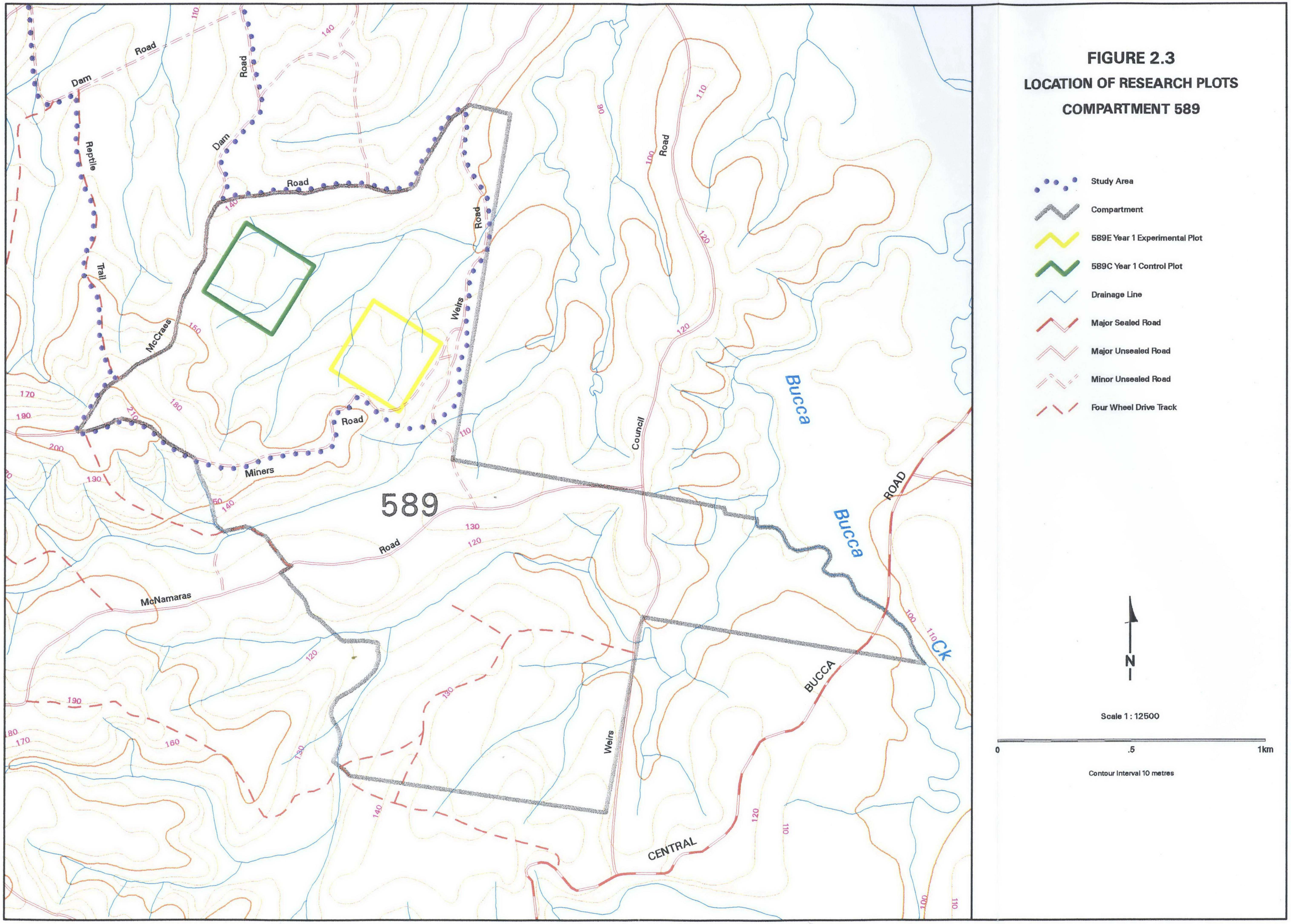

FIGURE 2.3
LOCATION OF RESEARCH PLOTS
COMPARTMENT 589

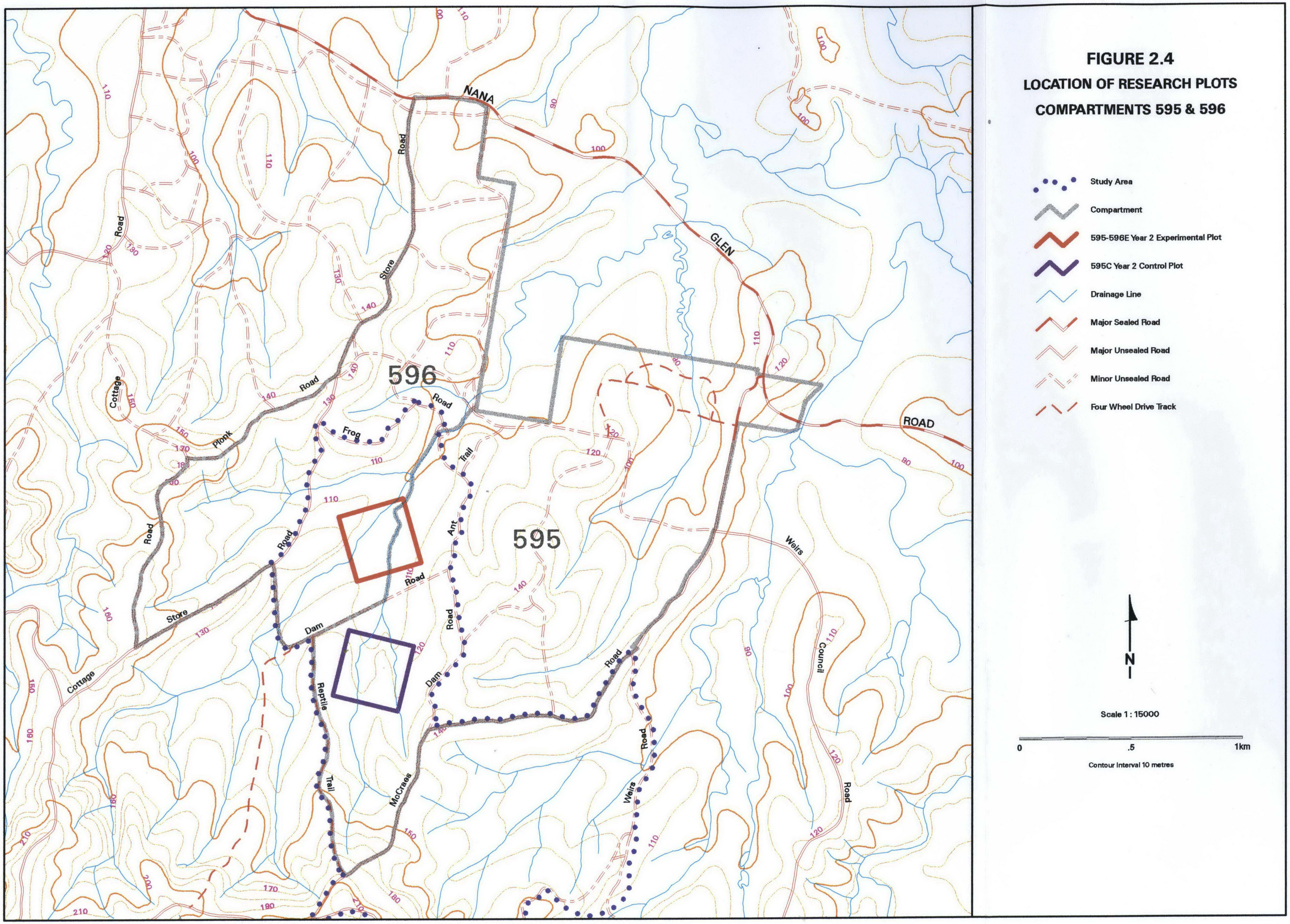

FIGURE 2.4
LOCATION OF RESEARCH PLOTS
COMPARTMENTS 595 & 596

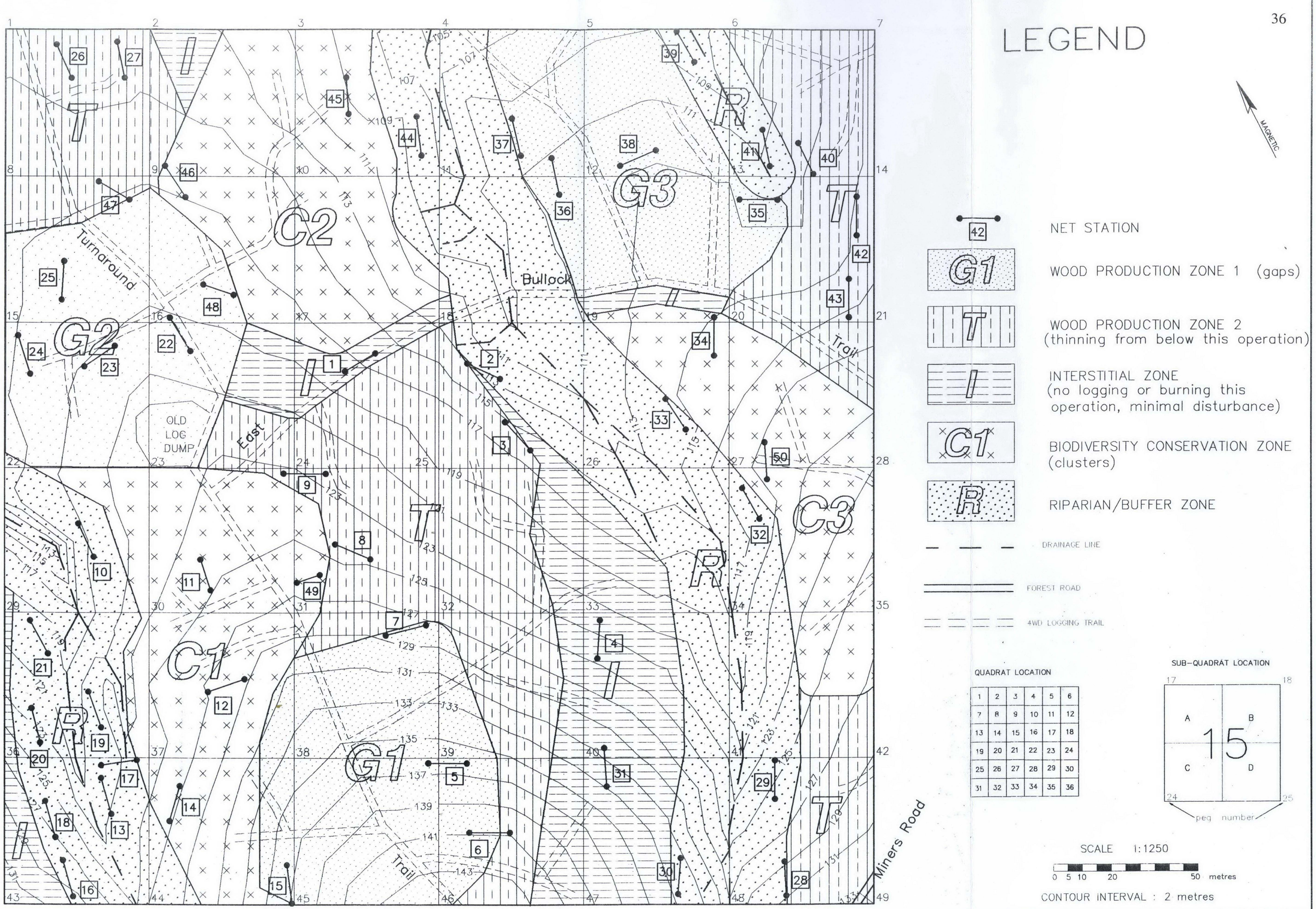

Figure 2.5 Detailed map of the Year 1 experimental plot in part of Compartment 589, Lower Bucca State Forest, showing gaps, clusters, thinning and interstitial areas, riparian zones, net stations, drainage, access trails and topography