RADIATA PINE RESOURCE CHARACTERISATION

WQI Benchmarking Study

FR Data Collection– Site 15 (Golden Downs Forest)

A Report Prepared for WQI Ltd
By

Russell McKinley, Dave Cown, Trevor Jones

REPORT NO. RES 33

DATE: February 2005

New Knowledge in Wood Quality

A JOINT VENTURE OF CSIRO & FOREST RESEARCH

REPORT INFORMATION SHEET

REPORT TITLE	**RADIATA PINE RESOURCE CHARACTERISATION** WQI Benchmarking Study FR Data Collection – Site 15 (Golden Downs Forest)
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RADIATA PINE RESOURCE CHARACTERISATION

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EXECUTIVE SUMMARY

Site 15 of the 1978 Genetic Gains Trial (the final plot in the Benchmarking series) is located in Golden Downs Forest in the Nelson region, and was shown in a previous study (Res 1 - WQI Pre-screening Study) to represent the "high-to-medium" density range of wood density sites (outerwood density at age 25yr. – 437 kg/m^3). Ten stems were selected to cover the density and diameter range within the plot and felled to yield discs at regular intervals up the tree for wood property assessments.

Discs were prepared in such a way as to give data on a range of wood properties:

1. Wood density (5-ring sample blocks)
2. Shrinkage (5-ring sample blocks)
3. Spiral grain (5-ring sample blocks)
4. Colour
5. Internal checking
6. Resinous features
7. *Fibre length**
8. *SilviScan samples**

This report documents some of the findings (1-6 above): the fibre length and SilviScan data for Golden Downs Forest will be reported later as they become available.

The site showed the less than average stem diameter growth for the 15 sample plots (average DBH 455 mm *vs.* average of 480 mm). Wood properties showed within-stem patterns similar to those established at the other sites. Stem density ranged from 345 kg/m^3 to 410 kg/m^3 (average 377 kg/m^3). Outerwood density explained 86% of the variation in stem average density. There was a weak positive relationship between stem acoustic velocity and density (r^2 = 0.27). Shrinkage and spiral grain values followed the "normal" pattern. Seven of the 10 stems showed signs of intra-ring checking in the lower stem (mainly the butt log). Incidence was "moderate to high" compared to other plots in this series, and most commonly in the 1992 annual ring. A high level of resinous features (blemishes, resin pockets, resinous patches) was recorded, confirming that the general region can have areas of resin pockets. Most of the observed resinous defects were located in bottom three logs.

The raw data will be entered into an Access WQI database and will contribute to modelling the effects of site, silviculture and genetics on wood formation.

* reported elsewhere

RADIATA PINE RESOURCE CHARACTERISATION

WQI Benchmarking Study – Site 12 (Golden Downs Forest)

FR Laboratory Data Collection

BACKGROUND

A major component of WQI Objective 1 - Radiata Pine Resource Characterisation - is a survey of the existing forest resource, collecting standard wood samples (non-destructive and destructive) from a significant number of well-documented sites and completion of comprehensive analyses of site factors affecting levels and distributions of major wood properties. Previous regional wood quality studies have identified a gradient in various properties, apparently associated with climatic and site effects (Cown, 1979; Cown *et al*. 1991a; Cown & Ball, 2001). These new WQI "benchmarking" studies have been planned to use trials comprising known genetic material, located in diverse environments (1978 Genetic Gains Trials). The actual stand conditions vary somewhat due to priorities of individual forest owners and environmental influences (climate, grazing, etc).

The data collection has been designed to provide comprehensive information on:

- Geo-spatial information on wood quality factors (density, shrinkage, spiral grain, microfibril angle, internal checking, fibre characteristics, resin, etc) and material properties (stiffness, strength, stability, appearance features) to yield new information on geographic and within-tree patterns of variability in major wood characteristics.
- Data on specific environmental influences on wood formation (latitude; elevation; soil type; climate).

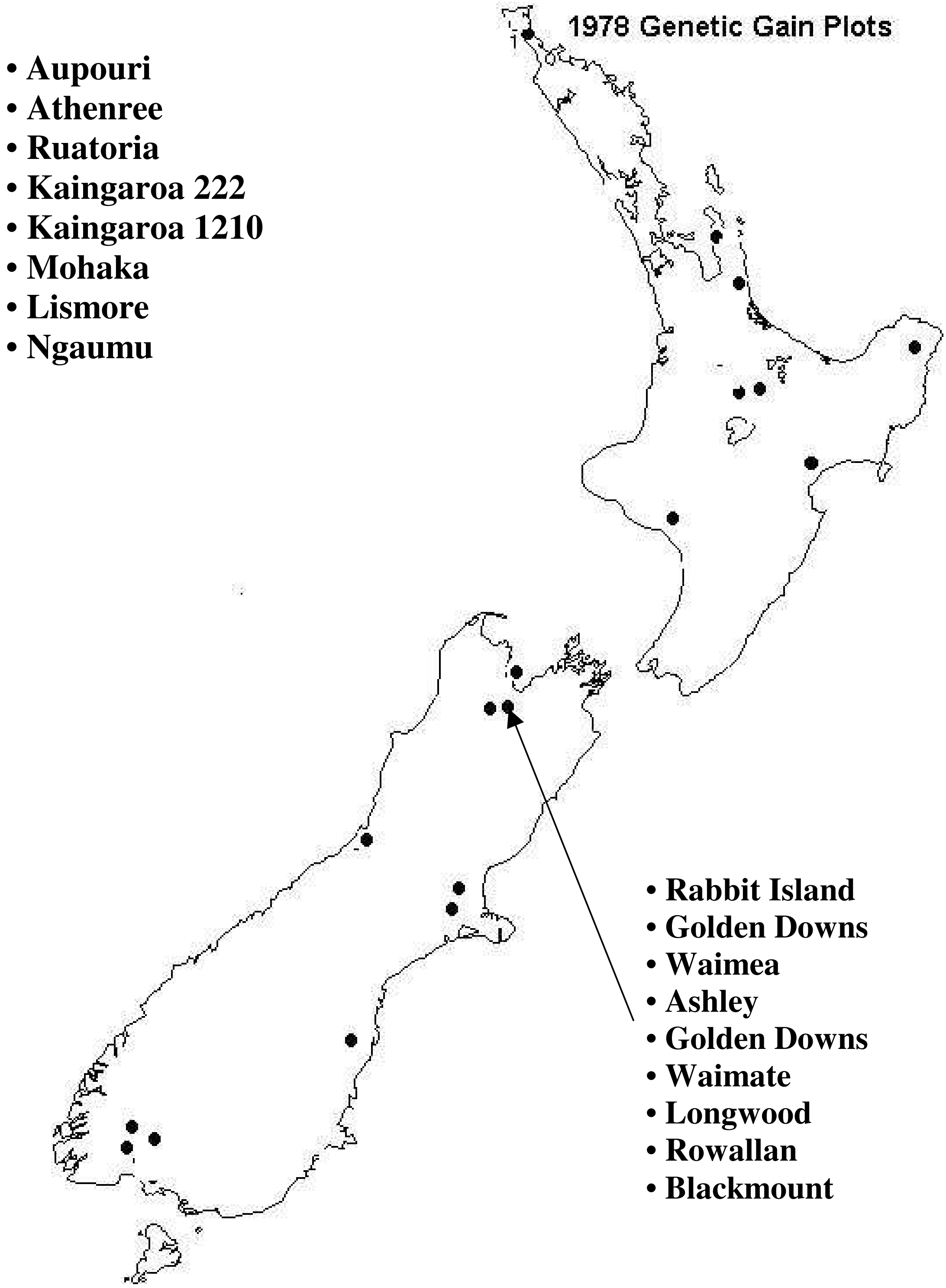
Silvicultural and genetic effects – genotype; stocking; thinning; pruning; fertilising; rotation length - will be examined later in other trials, subject to WQI priorities. The ultimate objective is to create a new archive of the major wood properties known to influence the value of radiata pine wood products, in relation to the major influencing factors, thus providing a valuable asset to WQI shareholders and new information for Decision Support Systems.

The Genetic Gains Trials were established in 1978 with known genotypes (3 open-pollinated commercial seedlots), sited in (now former) state-owned production forests at 22 sites selected to encompass a broad range of climatic and site conditions (Figure 1). Two plot designs were used:

1) Large plots with trees planted at 1111spha and managed under a typical sawlog regime
2) Row plots where trees were planted in single row plots at 833spha and managed as per the surrounding commercial forest.

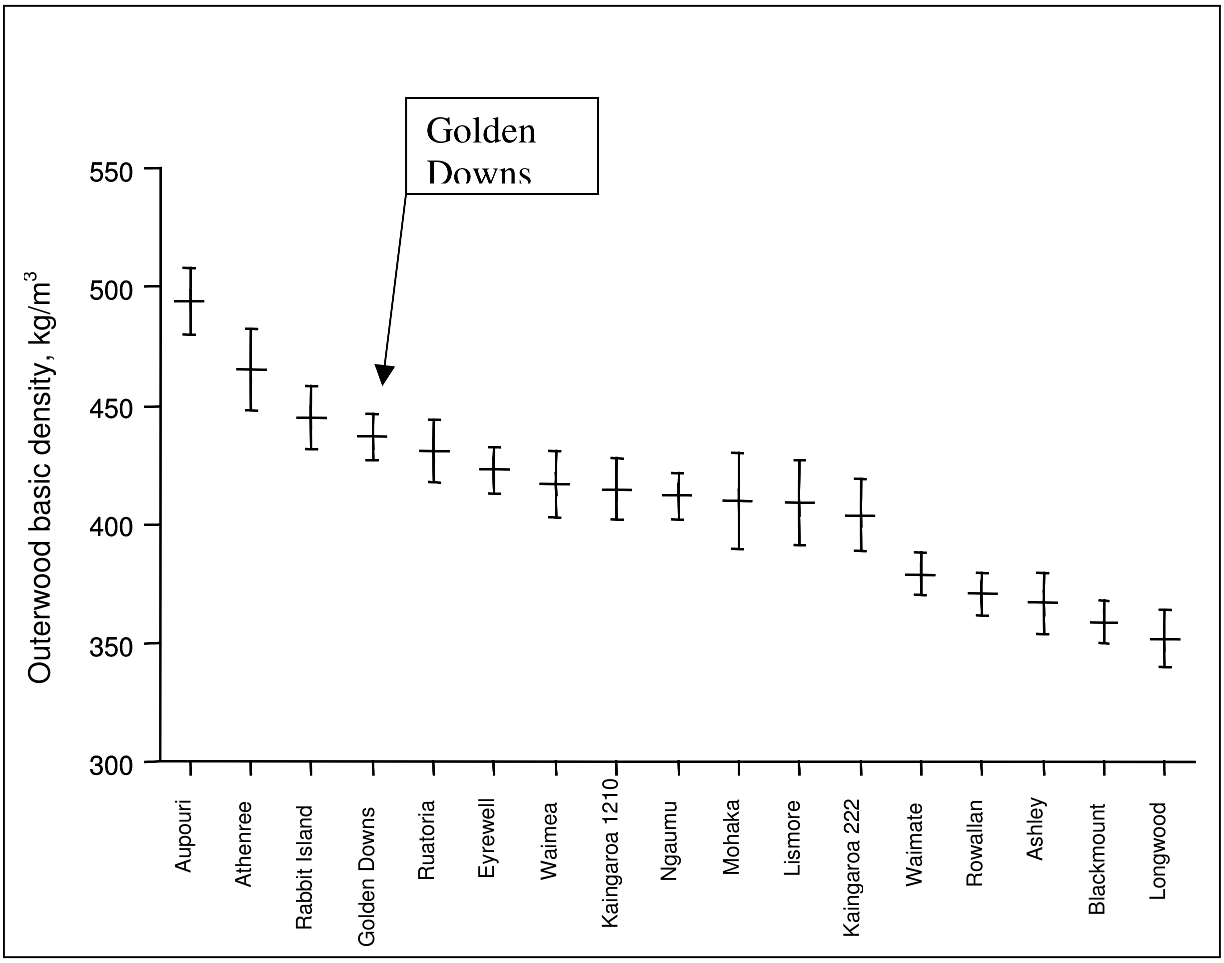
Seedlot WN/72/2 (GF 14) was selected for this study as being both well represented in the trial and exhibiting relatively good growth. Classified as GF 14 stock, it represents a significant degree of genetic improvement - similar to many current crops - and is available at a relatively mature age (25 years). At the time sampling commenced (2003), in addition to varied silviculture due to management policies, several of the trials had been abandoned as research areas due to damage from excessive grazing or severe storms. The location of the Golden Downs site is shown in Fig. 1.

Figure 1: Sites Sampled



A pre-screening phase was considered advisable to check the current condition of the plots, collect outerwood density cores and assess the potential for further sampling by felling representative stems. The work was contracted to Dean Witihera (Quality Forest Management), who visited the 20 remaining trials and assessed 30 trees/trial (where available) of WN/72/2, following standard non-destructive assessment techniques (Appendix 1). Outerwood increment core sampling for basic density was undertaken, along with measurement of size (DBH over bark) and visual assessment of sample stems for stem form, branch size, internode length, external resin bleeding and suitability for felling. The results of the pre-screening assessment were documented by McKinley and Cown (2003). The pre-screening phase gave a broad picture of wood density variation within the trial (Fig. 2) and allowed for selection of 10 crop trees of reasonable stem form for possible felling, covering the wood density and diameter range at each site. The intention was to provide material for more intensive studies of major wood properties and establish within-tree, between-tree and between-site patterns and relationships between properties. The aim is to collect detailed wood property data from 15 sites nationwide.

Figure 2: Average BH outerwood basic density (mean and standard deviation)



The major findings from the pre-screening study (15 plots) were:

As expected, there was a strong trend for density to decrease southwards. The highest values were found at Aupouri Forest in Northland (494 kg/m^3), and the lowest at Longwood Forest in Southland (352 kg/m^3). These are very significant differences between the various sites in this trial and while the overall trend is clear, there are apparent departures due to local site and climate. There is evidence that the wood density values recorded are significantly reduced from those found in the previous national survey of wood properties (1977-82).

Average for other observed characteristics were:

- *Breast height diameters (average 480 cm) ranged from 356 (Golden Downs) to 580 (Longwood and Mohaka).*
- *Branch index (average 4.3 cm) – 3.4 cm (Golden Downs) to 5.9 cm (Blackmount).*
- *Visual stem resin score (average 0.9) - from 0.5 (Ruatoria, Longwood) to 2.0 (Aupouri).*

In the context of this study, the Golden Downs outerwood density data seemed to be abnormally high.

DATA COLLECTION PROCEDURES

Prior to felling, visual observation of resin were made according to the method of McConchie & Turner (2002) and the North direction marked at breast height, and a North line marked along the stem after felling. The tree stems were de-limbed and crosscut at a small end diameter of approximately 100mm. The whole stem length was recorded and a CHH Director HM200 acoustic measure made prior to sectioning the stem into log lengths and discs as per Appendix 2. Further Director acoustic measures were made on all individual logs above the 1.4m sampling position. Internode lengths down to 0.3m were measured on the second log, *i.e.* between sampling heights 5m to 10m.

One complete set of discs from all sampling heights (0m, 1.4m, 5m and subsequent 5m intervals down to a SED of approximately 100mm) was removed for basic density, shrinkage and spiral grain assessment by 5-ring groups (Cown & McConchie, 1982, 1983; Treloar and Lausberg, 1995). Samples were also prepared for shipment to CSIRO for SilviScan analyses. Prior to sectioning into 5-ring groups, diameters were recorded over bark, inside bark, for heartwood and juvenile wood (inner 10 rings). Compression wood occurrence per quartile and resinous features were also recorded, along with a total ring count and the number of heartwood rings.

Internal checking analyses were undertaken on all discs up to and including the 10m sampling height, using the "oven drying method" of McConchie (2000). Bark-to-bark strips centred on the pith and an additional adjacent strip were collected at all heights for SilviScan, wood colour and archive samples. SilviScan samples were prepared according to established procedure (*i.e.* soaked in ethanol for several weeks with two changes of ethanol) prior to dispatch to CSIRO, Melbourne. Wood colour measurements were made for heartwood and sapwood in the green and air-dry condition using a Minolta CR-200 colorimeter (Dawson *et al.,* 2003).

Two additional samples from all trees (cut from 1.4m and 20m discs) were retained for Norske Skog - for kraft pulping and fibre length and width measurement using a Kajaani Fibrelab instrument (to be reported separately).

Results - Site 12 (Golden Downs)

Plot data for the Golden Downs trees, collected during the pre-screening exercise, are tabulated in Appendix 1.

Tree Stem Characteristics

Appendix 1 provides the plot information for Golden Downs, as supplied by Dean Witehira (who completed the initial pre-screening work). From the total trees assessed in the pre-screening phase (20 – and an additional 10 measured by Don McConchie on a later visit), 10 were selected that met the criteria of suitable crop trees as well as covering the outerwood density and diameter range.

Dean's comments:

"Trees are typically light branched with minimal internodes. Most trees showed signs of compression wood therefore tried to get the best samples possible. Some vegetation undergrowth. Small amount of blackberry, fern, gorse but operational/access hindrance not significant".

Table 1 gives all the visually-assessed data for the selected plot trees.

Table 1: Pre-screening attributes of selected trees

Tree No.	Outerwood Density (kg/m^3)	DBHOB (mm)	Visual Branch Class				Int. Index	Resin Score #	Comments
			Butt	2nd	3rd	4th			
Q 2	462	516	0	1	2	2	0	1	
Q 5	473	437	0	1	2	2	0	1	Comp wood, sev. in parts of tree
Q 9	451	411	0	1	1	1	0	1	
Q12	428	460	0	2	2	2	0	0	
Q13	430	536	0	2	2	3	0	1	
Q18	391	494	2	2	2	2	0	2	Bad galls
Q23	393	502	0	2	2	2	0	1	
Q25	421	390	0	1	1	2	0	1	Traces of comp wood
Q29	421	449	1	2	1	2	0	1	
Q30	383	446	0	1	1	2	0	1	
Sample mean	425	464	0.3	1.5	1.6	2.0	0.0	1.0	
Mean BIX			2.0	3.8	3.9	4.5			
Site mean (n = 30)	425	468	0.2	1.5	1.6	2.0	0.1	1.3	
Mean BIX			1.8	3.8	3.9	4.5			

\# 0 = Nil; 3 = Severe * Additional stems (10) were assessed by D. McConchie on a subsequent visit, so the Plot data are slightly different from that reported in the Pre-screening report.

BIX Score	Average Branch (cm)	Range	IIX Score	Average Internode Index	Description
0	0	No branches	**0**	0.3	No or very few internodes - < 40% of logs made of long internode material
1	3.0	3 cm or less	**1**	0.5	Some internode material - > 40% of logs made of long internode material
2	4.5	3 - 6 cm	**2**	0.7	Long internode material - > 70% of logs made of long internode material
3	7.5	6 - 9 cm			
4	>9.0	9 cm or greater			

Outerwood density and DBHOB of the sample stems averaged 425 kg/m^3 and 464 mm respectively, closely matching the plot values (437 kg/m^3 and 468 mm). Some of the butt logs were access pruned to 2.0m. Visual assessments of the other logs yielded estimates of branch classes averaging 1.8, 1.7 and 1.9 (logs 2-4) equating to BIX values of between 3.8 and 4.5 (the 15 plots averaged 4.3, ranging from 3.4 at Golden Downs to 5.9 at Blackmount – McKinley and Cown, 2003.

WOOD PROPERTIES - RESULTS AND DISCUSSION

1. Increment Cores

It was apparent from the WQI pre-screening exercise (McKinley & Cown, 2003) that outerwood wood density levels fell into the "medium-to-high" range in terms of this exercise (Fig. 2). The average value found in this plot (425 kg/m^3) ranked fourth overall in the national context, but considerably lower than the 470 kg/m^3 found for material of this age in Inland Nelson in a previous survey (Cown, 1979). In the broad national context, the Nelson region was considered to have some sites representing the Low Density Zone (Awatere Valley), as well as the High Density Zone (coastal Nelson).

2. Disc Properties (diameter, bark, juvenile wood, heartwood, compression wood)

Average disc properties by height are documented in Table 2, collected according to the disc sampling as shown in Appendix 2. Juvenile wood (inner 10 rings) and heartwood are calculated as the proportion of cross-sectional area of the entire disc. Compression wood was visually assessed by quartile and disc, with Quartile 1 centred on the North line marked on the disc.

Table 2 – Average disc properties by sampling height

Disc Ht. (m)	DIB (mm)	Bark (mm)	Total Rings	Heart Wood Rings	Heart Wood (%)*	Juv Wood (%)*	Compression wood by Quartile N (%)	E (%)	S (%)	W (%)	Disc (%)
0	450	33	25	6	7	19	3	2	3	4	2.6
1.4	406	29	23	6	10	30	5	3	5	5	4.3
5	369	15	20	5	14	44	3	4	3	3	3.3
10	331	10	17	5	16	53	2	2	2	2	1.5
15	284	8	14	4	12	63	3	3	2	2	2.3
20	229	6	11	2	5	82	3	5	4	2	3.3
25	169	5	8	1	2	100	2	3	1	2	2.1
							Un-weighted average CW				2.7

* Area based
* Area based

These data will be discussed further in the context of the overall results from the Genetic Gains Trial sites. At that point, realistic site comparisons can be made and trends observed.

3. Wood Density

Wood density values can be assessed in a number of different ways. Outerwood increment core values were determined for plot sample trees in the course of the pre-screening study, and detailed SilviScan within-ring data (resin-extracted) will be available at most disc sampling levels for all felled sample stems, giving information similar to past densitometry studies (Cown & Ball, 2001; Downes & Yang, 2004). In this part of the study, wood density was measured on 5-ring blocks from the pith outwards at each stem level (unextracted density), as indicated in Appendix 2. The weighted block and disc measurements (Table 3) allowed estimates of density for various stem components: juvenile wood (362 kg/m^3), mature wood (405 kg/m^3), and whole stem basic density (377 kg/m^3). These "unextracted" values are influenced to some degree by the presence of heartwood, particularly in the lower stem (Cown *et al.* 1991a).

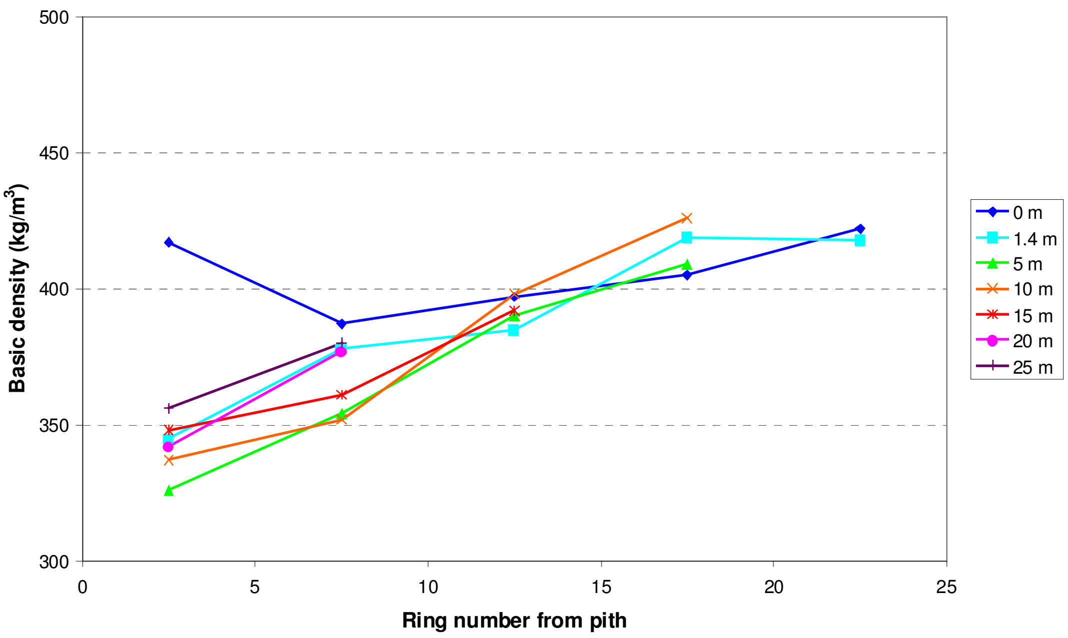
Table 3 – Pith-to-bark basic density trends by sampling height

Disc Ht. (m)	Basic density (kg/m^3) by ring group from pith 1 to 5	6 to 10	11 to 15	16 to 20	21 to 25	Basic density (kg/m^3) Juv.#	Mature	Disc
0	417	387	397	405	422	396	405	402
1.4	345	378	385	419	418	366	402	388
5	326	354	390	409		344	398	370
10	337	352	398	426		346	400	367
15	348	361	392			356	393	366
20	342	377				364	429	365
25	356	380				365		365
Average Stem Density: 377 kg/m^3		Range: 345 - 410 kg/m^3				362	405	375

Inner 10 growth rings

Unextracted densities are plotted by stem levels in Figure 3.

Figure 3: Basic wood density (unextracted) - all stem levels



Basic wood density values consistently increase outwards from the pith as has been documented in numerous studies. Juvenile wood density increases rapidly at all stem levels and the outerwood density decreased with height up the stem, reflecting the increasingly younger wood. The relatively high values for the inner rings of juvenile wood for the butt (0m) disc are simply a reflection of high levels of extractives in the "older" heartwood at the base of the stems and is observed at each site. This is very apparent in Fig. 3. Even although this site has been classified as "medium-to-high" density in the context of this study, little of the stem volume exceeds 400 kg/m^3 – a value suggested as a reasonable juvenile wood "cut-off" level (Cown, 1992).

Weighted whole tree density calculated from disc values using Smalian's formula averaged 377 kg/m^3 (range 345 - 410 kg/m^3). The relationship between BH outerwood density and whole-tree density for all 10 trees is shown in Fig. 4. The expected high correspondence was confirmed for these trees ($r^2 = 0.86$).

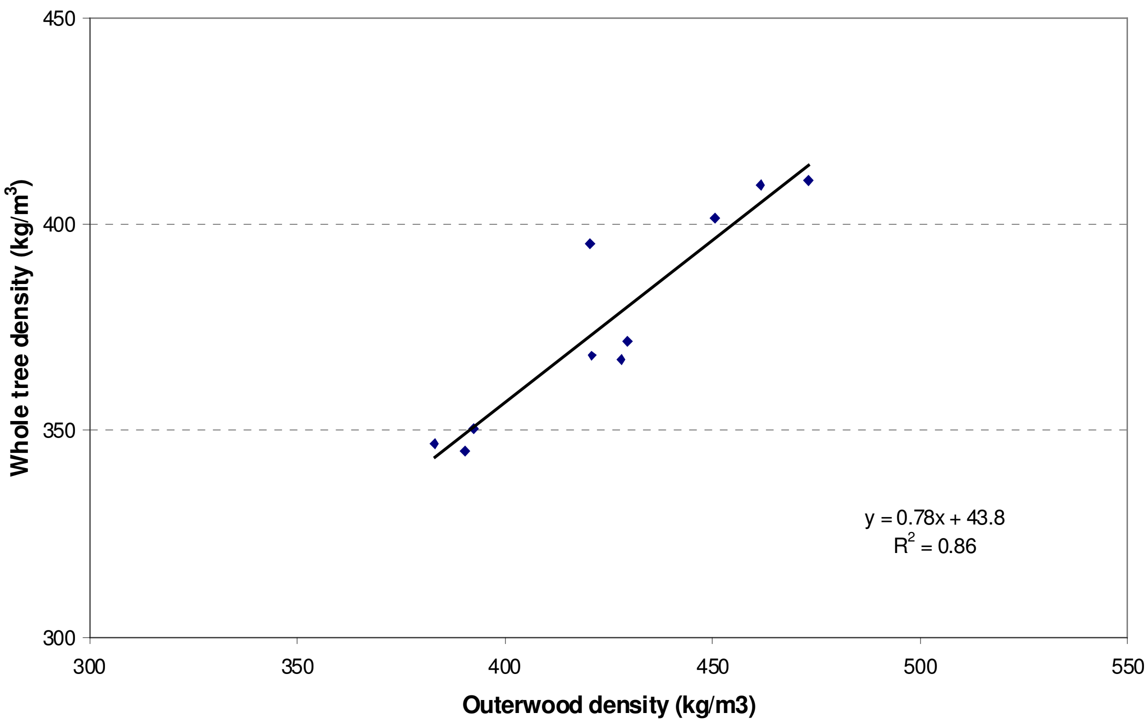


Figure 4: Basic wood density: breast height outerwood/whole stem relationship

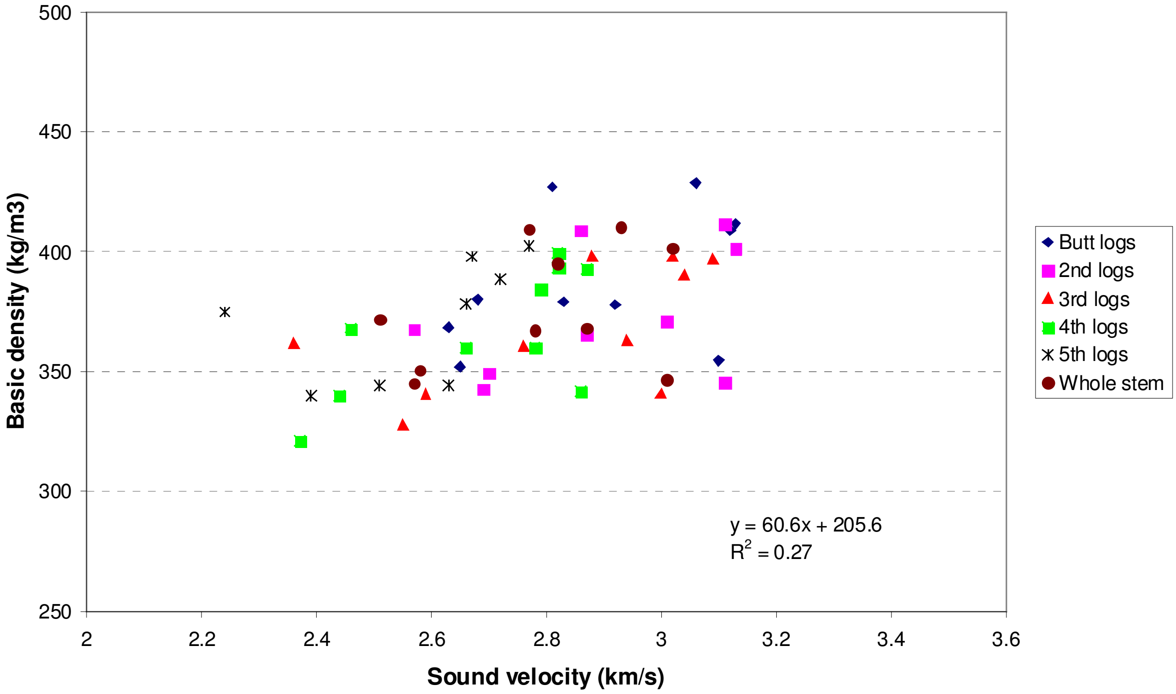
The dynamic stiffness data (CHH director HM 200 - Table 4) was examined in relation to average log and stem density (Fig. 5), where the relationship conforms to the pattern established previously – butt logs lower velocity than upper logs (Cown et al. 2004).

Table 4: CHH Director HM200 log and stem acoustic measures

Tree No.	Stem length (m)	Acoustic data (km/s)					
		Stem	Log 1*	Log 2+	Log 3+	Log 4+	Log 5+
Q 2	30	2.77	2.81	2.86	2.88	2.82	2.77
Q 5	25	2.93	3.06	3.11	3.02	2.87	2.72
Q 9	19.5	3.02	3.12	3.13	3.09	2.82	2.67*
Q12	18	2.78	2.83	2.87	2.76	2.66*	N/A
Q13	25	2.45	2.68	2.57	2.36	2.46	2.24
Q18	22.9	2.57	2.65	2.69	2.59	2.44	2.39*
Q23	18.5	2.58	2.63	2.70	2.55	2.37*	N/A
Q25	25	2.93	3.13	3.13	3.04	2.79	2.66
Q29	23	2.87	2.92	3.01	2.94	2.78	2.63*
Q30	18	3.01	3.10	3.11	3.00	2.86*	2.51
Mean	22.5	2.79	2.89	2.92	2.82	2.71	2.57

* ~ 3.5m length
+ ~ 5m length
# low confidence

Figure 5: Relationship between basic density and sound velocity for logs and whole stems (CHH Director)



Overall, there was a weak positive relationship, ($r^2 = 0.27$) with little indication of trends with log height class. This relationship is poorer than that found at some other sites.

4. Shrinkage

Shrinkage values were measured on all 5-ring block samples. The data for Golden Downs are summarised in Tables 5 and 6, and height trends plotted in Figure 6. Values are in line with previous results (Cown *et al*., 1991a; 2004). Both the tangential and radial values vary with both radial position and stem height. Radial values increase from around 1.5 % in the inner rings, to around 3.0 % in mature wood and tangential from 3.0 – 5.0% to 4.0 – 4.5%. Tangential values showed some high values close to the pith in the lower stem and tend to drop off significantly with height at given positions from the pith. Longitudinal shrinkage is generally very small (negligible?), apart from the relatively high values of the inner rings in the lower portion of the stem (in line with previous results and other sites). The negative values for the tree level longitudinal shrinkage averages reflect the difficulty of accurately detecting very small differences on the 5-ring block surfaces and possibly some apparent expansion in the longitudinal direction (tests using the "pin" method have confirmed that negative values are common in radiata pine).

Table 5: Pith-to-bark air-dry shrinkage trends by sampling height

Disc ht. (m)	Air-dry shrinkage* (%) by ring group from pith									
	1 to 5	6 to 10	11 to 15	16 to 20	21 to 25	1 to 5	6 to 10	11 to 15	16 to 20	21 to 25
	Longitudinal					Radial				
0	0.25	0.06	0.06	-0.05	-0.07	2.0	2.0	2.0	2.2	2.8
1.4	0.12	0.03	-0.02	-0.06	-0.08	1.7	1.8	1.7	2.4	3.1
5	0.00	-0.02	-0.04	-0.04		1.5	1.5	1.5	2.4	
10	0.02	-0.03	-0.05	-0.08		1.4	1.3	1.8	2.6	
15	0.06	-0.03	-0.05			1.2	1.6	2.1		
20	-0.01	0.00				1.1	1.5			
25	0.03	0.04				1.1	1.7			
	Tangential									
0	5.1	4.7	4.6	4.5	4.5					
1.4	4.1	4.0	4.1	4.4	4.4					
5	3.8	3.6	3.6	4.1						
10	3.2	3.6	3.8	3.9						
15	2.9	3.6	3.8							
20	2.8	3.2								
25	2.4	3.3								

* Adjusted to 12% m.c.

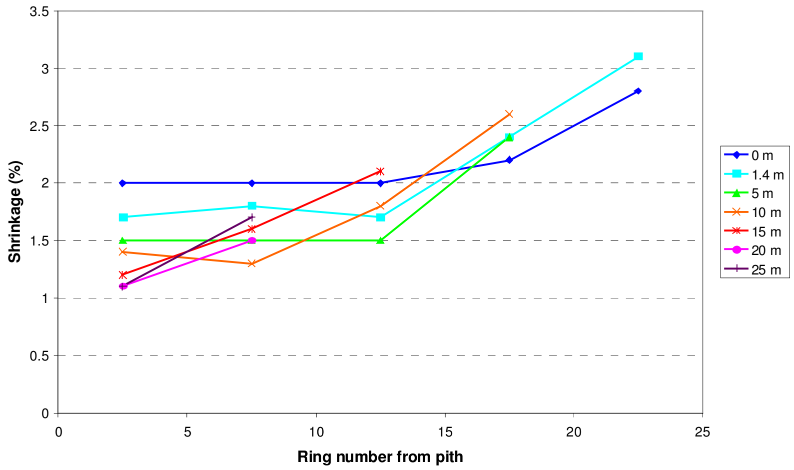
Table 6: Average air-dry shrinkage by sampling height

Disc ht. (m)	Air-dry shrinkage* (%)		
	Longitudinal	Radial	Tangential
0	0.05	2.2	4.7
1.4	0.00	2.1	4.2
5	-0.03	1.7	3.8
10	-0.03	1.6	3.6
15	-0.01	1.6	3.4
20	-0.01	1.3	3.0
25	0.03	1.2	2.6

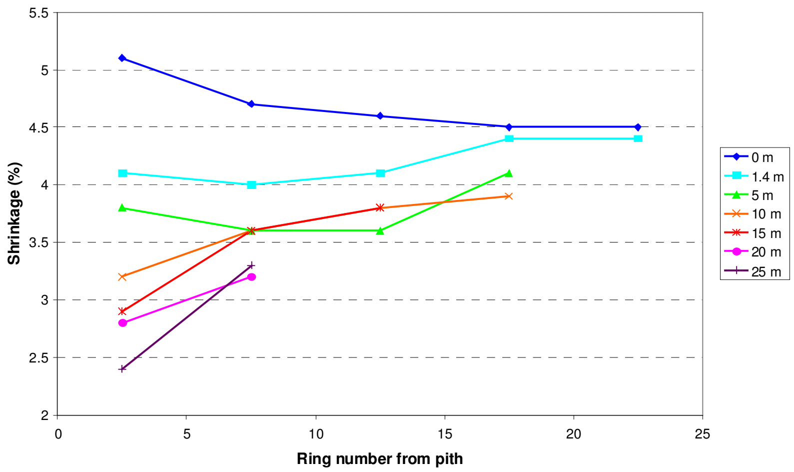
* Adjusted to 12% m.c.

Figure 6: Shrinkage (green to 12% MC) for all stem levels

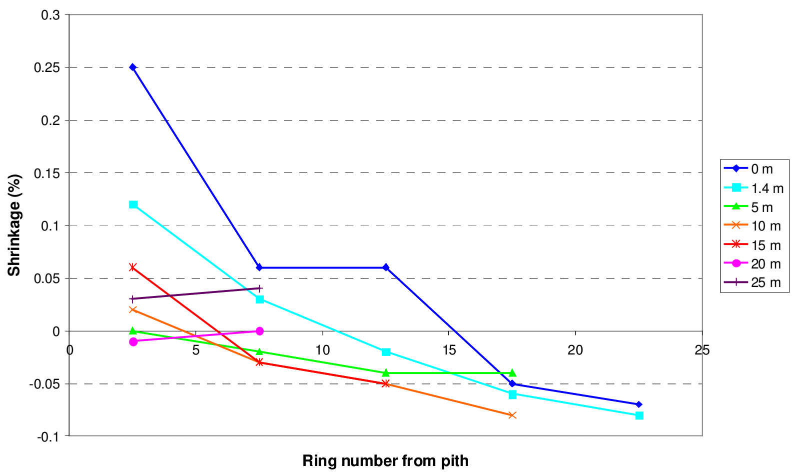
6a: Radial shrinkage



6b: Tangential shrinkage



c: Longitudinal shrinkage



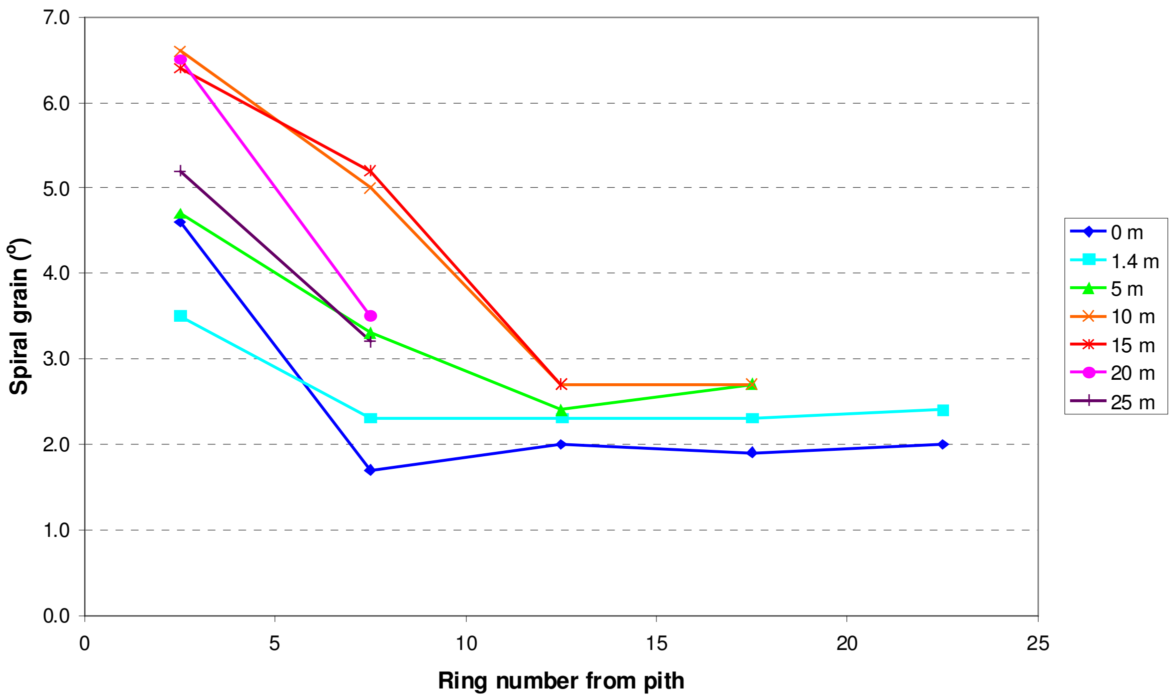
5. Spiral Grain

Average spiral grain values are summarised in Table 7 and Fig. 7. The butt and BH levels consistently show the lowest values. The average inner wood values (rings 5) increase from around 3.5 - 4.5° in the lower stem to around 6.5° in the mid stem region (5-20 m), and the outerwood grain angle averages (outside ring 15) are consistently low (about 2.5°). This corresponds to the known patterns (Cown, 1991b). More detailed analyses (including investigation of influencing factors) will be included in the final report.

Table 7 – Average pith-to-bark spiral grain patterns by sampling height

Disc ht. (m)	Spiral grain (°) by ring number from pith				
	5	10	15	20	25
0	4.6	1.7	2.0	1.9	2.0
1.4	3.5	2.3	2.3	2.3	2.4
5	4.7	3.3	2.4	2.7	
10	6.6	5.0	2.7	2.7	
15	6.4	5.2	2.7		
20	6.5	3.5			
25	5.2	3.2			

Figure 7: Spiral grain pattern for all stem levels



6. **Golden Downs Forest Wood Colour**

The Golden Downs forest site had light coloured heartwood and sapwood. The heartwood lightness (L* colour) was high (Table 8), similar to Rabbit Island and Waimea. The sapwood lightness (L* colour) was also high, similar to Southland and Kaingaroa 222. The heartwood red and yellow colour (a* and b* colour) were relatively low and similar to Waimea. The sapwood red (a* colour) was mid-ranged, and the sapwood yellow colour (b* colour) was low and similar to Southland and Kaingaroa 222.

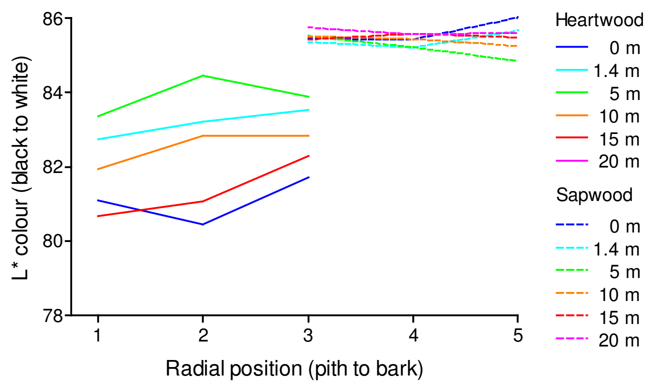
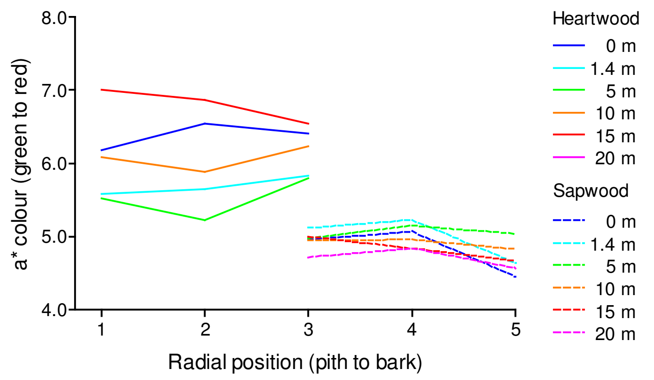
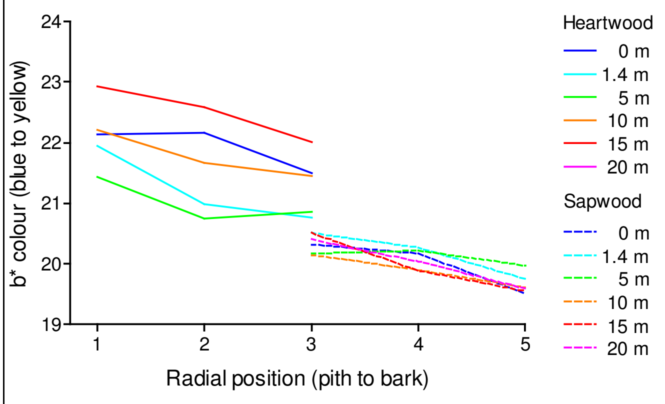
There was wide variation in heartwood colour, but very little change in sapwood colour with height (Figures 8a-c). The heartwood lightness (L* colour) increased from 0 to 5 metres, and then decreased to 15 metres height. The heartwood red and yellow colour (a* and b* colour) decreased from 0 to 5 metres and then increased to 15 metres height.

The heartwood and sapwood radial colour trends were generally consistent with height (Figures 8a-c). The lightness (L* colour) increased from inner to outer heartwood and sapwood. The heartwood and sapwood red colour (a* colour) showed little radial change, and the yellow colour (b* colour) decreased from inner to outer heartwood and sapwood.

Table 8: Tree mean, minimum and maximum values of the LAB colour co-ordinates for heartwood and sapwood

Wood properties	Mean	Range
Heartwood L* colour	82.9	80.3 - 84.4
Heartwood a* colour	6.1	5.3 - 7.1
Heartwood b* colour	21.4	20.7 - 22.3
Sapwood L* colour	85.4	84.6 - 86.2
Sapwood a* colour	4.9	4.4 - 5.2
Sapwood b* colour	19.9	19.0 - 20.4

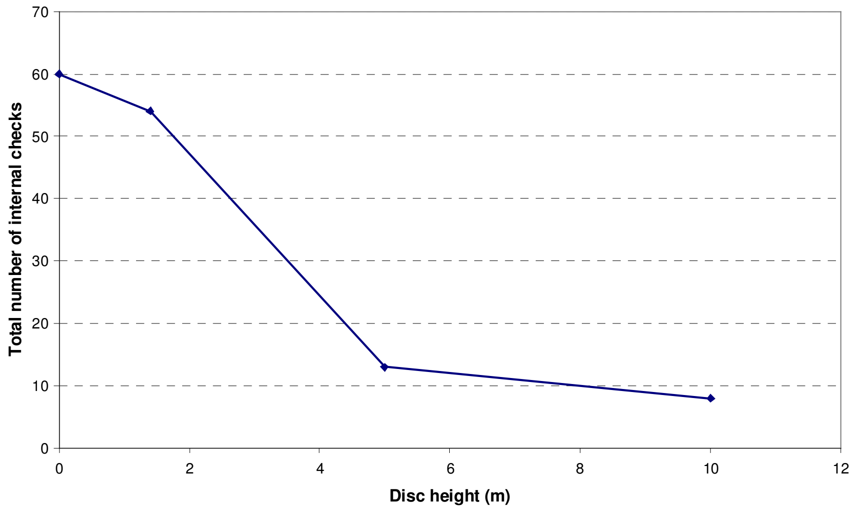
Figure 8 – Colour data - Golden Downs

8a) Height and radial patterns of the L* colour co-ordinate (black to white). Radial positions: 1-3 heartwood, 4-6 sapwood.	
8b) Height and radial patterns of the a* colour co-ordinate (green to red). Radial positions: 1-3 heartwood, 4-6 sapwood	
8c) Height and radial patterns of the b* colour co-ordinate (blue to yellow). Radial positions: 1-3 heartwood, 4-6 sapwood.	

6. Intra-ring checking

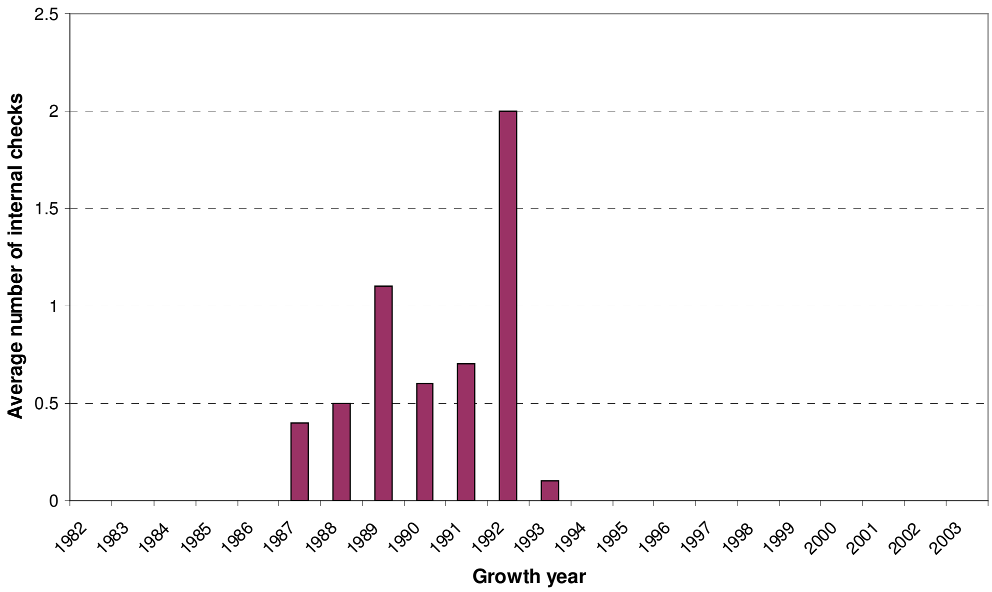
Within-ring internal checks are often observed at the base of the stem and there have been suggestions that site, climate, genotype and tree age can all have an effect on the levels found (Cown *et al* 2003; Beets *et al.,* 2002). At this site, 7 of the 10 felled trees exhibited some internal checking (total of 135 checks – Appendix 3a,b) concentrated at the base of the butt log (Fig. 9). Fig. 10 shows the distribution according to years at BH. Occurrence at this site was observed in 7 annual growth rings, but predominantly in the 1992 year. A preliminary classification would indicate a "moderate to severe" level of checking at this site.

Figure 9: Internal checks by height (7 of 10 trees affected*)



* - Samples processed 7-10 days after felling – this may have reduced apparent incidence.

Fig. 10: Internal checks by year (BH level)



8. Resinous Features

In the laboratory, notes were made of the occurrence of resin pockets, blemishes and needle flecks on the fresh discs. The totals for the Golden Downs site are given in Table 9. Both resin pockets and blemishes were concentrated in the lower stem. No intra-ring checks were recorded in the fresh discs.

Table 9: Downgrading clearwood features (totals) by height class

Disc ht (m)	Resin pockets	Blemishes	Needle Fleck
0	4	11	0
1.4	3	32	1
5	25	16	3
10	19	16	3
15	26	25	5
20	6	4	6
25	0	3	5
Totals	83	107	23

Note: 3 trees had galls.

This site showed the highest number of resin pockets (ranging from 1 to 83) and a relatively high number of blemishes. The bulk of the resin pockets and blemishes are concentrated in the bottom three logs.

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Laboratory: Wood property assessments – Pat Hodgkiss, Grant Holden, John Lee (ensis);

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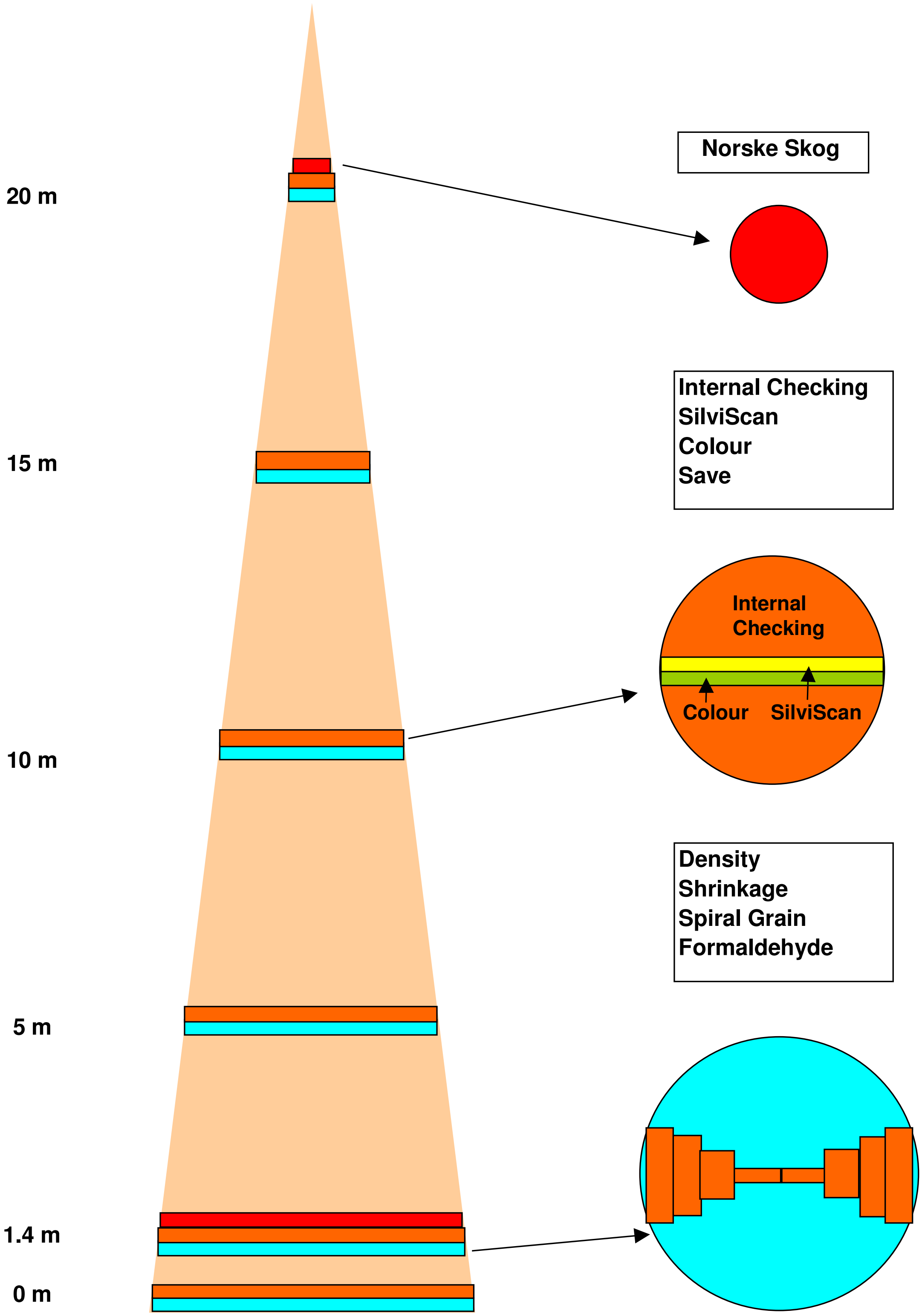
Appendix 1 – Pre-screening data – Golden Downs Forest

Trial: NN530/2 Forest: Golden Downs Cpt. 66 Forest Owner: Weyerhauser Assessor: D. Witehira/W. Witehira QFM No.: 2
Date: 13/04/03

Plot#	Tree#	Density O. wood (kg/m3)	DBH (cm)	BIX				IIX	Resin	Suitable to Fell (Y/N)	Acceptable Crop Tree (Y/N)	PSP #	Comments
				Log 1	Log 2	Log 3	Log 4						
10/51	1	447	509	0	1	2	2	0	0	y	y	-	
10/51	2	462	516	0	1	2	2	0	1	y	y	-	
10/51	3	439	498	0	1	1	2	0	1	y	y	3	Nice tree. A little bit of sweep in the butt.
10/51	4	438	414	0	1	1	2	0	2	y	y	4	
10/51	5	473	437	0	1	2	2	0	1	y	y	-	Comp wood, severe in parts of tree
10/51	6	444	372	0	1	1	2	0	2	y	n	6	Double leader at top 3rd log
10/51	7	440	491	0	1	1	2	1	1	y	y		
10/51	8	435	440	0	2	2	2	0	0	y	y		
10/51	9	451	411	0	1	1	1	0	1	y	y	9	
10/51	10	400	445	0	2	2	2	0	1	y	y		
10/51	11	445	370	0	1	1	1	0	1	y	y	11	
10/51	12	428	460	0	2	2	2	0	0	y	y	12	
10/51	13	430	536	0	2	2	3	0	1	y	y		
10/51	14	442	511	0	2	2	2	0	1	y	y	14	
10/51	15	378	528	0	2	2	2	0	3	y	y	15	Heavy resin bleeder
10/51	16	431	569	0	3	3	2	1	2	n	y		Double leader 11m
10/51	17	433	530	2	2	2	2	0	2	y	y	17	Prune 2.0m
10/51	18	391	494	2	2	2	2	0	2	y	y		Bad galls
10/51	19	409	432	1	1	2	2	0	2	y	y	19	Prune 2.0m, 3 cores, comp wood
10/51	20	395	491	0	1	2	2	0	1	y	y		
10/51	21	445	402	0	1	1	2	0	0	y	y	21	3 cores, comp wood
10/51	22	401	488	0	2	2	2	0	2	y	y	22	
10/51	23	393	502	0	2	2	2	0	1	y	y		
10/51	24	433	549	0	2	2	3	0	2	y	y	24	
10/51	25	421	390	0	1	1	2	0	1	y	y	25	Traces comp wood
10/51	26	431	441	0	1	1	2	0	3	y	y	26	Quite a lot of bleeding, some comp wood
12/61	27	412	543	0	1	2	2	1	1	y	y		
12/61	28	419	390	0	2	1	2	0	2	y	y		Malformation at 9m
12/61	29	421	449	1	2	1	2	0	1	y	y		
12/61	30	383	446	0	1	1	2	0	1	y	y		

APPENDIX 2: DISC SAMPLING PLAN



Appendix 3a – Internal Checking – Disc data (7 of 10 stems)

Tree ID	Sample ht. (m)	Strip width (mm)	HW Bdy (mm)	Rings Affected	Total checks	Growth year																				
						82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02
Q 5	0	100	85	2	5					4	1															
Q 5	1.4	100	85	2	7						3					4										
Q 5	5	100	88	0	0																					
Q 5	10	100	91	0	0																					
Q 12	0	100	84	2	17					1						16										
Q 12	1.4	100	86	3	9								2	2		5										
Q 12	5	100	89	1	4											4										
Q 12	10	100	90	0	0																					
Q 13	0	100	85	0	0																					
Q 13	1.4	100	86	4	10							2	4	2	2											
Q 13	5	100	89	0	0																					
Q 13	10	100	91	0	0																					
Q 18	0	100	85	6	18						6	5	3	1	2	1										
Q 18	1.4	100	88	4	5									1	1	2	1									
Q 18	5	100	90	0	0																					
Q 18	10	100	92	0	0																					
Q 23	0	100	87	0	0																					
Q 23	1.4	100	87	1	2								2													
Q 23	5	100	89	2	5										1	4										
Q 23	10	100	90	0	0																					
Q 25	0	100	86	6	18								1	2	5	6		3	1							
Q 25	1.4	100	86	6	18						1	3	1	1	4	8										
Q 25	5	100	88	2	4										1	3										
Q 25	10	100	90	3	8											2	5	1								
Q 29	0	100	87	1	2									2												
Q 29	1.4	100	87	2	3								2			1										
Q 29	5	100	88	0	0																					
Q 29	10	100	92	0	0																					

Appendix 3b – Internal checking – Totals for checked trees (7 of 10 stems)

Disc ht (m)	No. of checked trees	Years affected	Total Checks	Growth year																				
				82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	2002
0	5	17	60					5	7	5	4	5	7	23		3	1							
1.4	7	22	54						4	5	11	6	7	20	1									
5	3	5	13										2	11										
10	1	3	8											2	5	1								
Overall Totals			135					5	11	10	15	11	16	56	6	4	1							
Site Average (10 stems)			13.5					0.5	1.1	1.0	1.5	1.1	1.6	5.6	0.6	0.4	0.1							