**Additional File 1 – Information about the datasets used to develop the spiral grain angle models**

**Table 1. Summary of the studies in which spiral grain angle data were collected.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Site No. | Region | Forest | Age (yrs) | No. of trees | Heights | Rings |
| 1 | Auckland | Tairua | 11 | 60 | 0,1.4,6.4,11.4 | 2, 4, 6, 8, 10, 11 |
| 2 | Auckland | Mangakahia | 19 | 38 | 5, 10, 15 | 2, 4, 6, 8, 10, 15 |
| 3 | Auckland | Mangakahia | 23 | 40 | 0, 1.4, 5,10,15,20,25 | 2, 4, 6, 8, 10, 15 |
| 4 | Auckland | Aupouri | 25 | 10 | 0, 1.4, 5, 10,15,20, 25 | 5, 10, 15, 20, 25 |
| 5 | Auckland | Athenree | 25 | 10 | 0, 1.4, 5, 10,15, 20, 25 | 5, 10, 15, 20, 25 |
| 6 | Auckland | Woodhill | 33 | 20 | 1.4, 5, 10,15,20,25, 30 | 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30 |
| 7 | Auckland | Northland Forests | - | 83 logs | Varies - peeler logs cut in half | 2, 4, 6, 8, 10, 15, 20 |
| 8 | Rotorua | Rerewhakaaitu | 12 | 30 | 0, 1.4, 5, 10 | 2, 4, 6, 8, 10 |
| 9 | Rotorua | Rotoehu | 13 | 25 | 0, 1.4,5.5,10,15, 20 | 2, 4, 6, 8, 10, 12, 14 |
| 11 | Rotorua | Rotoehu | 15 | 25 | 0, 1.4,5.5,10,15,20 | 2, 4, 6, 8, 10, 12, 14 |
| 12 | Rotorua | Kaingaroa | 16 | 25 | 0,1.4,6,11,16,21 | 2, 4, 6, 8, 10, 12, 14 |
| 13 | Rotorua | Tarawera | 17 | 69 | 1.4, 5,10 | 2, 4, 6, 8, 10, 12, 14, 16 |
| 14 | Rotorua | Tikitere | 19 | 9 | 0,6,11,15 | 2, 4, 6, 8, 10, 12, 14, 16, 18 |
| 15 | Rotorua | Kaingaroa | 21 | 30 | 0,4.9,9.8,14.7,19.6, 24 | 2,4,6,8,10,12,14,16,18, 20 |
| 16 | Rotorua | Kaingaroa | 22 | 14 | 5.5 | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 |
| 17 | Rotorua | Kaingaroa | 22? | 16 | 0, 1.4, 7, 12.5, 18, 23 | 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22 |
| 18 | Rotorua | Tarawera Valley | 23 | 11 | 0, 4.9, 9.8, 14.7, 19.6, 24.5 | 2, 4, 6, 8, 10, 15, 20 |
| 19 | Rotorua | Tikitere | 23 | 20 | 0, 5, 10, 15, 20, 25, 30 | 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22 |
| 20 | Rotorua | Puruki Exp Catchment | 24 | 33 | 0, 5, 10, 15, 20, 25, 30 | 2, 4, 6, 8, 10, 15, 20, outer ring |
| 21 | Rotorua | Kaingaroa | 25 | 7 | 0, 1.4, 7, 12.5, 17.5, 23 | 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24 |
| 22 | Rotorua | Kaingaroa | 11 | 60 | 0, 1.4, 6.4, 11.4 | 2, 4, 6, 8, 10, 11 |
| 23 | Rotorua | Kaingaroa | 25 | 50 | 0, 6, 11, 16, 21, 26 | 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22 |
| 24 | Rotorua | Kaingaroa | 25 | 20 | 0, 1.4, 6.4, 11.4, 16.4, 21, 26, 31 | 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24 |
| 25 | Rotorua | Kaingaroa | 25 | 25 | 0, 5, 10 | 5, 10, 15, 25 |
| 26 | Rotorua | Kaingaroa  | 25 | 10 | 0, 1.4, 5, 10, 15, 20, 25 | 5, 10, 15, 20, 25 |
| 27 | Rotorua | Kaingaroa  | 25 | 10 | 0, 1.4, 5, 10, 15, 20, 25 | 5, 10, 15, 20, 25 |
| 28 | Rotorua | Kaingaroa | 26 | 30 | 0, 5, 10, 15, 20, 25 | 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24 |
| 29 | Rotorua | Tikitere | 26 | 19+59 2nd log discs | 0, 5, 10, 15, 20, 25 | 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22 |

**Table 1 continued**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Site No. | Region | Forest | Age (yrs) | No. of trees | Heights | Rings |
| 30 | Rotorua | Kaingaroa | 27 | 20 | 0, 3.9, 8.8, 13.7, 18.6, 23.4, 28.2 | 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26 |
| 31 | Rotorua | Kaingaroa  | 27 | 20 | 0, 1.4, 5, 10, 15, 20, 25, 30, 35 | 2, 4, 6, 8, 10, 15, 20, 25, outer ring |
| 32 | Rotorua | Kaingaroa | 28 | 22 | 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 22.5, 25, 30, 35 | 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26 |
| 33 | Rotorua | Northern Boundary | 28 | 20 | 1.4 | 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 27 |
| 34 | Rotorua | Kaingaroa | 30 | 30 | 0, 5, 10, 15, 20, 25, 30 | 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30 |
| 35 | Rotorua | Kaingaroa | 33 | 19 | 10 | 2,4,6,8,10,12,15,20,25 |
| 36 | Rotorua | Tarawera Valley | 35 | 30 | 0, 5, 10, 15, 20, 25, 30, 35 | 2, 4, 6, 8, 10, 15, 20, 25 |
| 37 | East Coast | Ruatoria | 25 | 10 | 0, 1.4, 5, 10, 15, 20, 25 | 5, 10, 15, 20, 25 |
| 38 | East Coast | Confidential | 17-26 | 95 | 1.4 | 2,4,6,8,10,15,20,25 |
| 39 | East Coast | Confidential | - | 24 | 0,5.5,11,16.5,20,24 | 2,4,6,8,10,15,20,25 |
| 40 | East Coast | Confidential | - | 22 | 0,5.5,11,16.5,20,24 | 2,4, 6,8, 10, 15, 20, 25 |
| 41 | Hawkes Bay | Mohaka | 25 | 10 | 0,1.4,5,10,15,20,25 | 5, 10, 15, 20, 25 |
| 42 | Wellington | Lismore | 25 | 6 | 0,1.4,5,10,15,20,25 | 5, 10, 15, 20, 25 |
| 43 | Wellington | Ngaumu | 25 | 10 | 0,1.4,5,10,15,20,25 | 5, 10, 15, 20, 25 |
| 44 | Nelson | Confidential | 22 | 15 | 0,4.5,10.2,15.9 | 2, 4, 6, 8, 10, 15, 20 |
| 45 | Nelson | Tasman Forest Nelson | 25 | 30 | 0,6,12 | 14, 20, 25 |
| 46 | Nelson | Golden Downs | 25 | 25 | 0,5,10 | 5, 10, 15, 25 |
| 47 | Nelson | Rabbit Island | 25 | 10 | 0,1.4,5,10,15,20,25 | 5, 10, 15, 20, 25 |
| 48 | Nelson | Golden Downs | 25 | 10 | 0,1.4,5,10,15,20,25 | 5, 10, 15, 20, 25 |
| 49 | Nelson | Waimea | 25 | 10 | 0,1.4,5,10,15,20,25 | 5, 10, 15, 20, 25 |
| 50 | Nelson | Golden Downs | 33 | 9 + 5X1.4m discs | 1.4,5,10,15,20,25,30 | 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30 |
| 51 | Canterbury | Ashley | 25 | 10 | 0,1.4,5,10,15,20,25 | 5, 10, 15, 20, 25 |
| 52 | Canterbury | Eyrewell | 25 | 10 | 0, 1.4,5,10,15,20, 25 | 5, 10, 15, 20, 25 |
| 53 | Canterbury | Waimate | 25 | 10 | 0,1.4,5,10,15,20,25 | 5, 10, 15, 20, 25 |
| 54 | Southland | Confidential | 25 | 10 | 1.4, 5.7, 11.2, 16.7 | 2, 4, 6, 8, 10, 15, 20 |
| 55 | Southland  | Blackmount | 25 | 2 | 0, 1.4, 5, 10, 15, 20, 25 | 5, 10, 15, 20, 25 |
| 56 | Southland  | Rowallan | 25 | 7 | 0, 1.4, 5, 10, 15, 20, 25 | 5, 10, 15, 20, 25 |
| 57 | Southland  | Longwood | 25 | 6 | 0,1.4,5,10,15,20,25 | 5, 10, 15, 20, 25 |
| 58 | Southland | Confidential | 26 | 10 | 1.4, 5.7, 11.2, 16.7 | 2, 4, 6, 8, 10, 15, 20, 25 |

**Summary of unpublished reports**

**A list of unpublished reports that contain more information about the datasets used to develop the model is given below. Reports that are commercially sensitive are not included in the list below. Access to these reports is on a case by case basis. Permission to access reports produced for the Wood Quality Initiative will need to be obtained from WQI (**[www.wqi.co.nz](http://www.wqi.co.nz)**), while permission for reports produced for the Radiata Pine Breeding Cooperative (now Company) needs to be obtained from RPBC (**[www.rpbc.co.nz](http://www.rpbc.co.nz)**).**

Cown, D, Lee, J, & Palomaa, L (2006a). *Circumferential variation in spiral grain in radiata pine*. (Ensis Wood Quality Report No. 15018 (unpublished)). Rotorua: New Zealand Forest Research Institute Limited.

Cown, D, McKinley, R, Kimberley, M, Downes, G, & Jones, T (2005). *WQI benchmarking study - final report*. (WQI Report RES 34 (confidential)). Rotorua: Wood Quality Initiative Ltd.

Cown, D, McKinley, R, Kimberley, M, Downes, G, McConchie, D, Lausberg, M, Rawley, B, & Zoric, B (2006b). *Effects of silviculture - Forsyth Downes spacing trial*. (WQI Report INT (confidential)). Rotorua: Wood Quality Initiative Ltd.

Cown, D, McKinley, R, Lee, J, & Riddell, M (2008). *Benchmarking the properties of GF19 genotypes with GF14 across four sites*. (WQI Report INT 14 (confidential)). Rotorua: Wood Quality Initiative Ltd.

Grace, JC, & McKinley, R (2009). *1975 final crop stocking trials: Crown and wood properties for trees of the same DBH from different silvicultural treatments*. (FFR Report R-022 (unpublished)). Rotorua: Future Forests Research Ltd

Jefferson, PA, Lee, J, Ball, R, & Cown, D (2001). *Development of a juvenile wood index*. (Report 114 (confidential)). Rotorua: New Zealand Radiata Pine Breeding Cooperative.

Kibblewhite, RP, Lausberg, M, Jones, T, McKenzie, C, Shelbourne, A, & Chapman, S (1997). *Wood, kraft and mechanical pulp properties of 25 individual radiata pine trees with "long" tracheids*. (Workplan No. 2639). Rotorua: Forest Research Institute.

Lausberg, M, & Donaldson, L (1994). *Documentation of wood quality results from clonal pulping study in compartment 327*. (Project Record No. 3978 (unpublished)). Rotorua: Forest Research Institute.

Lausberg, M, McConchie, D, McKinley, R, Skipwith, J, Gilchrist, K, & McConchie, M (1996). *Wood quality assessments of forward selections (875's and 880's)*. (Project Record No. 5552 (unpublished)). Rotorua: Forest Research Institute.

Lausberg, MJF, Cown, DJ, Gilchrist, K, Skipwith, J, & Treloar, CR (1995a). Physiological ageing and site effects on the wood properties of radiata pine. *New Zealand Journal of Forestry Science, 25*(2), 189-199.

Lausberg, MJF, Kimberley, M, Young, GD, & McConchie, DL (1995b). *Developing a non-destructive method for measuring spiral grain in radiata pine*. (Project Record No. 4526 (unpublished)). Rotorua: Forest Research Institute.

Lausberg, MJF, Skipwith, JH, & Gilchrist, KF (1996). *Wood properties of 25 radiata pine families included in a comprehensive evaluation of solid wood, kraft and thermomechanical pulp production*. (Project Record No. 5282 (unpublished)). Rotorua: Forest Research Institute.

McConchie, D, Gilchrist, K, & Weallans, K (1998). *Wood properties of radiata pine grown in the Wairau Valley*. (Project Record No. 6046 (unpublished)). Rotorua: Forest Research Institute.

McConchie, D, Lee, J, Cown, D, Dungey, H, Langford, P, Lausberg, M, Treloar, C, & Young, G (2003). *Utilisation studies of unpruned logs selected for high and low density, stiffness and spiral grain*. (WQI Report RES 3 (confidential)). Rotorua: Wood Quality Initiative Ltd.

McConchie, D, & McKinley, R (1998). *Selected wood properties of radiata pine discs representing peeler billets from northern region forests*. (Project Record No. 6010 (unpublished)). Rotorua: Forest Research Institute.

McConchie, M, & Gilchrist, K (1998). *Wood properties assessment of clonal trees from the Puruki catchment*. (Project Record No. 6178 (unpublished)). Rotorua: Forest Research Institute.

McKinley, R, McConchie, D, & Budianto, M (2000). *Wood properties of 26-year-old Pinus radiata from the Tikitere stocking trial*. (Forest and Farm Plantation Management Cooperative Report 74). Rotorua: New Zealand Forest Research Institute Limited.

McKinley, RB, McConchie, DL, & Gilchrist, KF (1994). *Utilisation of a 21-year-old new crop radiata pine stand. Part 1 - wood properties*. (Project Record No. 3884 (unpublished)). Rotorua: Forest Research Institute

McKinley, RB, McConchie, DL, Lausberg, MJF, & Gilchrist, KF (1997). *Wood properties of 23-year-old Pinus radiata grown under an agroforestry regime at Tikitere*. (Project Record No. 5629 (unpublished)). Rotorua: Forest Research Institute.

McKinley, RB, McConchie, DL, Lausberg, MJF, Gilchrist, KF, & Skipwith, JH (1996). *Wood properties of ten 27-year-old radiata pine clones grown in Kaingaroa Forest (complete data set)*. (Project Record No. 5525 (unpublished)). Rotorua: Forest Research Institute.

McKinley, RB, McConchie, DL, & Treloar, CR (1995). *Quantifying the benefits of adopting alternative sawing methods - the saw-dry-rip concept. Part 1 - wood properties*. (Project Record No. 4441 (unpublished)). Rotorua: Forest Research Institute.

McKinley, RB, McConchie, MS, McConchie, DL, & Budianto, M (2000). *Wood properties of 35-year-old Pinus radiata from the Tarawera regimes trial* (Report No. 8176 (unpublished)). Rotorua: Forest Research.

McKinley, RB, Young, GD, & McConchie, DL (1993a). *Effect of spacing on wood properties of 19-year-old radiata pine grown under an agroforestry regime*. (Project Record 3424). Rotorua: New Zealand Forest Research Institute.

McKinley, RB, Young, GD, McConchie, DL, & Gilchrist, KF (1993b). *Utilisation of a 30-year-old new crop radiata pine stand. Part 1 - wood properties*. (Project Record No. 3447 (unpublished)). Rotorua: Forest Research Institute

Young, GD, McConchie, DL, & McKinley, RB (1991). Utilisation of 25-year-old *Pinus radiata*. Part 1: Wood properties. *New Zealand Journal of Forestry Science, 21*(2/3), 217-227.

Young, GD, McConchie, DL, & McKinley, RB (1992). *Utilisation of 26-year-old new crop radiata pine. Part 1: Wood properties*. (Project Record No. 3203 (unpublished)). Rotorua: New Zealand Forest Research Institute Limited.