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Wood Availability Forecast – Otago and Southland 2021

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PREFACE

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We trust our report proves useful to you and we would be pleased to provide assistance to you again on future assignments.

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1 INTRODUCTION

This report presents the findings of a wood availability study for the Otago and Southland planted exotic forest estate. This is based on the Ministry for Primary Industries (MPI) National Exotic Forest Description (NEFD) as at 1 April 2020 which was rolled forward to January 2021. The forecasts then project annualised woodflows for 40 years thereafter. The study was commissioned by MPI with support from the major plantation forest owners in the region. The modelling, analysis, and report preparation for the study was undertaken by Margules Groome Consulting Ltd (Margules Groome).

Margules Groome prepared four scenarios for radiata pine wood availability and one for Douglas-fir availability. The scenarios indicate how the forest resource in the Otago and Southland region could be harvested from 2021 to 2060. The scenarios are based on the NEFD data which shows the available standing resource and potential yield for each stand. This was modelled to forecast regional log yield subject to a series of forecasting assumptions. Only radiata pine and Douglas-fir were included in the scenarios and wood availability forecasts. The forecasts for other exotic tree species are not included in the regional availability forecasts but are included in the New Zealand national forecasts.

The forecasts incorporate the harvesting intentions of the region’s large-scale forest owners. Large-scale owners are defined as exotic plantation owners:

- with 3 000 ha or more of forest in the region of interest; and
- with more than three age classes; and
- not a part of a syndicate.

In some regions, particularly those with only a few large-scale owners, some forest owners with just under 3 000 ha were also included.

In addition, discussions with forest managers and consultants were held to ensure the scenarios represented a realistic range of future wood availability.

The scenarios clearly show there are different ways for the regional resource to be harvested. The timing of each forest harvest is driven by a range of factors, including individual forest owner’s objectives, forest age, log prices, demand by local wood processing plants, and perceptions about future log prices and future wood supply. A model can only predict how woodflows may occur subject to assumptions that drive individual forest harvest.

In examining the scenarios, it is important to recognise that forests are normally managed in a way that maximises the benefits to the owners, and such benefits are not easily modelled particularly as prevailing market conditions will change. Each owner has their own harvesting strategy based on the woodflow objectives and forest revenue. Any change in harvesting strategies by forest owners affects the age structure and maturity of the forests they own. This in turn feeds back into future wood availability.

A key issue is the timing of harvesting by small-scale forest owners. The harvest age can vary markedly, even between neighbouring properties. While the volumes forecasted by larger forest owners are subject to alteration because of changes in harvesting intentions or changes in the resource description (for example, areas and yields), a higher level of confidence can generally be assumed for these owners than for the small-scale owners. Harvest intentions are less clear for small-scale owners who are more reactive, and resource descriptions tend to be less accurate.

2 SCENARIOS

Four wood availability scenarios have been modelled for radiata pine and one for Douglas-fir. These scenarios show the range of potential ways the forests in the region could be harvested in the future.

The scenarios were developed by the NEFD Steering Committee. Margules Groome undertook initial modelling of the scenarios, and these were presented to the major forest owners and consultants in the Otago and Southland wood supply region. Their feedback was considered in the final derived profiles.

There are around 19 137 ha of species other than radiata pine and Douglas-fir in the Otago and Southland region. The volumes from these species are not included in this regional wood availability forecasts but are included in a national forecast.

2.1 Scenario 1: Large-scale Owners Harvest at Stated Intentions, Small-scale Owners Harvest at Age 28

Large-scale owners' wood availability is based on stated harvest intentions for the period 2021 to 2032 (calendar year estimates, 10-years only). After 2032, the modelling assumption is that the wood availability from large-scale owners will not decrease. Small-scale owners are assumed to harvest their forest holdings at age 28.

2.2 Scenario 2: Non-declining Yield (NDY) – Target Rotation 28 Years

Large-scale owners' wood availability is assumed to be at stated harvest intentions for the period 2021 to 2032. After 2032, the wood availability from large-scale owners is assumed not to decrease (as for Scenario 1). The total wood availability of radiata pine is also assumed to not decrease.

2.3 Scenario 3: Split NDY – Target Rotation 28 Years

This is the same as Scenario 2 except that the total wood availability of radiata pine from the region is allowed to increase and decrease by the following amounts for the given periods:

Year	Large-scale Owners	All
2021-2027	Harvest intentions	NDY
2027-2044	Harvest intentions then NDY	10% increase/decrease
>2038	NDY	NDY

2.4 Scenario 4 (A & B): Target Rotation Age Variations

These are the same as Scenario 3 except in Scenario 4A the target rotation age is decreased by two years and in 4B it is increased by two years.

2.5 Scenario for Douglas-fir

The large-scale owners' resources are harvested at stated intentions up until 2031. After 2031, the wood availability from large-scale owners is modelled in a five-year period non-declining yield (NDY) block (i.e. 2031-2035, 2036-2040, etc). The total wood availability of the combined estate is also modelled to be non-declining within each of the five-year period NDY blocks. The harvest level for the first five-year NDY block is set to be the same as in 2031. The total wood availability from clearfell and production thinning operations can change by 100 000 m^3 per year for the large-scale owners' estate and by 150 000 m^3 per year for the combined estate. The target rotation is 43 years for the Douglas-fir stands.

2.5.1 Scenario for Combined Radiata Pine and Douglas-fir

A combined radiata pine and Douglas-fir scenario was undertaken in the Otago and Southland region. The following assumptions were made in this scenario:

- The large-scale owners' resources are harvested at stated intentions (for both Douglas-fir and radiata pine).
- The total wood availability from both species is constrained to be non-declining in perpetuity.
- Target rotation ages of 28 years for radiata pine and 43 years for Douglas-fir.
- After 2031 the large-scale radiata pine resources are modelled in a five-year period NDY block.
- Total wood availability from clearfell and production thinning operations of Douglas-fir can change by 100 000 m^3 per year for the large-scale owners' estate and by 150 000 m^3 per year for the region.

2.6 Discussion of Radiata Pine Scenarios

In Scenario 1, the forests owned by small-scale owners are assumed to be harvested at age 28. The scenario shows the "potential" availability of mature forest from small-scale owners in any given year. This scenario directly reflects the area of forest in the small ownership category in each age class in the Otago and Southland region. For practical reasons, it is unlikely that the future harvesting would occur this way. The intention of this scenario is to show the potential magnitude of harvesting under favourable market conditions in any given year.

Scenarios 2 and 3 are based on yield regulation and avoid the large year-to-year fluctuations in volume seen in Scenario 1. Yield regulation refers to where, when, and how these recoverable volumes should be extracted, and provides a more orderly harvesting volume profile that, to some degree, reflects logistical and market constraints. Under Scenario 2, the future harvesting is constrained to be non-declining (where possible): that is, each year the volume must either be the same or higher than in the previous year. However, this can lead to large fluctuations in the average rotation ages and is unlikely to be a realistic outcome.

The constraints placed on Scenario 3 are designed to keep the average rotation age close to the target rotation age while maintaining a more realistic flow of wood.

A fundamental property of the forests in Otago and Southland (like many regions in New Zealand) is the large area of forests established during the early 1990s, followed by very little new planting after that period. The remaining forest area planted during the 1990s has now either been harvested or will be harvested in the next five to seven years. This is leading to record harvest levels in most regions. Once this harvesting has been completed, Scenario 3 lets the volume decline again.

The main limitation of all scenarios is that log prices and other market factors are a significant determinant of harvesting in any given year. When log prices go up, harvesting will generally increase. When log prices fall, the level of harvesting will generally decrease. It is beyond the scope of this analysis to predict future log prices, yet it is important to note how prevailing market conditions will be a significant determinant in how the actual woodflows occur.

3 DATA AND METHODOLOGY

3.1 Development of Forest Areas

The forest areas were primarily sourced from the NEFD as at 1 April 2020.

A mapping study carried out by the University of Canterbury in 2020 for Otago and Southland[1] showed that the small-scale owners' resource NEFD area was overstated (specifically those with less than 1 000 ha). Of the small-scale owners with less than 1 000 ha, the study showed a mapped area that was 96% in Otago and 75% in Southland of the area reported in the NEFD indicating a significant anomaly.

The likely error in the NEFD comes from data on forest owners with less than 40 ha. These owners were not surveyed in the NEFD process; instead, data for these forests is collected from three sources:

1. New planting imputations from 1992 to 2006.
2. A survey of small forest growers from 2004.
3. Forests previously surveyed for the NEFD but which have dropped to below 40 hectares.

The Otago and Southland region has a portion of the area (~20%) which is assigned as either "new planting imputations" or from the "2004 Small Forest Owner Survey"; both were designed at the time to improve the accuracy of the NEFD.

The new planting imputation was estimated by subtracting the known new area planting (in the NEFD survey) from an estimate of total new planting calculated from the annual MPI nursery survey. The estimated new planting was calculated by dividing a nominal planting stocking (for radiata plantation development) into the total number of seedlings sold.

In 2004, AsureQuality ran a survey of small forest owners with less than 40 ha (2004 Small Forest Owner Survey). The survey results were subsequently included in the NEFD area statement alongside the New Planting Imputation.

It is Margules Groome's understanding that the NEFD does not currently have a process for harvesting and replanting of these areas as would typically occur in forest management. As such, these NEFD areas remain unchanged from 2004 which is highly unlikely in reality.

While much further work is required to improve the accuracy of small-scale forest ownership in New Zealand, to improve the area description for the purpose of wood availability forecasting in the Otago and Southland region, Margules Groome has made the following adjustments:

1. The "New Planting Imputations" and "2004 Small Forest Owner Survey" areas have been reduced so that the total area of the small-scale owners' resource

[1] Manley, B., Morgenroth, J., Xu, C. Map of the small-scale forest estate of New Zealand. New Zealand Journal of Forestry, May 2021, Vol 66, No. 1.

less than 1 000 ha is 96% (Otago) and 75% (Southland) of the area of the reported NEFD as at 1 April 2020.

2. All standing forests derived from "New Planting Imputations" and "2004 Small Forest Owner Survey" with an age equal to or greater than 24 years were assumed to be harvested and removed from the NEFD data. The residual area (less 7.4% Otago and 9.4% Southland deforestation[2]) was assumed to have been replanted in equal amounts over the last five years.

The area for the small-scale owners with area between 1 000 ha and 3 000 ha, and large-scale owners was unadjusted for the purpose of modelling.

3.2 Development of Yield Tables

The 2015 NEFD yield tables were used for the wood availability forecasts. These yield tables supplied by MPI were originally developed in the following way:

- Large-scale forest owners provided yield tables for their forest estates.
- The large-scale owner yield tables were averaged on an area-weighted basis to derive regional yield tables for each crop-type.
- The area-weighted average regional yield tables for "old" radiata pine (planted before 1990), and Douglas-fir were calibrated to match the harvest intentions data provided by large-scale owners. The assumption is that the harvest intentions data is the most accurate information available, as it is based predominantly on detailed inventory.
- The area-weighted average regional yield tables for "young" radiata pine crop-types (planted in 1990 and later) were adjusted based on consultation with large-scale owners.
- The area-weighted average regional yield tables developed for the large-scale owners' estate were applied to the small-scale forest owners' estate under the assumption that large-scale owner data is regionally representative across all sizes of forest owner.

As part of these forecasts, the 2015 NEFD yield tables were calibrated against the yields (m^3/ha) calculated from the large-scale owners' harvest intentions. In the case of Otago and Southland, no adjustments were made to the 2015 NEFD yield tables.

[2] The deforestation assumption was sourced from the 2015-2016 Ministry for the Environment deforestation mapping report (Ministry for the Environment. 2018. Deforestation Mapping 2015 & 2016 – Final Report. Submitted by Indufor Asia Pacific for the Ministry for the Environment).

3.3 Large-scale Owners' Harvest Intentions

Large-scale owners were asked to provide details of their projected harvest volumes for all species for the period 2021 to 2041. The survey specifically asked for:

- Radiata pine:
  - Domestic grades – pruned, unpruned, pulp
  - Export grades – A, K, KI, KIS
  - Split by pruned/unpruned area if possible
- Other Species:
  - Douglas-fir domestic and export grades
  - Other Softwoods and Hardwood: Sawlog, pulp
- Additional questions to assist with modelling

The area covered by the large-scale owners covered 56% of the total NEFD area. Inclusion of the actual levels of intended harvest by the large-scale owners is considered a critical step, as it provides the best estimate of future wood availability for the first twenty years (2021-2041) of the forecast horizon.

3.4 Modelling Assumptions

In addition to the modelling assumptions specific to each scenario, the wood availability forecast for the Otago and Southland region is based on the following modelling assumptions:

- Radiata pine area in the large-scale owners' estate aged over 35 years is assumed to be non-commercial and therefore will not be harvested.
- Radiata pine area in the small-scale owners' estate aged over 40 years is assumed to be non-commercial and therefore will not be harvested.
- Douglas-fir area in all estates aged over 60 years is assumed to be non-commercial and therefore will not be harvested.
- A downwards adjustment of 5% was applied to all areas aged 1 to 4 to reflect losses in stocked area due to factors such as erosion, slips, and various setbacks.
- An area awaiting restocking of 2 562 ha is added to the model area based on MPI data. All areas are replanted, with a regeneration lag of one year. Replanting rules are as follows:
  - Large-scale forest owners:
    - All radiata pine areas are planted back into radiata pine. All Douglas-fir is replanted into Douglas-fir.
    - Forty percent of all pruned areas will be replanted as a pruned regime with 60% transferring to an unpruned regime.
  - Small-scale forest owners:
    - All radiata pine areas are planted back into radiata pine. All Douglas-fir is replanted into Douglas-fir.
    - Seventy percent of all pruned areas will be replanted as a pruned regime with 30% transferring to an unpruned regime.
- The total harvest for 2021 has been constrained to be no greater than 3.08 million m^3.
- The model assumes no future afforestation and deforestation.

4 WOOD AVAILABILITY FORECASTS FOR OTAGO AND SOUTHLAND

4.1 Otago and Southland Region Area Description

The Otago and Southland region has a plantation resource of 216 953 ha. Of this, 140 008 ha consists of radiata pine, and 57 809 ha of Douglas-fir – as reported by the NEFD as at 1 April 2020. After adjustments are applied to the NEFD area (see Section 3.4), the modelled area reduces to 182 257 ha.

The modelled resource consists entirely of radiata pine and Douglas-fir. Figure 4-1 shows the age-class distribution for the Otago and Southland estate by owner size. Large-scale owners held 56% of the modelled resources, and small-scale owners held 44%.

Figure 4-2 shows the age-class distribution for the Otago and Southland by species. Most of the estate is radiata pine, of which 36% is recorded as managed under a pruned regime. A small amount of production thinning is undertaken in the Otago and Southland region, mostly by one of the large-scale owners and has been modelled where appropriate.

Figure 4-1:
Otago and Southland Modelled Age-class Distribution for All Species

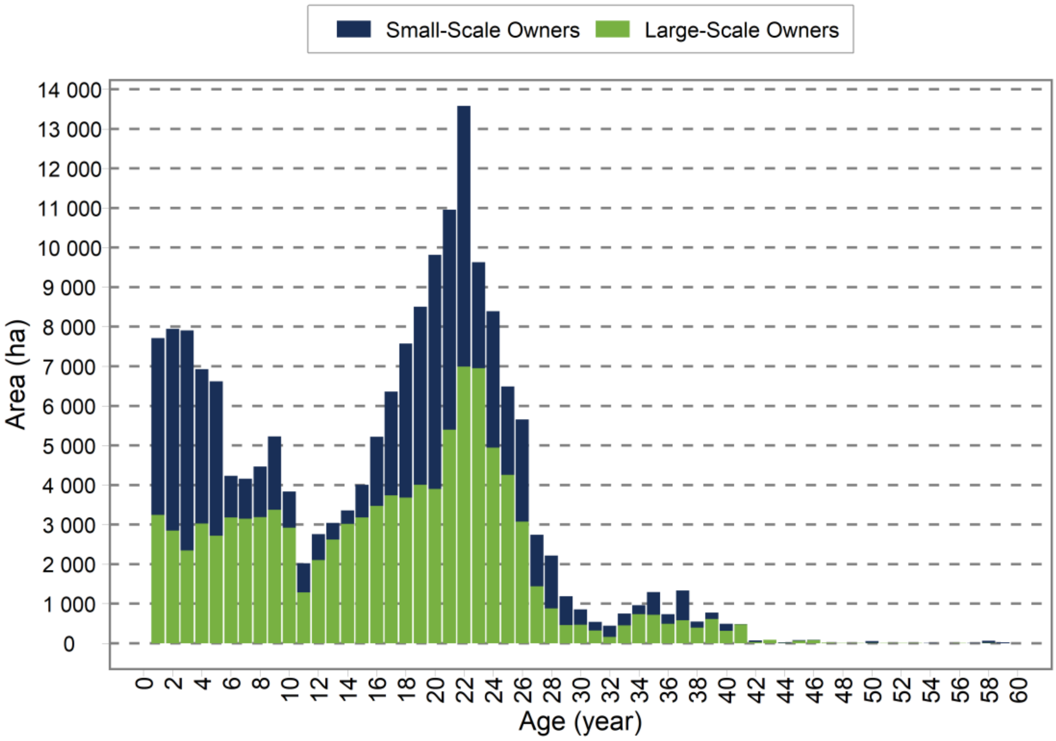
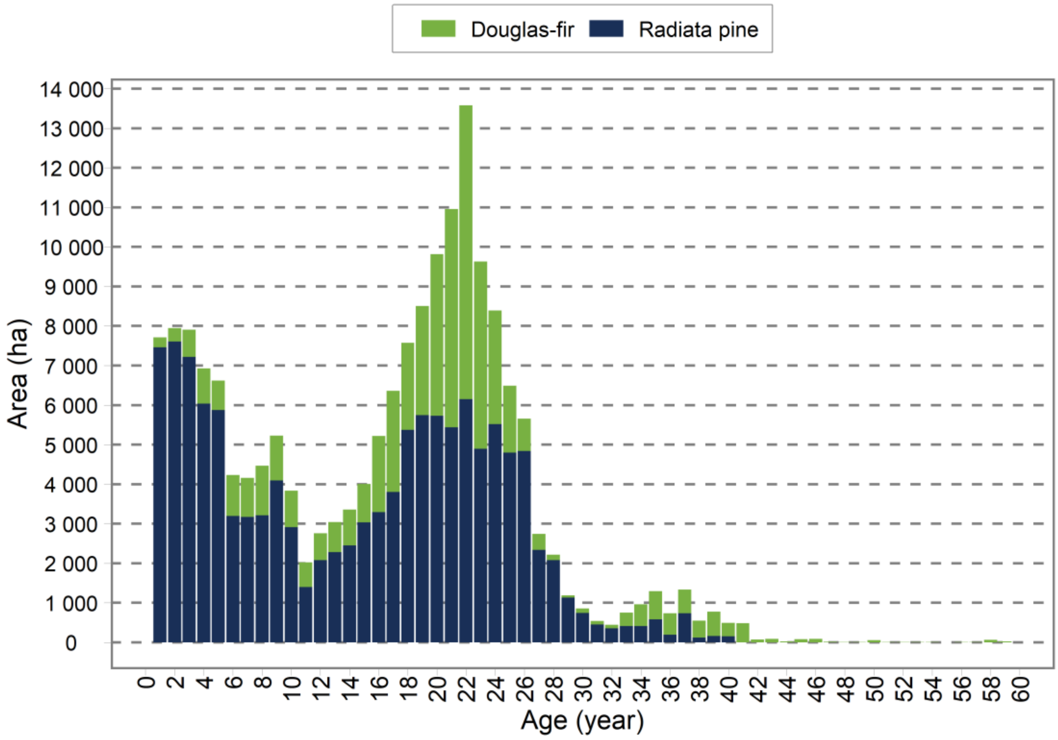


Figure 4-2:
Otago and Southland Modelled Age-class Distribution by Species



4.2 Scenario 1

In Scenario 1, large-scale owners are modelled to harvest according to their stated intentions and small-scale owners are modelled to harvest their forests at age 28. Figure 4-3 shows the age-class distribution for the Otago and Southland radiata pine estate for both large-scale and small-scale owners combined. Figure 4-4 shows the age-class distribution for the radiata pine estate separated by sub-region (i.e. Otago and Southland).

Figure 4-3:
Otago and Southland Age-class Distribution of Radiata Pine

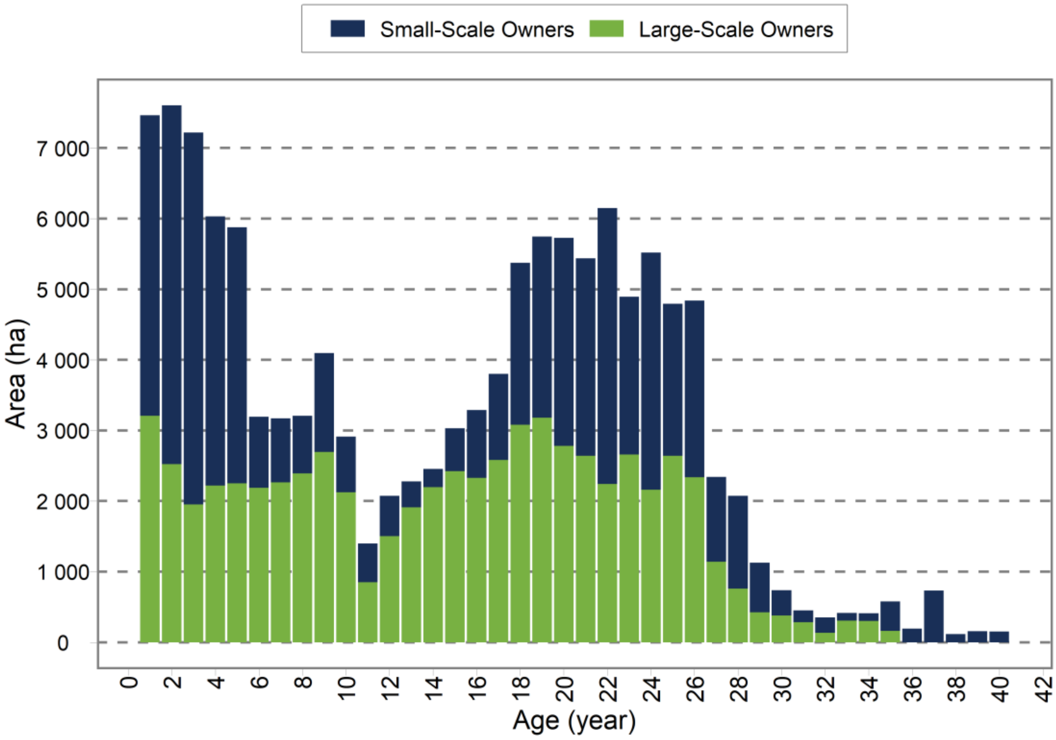
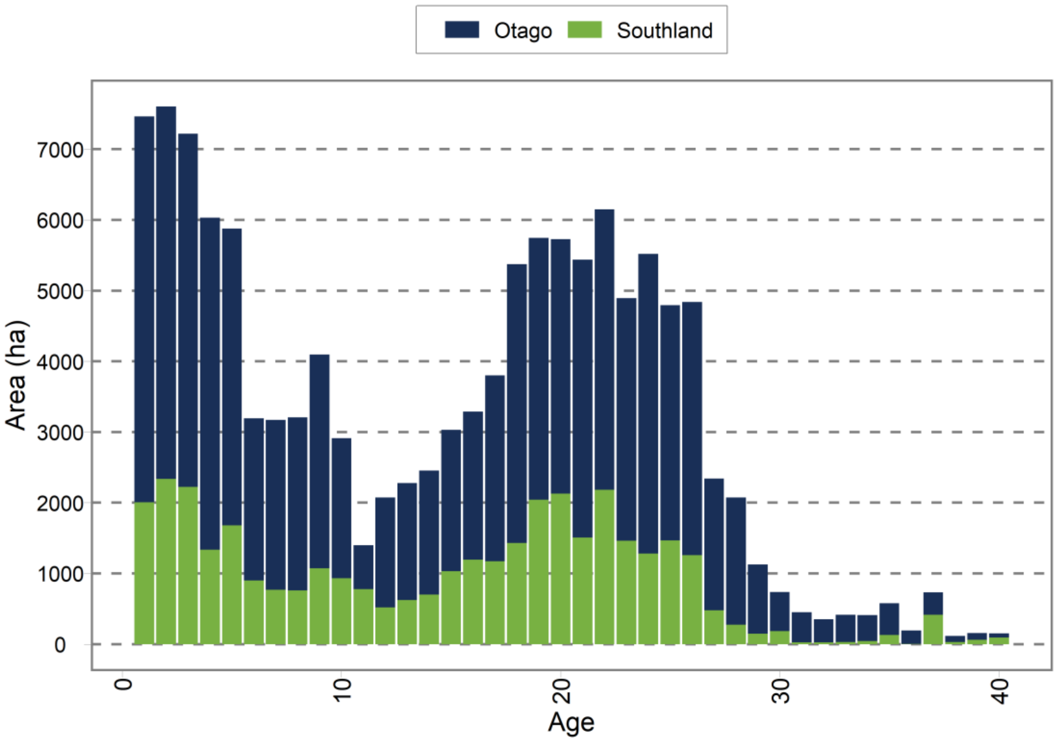


Figure 4-4:
Otago and Southland Age-class Distribution of Radiata Pine by Sub-Region



The wood availability from all owners in Otago and Southland under Scenario 1 is presented in Figure 4-5. The estate has the potential to generate a substantial increase in the amount of wood available over the next three to four years, coming mostly from the small-scale owner resource. This volume reduces substantially as the large plantings from the 1992 to 1995 period are harvested. Figure 4-6 gives the wood availability under Scenario 1 separated by sub-region.

Figure 4-5:
Otago and Southland Radiata Pine Availability under Scenario 1

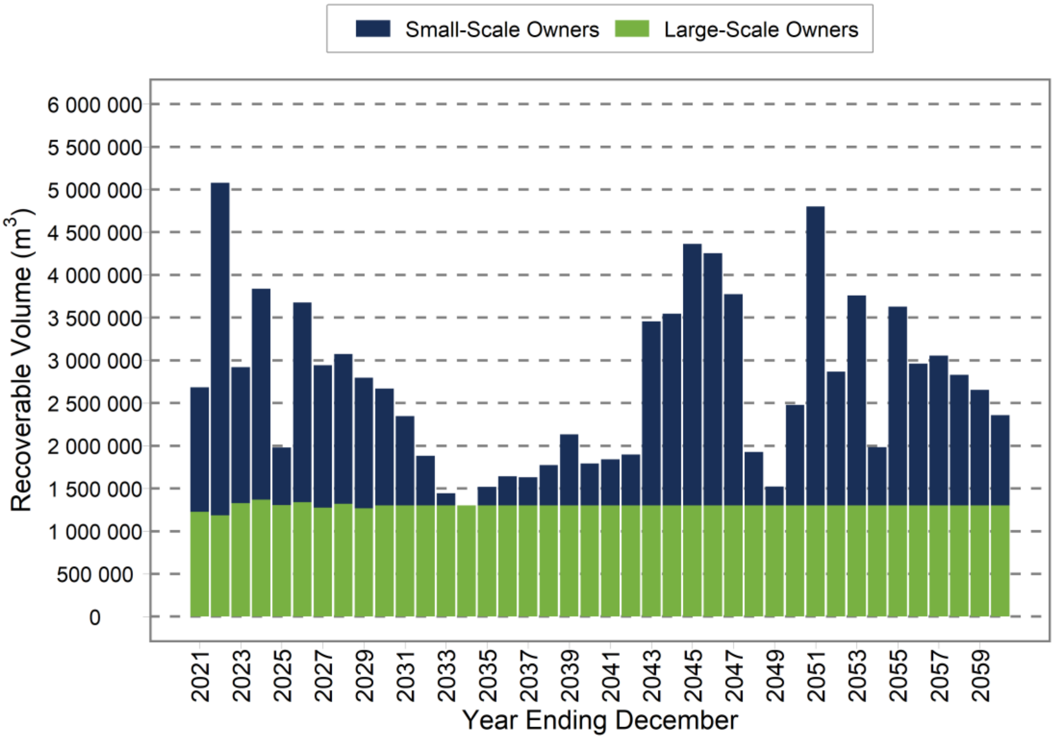
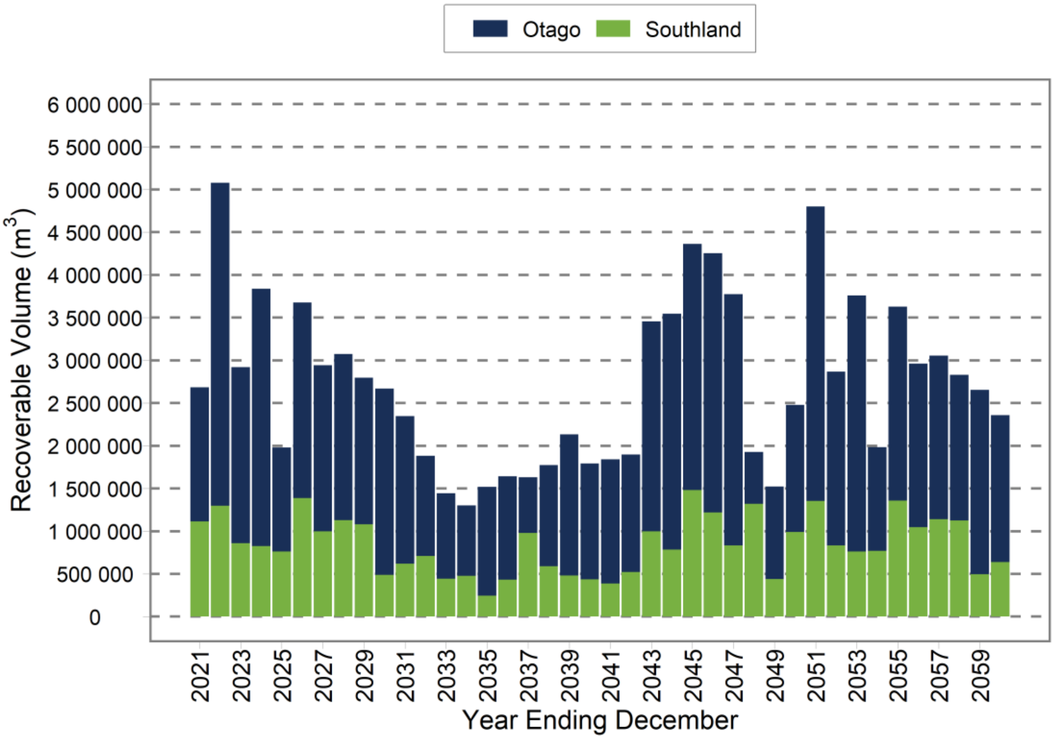


Figure 4-6:
Otago and Southland Radiata Pine Availability by Sub-Region under Scenario 1



4.3 Scenario 2

Figure 4-7 and Figure 4-8 (by sub-region) show the radiata pine availability for all owners under Scenario 2. The sustainable yield under a non-declining yield constraint for the Otago and Southland region is just over 2.6 million m^3 per year.

Figure 4-7:
Otago and Southland Radiata Pine Availability under Scenario 2

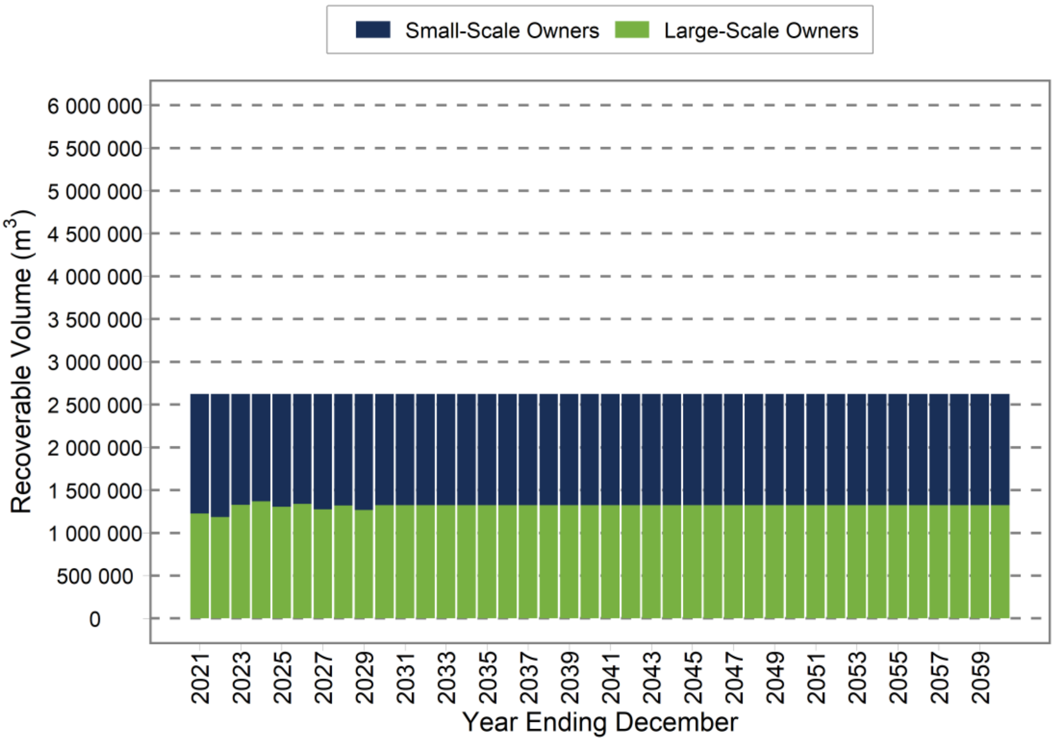


Figure 4-8:
Otago and Southland Radiata Pine Availability by Sub-Region under Scenario 2

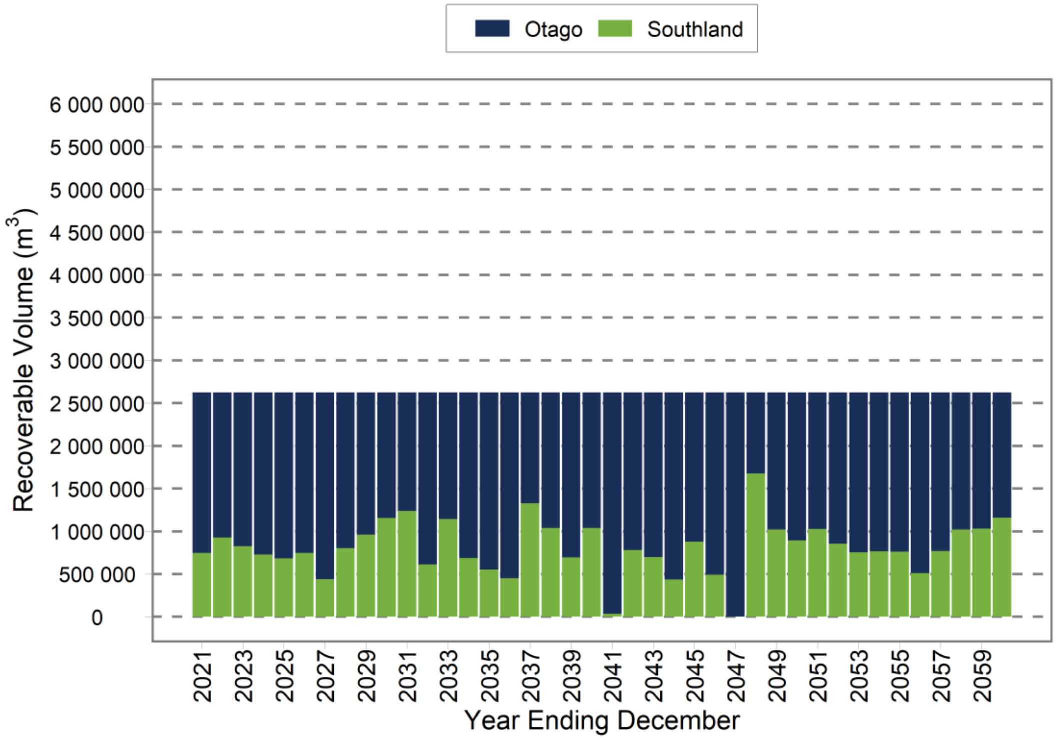
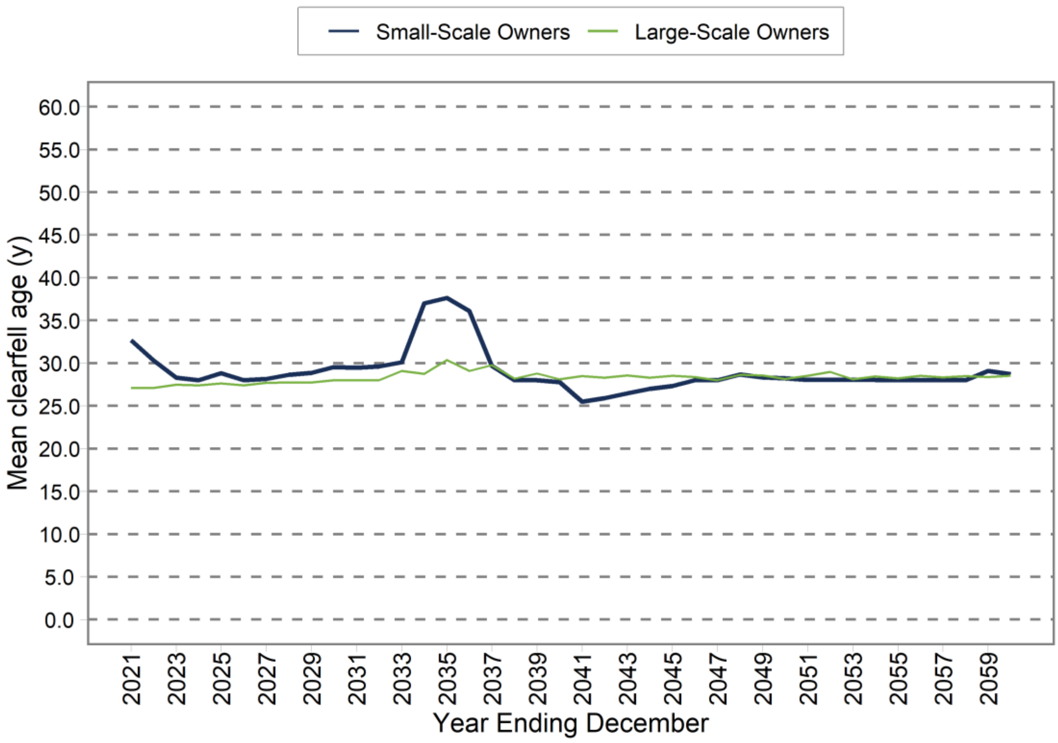


Figure 4-9 shows that the harvest age varies from the target rotation of 28 years for both forest owner types under the constraints of Scenario 2.

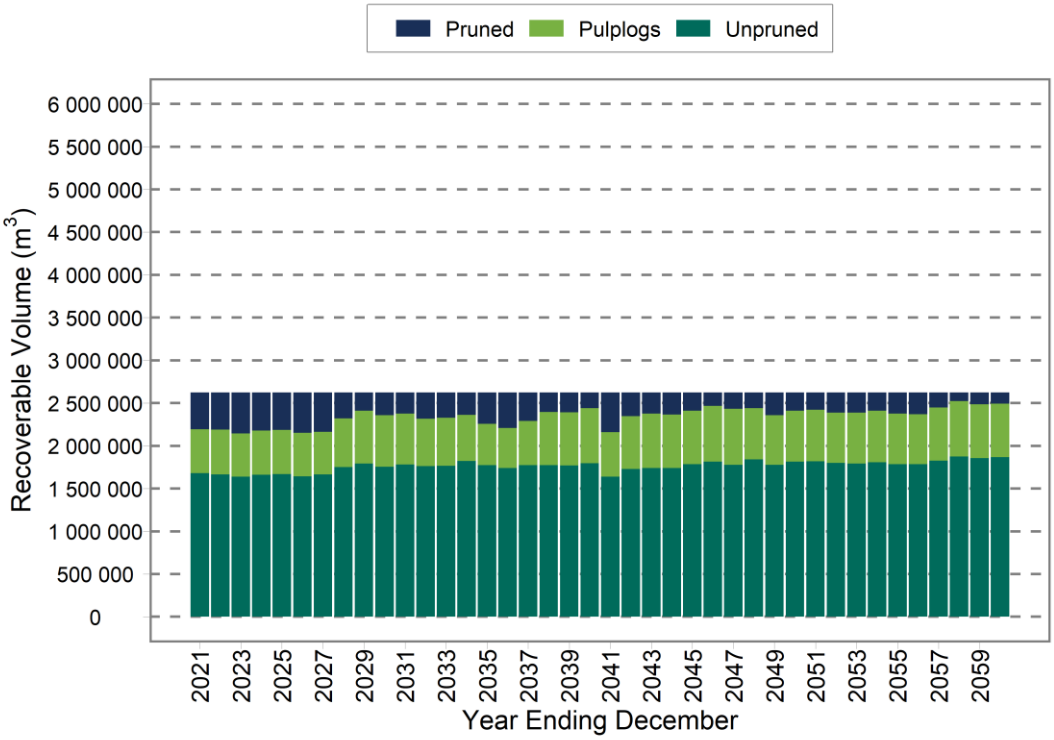
Figure 4-9:
Otago and Southland Average Radiata Pine Clearfell Age under Scenario 2



The rotation age for the small-scale owners needs to increase above the target rotation age of 28 in the period 2032-2037 to be able to maintain the non-declining yield.

The harvest volume forecast under Scenario 2 is shown by log grade in Figure 4-10.

Figure 4-10:
Otago and Southland Radiata Pine Availability by Log Grade under Scenario 2



4.4 Scenario 3

The Scenario 3 model assumes large-scale owners' resources are harvested in-line with their harvesting intentions between 2021 and 2032, and then a non-declining yield constraint is applied after 2032. The total yield for all owners has been regulated in a manner that tries to maintain the target rotation age for both ownership types at around 28 years.

Figure 4-11 and Figure 4-12 (by sub-region) show the radiata pine availability from all owners. The total volume increases to over 3.25 million m^3/a for six years, then drops to around 1.5 million m^3 in 2034. The harvest then increases to a sustainable annual cut of 2.6 million m^3.

Figure 4-13 shows the radiata pine average clearfell age by ownership. Under this scenario the average rotation age of small-scale owners' resource is maintained closer to the target rotation than in Scenario 2.

Figure 4-11:
Otago and Southland Radiata Pine Availability under Scenario 3

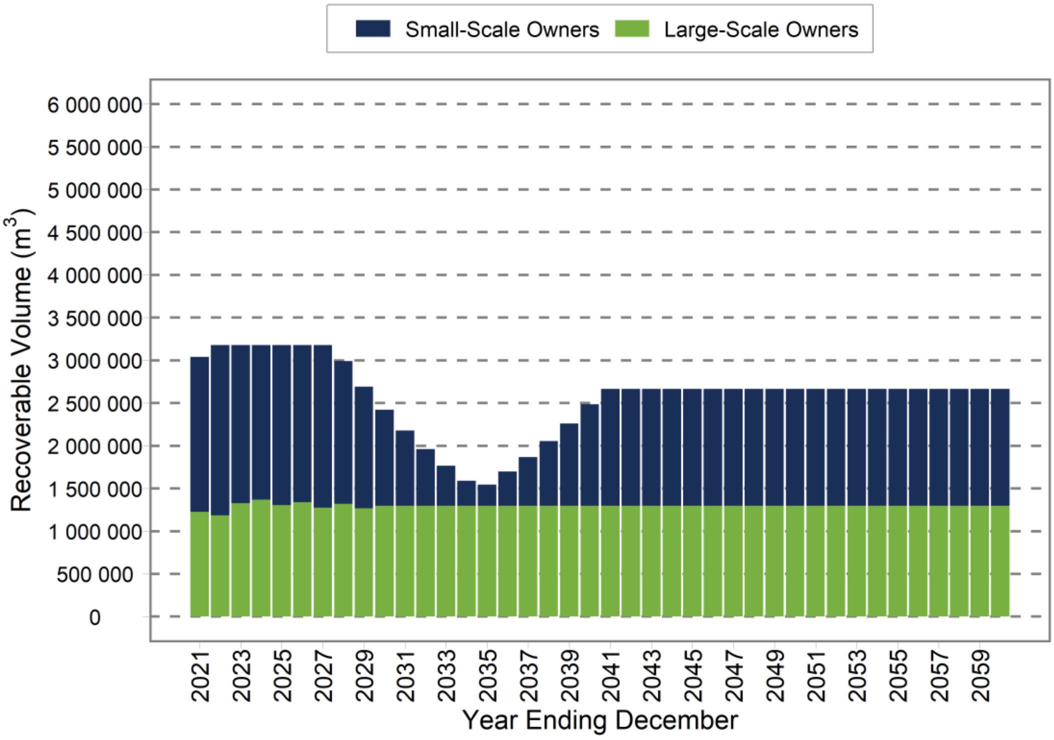


Figure 4-12:
Otago and Southland Radiata Pine Availability by Sub-Region under Scenario 3

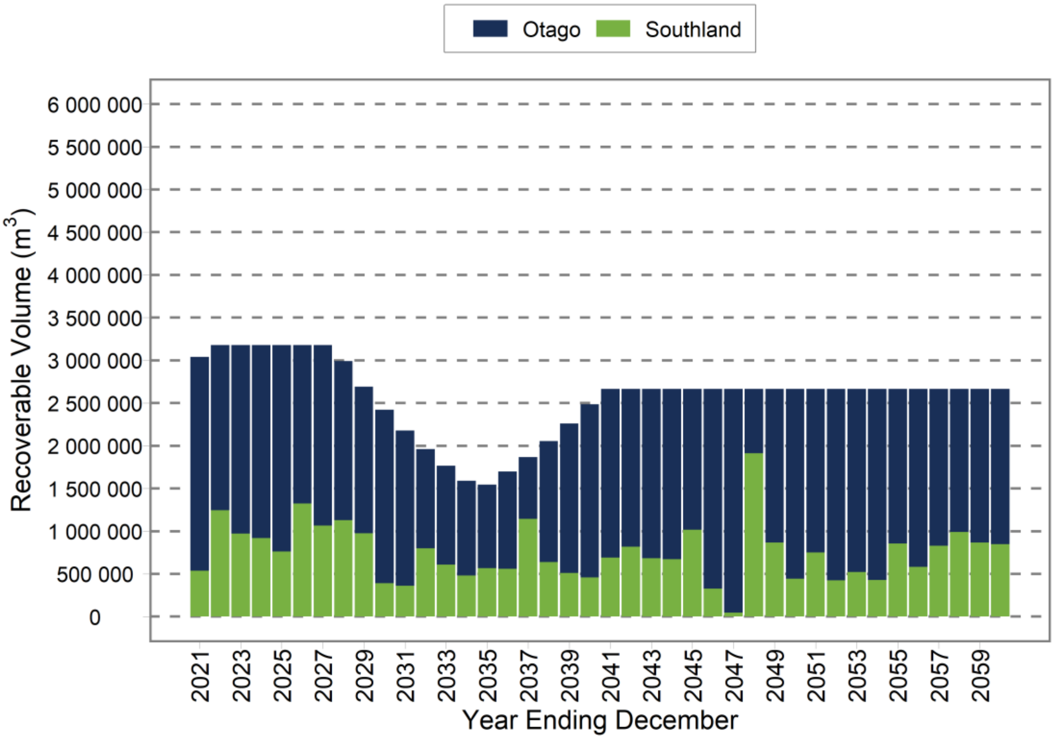


Figure 4-13:
Otago and Southland Average Radiata Pine Clearfell Age under Scenario 3

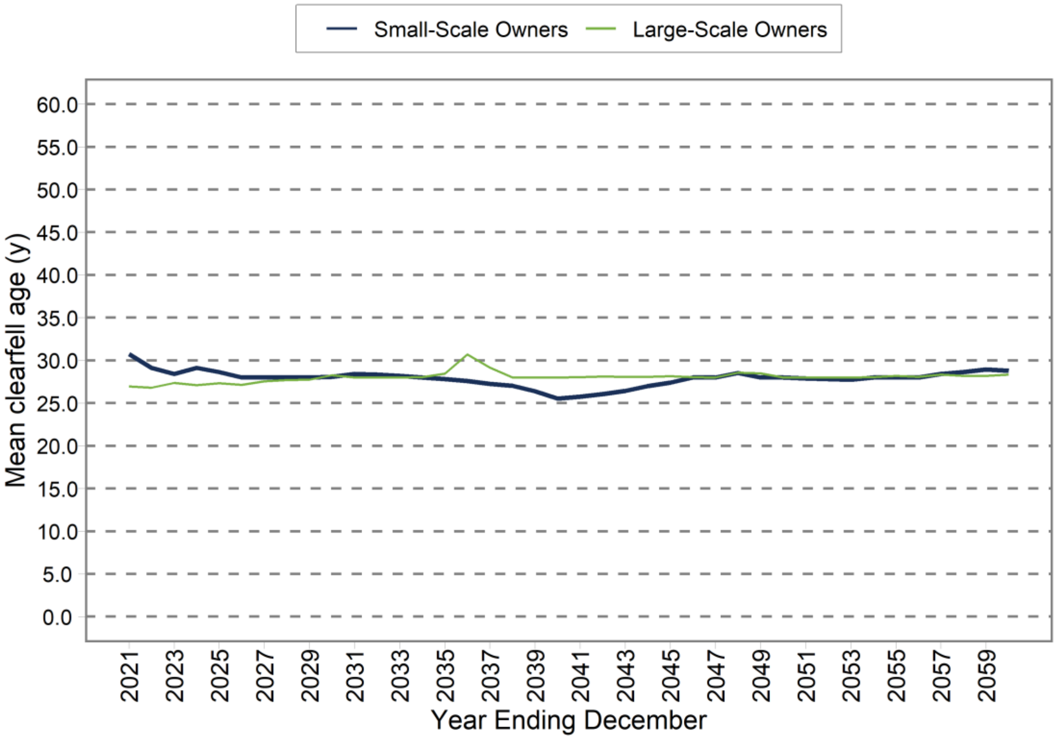
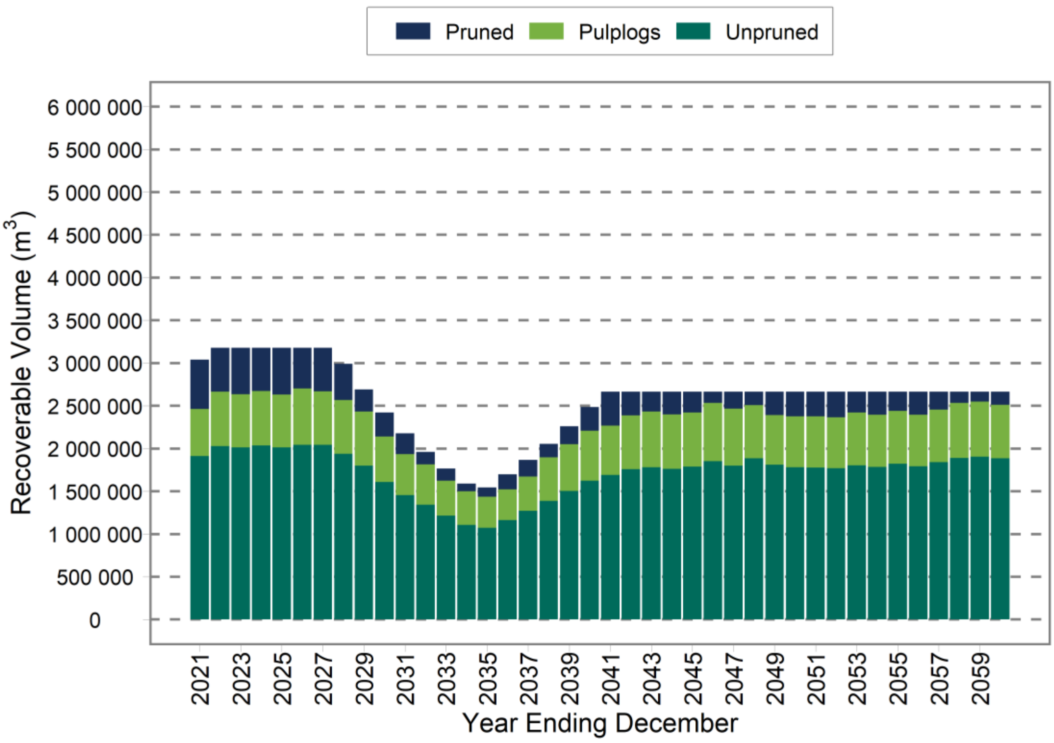


Figure 4-14 shows the radiata pine availability by log grade for all owners. Proportionally, the pruned volume reduces throughout the forecast period as areas of pruned forest are replanted into an unpruned regime.

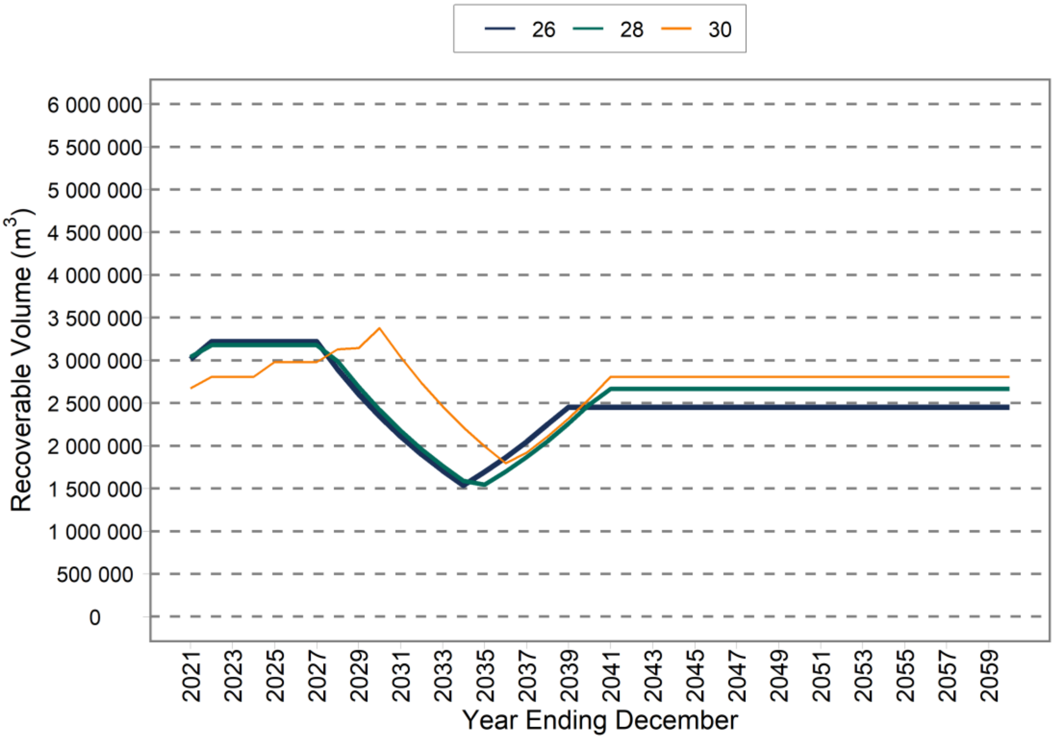
Figure 4-14:
Otago and Southland Radiata Pine Availability by Log Grade under Scenario 3



4.5 Scenario 4

In Scenario 4, target rotation ages of 26 or 30 years are used (rather than 28 years) and the same constraints are applied as in Scenario 3. Figure 4-15 shows the woodflows for the three target rotation ages. The older target rotation age of 30 results in a large delay in volume harvested (as expected) and can reach the same peak in volume of 3.3 million m^3, nine years later, only maintaining that level for one year. A rotation age of 26 results in almost the same woodflows as in Scenario 3.

Figure 4-15:
Otago and Southland Radiata Pine Availability by Target Rotation Age under Scenario 4



4.6 Douglas-fir

The area of Douglas-fir in Otago and Southland is 57 809 ha. The age-class distribution of Douglas-fir in Otago and Southland is uneven with a large area planted in the last couple of years by small-scale growers, as shown in Figure 4-16 and Figure 4-17 (by sub-region). The model requires all Douglas-fir area to be replanted back into Douglas-fir.

Figure 4-16:
Otago and Southland Age-class Distribution of Douglas-fir

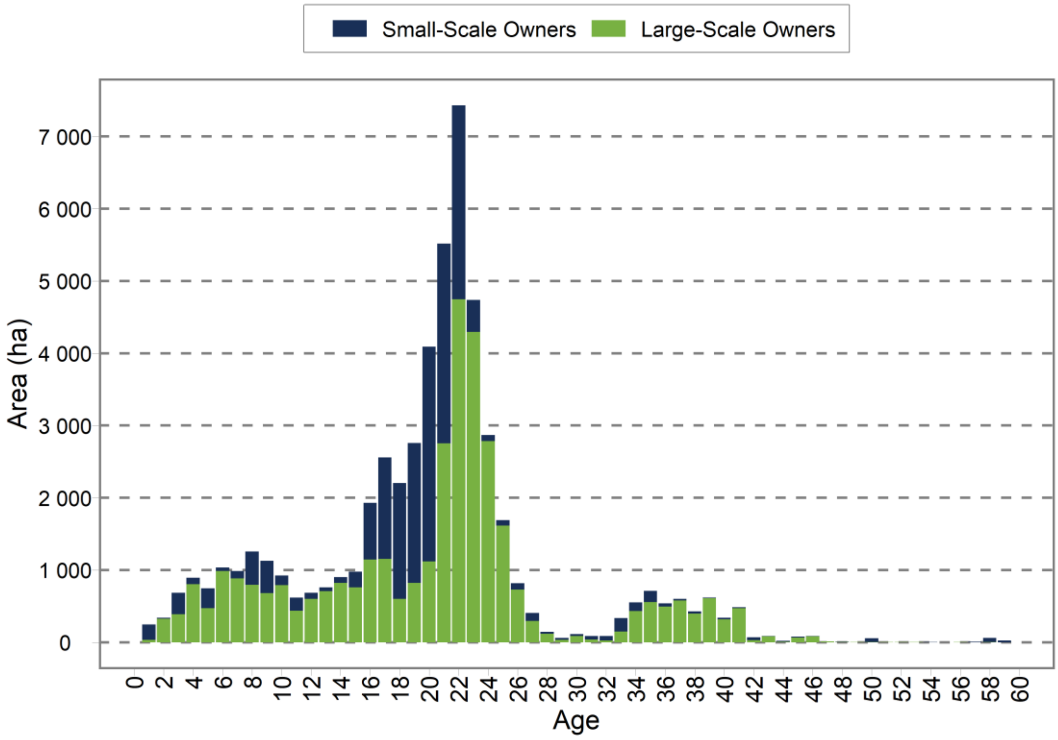
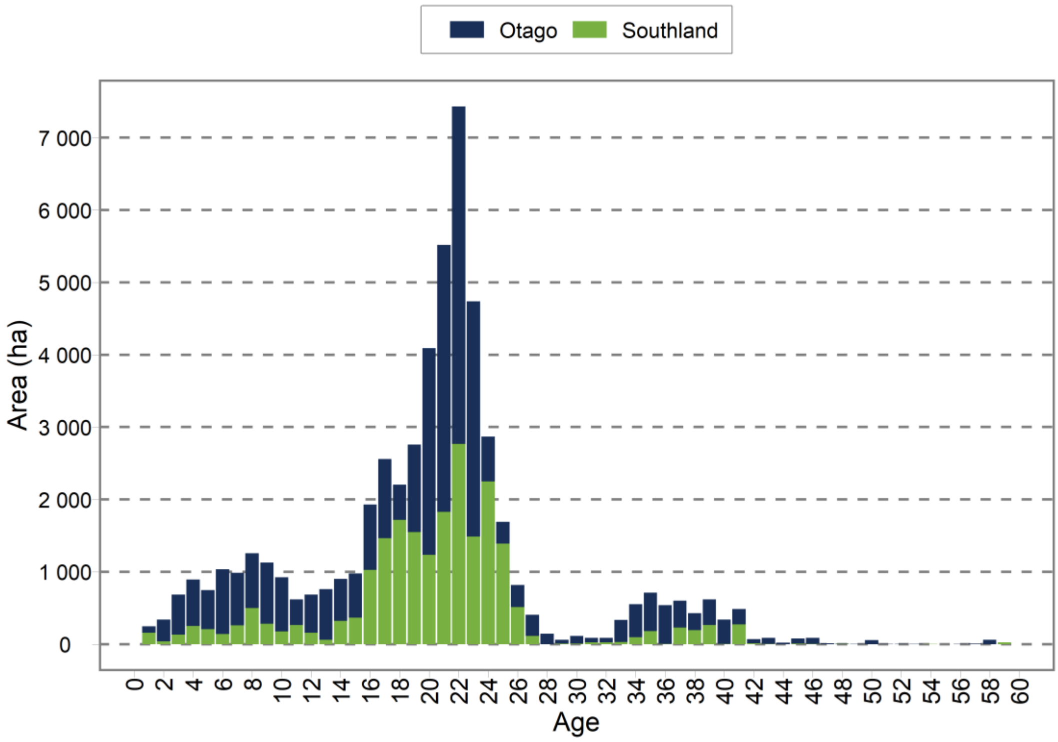


Figure 4-17:
Otago and Southland Age-class Distribution of Douglas-fir by Sub-Region



The Douglas-fir harvest for the large-scale owners' estate is based on intentions for 2021 to 2031. From 2032, the Douglas-fir wood availability increases to a peak of approximately 1.4 million m^3/a after which it drops backs down to current harvest levels (Figure 4-18 and Figure 4-19).

The target rotation age is 43 years for Douglas-fir. The average clearfell age of the Douglas-fir estate in the Otago and Southland region is presented in Figure 4-20.

Figure 4-18:
Otago and Southland Douglas-fir Availability

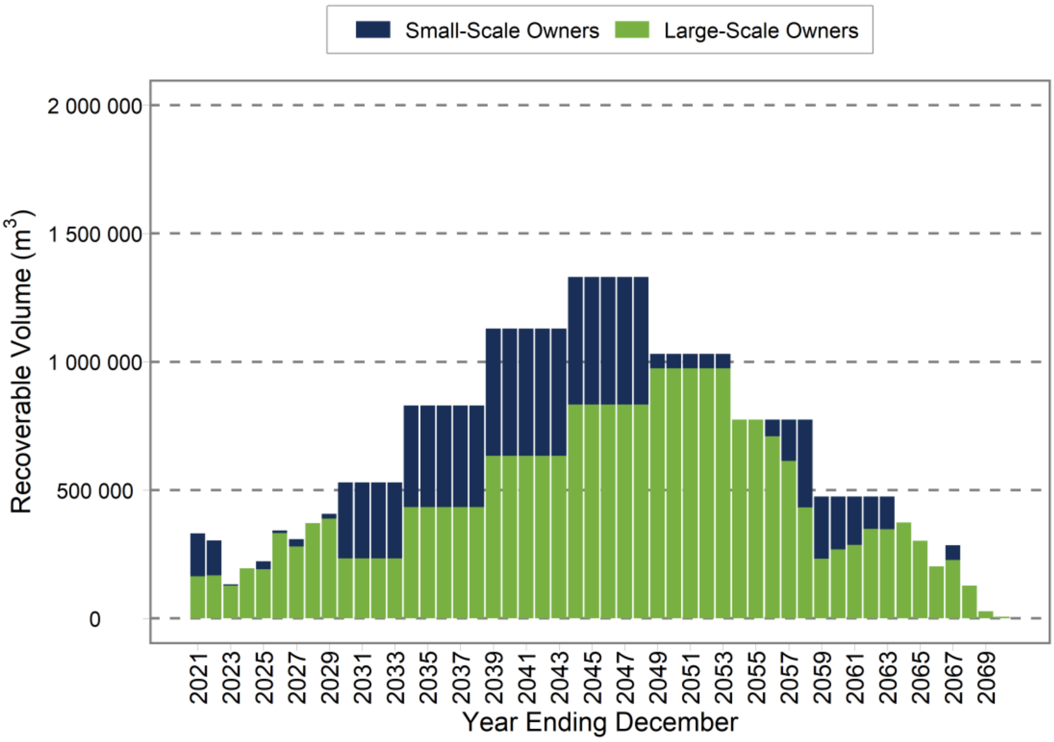


Figure 4-19:
Otago and Southland Douglas-fir Availability by Sub-Region

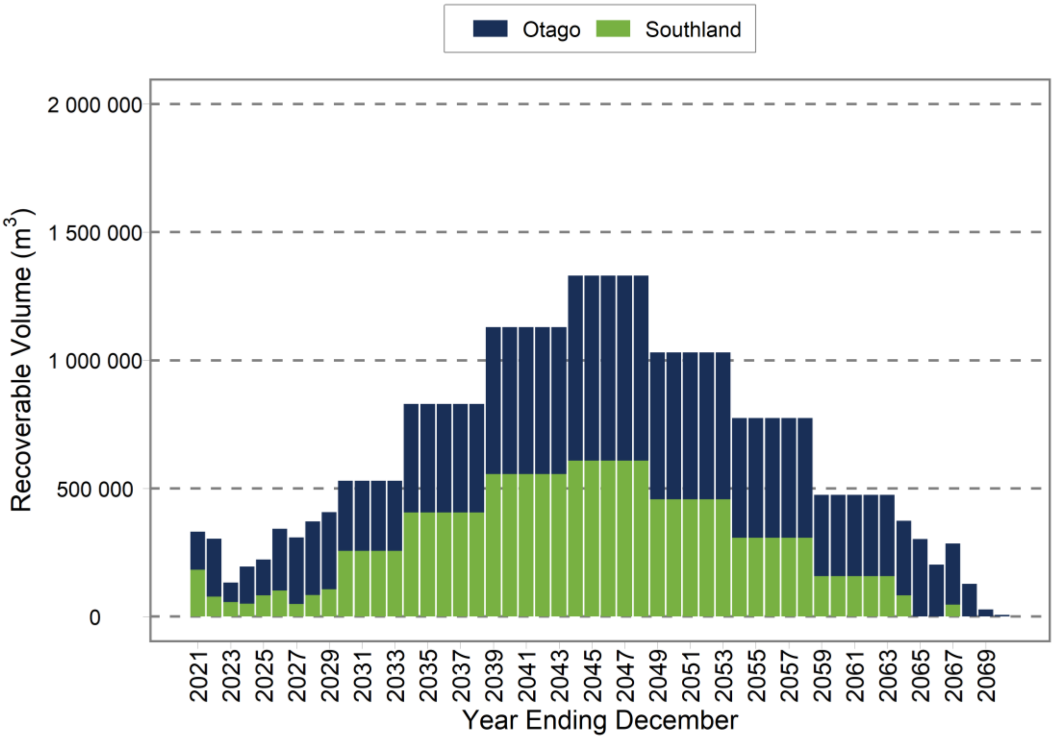
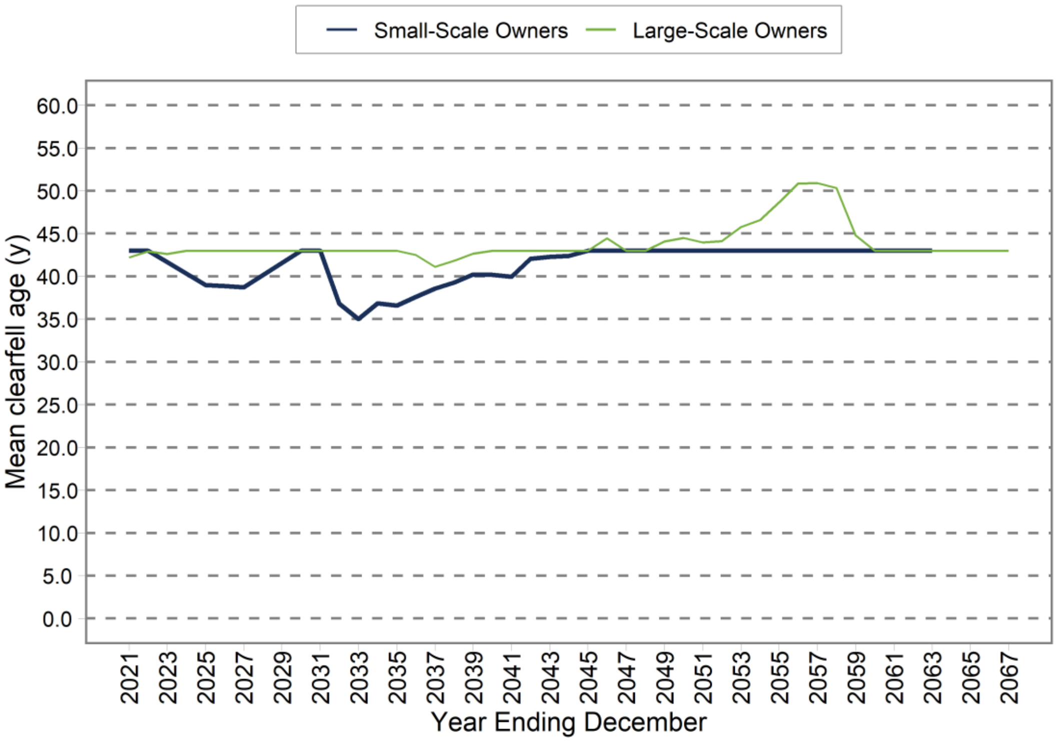


Figure 4-20:
Otago and Southland Average Douglas-fir Clearfell Age



4.7 Combined Scenario

The combined woodflow for radiata pine and Douglas-fir is presented in Figure 4-21. The Otago and Southland region can reach a combined sustainable woodflow of around 3.4 million m^3/a.

Figure 4-21:
Otago and Southland Combined Radiata Pine and Douglas-fir Availability by Species

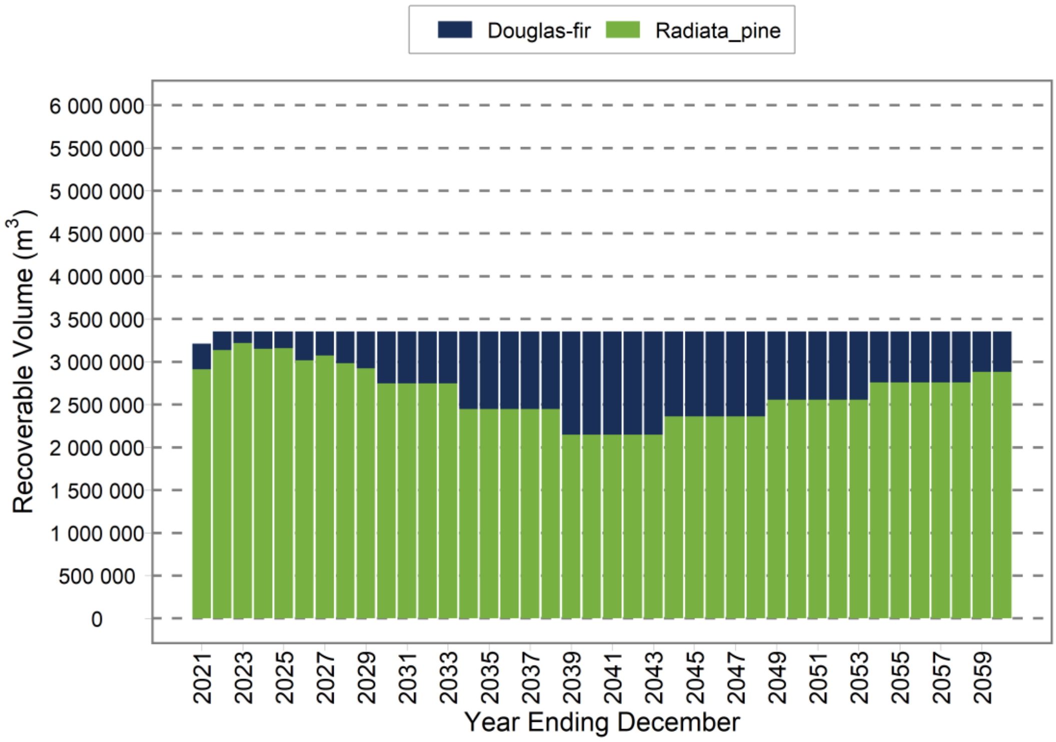
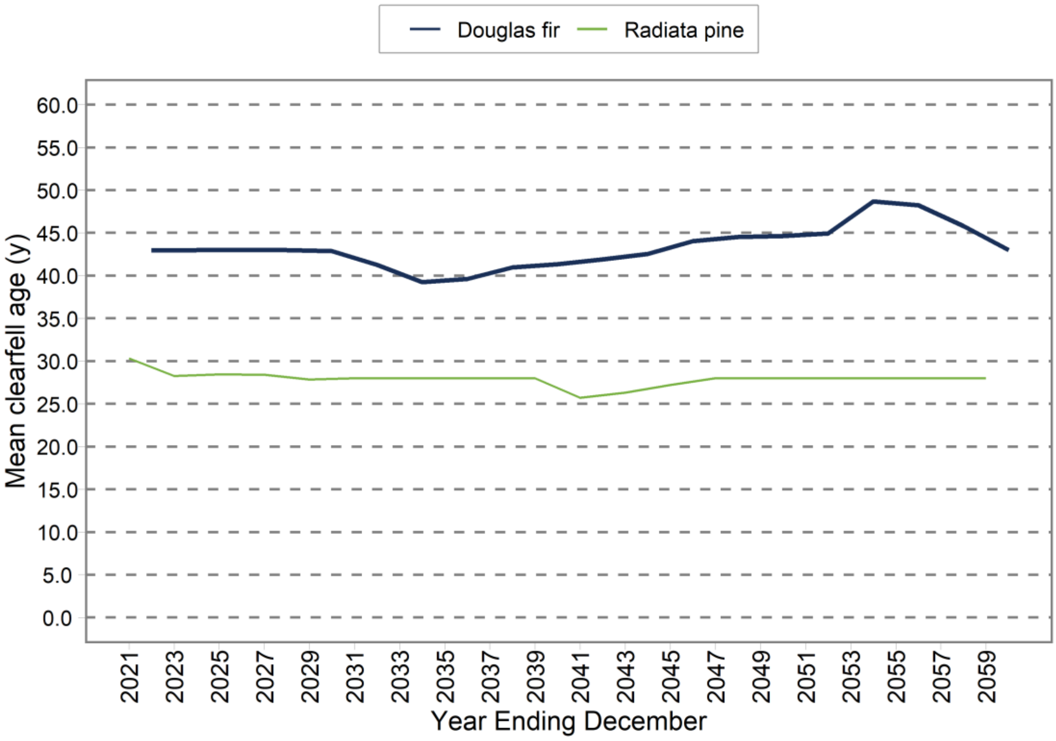


Figure 4-22:
Otago and Southland Average Radiata Pine and Douglas-fir Clearfell Age



5 COMPARISON TO PREVIOUS FORECAST

The results of the 2021 wood availability forecasts were compared with the previous forecasts undertaken in 2014. The comparison is based on Scenario 2 (Figure 5-1) and Scenario 3 (Figure 5-2).

The long-term sustainable cut from the Otago and Southland region under Scenario 2 has increased slightly. This is likely due to the NDY constraints being applied to the combined volume from Otago and Southland and not individually, as was the case in the previous forecasts.

In Scenario 3, the difference in the woodflow is more marked. To maintain a target rotation age around 28 for both ownership types in these forecasts, the volume harvested is higher for the first five years, with the harvest dropping to its lowest levels approximately five years earlier than the previous forecast.

Figure 5-1:
Wood Availability Forecasts (All Radiata Pine): 2014 vs 2021 under Scenario 2

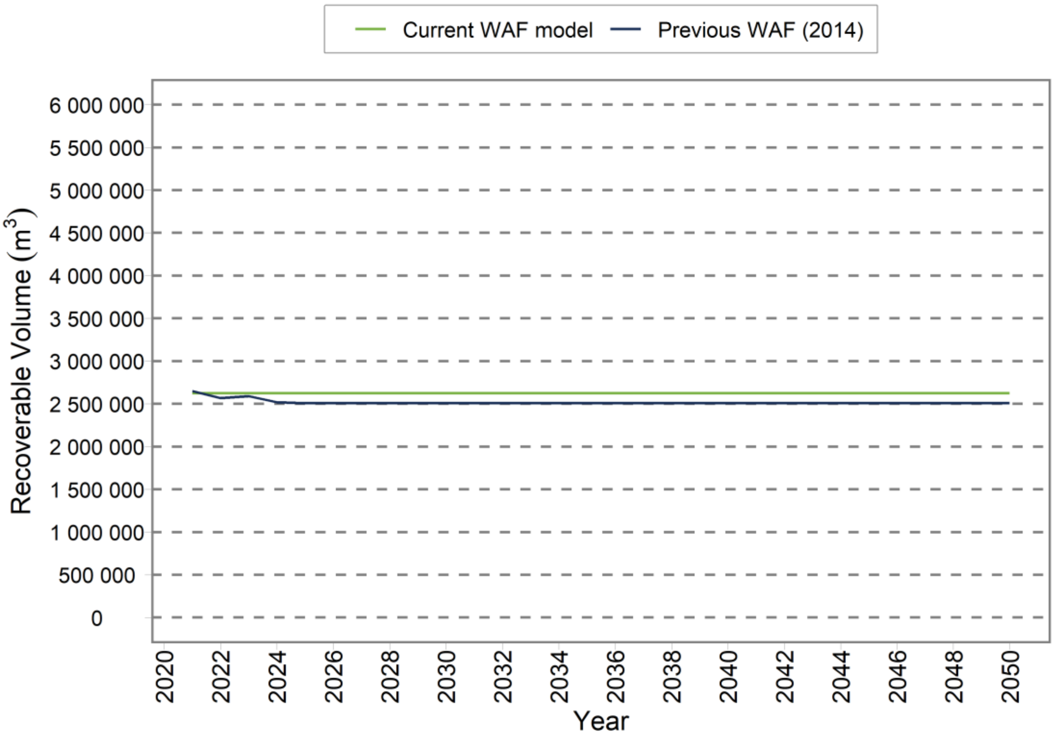
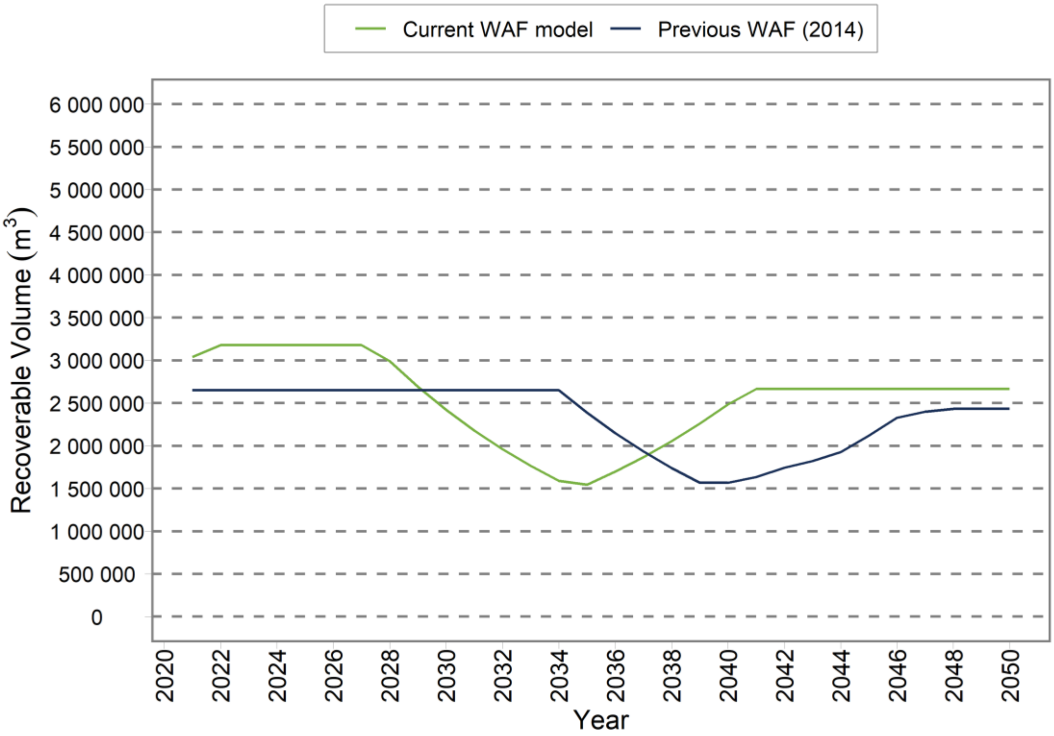
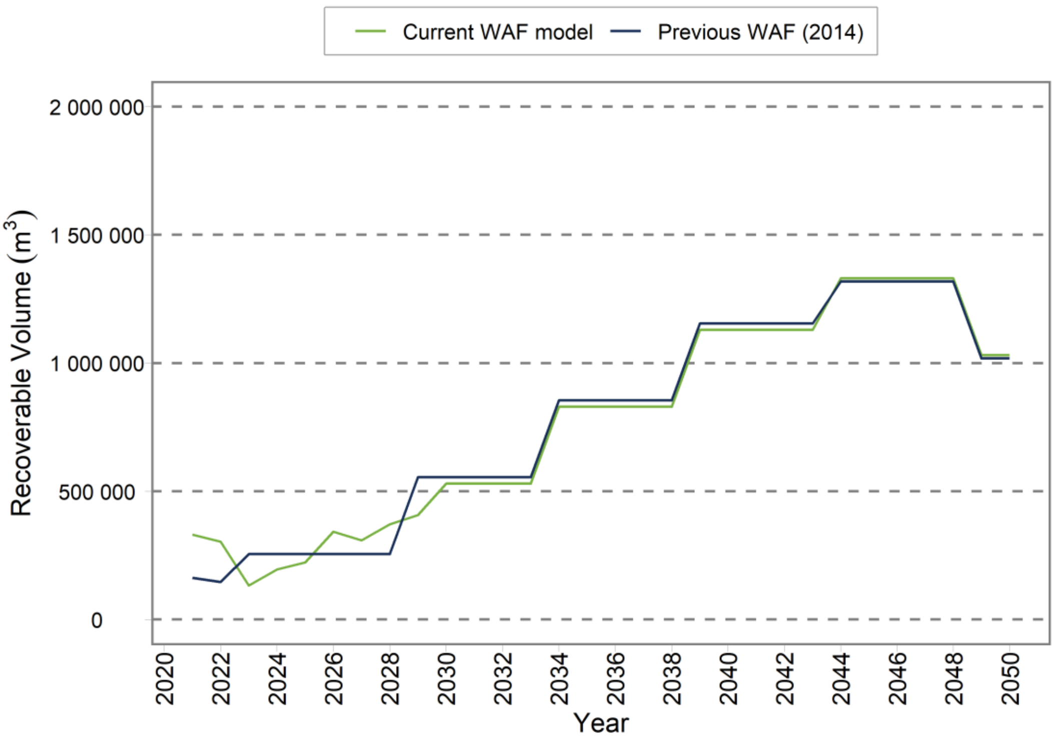


Figure 5-2:
Wood Availability Forecasts (All Radiata Pine): 2014 vs 2021 under Scenario 3



The current and previous forecasts for Douglas-fir are almost identical, except for the first 10 years where the current forecast has more year-to-year variability due the large-scale owners' harvest intentions (Figure 5-3).

Figure 5-3:
Wood Availability Forecasts (Douglas-fir): 2014 vs 2021



The factors contributing to the variations include the following (refer to Table 5-1):

- The total model area has increased by 5% in 2021. The stocked area in Table 5-1 are as reported in the NEFD and have not had the area adjustments outlined in this report applied.
- Changes in modelling methodology, in the current forecast constraints were placed on the total harvest volumes from Otago and Southland whereas in the previous forecast constraints were placed separately across Otago and Southland.
- There are now greater proportions of the estate described by the higher yielding yield tables derived from stands planted in 1990 and thereafter. Just under 3 562 ha of forest planted before 1990 is now remaining in the Otago and Southland region.

Table 5-1:
Key Differences between 2014 and 2021 WAF

Item	2014 WAF	2021 WAF	Change (%)
Stocked Area (ha)[1]	205 200	216 952	5
Average Age (years)	N/A	16.7	N/A
Productivity (m^3/ha at age 30)	N/A	512	0
Clearfell Age Target (years)	28	28	0
Annual Sustainable Harvest (million m^3)	2.5	2.6	4

[1] Excluding Adjustments

The "Productivity" is the area weight average yield from the yield tables at a reference age. The "Annual Sustainable Harvest" is the annual harvest as determined in Scenario 2. "N/A" indicates where the previous wood availability report does not provide that parameter.

6 CONCLUSION

Radiata pine wood availability from the Otago and Southland wood supply region is expected to continue to increase in the next couple of years to a maximum of 3.2 million m^3/a. This increase is required to complete the harvesting at an average rotation age of around 28 years. Once the peak of harvesting has been completed, the volume will likely decrease to a low of just over 1.5 million m^3/a then rebound to a sustainable cut of 2.6 million m^3/a. The availability of Douglas-fir will increase over the next 20 years to reach a peak of 1.35 million m^3/a after which it will decrease back to current harvest levels.

Market conditions (e.g. demand from China) and logistical constraints (e.g. trucking and port constraints) will determine the actual rate of harvest increase, and the peak that is reached.

The increase in wood availability in the next couple of years is largely driven by the small-scale owner resource, however, the confidence around the NEFD age-class distribution and area for these owners is low. Margules Groome has made some adjustment to areas of the owners with less than 1 000 ha – this is to account for a recent mapping study showing a likely over-prediction of NEFD area for this group of forest owners in the region. This uncertainty will impact the wood availability from the Otago and Southland region, particularly in the short term.

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Appendix - Otago & Southland Wood Availability Forecasts for the Period 2021-2060

Table 1: Otago and Southland Wood Avaliability under Scenario 1

(Assumes that large-scale owners harvest at stated intentions and then at non-declining yield, and target harvest age of 28 years)

Year Ending December	Large-Scale Owners (000 m^3)	Small-Scale Owners (000 m^3)	All Owners (000 m^3)
2021	1 227	1 456	2 684
2022	1 187	3 893	5 080
2023	1 328	1 594	2 922
2024	1 369	2 470	3 839
2025	1 305	677	1 981
2026	1 340	2 336	3 676
2027	1 276	1 668	2 944
2028	1 319	1 756	3 075
2029	1 267	1 529	2 795
2030	1 301	1 369	2 670
2031	1 301	1 045	2 345
2032	1 301	580	1 881
2033	1 301	143	1 443
2034	1 301	0	1 301
2035	1 301	220	1 521
2036	1 301	342	1 643
2037	1 301	329	1 630
2038	1 301	472	1 773
2039	1 301	831	2 132
2040	1 301	491	1 792
2041	1 301	542	1 843
2042	1 301	597	1 898
2043	1 301	2 155	3 456
2044	1 301	2 246	3 547
2045	1 301	3 062	4 363
2046	1 301	2 954	4 255
2047	1 301	2 475	3 776
2048	1 301	625	1 926
2049	1 301	221	1 521
2050	1 301	1 179	2 480
2051	1 301	3 501	4 802
2052	1 301	1 565	2 866
2053	1 301	2 460	3 760
2054	1 301	683	1 984
2055	1 301	2 329	3 630
2056	1 301	1 662	2 963
2057	1 301	1 755	3 056
2058	1 301	1 529	2 830
2059	1 301	1 355	2 655
2060	1 301	1 058	2 359

Notes: m^3 = cubic metres inside bark

Table 2: Otago and Southland Wood Avaliability under Scenario 2

(Assumes that large-scale owners harvest at stated intentions and then at non-declining yield, and total wood availability is modelled at a non-declining yield)

Year Ending December	Large-Scale Owners (000 m^3)	Small-Scale Owners (000 m^3)	All Owners (000 m^3)
2021	1 227	1 397	2 624
2022	1 187	1 437	2 624
2023	1 328	1 296	2 624
2024	1 369	1 254	2 624
2025	1 305	1 319	2 624
2026	1 340	1 284	2 624
2027	1 276	1 348	2 624
2028	1 319	1 305	2 624
2029	1 267	1 357	2 624
2030	1 324	1 299	2 624
2031	1 324	1 299	2 624
2032	1 324	1 299	2 624
2033	1 324	1 299	2 624
2034	1 324	1 299	2 624
2035	1 324	1 299	2 624
2036	1 324	1 299	2 624
2037	1 324	1 299	2 624
2038	1 324	1 299	2 624
2039	1 324	1 299	2 624
2040	1 324	1 299	2 624
2041	1 324	1 299	2 624
2042	1 324	1 299	2 624
2043	1 324	1 299	2 624
2044	1 324	1 299	2 624
2045	1 324	1 299	2 624
2046	1 324	1 299	2 624
2047	1 324	1 299	2 624
2048	1 324	1 299	2 624
2049	1 324	1 299	2 624
2050	1 324	1 299	2 624
2051	1 324	1 299	2 624
2052	1 324	1 299	2 624
2053	1 324	1 299	2 624
2054	1 324	1 299	2 624
2055	1 324	1 299	2 624
2056	1 324	1 299	2 624
2057	1 324	1 299	2 624
2058	1 324	1 299	2 624
2059	1 324	1 299	2 624
2060	1 324	1 299	2 624

Notes: m^3 = cubic metres inside bark

Table 3: Otago and Southland Wood Avaliability under Scenario 3

(Assumes that large-scale owners harvest at stated intentions then at non-declining yield, and total wood availability is modelled at a split non-declining yield)

Year Ending December	Large-Scale Owners (000 m^3)	Small-Scale Owners (000 m^3)	All Owners (000 m^3)	Pruned (000 m^3)	Unpruned (000 m^3)	Pulp Logs (000 m^3)
2021	1 227	1 813	3 040	578	1 911	551
2022	1 187	1 993	3 180	516	2 030	635
2023	1 328	1 852	3 180	545	2 013	622
2024	1 369	1 811	3 180	509	2 035	637
2025	1 305	1 875	3 180	550	2 014	616
2026	1 340	1 840	3 180	477	2 045	658
2027	1 276	1 904	3 180	511	2 045	624
2028	1 319	1 672	2 991	422	1 937	631
2029	1 267	1 425	2 692	258	1 800	634
2030	1 300	1 123	2 423	282	1 610	531
2031	1 300	881	2 180	245	1 456	479
2032	1 300	663	1 962	149	1 342	471
2033	1 300	466	1 766	141	1 215	410
2034	1 300	290	1 589	88	1 109	393
2035	1 300	244	1 544	108	1 074	362
2036	1 300	398	1 698	174	1 163	361
2037	1 300	568	1 868	194	1 270	404
2038	1 300	755	2 055	159	1 387	509
2039	1 300	961	2 260	210	1 504	546
2040	1 300	1 187	2 486	278	1 625	583
2041	1 300	1 364	2 664	395	1 690	579
2042	1 300	1 364	2 664	277	1 758	629
2043	1 300	1 364	2 664	230	1 782	652
2044	1 300	1 364	2 664	263	1 762	638
2045	1 300	1 364	2 664	242	1 788	634
2046	1 300	1 364	2 664	128	1 853	684
2047	1 300	1 364	2 664	197	1 800	666
2048	1 300	1 364	2 664	155	1 887	622
2049	1 300	1 364	2 664	272	1 811	582
2050	1 300	1 364	2 664	288	1 781	595
2051	1 300	1 364	2 664	286	1 779	599
2052	1 300	1 364	2 664	298	1 769	597
2053	1 300	1 364	2 664	243	1 805	616
2054	1 300	1 364	2 664	269	1 785	610
2055	1 300	1 364	2 664	223	1 823	618
2056	1 300	1 364	2 664	270	1 794	600
2057	1 300	1 364	2 664	210	1 840	614
2058	1 300	1 364	2 664	129	1 890	646
2059	1 300	1 364	2 664	114	1 905	645
2060	1 300	1 364	2 664	153	1 888	623

Notes: m^3 = cubic metres inside bark

Table 4: Otago and Southland Wood Avaliability under Scenario 4

(Assumes that large-scale owners harvest at stated intentions then at non-declining yield, and total wood availability is modelled at a split non-declining yield with target rotation ages of 26, 28 and 30 years)

Year Ending December	Recoverable Volume Target Age 26 (000 m³)	Average Age (Years)	Recoverable Volume Target Age 28 (000 m³)	Average Age (Years)	Recoverable Volume Target Age 30 (000 m³)	Average Age (Years)
2021	3 015	28	3 040	29	2 673	31
2022	3 219	28	3 180	28	2 809	29
2023	3 219	27	3 180	28	2 809	29
2024	3 219	29	3 180	28	2 809	29
2025	3 219	27	3 180	28	2 981	29
2026	3 219	28	3 180	28	2 981	29
2027	3 219	27	3 180	28	2 981	29
2028	2 897	27	2 991	28	3 132	30
2029	2 607	27	2 692	28	3 144	30
2030	2 347	27	2 423	28	3 377	30
2031	2 112	27	2 180	28	3 039	30
2032	1 901	27	1 962	28	2 735	30
2033	1 711	27	1 766	28	2 462	30
2034	1 540	28	1 589	28	2 216	31
2035	1 694	29	1 544	28	1 994	31
2036	1 863	26	1 698	30	1 795	31
2037	2 049	25	1 868	29	1 919	30
2038	2 254	25	2 055	28	2 111	30
2039	2 453	25	2 260	27	2 322	30
2040	2 453	25	2 486	27	2 554	28
2041	2 453	25	2 664	27	2 809	28
2042	2 453	26	2 664	27	2 809	28
2043	2 453	26	2 664	27	2 809	29
2044	2 453	26	2 664	28	2 809	29
2045	2 453	26	2 664	28	2 809	29
2046	2 453	27	2 664	28	2 809	29
2047	2 453	26	2 664	28	2 809	30
2048	2 453	26	2 664	29	2 809	30
2049	2 453	26	2 664	28	2 809	30
2050	2 453	26	2 664	28	2 809	31
2051	2 453	26	2 664	28	2 809	31
2052	2 453	26	2 664	28	2 809	30
2053	2 453	26	2 664	28	2 809	30
2054	2 453	26	2 664	28	2 809	30
2055	2 453	26	2 664	28	2 809	30
2056	2 453	26	2 664	28	2 809	30
2057	2 453	27	2 664	28	2 809	30
2058	2 453	27	2 664	28	2 809	30
2059	2 453	28	2 664	29	2 809	30
2060	2 453	28	2 664	29	2 809	30

Notes: m³ = cubic metres inside bark

Table 5: Otago and Southland Wood Avaliability for Douglas-fir

(Assumes that large-scale owners harvest at stated intentions with yield regulated in subsequent years and a target rotation age of 43 years)

Year Ending December	Large-Scale Owners (000 m^3)	Small-Scale Owners (000 m^3)	All Owners (000 m^3)	Average Age (Years)
2021	164	167	331	43
2022	168	137	304	43
2023	128	5	133	43
2024	195	0	196	43
2025	192	31	223	42
2026	332	11	343	43
2027	281	28	309	43
2028	371	0	371	43
2029	389	20	408	32
2030	234	295	530	43
2031	234	295	530	43
2032	234	295	530	42
2033	234	295	530	41
2034	434	395	830	40
2035	434	395	830	40
2036	434	395	830	40
2037	434	395	830	40
2038	434	395	830	41
2039	634	495	1 130	42
2040	634	495	1 130	42
2041	634	495	1 130	42
2042	634	495	1 130	43
2043	634	495	1 130	43
2044	834	497	1 331	43
2045	834	497	1 331	43
2046	834	497	1 331	44
2047	834	497	1 331	43
2048	834	497	1 331	43
2049	975	56	1 031	44
2050	975	56	1 031	45
2051	975	56	1 031	44
2052	975	56	1 031	44
2053	975	56	1 031	46
2054	775	0	775	48
2055	775	0	775	50
2056	710	65	775	50
2057	614	161	775	49
2058	432	343	775	47
2059	233	242	475	44
2060	269	206	475	43

Notes: m^3 = cubic metres inside bark

Table 6: Otago and Southland Wood Avaliability Split by Sub-Region

Year Ending	Scenario 1		Scenario 2		Scenario 3	
December	Otago	Southland	Otago	Southland	Otago	Southland
2021	1 568	1 116	1 876	747	2 503	537
2022	3 784	1 297	1 696	928	1 935	1 245
2023	2 061	861	1 800	824	2 207	973
2024	3 011	828	1 896	728	2 260	921
2025	1 220	762	1 938	685	2 419	762
2026	2 288	1 388	1 876	747	1 857	1 324
2027	1 945	998	2 186	438	2 113	1 067
2028	1 946	1 129	1 822	802	1 862	1 129
2029	1 715	1 081	1 665	959	1 715	977
2030	2 182	488	1 467	1 156	2 033	390
2031	1 726	619	1 384	1 239	1 818	362
2032	1 172	709	2 012	612	1 161	801
2033	998	445	1 479	1 145	1 158	608
2034	823	478	1 938	686	1 107	482
2035	1 276	245	2 072	551	976	568
2036	1 210	433	2 171	452	1 137	561
2037	652	978	1 297	1 327	725	1 143
2038	1 181	592	1 584	1 040	1 415	640
2039	1 652	480	1 928	696	1 750	510
2040	1 357	435	1 584	1 040	2 026	460
2041	1 455	388	2 588	36	1 974	690
2042	1 376	522	1 842	782	1 845	819
2043	2 458	997	1 925	698	1 979	685
2044	2 761	786	2 188	435	1 993	671
2045	2 881	1 481	1 747	877	1 645	1 019
2046	3 035	1 220	2 131	493	2 335	329
2047	2 941	835	2 624	0	2 619	45
2048	606	1 320	948	1 676	751	1 913
2049	1 083	439	1 603	1 021	1 798	866
2050	1 488	991	1 732	892	2 222	442
2051	3 448	1 354	1 597	1 027	1 913	751
2052	2 033	833	1 769	855	2 239	425
2053	3 000	761	1 867	756	2 143	521
2054	1 215	769	1 857	766	2 235	429
2055	2 271	1 358	1 862	762	1 810	854
2056	1 915	1 048	2 111	513	2 082	582
2057	1 915	1 141	1 852	771	1 834	830
2058	1 703	1 127	1 604	1 019	1 672	992
2059	2 158	498	1 593	1 030	1 797	867
2060	1 721	638	1 466	1 158	1 814	850

Notes: m^3 = cubic metres inside bark