Tasman Bay Storm Event July 2025

Post Event Woody Debris Assessment – Tasman Bay

Prepared for **Forest Growers Levy Trust and Te Uru Rākau – New Zealand Forest Service**

Print Date: Thursday, 28 August 2025

Ref. No: **J10098**

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Document Version Control

Version	Date	Comment	Name
1	06/08/2025	**DRAFT** released to NZ Forest Owners Association for review and feedback.	T Redpath
1.1	14/08/2025	**Revised DRAFT** following feedback	T Redpath
1.2	15/08/2025	Minor edits	T Redpath
1.3	28/08/2025	Final version	T Redpath

This report was commissioned by the The Forest Growers Levy Trust and Te Uru Rākau – New Zealand Forest Service.

1 Executive Summary

Through June and July of 2025, a succession of two severe weather events bought heavy rain and strong winds to the Tasman Region. These weather events resulted in significant river and surface flooding, wind damage across the region's forests, and accumulation of woody debris in coastal areas. Media and public commentators have called this woody debris material 'slash'. Slash is the term for woody material that is left as waste after a plantation forest is harvested. The media's use of this term, and the public's perception, suggest that most of the woody debris that caused damage to infrastructure came from waste that was not cleared after harvesting the plantation forest. The Forest Growers Levy Trust (FGLT) and Te Uru Rākau – New Zealand Forest Service (TUR) commissioned an analysis and report to independently measure large woody debris (LWD) content along the Tasman Bay coastline, describing it by species, probable source, volume per hectare, and total volume accumulated – consistent with the methodology implemented in Hawke's Bay following Cyclone Gabrielle (Herries, 2023).

This report used a modified Line Intersect Sampling (LIS) method to measure the volume of woody debris. This method is a common way to estimate how much woody debris is left after clear-cut logging, and has been used since 1964 by foresters. The modification was to account for the non-random direction of the LWD pieces due to water or wave movement. This was done by using a plot shaped like an equal-sided triangle with random plot locations and random starting direction of the first side of the triangle.

The mapping of woody debris shows 30 ha of potential coastal woody debris in Tasman Bay. A network of 86 plots was set up at random locations within the mapped AOI for measurement. Because of access limitations in the aftermath of the severe weather events, as well as time constraints, 59 survey plots were installed and measured spanning from Kaiteriteri in the northwest to Tāhunanui in the southeast of Tasman Bay.

The average volume of LWD measured in plots was 103 m^3/ha (34.6 % probable limit of error (PLE)). Of this, 5% of the LWD had clear signs of originating from harvest residue and was classified as such (CH class). A further 6% of the average measured LWD volume was classified as other conifer of plantation origin (CO class). Non-plantation conifer made up 21% of the average LWD volume. 73 % of the LWD was 3 m or less in length, and only 1 % was longer than 12 m. 11% of LWD was native, 6% of the LWD was willow or poplar, 5% was eucalypt and posts/timber/firewood products made up 5%. A large proportion (40%) was classified as other and not able to be specifically identified, due to heavy weathering. This may reflect older origin material that has spent some time being transported down rivers and/or afloat in Tasman Bay.

2 INTRODUCTION

2.1 BACKGROUND

During June and July of 2025, the Nelson/Tasman Region of New Zealand was affected by a succession of two severe weather events, featuring heavy rain, flooding, and during the second event in particular, strong and damaging winds. As a result of these weather events, accumulations of woody debris have been deposited on beaches across Tasman Bay. Commentators from the media and the public have referred to this material as 'slash'. Slash is defined as woody material left as waste after harvest of plantation forest. The implication of this categorisation by the media, and resulting public impressions, is that the majority of woody debris implicated in infrastructure damage and diminished amenity value originated from left behind after the harvesting of the plantation forest estate. The The Forest Growers Levy Trust (FGLT) and Te Uru Rākau – New Zealand Forest Service (TUR) commissioned a report to independently quantify large woody debris (LWD) content along the Tasman Bay coast, characterising it by species, likely source, volume per hectare, and total volume accumulated. This investigation was undertaken using the methodology developed and implemented for LWD assessment in Hawke's Bay following Cyclone Gabrielle (Herries, 2023).

Mapping of woody debris indicated approximately 30 ha of coastal area that was affected by woody debris accumulation. This occurred along approximately 18 km of the 50 km coastline of Tasman Bay between Tāhunanui and Mārahau. Across this area, 86 random plots allocated for sampling (Figure 1). A total of 59 plots were installed from the 17th to 21st July 2025. Sampling effort focused on beaches. Plots were selected from the random pre-planned plot network, with some constraints on access following the severe weather events. Plots were abandoned where hazardous.

2.2 Objective

This study was commissioned to establish a robust data set for accurately categorising LWD volume and proportion by species, in areas where it has had community impact; with a focus on the Tasman Bay coastline.

Figure 1: Predetermined random sample locations, with actual surveyed sites in March 2023 shown in red.

3 METHODOLOGY

For completeness the Methodology section is extracted from Herries, 2023. The following recommendations (Herries, 2023) were implemented, and the methodology has been extended to include;

- Transect edge plots where the transact extends outside of the mapped debris extent, a fold back transect mirage plotting methodology was implemented (Section 3.3.2).
- The extent of wood weathering was recorded to help distinguish debris that was aged beyond the target storm events. This classification was undertaken to help to distinguish debris from previous events (Section 3.3.4).
- Piece length data is collected with categorisation into length bins (e.g., <1m, <3m, <6, <9m, <12m, >12m etc.) (Section 3.3.6)

3.1 MAPPING WOODY DEBRIS POST EVENT

Using post event satellite imagery along the length of the coastline, areas of likely wood debris accumulation were mapped in ArcGIS. Sampling locations for plots were then applied across the mapped area as described in section 3.3.8 Initial priority was given to the coastline areas. The mapped areas were allocated to geographic zones for analysis and reporting.

Plot locations were then provided in georeferenced PDF Map format for field survey.

Table 1: Mapping criteria used in woody debris sampling strata.

Mapped Strata	Mapping Criteria	Coverage
Coastal beaches and river mouths	Concentrated wood debris accumulation areas > 0.1ha, eg. 50*20m. May have sporadic gaps between debris up to 10m to map accumulated aggregate areas of impact.	Full coastline of Tasman Bay including major river mouths from Tāhunanui to Mārahau.

3.1.1 Satellite or Aerial Photography Sources

Various qualities of imagery became available following the storm events. Initially use of Planet Labs Monitoring 3-4m resolution near daily satellite imagery was used, due to timely access following the events. While the imagery provided a medium-resolution image, this enabled a quick assessment of the entire coastline and catchment areas assessed for accumulated woody debris.

Examples can be seen in Figure 2 and Figure 3, where woody debris is showing up clearly in imagery.

Figure 2: Coastline assessed with an image from the 17th of July showing the woody debris appearing in the 3-4m imagery at Motueka. Image Source: Planet Labs LLC

High-resolution (50-cm) SkySat imagery was also tasked and became available from July 17, 2025. When additional high-resolution satellite imagery became available throughout the project, it was used to validate and update the previous mapping extents as being sufficient for establishing the sampling frame for the wood debris survey (example Figure 3) and providing a consistent approach across the region.

Figure 3: Example of coastline from SkySat imagery gathered on the 19th of July, with enlarged view of the Motueka Beach, and example of mapping the woody debris area (magenta polygons) impacted on the beach. Randomised sample locations are also shown (orange points).

3.2 Drone Aerial Photo Mapping

Previously (e.g., for Hawke's Bay following Cyclone Gabrielle), the use of drones for on-demand capture of very high-resolution imagery has benefitted woody debris surveys. In this case, a combination of complex airspace, large numbers of public present in target areas and time constraints precluded the acquisition and use of drones for imagery acquisition.

3.3 Sampling Methodology Review

3.3.1 Line Intercept Sampling Method History

Due to nature of the LWD, the Line Intercept Sampling (LIS) technique was adapted from that used for cutover waste assessment as per training guidance in "NZQA Unit Standard 6956 – Carry Out Waste Assessment in Cutover Forest".

Since its original description for merchantable cutover residue assessment (Warren and Olsen, 1964), LIS is used to quantify wood lying on or near the ground. LIS continued to develop, as a simple and practical method (Bailey, 1970; Wagner & Wilson, 1976; Hall, 1986; Bell et al., 1996).

Proof of its mathematical basis (De Vries, 1973) and practical aspects of LIS to overcome bias and improve precision (Wagner, 1982; Pickford & Hazard, 1978; Bell et al., 1996) have seen it adapted worldwide for woody debris in forestry settings. Therefore, LIS is a peer reviewed and well-established method for measuring the volume of woody debris effectively.

3.3.2 Line Intercept Sampling Process

To remove the bias of piece orientation, an equilateral triangle sample plot was used. Each side of the triangle is 10 m, with each plot being a total length of 30 m (horizontal length), as per Figure 4. Where slope of the transect is greater than 5 degrees, a slope adjusted distance is applied to each side of the triangle.

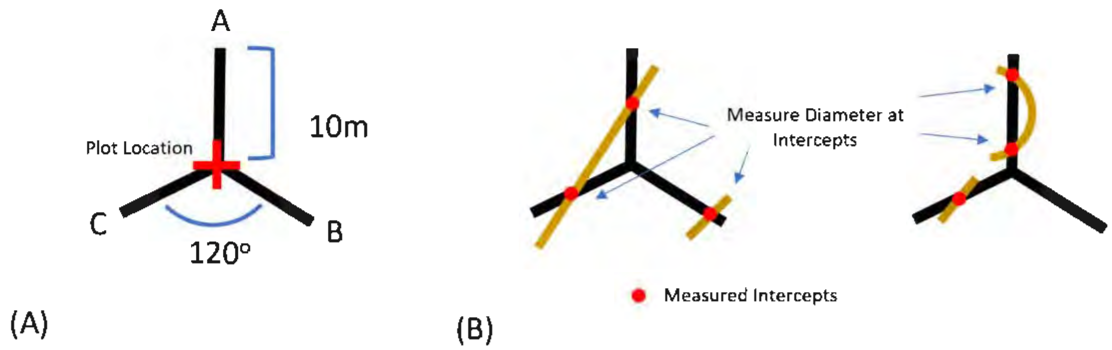

Figure 4: (A) Line Intercept Sampling 120 degree Y layout (B) Measure and Record Piece Diameters at Crossover

The diameter of each LWD piece intersected by a line was measured at the point wherever it intercepts the line. A lower limit diameter of 100 mm is used; all material greater than or equal to 100 mm was recorded and measured. Comments were made alongside photos collected of each of the three lines per plot. There was no minimum length restriction, as the statistical likelihood of the line intersecting the piece accounts for length without arbitrary bias towards longer pieces. This also ensure inclusion of harvest slovens, and log bucking waste.

To further address the bias in debris accumulation orientation, each Y plot sample has a random orientation based on a random bearing between 0 and 90 degrees (Figure 5).

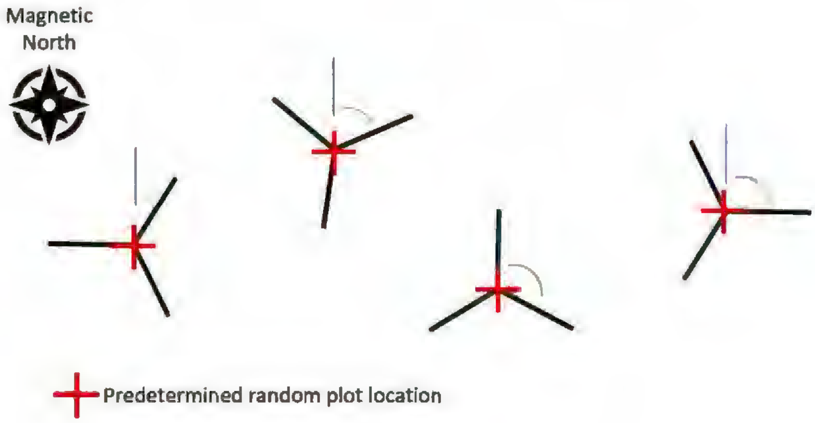

Figure 5: Sample orientation to a baseline to ensure sample remains unbiased to direction of accumulation of woody debris.

Where the transact extends outside of the mapped debris extent, a reflected transect mirage plotting methodology is implemented, whereby the edge of plot is folded back on itself into the sample area as shown in Figure 6. Pieces that intersected both the initial and reflected transect were counted twice. Pieces that intersected only the reflected transect (e.g., where the reflected transect crossed the plot centre) were counted once.

Figure 6: Edge plot mirage methodology for narrow debris piles or where transects fall into areas outside of the mapped debris extent.

3.3.3 Measurement of Pieces

Diameter is to be measured to the nearest cm in line with the woody debris orientation as shown in Figure 7.

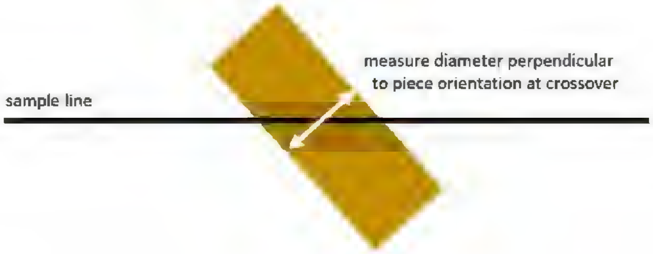

Figure 7: Measurement of diameter of each intersecting pieces

3.3.4 Classification of Debris

Each intercept diameter measured will be classified into the classes shown in Table 2. Note that the classes CH, CT and CO together contribute to conifer of plantation origin.

Table 2: Classification of Debris

CODE	CLASS	Aggregation level
CH	Conifer (e.g. Pine/Douglas) Plantation Harvest Residue *evidence of flush cuts / slovens / processor damage / branches cut off / cut stumps*	**Plantation conifer**
CT	Conifer (e.g. Pine/Douglas) Plantation Full Tree Residue *evidence of full tree slippage of preharvest standing trees / full tree lengths / root plates visible / branches attached.*	
CO	Conifer (e.g. Pine/Douglas) Other *Likely plantation origin, but no evidence of harvest residue (CH) or full tree lengths (CT)*	
CN	Conifer (e.g. Pine/Douglas) Non-Plantation *old man's pine, streambank large old open grown pine.*	N/A
N	Native Species	N/A
PT	Posts / Timber / Bins / Firewood	N/A
PW	Poplar or Willow	N/A
E	Eucalyptus	N/A
O	Other *other orchards species (apple, avocado, citrus etc), and where possible make comment species / type comment.*	N/A

Debris is to be classified for its link to the target event (Table 3). Weathered wood that is clearly aged beyond the event in question should be recorded separately and distinct from fresh woody debris likely from the target event. If the survey is to be completed sometime after the target event an additional classification is available where debris is likely from a more recent event.

Table 3: Classification of Debris Link to Target Event

CODE	DEBRIS EVENT LINK
Fresh	Likely from target event
Too Fresh	Likely from another event after the target event
Weathered	Likely from a previous event

3.3.5 *Species Identification*

To ensure expert and objective species identification were made of the LWD, two Interpine crew members measured each plot, and were accompanied at some plots by a local forestry industry representative. It should be noted that extensive weathering of measured debris frequently precluded confident species identification, resulting in assignment to the *Other* piece class. At least one photo was taken of every measured piece, along with additional plot photos, in order to assist potential revision of species classification. These images are included in the individual plot PDF reports.

3.3.6 *Piece Length Assessment*

Piece length data is collected with categorisation into length bins. While the LIS does not require length to calculate volume, reporting on piece length enables categorization of volume and potential impact or recovery activity. (Table 4).

Table 4: Piece Length Class

CODE	PIECE LENGTH CLASS
<1m	Less than 1m
<3m	Greater or equal to 1 m, but less than 3 m
<6m	Greater or equal to 3 m, but less than 6 m
<9m	Greater or equal to 6 m, but less than 9 m
<12m	Greater or equal to 9 m, but less than 12 m
>12m	Greater or equal to 12 m

3.3.7 *Calculating Woody Debris Volume and Summary*

Volumes were calculated using the following LIS formula (Wagner, 1968).

Volume of debris: $Volume\ m^3/\ ha = (\pi^2/8*L)*sum(d^2)$

Where:

V= volume per unit area (m^3/ha)
d= piece diameter at intersection (cm)
L= length of the sample line (m)

The resulting dataset yields volume per hectare by woody debris type. This yield of woody debris was applied to the mapped area of woody debris.

3.3.8 Randomised LIS Sampling Plot Locations and Intensity

Satellite imagery was used to pre-identify areas of woody debris depositions. Due to the nature of the material in isolated piles or long narrow beach accumulation, the plot placement was adapted from one of two approaches.

A. Predefined Plot Locations

The preferred method, in which random plots using geo-spatial plot sample tools (e.g., GeoMaster Assessment Planner) identifies plots which were navigated to using a GPS. Plots were placed using a random sampling approach (best suited for narrow width of the sample areas and yet to be determined time and resources). These plots are defined in mapped debris areas as described in 3.1.

B. Onsite Random Systematic Grid Plot Locations

Random systematic grid plot locations were not implemented for this assessment.

3.3.9 Field Plot Sampling Methodology Workflow in Practice

1. Determine the baseline (beach orientation, river flow direction)
2. Locate predefined plot locations using a GPS as outlined in 3.3.8 above, mark with stick paint mark – POINT A.
3. Record the GPS Location of the plot.
4. Determine plot orientation from base line with a random number between 0 and 90 (select from Appendix A).
5. Using a 30 m tape or measured survey rope, hold the tape/rope at 0m and 30m at Point A. Lay out the first transect of 10 m from the start point to POINT B. Then complete the triangle by pulling the remaining tape out to 20 m POINT C.
6. Record wood debris diameters where piece at intercept is =>100 mm and classify each piece by debris type, link to event, length class.
7. At each corner, check slope of transect and where greater than 5 degrees add an additional length to transect as per Table 2, recording any additional wood debris.
8. Record as depth of the pile per transect 10 m length which was not able to be assessed (if you measured all the pieces then depth will be 0 m). Record to nearest 0.5 m
9. Continue to measure wood debris each side of the triangle.
10. Take photos along each side of the transect, and any other items of interest for future reference.

Figure 8: Example of LIS plots laid out and photos taken of each side of the transects being surveyed.

4 Results

4.1 Wood Debris Mapping and Sample Plot Allocation

Mapping approximately 50 km of coastline from Kaiteriteri to Tāhunanui identified a total of 30 ha of potential debris piles on coastal beaches and adjacent to river mouths.

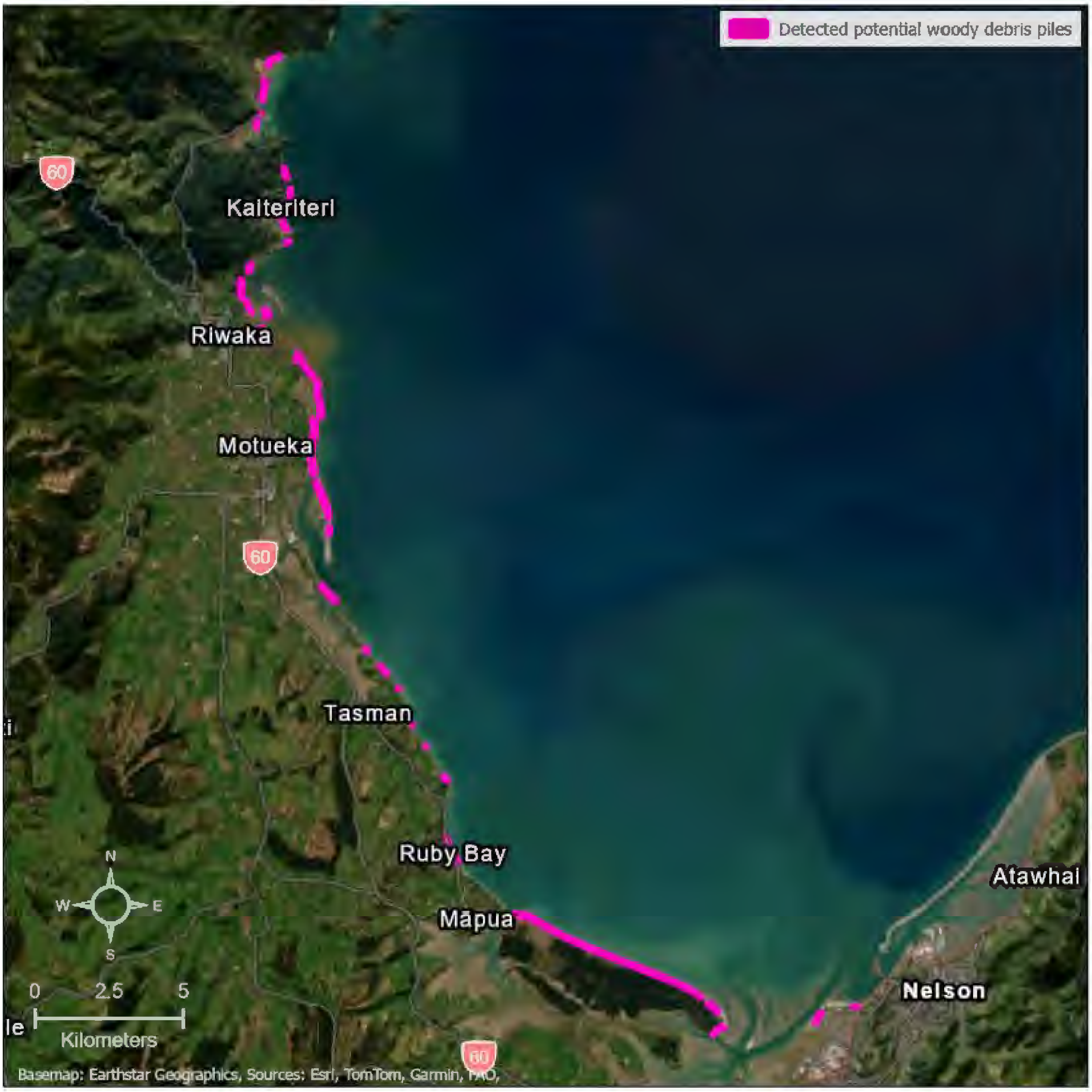

Figure 9: Woody debris detected in post event satellite imagery to set sampling frame for survey (note polygon areas are exaggerated for visualisation).

From the mapped area, 86 random plots were allocated for potential survey, 58 of which were measured during July 2025. One additional ad-hoc plot was installed in the field at Kaiteriteri for a total of 59 measured plots (Table 5). The overall sampling intensity of 0.51 ha/plot represents a high-intensity sample across the AOI.

Figure 10: Predetermined random sample plot locations, showing planned and completed plots.

The total area of mapped debris zone, as well as the number of ground survey plots per hectare, are shown in Table 5. A total of 59 plots were measured. Figure 14 displays the images taken during the survey using ESRI Survey123. Appendix E contains detailed field plot reports for future reference.

Figure 11: Field Survey images gathered using Survey123

Table 5: Woody debris areas by zone and planned and measured plots.

Zone	Area (ha)	%	Planned plots		Measured plots	
			Number	*ha/plot*	*Number*	*ha/plot*
Jacket Island	1.61	5%	2	0.80	0	N/A
Kaiteriteri	1.42	5%	14	0.10	10	0.14
Kina	0.23	1%	3	0.08	1	0.23
Mārahau	1.27	4%	9	0.14	7	0.18
Motueka	12.89	43%	22	0.59	13	0.99
Rabbit Island	8.30	28%	14	0.59	14	0.59
Riwaka	2.27	8%	15	0.15	9	0.25
Ruby Bay	0.36	1%	2	0.18	2	0.18
Tāhunanui	1.40	5%	3	0.47	3	0.47
Tasman	0.23	1%	2	0.11	0	N/A
Total	**29.99**	**1**	**86**	**0.35**	**59**	**0.51**

4.2 LINE INTERSECT SAMPLING OF WOOD DEBRIS

4.2.1 Tasman Bay

A total of 59 plots were installed and measured from the 17th to 21st of July 2025. The 59 plots sampled focused on river mouths and beaches. Plots were selected from the random pre-planned plot network. The number of plots collected within each zone was constrained by time and access. All plots within the Tasman and Jackett Island Zone plots were inaccessible during the fieldwork period. A single plot (plot 65 at Riwaka) was abandoned due to its hazardous location on a breakwater with an incoming tide. While some plots did fall in locations where transects were free from measurably sized pieces (or, in some cases, any pieces at all), these plots were still measured as they lay within broader areas where woody debris had accumulated within the mapped AOIs. Overall, the measured plots represent a plotting intensity of 0.51 ha per plot of mapped woody debris across Tasman Bay.

Plots show an average of 102.8 m^3/ha in the woody debris piles mapped across the region (Table 6, Figure 12) with a probable limit of error (PLE) of 34.6 % (95 % confidence interval of the mean expressed over the mean). Note that these statistics are inclusive of plots where no pieces of measurable size intersected transects, which therefore yielded zero volume.

Table 6: Average volume and percentage of total volume of LWD by class, across all measured plots.

	CODE	CLASS	Volume (m^3/ha)	Percentage of total volume	Combined percentage
Combined plantation conifer	CH	Conifer (e.g. Pine/Douglas) Plantation Harvest Residue	5.6	5	**11**
	CT	Conifer (e.g. Pine/Douglas) Plantation Full Tree Residue	0	0	
	CO	Conifer (e.g. Pine/Douglas) Other *Likely plantation origin*	6.0	6	
All other classes	CN	Conifer (e.g. Pine/Douglas) Non-Plantation	21.5	21	**89**
	N	Native Species	11.7	11	
	PT	Posts / Timber / Bins / Firewood	4.7	5	
	PW	Poplar or Willow	6.5	6	
	E	Eucalyptus	5.5	5	
	O	Other	41.3	40	
	Total		**102.8**	**100**	**100**

Plantation pine/conifer accounted for 11 % of the total survey volume per hectare (11.6 m^3/ha) with the next highest classification being other at 40% (41.3 m^3/ha). It should be noted that the high proportion of other is largely due to difficulties in confidently identifying the species of heavily weathered wood. 11% of measured pieces were identified as native, and 6% as poplar/willow. Pine/conifer harvest slash accounted for 5 % of the total survey volume per hectare (5.6 m^3/ha). No measured pieces were identified as full-tree plantation conifer. 21% of measured pieces were identified as non-plantation conifer.

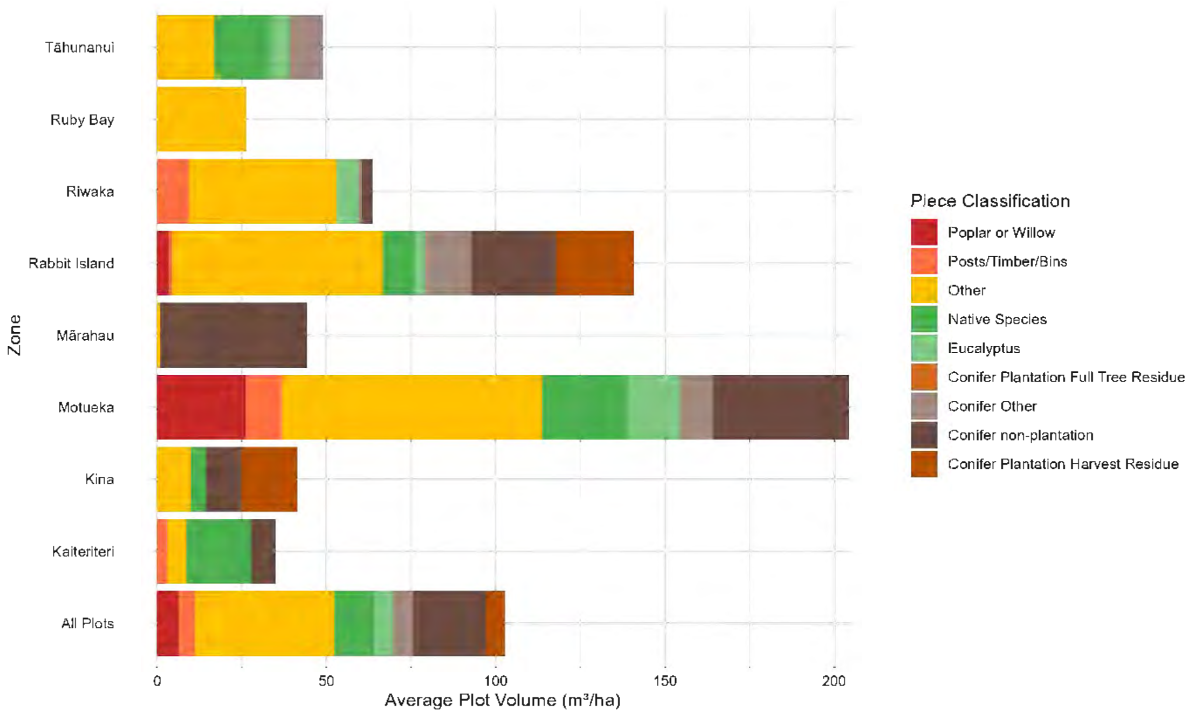

Figure 12: Average woody debris volume for each zone, and across all plots, by piece classification.

Spatially, the occurrence of LWD associated with plantation forestry (CH, CT, CO) was not extensive, but mostly contained within distinct areas. This is evident when considering the volume and proportion of LWD belonging to the plantation classes (CH, CT and CO) at the plot level (Figure 13, Figure 14). This is also evident at the zone level, with plantation classes being absent from some zones (Figure 12, Figure 15)

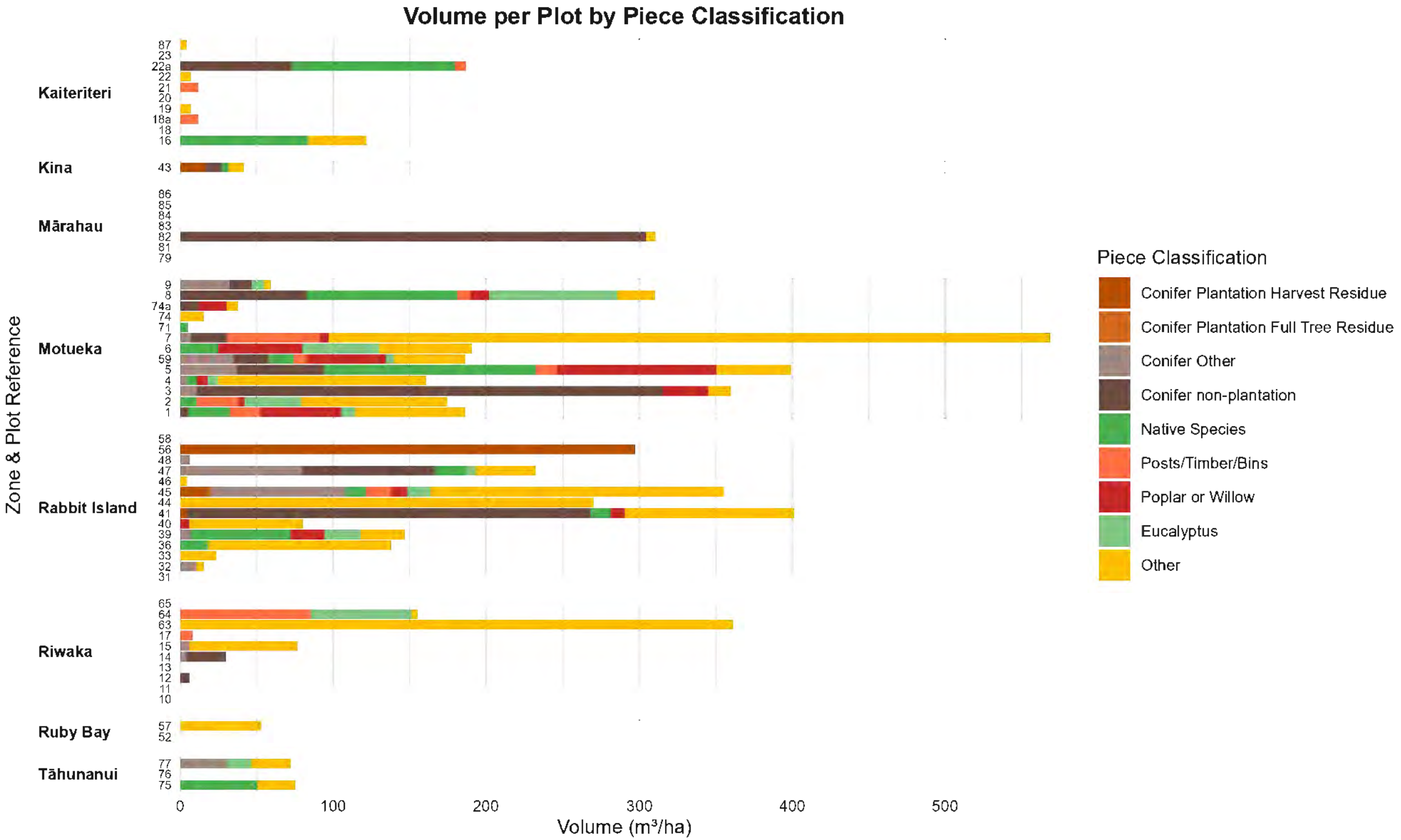

Figure 13: Plot level woody debris volumes across the surveyed zones. Note the presence of zero-volume plots where all pieces were below the measurement threshold. Some of these plots had no pieces intersecting transects.

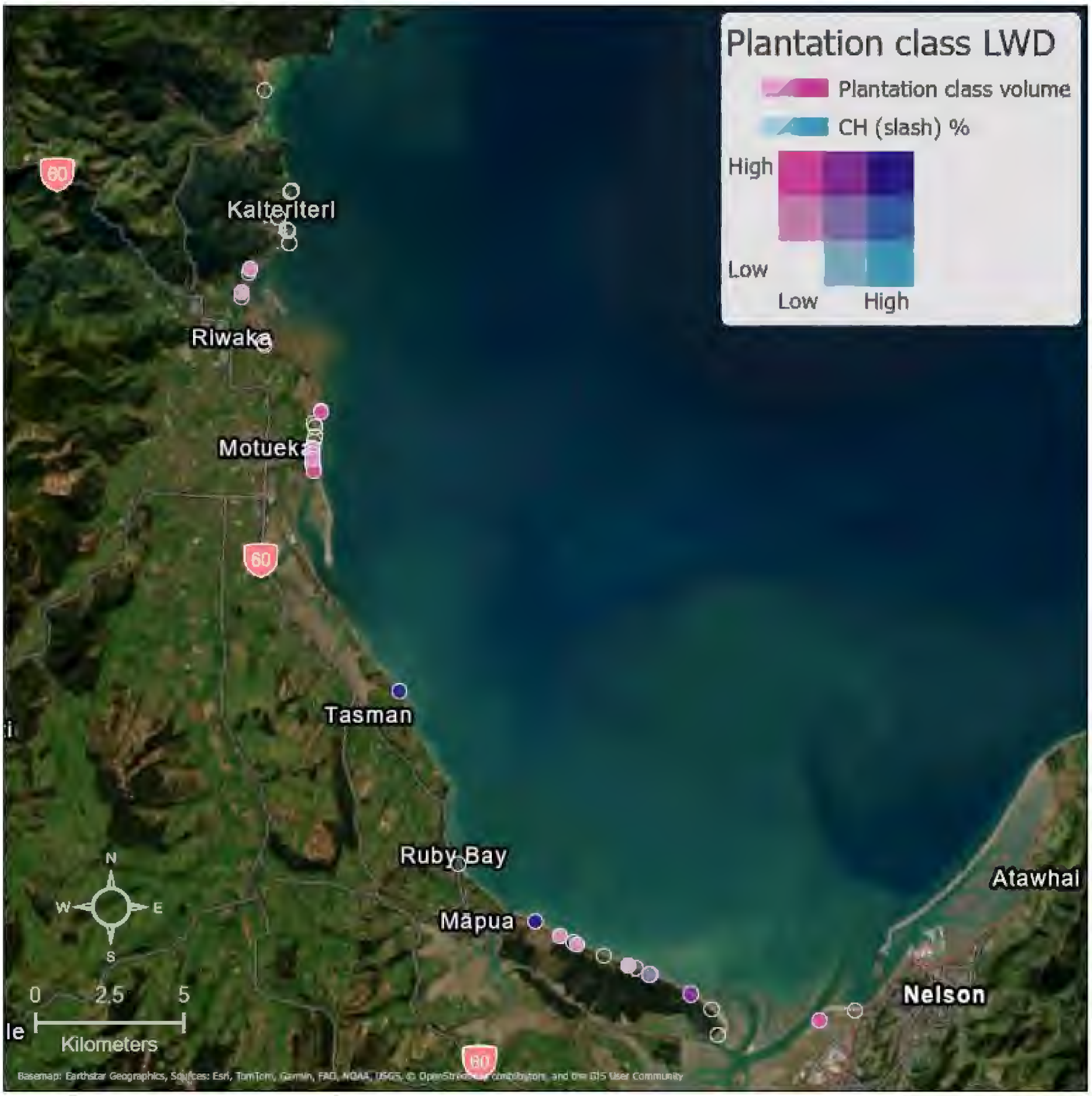

Figure 14: Bivariate map of plantation class LWD, showing plot-level volume of LWD from plantation classes (CH, CT, CO) and the percentage plot-level LWD volume assigned to the CH (slash) class. Plots represented by empty circles had no LWD of classes CH, CT or CO. The plot-level volume of LWD belonging to plantation classes, CH, CT or CO, increases vertically (pink) in the legend diagram, while the plot-level percentage of LWD volume belonging to the CH class increases horizontally (blue) in the legend diagram. Plots with a high volume of plantation class LWD, and a high percentage of CH (slash) appear purple.

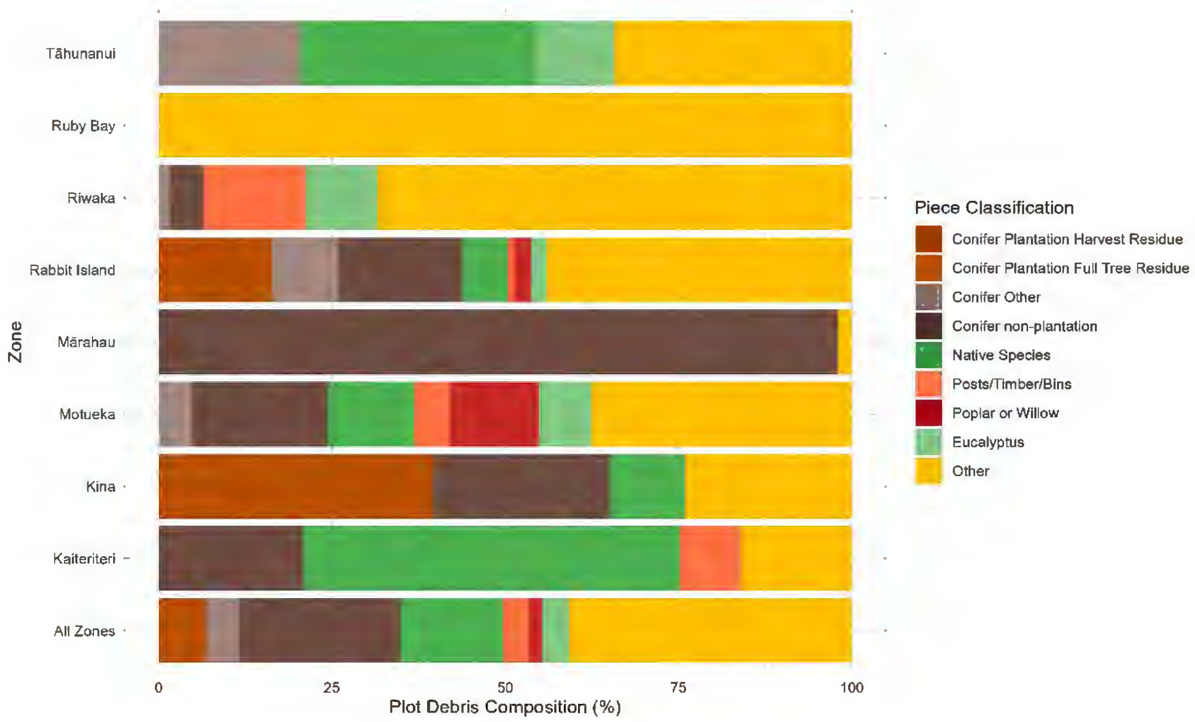

Figure 15: Percentage composition of woody debris plots by piece classification.

Overall, the distribution of pieces was dominated by smaller diameters, with most measured pieces having a diameter between 100 and 150 mm (Figure 17). The mean diameter overall was 202 mm, with a standard deviation of 142.2 mm.

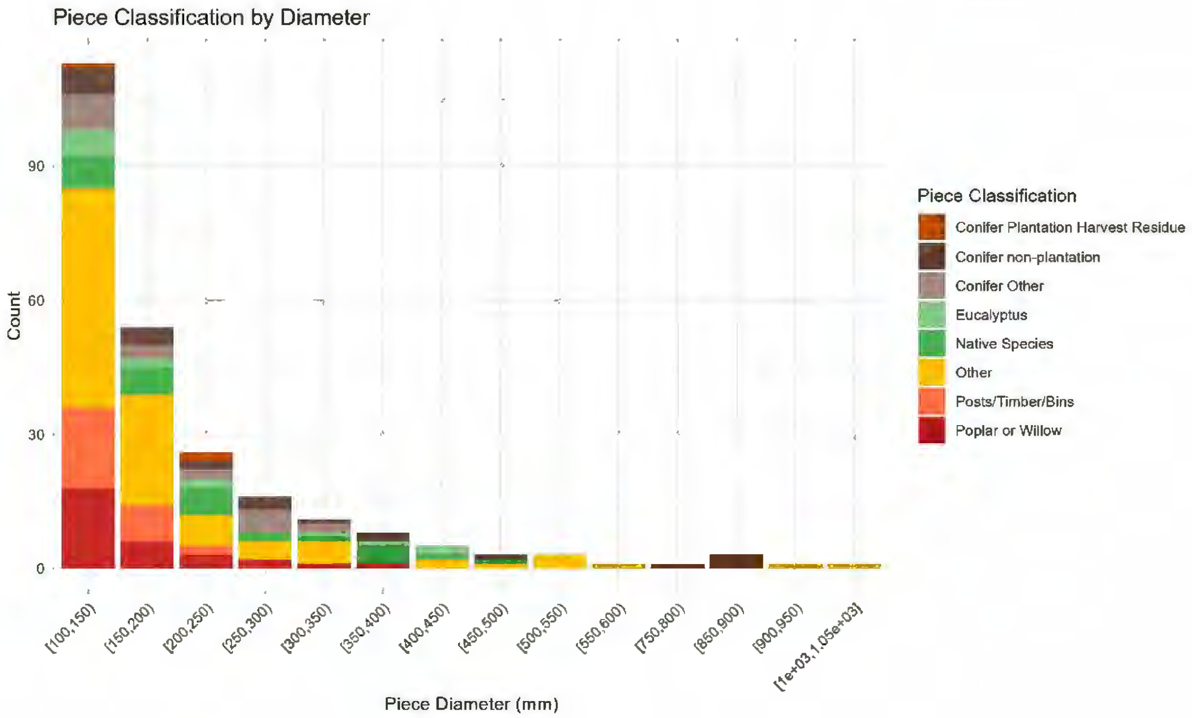

Figure 16: Piece classification by diameter, diameter has been binned in 50 mm increments.

Table 7: Mean and standard deviation (s.d.) of measured piece diameter.

Piece Classification	Mean diameter (mm)	s.d. diameter (mm)
Conifer Other	193.8	79.7
Conifer Plantation Harvest Residue	342.5	342.4
Conifer non-plantation	302.0	232.5
Eucalyptus	211.1	115.5
Native Species	225.6	103.2
Other	194.6	152.4
Poplar or Willow	159.5	72.5
Posts/Timber/Bins	154.5	20.2
Overall	**202.0**	**142.2**

Most measured pieces belonged to length classes of <1 m, <3 m and <6m, with 90% of measured pieces being 6 m or less in length. The longest observed pieces that could be assigned to a species class belonged to Eucalyptus (where there was evidence of complete or near-complete stems) Poplar or Willow and Native Species.

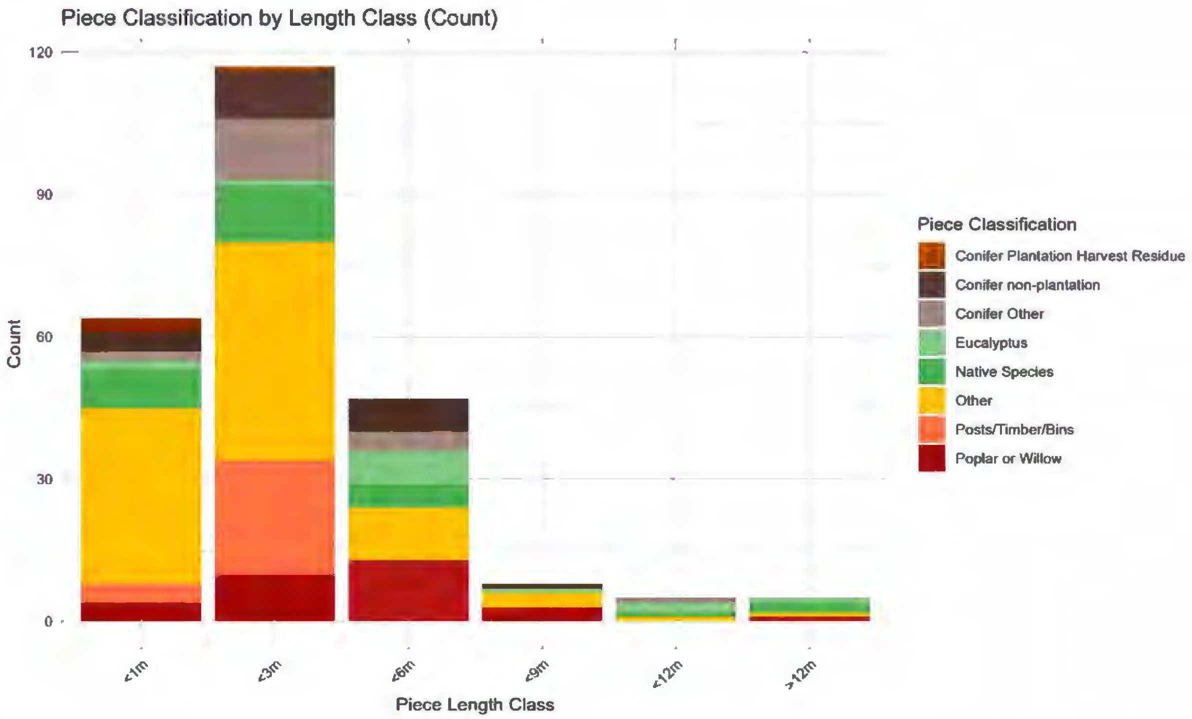

Figure 17: Piece classification by length class, from the survey length class bins.

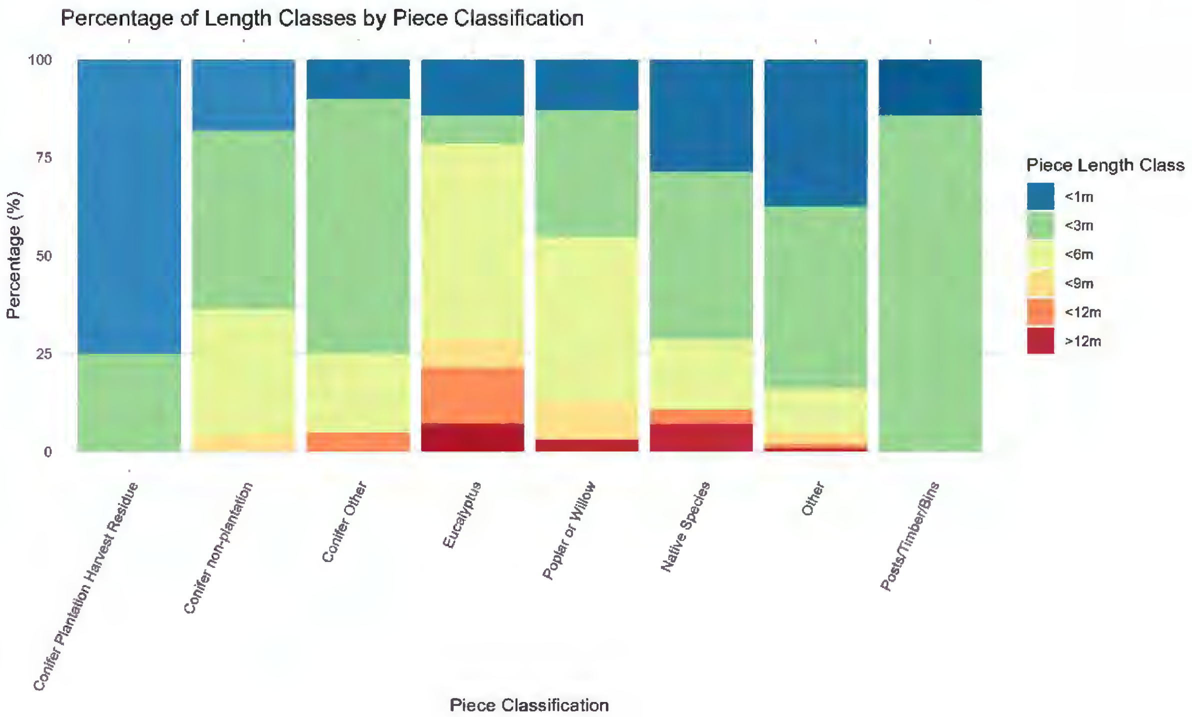

Figure 18: Percentage of length classes by piece classification.

The proportion of measured pieces that could be confidently assigned to the *Fresh* Piece Event Link class was relatively low. Most of the observed pieces were substantially weathered, with little to no bark present and extensive rounding and chipping/pitting. As well as indicating that much of the measured woody debris had entered water ways and/or reached the coast prior to the target storm events, this also complicated the identification and species assignment of many pieces, accounting for the high proportion of pieces assigned to the *Other* piece classification.

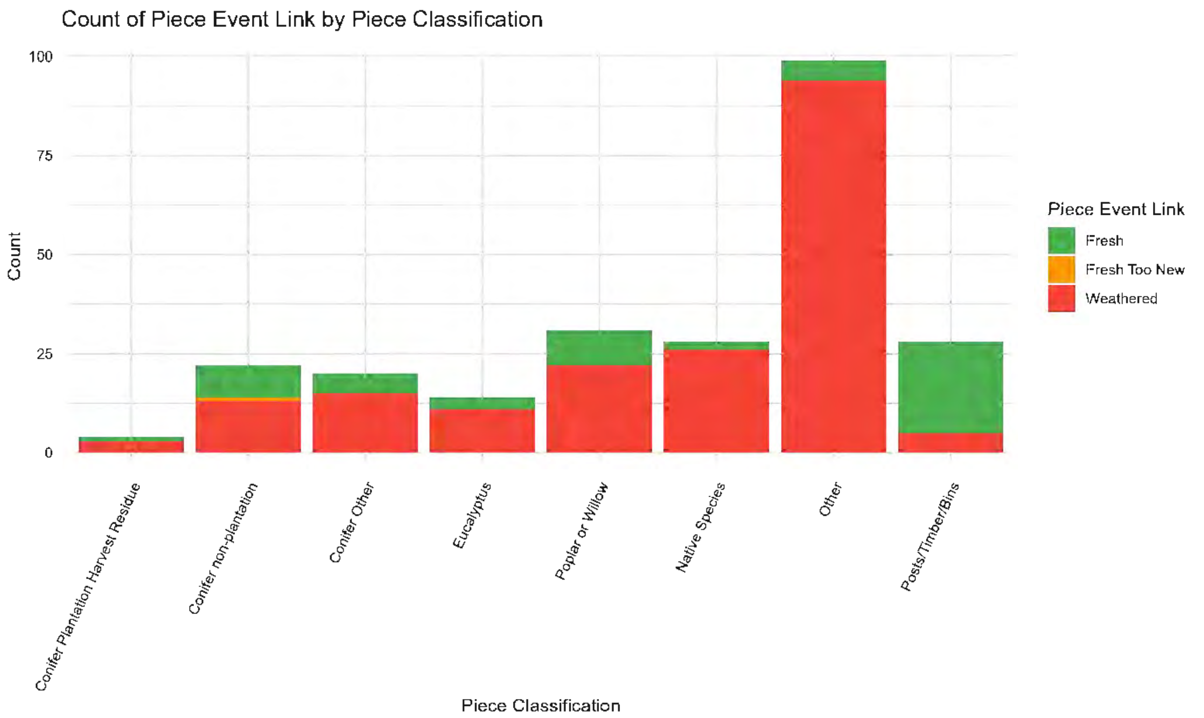

Figure 19: Piece event link (extent of weathering) by piece classification.

4.2.2 Kaiteriteri

The Kaiteriteri woody debris deposition AOI was measured to be 1.4 ha. 10 plots were measured, representing a plotting intensity of 0.14 ha per plot of mapped woody debris.

Plots show an average of 35 m^3/ha in the woody debris piles mapped across the Kaiteriteri zone with a PLE of 132%.

The total Kaiteriteri survey volume per hectare at Kaiteriteri was 186 m^3/ha, with the highest classification being native at 54 % (19 m^3/ha). Non-plantation conifer comprised 21% of woody debris (7 m^3/ha).

No measured LWD at Kaiteriteri was assigned to the CH, CT or CO classes.

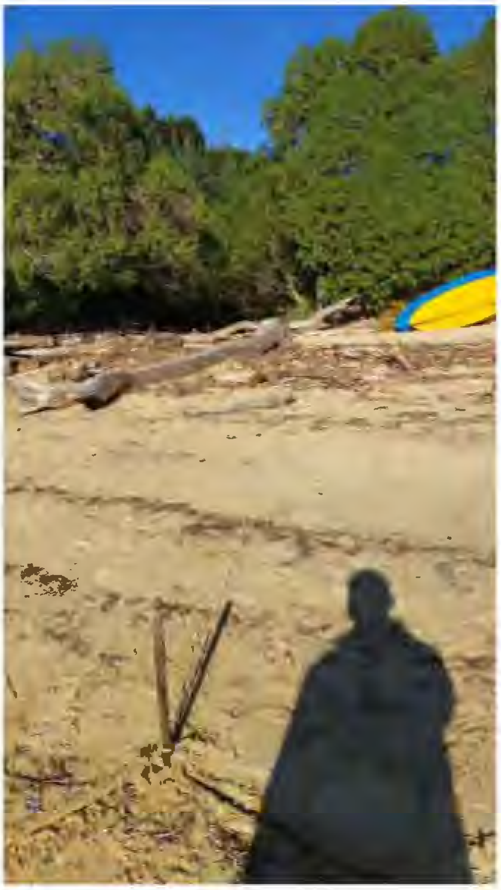

Figure 20: Transect C of plot 19 at Kaiteriteri. Note that the largely clean transect is located near an area of larger LWD accumulation - this small area in the depression of a stream channel entering the beach was the most concentrated accumulation of LWD seen in the Kaiteriteri zone.

4.2.3 Kina

The Kina woody debris deposition AOI was measured to be 0.23 ha. One plot was measured, representing a plotting intensity of 0.23 ha per plot of mapped woody debris.

Plots show an average of 41 m^3/ha in the woody debris piles mapped across the Kina zone. As there was only a single plot measured, no PLE is available at the zone level.

Plantation pine/conifer accounted for 40 % of the total Kina survey volume per hectare (16 m^3/ha), all of which was classified as harvest slash (CH), with the next highest classification being non-plantation conifer (CN) at 25 % (10 m^3/ha).

Figure 21: Plot 43, Transect B at Kina Beach.

4.2.4 Mārahau

The Mārahau woody debris deposition AOI was measured to be 1.27 ha. 7 plots were measured, representing a plotting intensity of 0.18 ha per plot of mapped woody debris.

Plots show an average of 44 m^3/ha in the woody debris piles mapped across the zone with a PLE of 244 %.

None of the measured debris pieces at Mārahau were classified as plantation pine/conifer. 98% (43 m^3/ha) was classified as non-plantation conifer (CN). The remainder was classified as other. It should be noted that for 6 of the 7 plots at Mārahau all transects were clear of debris pieces over the measurement threshold.

Figure 22: Area in vicinity of Plot 84 at Mārahau showing scattered LWD pieces, and more extensive cover of wood pulp material.

4.2.5 Motueka

The Motueka woody debris deposition AOI was measured to be 12.9 ha. 13 plots were measured, representing a plotting intensity of 1.0 ha per plot of mapped woody debris.

Plots show an average of 204 m^3/ha in the woody debris piles mapped across the zone with a PLE of 49.4 %.

Class CO accounted for 5% of the total Motueka survey volume per hectare (10 m^3/ha), and this was the only plantation class that measured pieces were assigned to at Motueka. The most frequent classification was other at 38 % (77 m^3/ha). The high proportion of other was largely due to heavy weathering precluding confident species attribution.

Non-plantation conifer (CN) accounted for 20% of the Motueka survey volume (40 m^3/ha). Native comprised 12% (25 m^3/ha), poplar/willow 13% (26 m^3/ha) and posts/timber/firewood 5% (11 m^3/ha)

There was no clear evidence of pine/conifer harvest slash measured in plots at Motueka. Some non-plantation conifer did, however, exhibit evidence of having been cut. These pieces exhibited a combination of poor form and cut patterns that were inconsistent with plantation practices.

Figure 23: View of the area surrounding Plot 59 at Motueka, looking south-east.

4.2.6 Rabbit Island

The Rabbit Island woody debris deposition AOI was measured to be 8.3 ha. 14 plots were measured, representing a plotting intensity of 0.59 ha per plot of mapped woody debris.

Plots show an average of 141 m^3/ha in the woody debris piles mapped across the zone with a PLE of 60%.

At Rabbit Island, 16% (23 m^3/ha) of the LWD volume was assigned to CH, and 10% to CO (14 m^3/ha), therefore plantation pine/conifer contributed 26 % of the total Rabbit Island survey volume overall. The highest classification was other at 44 % (62 m^3/ha).

Seven percent of the Rabbit Island survey volume was identified as native (9 m^3/ha), while eucalyptus, poplar/willow and posts/timber/firewood contributed minor amounts to the volume.

Figure 24: View of the area surrounding Plot 45, Rabbit Island.

4.2.7 Riwaka

The Riwaka woody debris deposition AOI was measured to be 2.3 ha. 9 plots were measured, representing a plotting intensity of 0.25 ha per plot of mapped woody debris.

Plots show an average of 64 m^3/ha in the woody debris piles mapped across the zone with a PLE of 130%.

The only plantation pine/conifer class measured at Riwaka was CO, which accounted for 2% of the total Riwaka survey volume per hectare (1 m^3/ha), with the highest classification being other at 68% (44 m^3/ha). Relatively high proportions of posts/timber/firewood (15%, 9 m^3/ha) and eucalyptus (10%, 7 m^3/ha) were identified at Riwaka. The posts/timber/firewood class included apple bins.

Figure 25: View of area surrounding Plot 64, Riwaka.

4.2.8 Ruby Bay

The Ruby Bay woody debris deposition AOI was measured to be 0.36 ha. 2 plots were measured, representing a plotting intensity of 0.18 ha per plot of mapped woody debris.

The plots showed an average of 26 m^3/ha in the woody debris piles mapped across the zone. The PLE for this zone is poorly constrained due to the measurement of only two plots so is not provided for this zone. All measured pieces at Ruby Bay were classified as other, due largely to substantial weathering precluding specific identification.

Figure 26: Plot 57, Ruby Bay.

4.2.9 Tāhunanui

The Tāhunanui woody debris deposition AOI was measured to be 0.23 ha. 3 plots were measured, representing a plotting intensity of 0.47 ha per plot of mapped woody debris.

Plots show an average of 49 m^3/ha in the woody debris piles mapped across the region with a PLE of 215%.

The only plantation pine/conifer class measured at Tāhunanui was CO accounting for 20 % of the total Tāhunanui survey volume per hectare (10 m^3/ha). The most frequent occurring classifications were both other and native at 34% (17 m^3/ha) each. The remainder of the pieces measured within plots was Eucalypt. No pine/conifer harvest slash accounted occurred within plots at Tāhunanui, although it was evident in the wider area.

Figure 27: Area surrounding Plot 77 at Tāhunanui.

5 DISCUSSION AND RECOMMENDATIONS

5.1 FINDINGS AND DISCUSSION

The results of this study show that large woody debris presenting clear evidence of harvest activity, i.e., flush cuts / slovens / processor damage / branches cut off / cut stumps and classified as pine or conifer harvest slash accounted for approximately 5% of the total woody debris measured on Tasman Bay beaches following the June and July severe weather events. An additional 6% of LWD was classified as conifer with a likely plantation origin. There were no measured examples of full conifer stems of plantation origin with the root ball still attached on plot transects. Overall, 32% of measured pieces were classified as conifer species. This includes 21% of measured pieces which, due to poor form inconsistent with crop trees from plantation forests, were classified as conifer non-plantation. Such pieces may potentially have originated as old man pine, single or sparsely established trees in open areas, or within shelterbelts.

Figure 28: Example of large piece classified as conifer non-plantation (Plot 3, Transect A, measured piece 4).

While the Tasman Region features extensive areas of conifer plantation (predominantly Pinus radiata) on hill country and in catchment headwaters, areas of coastal non-plantation P. radiata were noted during this survey along, and near, the coast. This indicates that there are potentially highly localised sources of coniferous LWD that may contribution to accumulation on beaches, particularly when located on actively eroding landforms and shorelines (e.g., Figure 29).

Figure 29: Actively eroding cliff occupied by non-plantation P. radiata, and freshly fallen trees, adjacent to Plot 17 at Riwaka.

It should be noted that much of the measured LWD pieces were significantly weathered, with no remaining bark or attached foliage to support confident species classification. Weathered wood also tended not to exhibit evidence of recent breakage, with ends of pieces and remaining sections of branches featuring rounded edges. This resulted in a high proportion of pieces (40% overall) being classified as other. The high degree of weathering of much of the observed and measured LWD may reflect longer-term transport of LWD from its origin and through the river systems of local catchments before reaching the coast. It is possible that pieces may undergo several instances of deposition and re-mobilisation during subsequent flood events and may be partially or fully submerged in water bodies for extended periods of time, which would further promote weathering of the wood. These factors limit the certainty with which the origin of LWD can be linked to specific land uses and weather and flooding events.

LWD classified as native made up 11% of the LWD volume measured across all plots. The native proportion was as high as 54% at Kaiteriteri, while LWD classified as native was absent from plot transects at Mārahau, Riwaka and Ruby Bay. Overall, the proportion of observed and measured native LWD appears to be consistent with potential local source areas of native LWD within the Tasman region, particularly near to the coastline.

Eucalyptus was observed and measured on plot transects at Motueka, Rabbit Island, Riwaka and Tāhunanui. Across all plots it represented 5% of measured volume but was as high as 11% and 10% at Tāhunanui and Riwaka respectively, and as low as 2% at Rabbit Island. Similarly to P. radiata, Eucalypt trees were noted growing along the coastline, either as single trees or in small non-plantation stands, at several locations during the field component of this study.

Figure 30: Small stand of non-plantation Eucalyptus trees on Kaka Point at eastern end of Breaker Bay, Kaiteriteri, in proximity to Plot 23.

The posts/timber/bins LWD class, which represents manufactured and derived timber products and includes firewood comprised 5% of measured volume overall. This class was present amongst measured woody debris at Kaiteriteri (9% of zone volume), Motueka (5% of zone volume), Rabbit Island (1% of zone volume) and Riwaka (15% of zone volume). At both Motueka and Riwaka timber apple bins were present amongst measured LWD, which are likely to have originated on nearby orchards. At Motueka, a section of intact boardwalk was measured within Plot 7. The presence of such debris highlights the infrastructure damage associated with these flood events, as well as the potential for vulnerable infrastructure to itself become hazardous LWD.

Figure 31: Apple bin measured in Plot 64 at Riwaka (left) and section of boardwalk and apple bin measured in Plot 7 at Motueka (right).

LWD assigned to the poplar and willow species class was identified at Rabbit Island (2% of zone volume) and Motueka (13% of zone volume). These species are commonly planted alongside waterways for amenity values and erosion control. Aerial imagery of 0.25 m resolution was commissioned by the Tasman District Council and captured between December 26, 2024, and 27 March 2025. Using this imagery as a baseline for comparison with the SkySat 0.5 m imagery acquired on July 19, 2025, indicates that bank erosion during the recent Tasman Storm events has likely resulted in riparian plantings, including willow, toppling into waterways such as the Motueka River. As willow trees are deciduous, comprehensive and systematic assessment of their loss along waterways during winter is challenging. The acquisition of additional high resolution satellite imagery in the spring would allow the impact of these storms on riverside trees, and their potential contribution to LWD in the region, to be more robustly quantified.

Figure 32: Summer 2024/2025 Tasman District Aerial Imagery (0.25 m), top, and SkySat 0.5 m imagery captured 19/07/2025 (bottom), showing areas of vegetation loss (red ellipse) and silt deposition alongside the Motueka River.

With a mean overall volume of 103 m^3/ha, the measured volumes of LWD across the beaches of Tasman Bay were low relative to comparable recent events in New Zealand (e.g., Hawke's Bay 2023, where woody debris piles had a mean volume of 428 m^3/ha). Where LWD did occur, it was often scattered in nature, with areas of localised concentration. The depth of debris piles rarely exceeded the diameter of the largest pieces (i.e., there was frequently only a single layer of debris present). In terms of length class, 74% of measured LWD was less than 6 m in length, while only 4% was greater than 9 m in length. This indicates that most of the measured material is of relatively low destructive potential. It also reflects that

Future post-storm LWD assessments in this region (and elsewhere in New Zealand) will be better informed if baseline LWD quantities and type are better known and characterized. While intensive field plotting is most beneficial in the wake of storm events of interest, the establishment of reference photo points along the coastline, and/or routine monitoring of coastlines via remote sensing could contributed to improved understanding of baseline LWD conditions. Satellite remote sensing, while cost effective, is currently best suited to mapping the areal extent of LWD accumulation and does not yet yield volume estimates or characterisation of the LWD type.

Much of the plantation forest areas of the Tasman Region occupy moderate to steep hill country and erosion prone soils. While there is the potential for LWD to originate within areas of plantation forest during severe weather events, overall erosion and sediment production rates are reduced compared to other productive land uses (Basher & Dymond, 2013; Fahey & Marden, 2000; Fransen & Brownlie, 1996; Page et al., 1999; Phillips et al., 2012). By increasing the level of tall, closed-canopy woody vegetation, the overall risk of sedimentation decreases by a factor of 3 to 4 (Fahey & Marden, 2000). The Pakuratahi land-use study (Eyles & Fahey, 2006) states, "Over the 12-year period of record, the total suspended yield from the pasture catchment was over one-and-a-half times that for the catchment going through the forest rotation". Further analysis into the aspect, slope, and vegetation cover, type and so forth of areas that have eroded into the waterway after this event will help guide future land use decisions, and a topic for future work. Ongoing work to improve the management of harvest residue and reduce potential LWD sources within plantation forests will assist in reducing the potential LWD volumes following storm events, while likely also resulting in an increase in the propotion of LWD from other sources.

5.2 CONCLUSION

Following two severe weather events during June and July of 2025, there was mobilisation and accumulation of LWD on beaches across Tasman Bay. Overall, measured volumes of LWD were relatively low compared to similar recent events in New Zealand (e.g., Cyclone Gabrielle in Hawke's Bay). The proportion of LWD that could be confidently classified as slash was relatively low (5%), with another 6% being other plantation conifer material. A larger proportion of LWD volume (21%) was classified as conifer non-plantation on the basis of form and other characteristics inconsistent with managed crop trees. Substantial weathering limited this survey's ability to confidently assign a large proportion of measured LWD pieces to a species class, resulting in 40% of the volume being classified as other. While it is likely that some of this material has plantation origins, these links cannot be made with a high degree of certainty. Overall, it is apparent that these storm events led to damage to the landscape affecting all types of standing woody vegetation on the most erodible sites within the Tasman Region.

The data show that LWD deposits across Tasman Bay do not contain high levels of harvest residue. Therefore, it is inaccurate to use the catchall term 'slash' when referring to causes of damage to infrastructure across the Tasman region.

6 ACKNOWLEDGEMENTS

Interpine would like to acknowledge the following parties for their contribution to the project.

This report builds on the methodology developed for woody debris assessment in Hawke's Bay following Cyclone Gabrielle: Pan Pac Forest Products Ltd (Hamish Scown, Anna Zhang, and Damon Wise), RedAxe Forestry Intelligence (James Powrie), Aratu Forests Ltd (Andy Costello), Hawke's Bay Forestry Group (Damon Wise, Matthew Croft, James Powrie, and Paul Van Der Voort), and Kees Weytmans for their contributions to refinement of the methodology applied.

Dan Montgomeroy of Tasman Pine Forests Ltd provided guidance on the AOI, assisted in the field and coordinated access to sites, particularly Mārahau. Marty Kalliher of PF Olsen provided access to Rabbit Island.

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USDA Forest Service Research Note PNW-183

Further detail on this can be found in a review of the line intercept approach.

- Harvest Cutover Residue Assessment > History | Interpine Innovation
- Cutover Residue Assessment Using Line Intercept Sampling | Interpine Innovation
- Drone based Harvesting Cutover Merchantable Volume Assessment | Interpine Innovation

Downloads

- NZQA Competenz 6956 Unit Module Study Guide:
- EXCEL Sheet – Plot Form and Appendices
- Woody Debris Sampling Methodology (as a PDF)

8 APPENDICES

8.1 APPENDIX A – RANDOM BEARINGS 0 TO 90 AND SLOPE ADJUSTMENT TABLE FOR 10M

Random Number Table Between 0-90				
46	74	90	46	61
88	3	53	75	1
3	3	69	27	70
58	56	59	2	66
22	8	71	57	51
89	64	69	60	38
79	30	85	29	9
90	11	32	60	40
50	82	11	4	74
70	73	66	68	88
1	69	42	83	33
10	2	22	74	70
59	50	63	22	79
66	69	56	77	65
72	47	5	8	27
26	15	88	5	28
62	64	65	61	66
52	59	69	27	81
26	66	44	69	65
2	63	61	52	84
62	2	54	60	73
65	48	45	11	19
6	25	73	72	60
79	16	19	6	85
7	4	43	51	10
38	71	43	22	58
10	14	4	35	1
50	78	4	49	34

Slope	Slope Adjusted 10m Dist. (m)	Extra Length (m)
0	10.00	0.00
5	10.04	0.04
7.5	10.09	0.09
10	10.15	0.15
12.5	10.24	0.24
15	10.35	0.35
17.5	10.49	0.49
20	10.64	0.64
22.5	10.82	0.82
25	11.03	1.03
27.5	11.27	1.27
30	11.55	1.55
32.5	11.86	1.86
35	12.21	2.21
37.5	12.60	2.60
40	13.05	3.05
42.5	13.56	3.56
45	14.14	4.14
47.5	14.80	4.80
50	15.56	5.56
52.5	16.43	6.43
55	17.43	7.43
57.5	18.61	8.61
60	20.00	10.00
62.5	21.66	11.66
65	23.66	13.66
67.5	26.13	16.13
70	29.24	19.24

8.2 Appendix B – Plot Form Paper Format

WOODY DEBRIS SURVEY FORM					
Plot Ref			Date & Time		
Location Description:					
Organisation & Plotting By:					
GPS:					
Random Orientation Bearing (0-90):					
Transect	**Slope (Deg)**	**SlopeDist (m)**	**Debris Depth (m)**	**Comment**	
A (A to B)					
B (B to C)					
C (C to A)					
Transect (ABC)	Diameter (cm)	Class/Type	Length Class	Event Link	Comment

8.3 APPENDIX C – FIELD PHOTOS

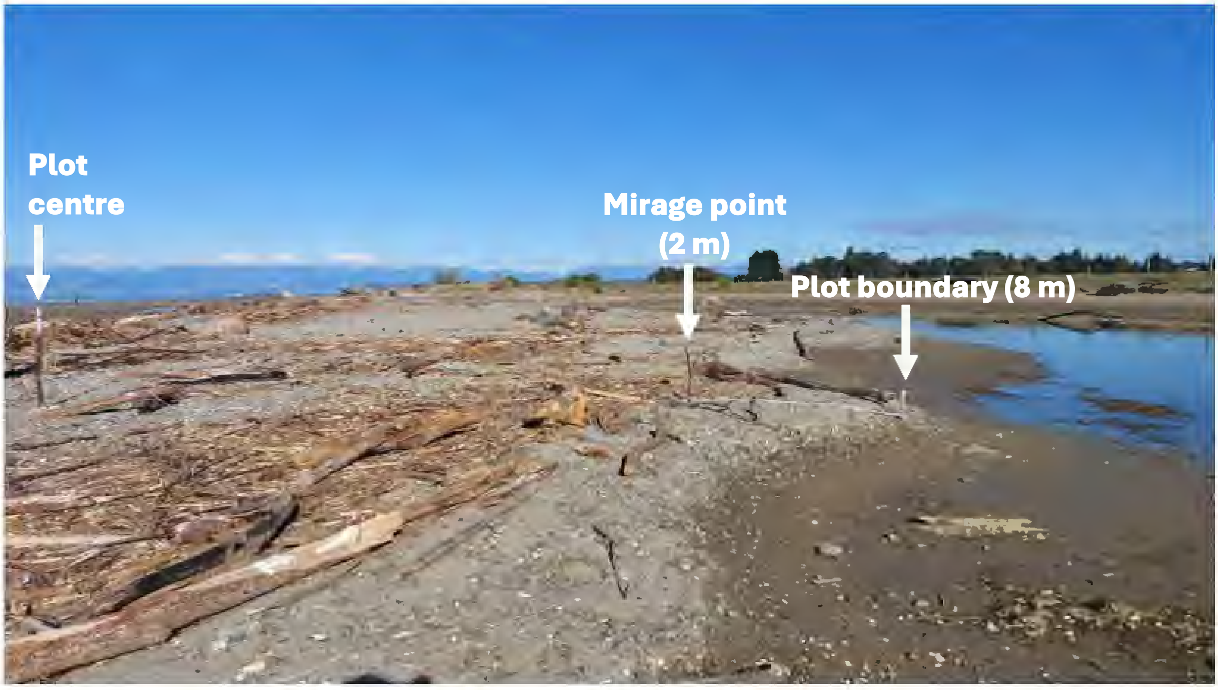

Figure 33: Example of mirage layout from Transect C of Plot 74a at Motueka.

8.4 Appendix E – Survey123 Field Records and Photos

Reports for each of the 59 plots surveyed can be provided and accessed using the link provided below. An example of the report format is shown below. Field crews took photos of all transects, and all of the pieces measured. This can also be made available as a geodatabase on request.


INTERPINE

Plot Reference: 3
Date: 22 July 2025 3:01 PM

Tasman Bay Storm Event July 2025
Post Event Woody Debris Assessment - Tasman Bay

Prepared for New Zealand Forest Owners Association
Print Date: Monday, 4 August 2025

Ref. No: J10098


1 Plot Information

Attribute	Value
Measurement Date	22 July 2025 3:01 PM
Plot Reference	3
Plot Crew Initials	NT TR
Risk Assessment	Safe to walk on debris, This is not a known contaminatated area, Area is not water-logged, Area does not have potential for collapse
Risk Assessment Other	
Plot Status	Measured
Plot Random Bearing (deg)	65
Edge Plot Status	Not an Edge Plot
Plot Comments	pinecones present, hay bale. most debris are small and in a narrow row.
Plot Location	Lat: -41.11232096462345 Lon: 173.02946840914638

Plot Location Maps

Attribute	Value
Transect Section	A (A to B)
Slope (deg)	0
Slope Distance (m)	10
Debris Depth (m)	1
Comment	


Photo Along Transect: B (B to C)

Attribute	Value
Transect Section	B (B to C)
Slope (deg)	0
Slope Distance (m)	10
Debris Depth (m)	0
Comment	Runs parallel along the debris ridge most material small and all under 100mm.

Download Link
Survey123 Plot Reports