



27 July 2025

**Address for Service:**

Ernslaw One Limited

Level 4, Building B, 8 Nugent Street, Grafton, Auckland 1023

Attention: Darren Mann, Chief Executive

**Submission on proposed changes to National Direction under the RMA**

Submitted by email to [ndprogramme@mfe.govt.nz](mailto:ndprogramme@mfe.govt.nz)

National direction consultation, Ministry for the Environment, PO Box 10362, Wellington 6143

**Package 2. Primary sector (Eight instruments of National Direction).**

Regarding proposed amendments to the:

**National Environmental Standards for Commercial Forestry.**

We refer:

<https://environment.govt.nz/publications/package-2-primary-sector-discussion-document/>

<https://environment.govt.nz/publications/attachment-2-2-proposed-provisions-amendments-to-the-resource-management-national-environmental-standards-for-commercial-forestry-regulations-2017/>

and the Regulatory Impact Statement (RIS)

<https://environment.govt.nz/what-government-is-doing/cabinet-papers-and-regulatory-impact-statements/interim-ris-rm-package/>

and

[www.mpi.govt.nz/consultations/proposed-changes-to-primary-sector-national-direction-instruments/](http://www.mpi.govt.nz/consultations/proposed-changes-to-primary-sector-national-direction-instruments/)

**Overview**

Ernslaw One Ltd (Ernslaw) welcomed the gazettal of the NES for Plantation Forestry (NES-PF) in 2017 which, as of 1 May 2018, significantly streamlined the regulatory and consenting framework for the forestry sector and the variability of regulation between Councils. The NES-PF much reduced our interaction and associated transaction costs with District Councils and, for a period of about five years, streamlined our interactions with Regional Councils, with the exception of our operations in the Tairāwhiti region, as regulated by the Gisborne District Council, where much of the land under plantation forestry is appropriately categorised as red zone in the National Regulation's associated Erosion Susceptibility Classification (ESC).

Ernslaw strongly supports the Government's rationale for proposed changes to the NES for Commercial Forestry (NES-CF 2017) in the current primary sector reform package. We concur with Forest Minister McClay's statements that recent adjustments to provisions in November

2023 have created an “*unworkable regulatory burden*” leading to “*confusion and cost*”, and that the current proposals “*will help restore national consistency and protect the sector’s right to operate*”.

We refer to Minister McClay statement dated Sept 2024:

[www.beehive.govt.nz/release/resource-management-reform-make-forestry-rules-clearer](http://www.beehive.govt.nz/release/resource-management-reform-make-forestry-rules-clearer)

and that of May 2025

[www.beehive.govt.nz/release/government-backs-commercial-forestry-practical-rule-changes](http://www.beehive.govt.nz/release/government-backs-commercial-forestry-practical-rule-changes)

### **Request to speak to this submission**

Should there be an opportunity to speak to this submission at a select committee or other forum, then Ernslaw requests to be heard. The principal author, Peter Weir, Fellow of NZIF, has worked in forestry in both Canada and NZ as a forest hydrologist and as a forest Geotech. Weir was registered as Professional Geoscientist (P. Geo.) in British Columbia with a scope of practice including assessing landslide terrain and undertook contract work for the BC Ministry of Forests investigating debris flows. Weir was one of four New Zealand experts selected by Scion and sponsored by MPI to visit Chile and Germany, Italy and Switzerland in Western Europe in 2013 to contribute to a study of forestry practices in relation to landslides occurring after harvest<sup>1</sup>. Between 2011 and 2017 Weir was a member of several MfE and MPI working and technical advisory groups assisting officials to develop the NES-Plantation Forestry. Weir is currently Principal Environment Advisor to Ernslaw One Ltd in New Zealand.

### **About Ernslaw One**

Ernslaw One Ltd (Ernslaw) owns or manages around 53,000 planted hectares of plantation forest across NZ, with total land holdings of 130,100 ha regulated by 12 Territorial Local Authorities (11 District Councils and one city council), 4 Regional Councils and 2 Unitary Authorities.<sup>2</sup>

Ernslaw is NZ’s largest grower of Douglas-fir and owns NZ’s only Douglas-fir seed orchard.

Ernslaw is a member of the NZ Forest Owners Association and as such is bound by the NZ Forest Accord signed with NZ’s main ENGOs in 1991.

Refer [www.nzfoa.org.nz/resources/file-libraries-resources/agreements-accords/10-nz-forest-accord/file](http://www.nzfoa.org.nz/resources/file-libraries-resources/agreements-accords/10-nz-forest-accord/file)

The NZ Forest Owners Association Facts and Figures publication (2023) ranks Ernslaw as NZ’s fourth largest forest owner by area and second largest owner of free hold land (~60,000 ha).

Refer [www.nzfoa.org.nz/images/Facts\\_and\\_Figures\\_2023-24\\_-\\_Web\\_version.pdf](http://www.nzfoa.org.nz/images/Facts_and_Figures_2023-24_-_Web_version.pdf)

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<sup>1</sup> Amishev D. et al 2014. New Forest Management Approaches to Steep Hills. Scion  
<https://www.mpi.govt.nz/dmsdocument/4586/direct/>

<sup>2</sup> Please refer to our web site for more information. We suggest that you watch our company video [About Us – Ernslaw One](https://www.ernslaw.co.nz/about) <https://www.ernslaw.co.nz/about>

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**9(2)(a)**

**Authorised by**

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## Submission

### PART A. Policy analysis

#### Regulation 6(4AA)

Ernslaw One does not believe that adequate policy analysis was undertaken prior to November 2023 to justify the introduction in of Regulation 6(4AA). This provision undermines the very intent of the national direction in the NES-CF by giving very wide discretion to Councils in matters relating to afforestation on private freehold land which, in combination with proposed regulatory change to prevent afforestation on low erosion risk land (Land Use Class (LUC) 1 to 5) and to severely limit afforestation on LUC 6 from being entered into the NZ Emissions Trading Scheme, has created huge investor uncertainty and will severely constrain NZs afforestation ambition putting our Paris Nationally Determined Contribution (NDC) for emission reductions target in doubt.

We cite two notable examples from Otago where councils are using Regulation 6(1A) and 6(4AA) to propose plan changes which would significantly further constrain commercial forestry:

In October 2024, the Otago Regional Council (ORC), under the direction of Ministers, withdrew a freshwater planning proposal (a plan change) that would have otherwise prohibited any further afforestation and could have constrained replant (potentially triggering very large deforestation liabilities under the Climate Change Response Act 2002; a serious matter that ORC appeared blind to).

**As evidence**, we submit below an extract from the proposed Otago Freshwater Plan 2024 in which ORC used the stringency afforded under Regulation 6(1A) to propose rules that would have closed out opportunity for afforestation and would have imposed very significant costs and uncertainty by requiring consenting on predominantly green Erosion Susceptibility Classification (ESC), and hence low erosion risk land. The stringency was proposed with no accompanying evidential basis, and therefore for no apparent environmental benefit, given there was no adverse risk to mitigate. We submit that ORC's planners went well beyond the intent of the stringency delegated under the NES-CF.

#### **Proposed Otago Freshwater Policy: FF-P9 – Planting forestry**

When compared to the land use as at 30 October 2024, manage the adverse *effects* associated with the establishment of *commercial forestry* by avoiding adverse *effects* on surface *water* yield and *groundwater* recharge in *rivers* and recharge areas of *aquifers* where the *take limit* is exceeded, or *environmental flows* or *levels* are not being achieved.

#### **Proposed Otago Freshwater Rule: FF-R19-CON1**

From 1 November 2026, the harvesting of commercial forestry, including any associated land use, disturbance of the bed of a lake or river, or discharge of contaminants or water to water or to land in circumstances where the water or a contaminant may enter water, is a controlled activity [*even though almost all Plantations in Otago are Green zoned*].

ORC reserves control over the following matters:

- (1) the quality and content of, and implementation of, the:
  - (a) harvest plan prepared in accordance with Schedule 6 of the NESCF; and

- (b) forestry earthworks management plan prepared in accordance with Schedule 4 of the NESCF; and
- (2) the management of critical source areas and, setbacks, and effects on natural inland wetlands, outstanding water bodies, and significant natural areas; and
- (3) the management of *riparian margins*, sediment, and slash; and
- (4) timing of *replanting* or grassing as an interim measure; and
- (5) the lapsing period and duration of the resource consent; and
- (6) review of the conditions of the resource consent; and
- (7) **the need for a bond**; and
- (8) the collection, recording, monitoring, and provision of information about the exercise of the resource consent; and
- (9) the extent to which the activity is consistent with the matters in APP8 – Mana whenua environmental indicators.

ORC's proposal for the imposition of bonds at harvest, item 7 above, is particularly concerning. That would have been crippling for farm foresters and wood lot owners and would likely have driven the perverse outcome of forests left unharvested.

Separately, the Waitaki District Council notified a plan change where very broad Outstanding Natural Landscape (ONL) designations, using stringency afforded under Regulation 6(4AA), which also would have closed out opportunity for afforestation, again without evidenced justification for doing so. We submit that a District Plan proposing broad-scale **prohibited activity** status for a legitimate primary sector activity is unjustified.

An extract is provided below.

#### **Waitaki District Planners S32 report re ONLs:**

##### *3.2.2 National Environmental Standards*

The NESCF makes forestry within an ONF and ONL a restricted discretionary activity. However, the proposed district plan makes it a non-complying activity [*in the Waitaki District*]. The regulation (clause 6(2)) allows a rule in a district plan to be more stringent than a rule in the regulation if it recognises and provides for the protection of ONF and ONL from inappropriate use and development.

New [NES-CF] **clause 6(4A)** provides that in relation to afforestation covered by Subpart 1 of the NES-CF, a rule in the plan can be more restrictive than the NES-CF provisions noted above. Accordingly, the NFL chapter provides for commercial forestry as a controlled activity within SNF or RSL. It also proposes plantation forestry move to **prohibited activity** status on or within ONFs and ONL.

Permitted activity status for primary production activities in ONF/Ls and RSL/SNFs (**except** buildings, mining, quarrying, intensive indoor and outdoor primary production, and **commercial forestry**), unless the activity involves agricultural intensification or horticulture.<sup>3</sup>

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<sup>3</sup> [www.waitaki.govt.nz/files/assets/public/v/1/files/our-council/consultation/2025/pdp/section-32/section-32-evaluation-report-natural-features-and-landscapes.pdf](http://www.waitaki.govt.nz/files/assets/public/v/1/files/our-council/consultation/2025/pdp/section-32/section-32-evaluation-report-natural-features-and-landscapes.pdf)

While we accept that, since 2017, the NES-PF/CF has enabled councils to regulate afforestation in Outstanding Natural Landscapes under Regulation 12, we are grateful that Ministers have now put these and other statutory plan changes on hold as part of the Governments wider RMA reform agenda.

We regard the impact of Regulation 6(4AA) as a “slow burn”. While the provision has not spawned plan changes that impact Ernslaw as yet, many forest owners expect that if Regulation 6(4AA) remains as is, then the proposed unequal treatment of forestry versus pastoral farming, as seen in the Waitaki District, will be amplified with considerable contagion. Given that Ernslaw operates across 18 different Council jurisdictions, the future cost of engaging in plan changes facilitated by Regulation 6(4AA) is likely to be significant in terms of cost and resourcing.

### **Permitted Activity Regulation 69-5 to 7 (Residual Slash on slopes)**

Ernslaw submits that the government’s regulatory focus on harvest slash on slopes, as introduced in late 2023, was mis-directed. We know of no precedent for slash removal from slopes in forestry regulation or Codes of Practice in the Pacific North-West of the USA nor in British Columbia, Canada where planted conifer forests are almost universally clearfelled. We see the root-cause of NZ’s “slash problem” as landslides, exacerbated by previous afforestation of landslide prone terrain by the NZ Government agency the former NZ Forest Service or More recently incentivised by Government and Council policy (e.g., the East Coast Forestry Project)<sup>4</sup>, but not slash *per se*. Retention of harvest slash on slopes is important for carbon and nutrient cycling and offers protection against rain splash erosion.

The 2023 Ministerial Inquiry into Land Use Report<sup>5</sup> states that “*many of [Tairāwhiti’s Red & Orange zoned] areas under pine should never have been planted in the first place*” due to their steep slopes and fragile geology.

As a related matter, we submit that Government policy that continues to deliberately steer, or worse incentivises or subsidises, new plantation forests onto LUC Class 7e land is highly flawed. Recently signalled changes to NZ’s ETS forestry regulations do precisely that

The NES-CF definition of slash needs urgent clarification to eliminate the current widespread confusion as to whether woody debris arising from windthrown trees is, or is not, slash. We submit that windthrown trees cannot be slash arising from the Activity of Afforestation nor Replant, as those two discrete and time bound seasonal activities involve the planting of seedlings that are seldom taller than 30cm with a root collar diameter of around 6 to 10cm. We suggest the following amendment in Part 1: Interpretation of the NES-CF:

**slash** means any tree waste left behind after the following commercial forestry activities:

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<sup>4</sup> [www.beehive.govt.nz/release/review-east-coast-forestry-project-confirmed](http://www.beehive.govt.nz/release/review-east-coast-forestry-project-confirmed) (1997)

<sup>5</sup> <https://environment.govt.nz/what-government-is-doing/areas-of-work/land/ministerial-inquiry-into-land-use/>

[Pruning and Thinning, Earthworks, Harvesting (including production thinning), and Slash Trap installation or clearance].

The November 2023 NES-CF amendments introduced permitted activity harvest Regulation 69-5 to 7 set a quantitative threshold for residual slash on orange and red ESC zoned cutover not exceeding 15m<sup>3</sup>/h for lengths greater than 2m. Our contractors advise that a 15m<sup>3</sup>/h residual threshold on steep dissected ESC Orange and Red zoned slopes is effectively unachievable when the target length is just 2m, despite their new focus and best endeavours. We submit that good policy making should not set impossible or near-impossible permitted baseline targets.

Harvey and Visser 2022 field surveys of harvested areas shows that Regulation 69-5's permitted baseline for residual slash on cutover effectively amounts to the upper 5% of current best practice at that date (when not corrected for rotten wood or length)<sup>6</sup>.

Ernslaw submits that the upper quartile (30 - 40 m<sup>3</sup>/ha) from Harvey and Visser 2022 survey could, and should, have been adopted in regulation as an achievable permitted activity "stretch target" for harvest contractors operating in Orange and Red ESC zones, and that the target length should have been no shorter than 3m and pragmatically 4m reflecting current industry practice, rather than confronting contractors operating with current cable harvest technology with a new regulatory target that was, and still is, frankly unachievable.

**Evidence - Extract from Harvey and Visser 2022:**

*Results* [of field surveys by Harvey and Visser 2022]: The median volume of woody residues [remaining after harvest] was 88 m<sup>3</sup>/ha, ranging from 0 m<sup>3</sup>/ha in an area swept bare, up to 580 m<sup>3</sup>/ha in an area severely impacted by windthrow prior to harvest. A distribution of volumes by plot showed a positive skew with an interquartile range of 87 m<sup>3</sup>/ha. Timber that was considered merchantable as a log at the time of harvest, **being >10 cm in small end diameter and >4 m in length**, accounted for a median of 11 m<sup>3</sup>/ha. .... Cutovers harvested with **cable-based systems** had greater median total residue volumes than those harvested with ground-based systems (**110 m<sup>3</sup>/ha versus 68 m<sup>3</sup>/ha**).

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<sup>6</sup> Harvey and Visser in 2022: Characterisation of harvest residues on New Zealand's steepland plantation cutovers. (NZJ For Sc).

<https://nzjforestryscience.nz/index.php/nzjfs/article/download/174/66/3076>

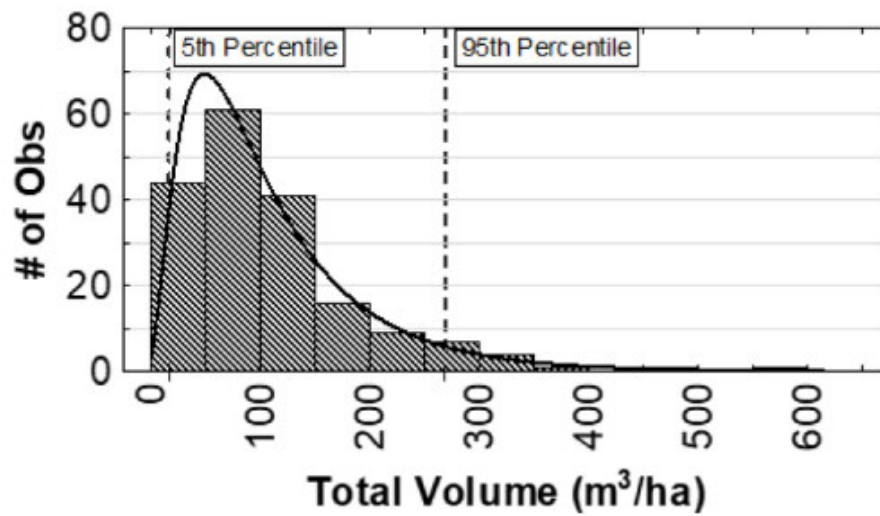


FIGURE 2: Distribution of total volume of residues >25 mm in diameter as measured across the 17 sites and 185 LIS plots.

### Regulatory Impact:

The introduction of Regulations 69(5 – 7) have driven a significant change in our harvest methods. Many forest owners and contractors now put much more focus on hauling recoverable non-merchantable wood (sound wood) but, for Ernslaw and no doubt others, that has come at an increased harvest cost of between \$2 - \$10 per tonne not including a new secondary cost of moving retrieved slash to a dump site often for subsequent burning (there not being enough space on operational landings to safely store the additional retrieved slash). The increased harvest cost, in combination with exchange rate and log price variations, will almost certainly have turned some marginally profitable harvest sites into loss making operations. That said, the regulations have driven innovation by way of remote measurement of residual slash (via Skylab Global) which enables us to give invaluable and prompt feedback to cable harvest contractors operating in Orange and Red ESC zoned settings. Our contractors have risen to the challenge but in dissected terrain some struggle to consistently achieve it, hence Ernslaw sought consents leave 30 to 45m<sup>3</sup>/ha in place, rather than the previous industry average for cable harvest of around 100 to 110m<sup>3</sup>/ha. Horizons-MW Regional Council have granted Ernslaw a consent to that effect.

Regulations 69-5 to 7 have imposed significant new RMA transaction costs on our business as below:

Region	Consent number	Our preparation cost (costed at \$150 per hour for staff, allowing for overhead)	Council consent charges (including s.92)	Harvest area & duration
Horizons RC	ATH-2020203932.00 (Granted)	5,500	5,200	1,700 ha over 10 years
Hawkes Bay RC	AUTH-131436-01 (Granted)	19,800	6,500	364 ha over 5years
Gisborne DC	NF-2024-112388-00 (Granted)	15,000	8,000	153 ha over 10 years
Gisborne DC	NF-2025-113002-00 (Lodged)	6,000	1,200	1600 ha
Gisborne DC	NF-2024-112310-00 (Granted)	7,000	5,000	16 ha over 2 years
Gisborne DC	NF-2024-112355-00 (Lodged)	18,000	1,200	500 ha
Gisborne DC	NF-2025-112993-00 (Lodged)	8,000	3,000	85 ha
Gisborne DC	NF-2025-113001-00 (Lodged)	6,000	3,000	58 ha

Note:

1. Ernslaw has many other consents in play for harvest in Red and Orange ESC zones, but Councils have not called-in those consents to add a Residual Slash condition.
2. Ernslaw aims to UAV (drone) fly all Orange and Red ESC zoned settings after harvest to quantify the volume of slash left in the cutover, so we treat all harvest sites as if Regulation 69(5) residual slash ( $15 \text{ m}^3/\text{ha}$ ) threshold was in play. At no point have our contractros ever achieved the NES-CF's PA baseline of  $15 \text{ m}^3/\text{ha}$ .

## **PART B: Other matters for consideration by policy makers**

### **Regulation 6. Relationship between rules and these regulations**

Regulation 6(3) could be usefully expanded to capture a second *unique and sensitive [erosion] environment*, and in so doing conferring discretion to Gisborne District Council and to Horizons Regional Council to create more stringent regulations over commercial forests established in the Tolaga Bay mudstones (this highly problematic very hard, impervious, landslide-prone geology occurs in both regions<sup>7</sup>). We suggest the amendment as below to Regulation 6:

#### ***Unique and sensitive environments***

- (3) A rule in a plan may be more stringent than these regulations if the rule manages any
- (a) activities in any green, yellow, or orange zone containing Separation Point granite soils [or Tolaga Bay mudstone<sup>8</sup>] areas that are identified in a regional policy statement, regional plan, or district plan.

### **Regulation 85. Slash traps - Permitted activity conditions: Placement**

Regulation 85(3) sets a 20-hectare permitted activity contributing land area threshold. We submit that 20 hectares is simply too small a catchment to be of any utility as it effectively captures and consigns almost every slash trap in a Council consenting regime, adding significant cost and delays. We suggest that the area threshold in 85(3) *Placement* could be usefully increased to 50ha without adding material risk.

It is difficult to understand the regulatory intervention logic to constrain a landowner from erecting and maintaining robust, well-engineered and cost-effective slash trap structures in small streams as a permitted activity as this would prevent slash mobilised in storms and landslides from leaving the forest. We do not accept that temporary impediment of fish passage is a sufficient reason to require a resource consent (noting that there are innumerable permanent barriers to fish passage posed by culverts on small streams in state highway and district council road networks). The timeframes in Regulation 85(1), being 5 days to inspect after significant storms and 20 days to clear after a 5% AEP flood, were developed in consultation with Fish & Game and DoC, and effective, defensible and sufficient to ensure fish passage is reinstated to as to not impact fish populations.

We submit that a robust cost-benefit analysis would show that when the cost of consenting is greater than the installed cost of a slash trap, it should be expected that a forest owner will simply avoid proposing to install devices that would otherwise reduce slash migration to downstream stakeholders living on flood plains, and to natural ecosystems, when severe weather causes landslides to mobilise slash into waterways and flooded channels.

We refer to advice commission by Gisborne District Council with MfE *EnviroLink* funding from the forest engineering school at Canterbury University on slash trap design:

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<sup>7</sup> GNS's 1:250,000 scale geological maps shows that the Tertiary era Tolaga Bay mudstone assemblage to underly plantation forests in southern Hawkes bay and east of Dannevirke.

Refer [www.gns.cri.nz/data-and-resources/geological-map-of-new-zealand/](http://www.gns.cri.nz/data-and-resources/geological-map-of-new-zealand/)

<sup>8</sup> Tolaga Bay mudstones were laid down during the Miocene epoch of the Neogene period, roughly 23 to 5.3 million years ago, with rapidly uplift continuing today.

R Visser and C Harvey (2020). Design of Debris Slash Traps: Considerations for NZ Plantation Forestry. University of Canterbury (35p).

That guidance is available at:

[https://www.gdc.govt.nz/\\_data/assets/pdf\\_file/0010/11305/forestry-slash-traps-uc-visser-harvey-2020-final.pdf](https://www.gdc.govt.nz/_data/assets/pdf_file/0010/11305/forestry-slash-traps-uc-visser-harvey-2020-final.pdf)

The Visser and Harvey 2020 document could usefully serve as guidance for improved national direction regarding slash traps.



Photo credit: Visser and Harvey (2020).

We draw particular attention to the size of trapped woody debris in the slash trap above. A welded steel pipe or I-beam pylon structure, as above, which we estimate to have an installed cost of around \$80 to 100K plus Council consenting fees, including geotechnical foundation and engineering design, inherently allows smaller lengths of slash to pass until such time as it becomes blocked with larger lengths. We make the case elsewhere in this submission for a change to Permitted Activity Regulation 97 (Discharges) to specifically allow shorter pieces of slash and pinecones to pass. It is only the very expensive European manufactured mesh-net slash traps (photo overleaf) that contain small lengths of slash, but we are advised that the installed costs of such traps are typically around \$10K per lineal metre, around 3 times the cost of a pylon design, is a sum that is clearly unaffordable for owners of small woodlots and farm foresters, and a severe financial burden for larger forest owners.



photo courtesy of Matariki Forests Ltd, Hawkes Bay – Consented ‘net type’ slash trap

Note that net-type Slash Traps catch almost all piece sizes other than pinecones, but once their capacity is exceeded (as in the photo above) slash of all sizes is washed over such structures and inevitably migrates downstream.

#### **Regulation 97. Permitted activity: (Discharges, Disturbances & Diversions) - Regional Council**

The NES-CF has a fundamental conflict in that it essentially imposes a zero-discharge slash regulation across all forestry operations while there is an implied acceptance in Regulation 69(4) that slash is in fact discharged into freshwater during harvest.

Regulation 69(4) identifies scenarios where all slash deposited in a water body or on a river bank (ie on land) that might be covered in greater a 1 in 20-year flood does not need to be removed. This Regulation 69(4) effectively allows slash to remain in place under defined circumstances. A reasonable interpretation of clause 69(4) is that if harvest slash does not confer a risk arising from (a) – (d), then slash can be left in situ.

As a result, there are situations where slash may lawfully enter water or land adjacent to water, without triggering removal requirements. We therefore submit that the regulations could usefully be clarified with respect to the issue of slash discharge to water, or to land where it could enter water.

Regulation 97(1) could usefully be clarified to accept the reality that small volumes of small woody debris (aka slash), including pinecones twigs and small branches can and are discharged from streams, leaving forest boundaries at times of high flow.

We propose that a variant of the current size limits in Regulation 69(5) for residual slash be drafted into permitted activity Regulation 97(1)- Discharges. We suggest the below amendment, or words to the effect:

slash not exceeding 2m in length and with a large-end diameter not exceeding 10cm, or pine cones,...

**97 (1)** Any discharge of sediment into water or to land in circumstances that may result in it entering water, [*including any discharge of slash not exceeding 2 m in length and with a large-end diameter not exceeding 10 cm, or pine cones*], or disturbance of the bed or vegetation in the bed of a river or lake, or diversion of water associated with a commercial forestry activity is a permitted activity if subclauses (3) and (4) are complied with, and— (a) pruning...

Explanation – the slash piece dimensions suggested for insertion into permitted activity Regulation 97(1), typically branches and tree tops, are equivalent to that of a broom handle through to a small sheep-fence post, and will be highly unlikely to build up on a conventional bridge pier and will be much smaller than entire willow trees planted for river bank protection, which are commonly recruited when floodwaters undermine river banks.

A further amendment to Regulation 97(1) permitting the discharge of (small piece sized) harvest slash beyond the forest boundary could usefully incorporate a variant of the permitted activity conditions from Harvest Regulation 69(4), with drafting to the effect:

*Slash discharges beyond the forest boundary in up to the 5% AEP storm (the one in 20-year ARI event) must be managed to* minimise :

- (a) blocking or damming of a water body:
- (b) eroding river banks:

While avoiding

- (c) significant adverse effects on aquatic life:
- (d) damaging downstream infrastructure, property, or receiving environments, including the coastal environment

### **What sized natural event do policy makers expect forest owners to manage to?**

The NESCF currently provides neither clear nor certain direction as to what return period storm (and hence natural erosion event with shallow landsliding) forest owners must manage to when operating under the permitted activity regulations on high-risk land, zoned Orange or Red in the Erosion Susceptibility maps.

The back-to-back ex-tropical cyclones Hale and Gabrielle (each judged to be about one in 30-year recurrence interval storms in the Tairāwhiti / Gisborne District for a 48-hour period<sup>9</sup>) in 2023, showed that even Yellow zoned land was subject to widespread erosion, including under the canopy of healthy 12 to 15 year-old standing crop trees. Aside, Cyclone Gabrielle had a much larger recurrence interval in the Hawkes Bay, well exceeding a one in 100-year ARI.

We propose that a single 5% AEP (i.e. the one in 20-year Average Recurrence Interval (ARI)) for a 6 hour and a 24-hour duration storm be drafted in regulation, or be proposed in guidance, as is consistent with Permitted Activity River Crossing (Single Culvert) Regulation 46(1) design discharge standard. This is not a low bar, as floods in a one in 20-year ARI storm are typically around 80% of the one in 100-year event. Further, the guidance needs to signal a clear

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<sup>9</sup>Harrington et al 2023. The role of climate change in extreme rainfall associated with Cyclone Gabrielle over Aotearoa New Zealand's East Coast, Imperial College of London. DOI: <https://doi.org/10.25561/102624> )

acceptance that erosion (shallow landsliding) can be expected to occur if slopes are already saturated from a recent previous storm (i.e. times of high antecedent soil moisture) as has just occurred in the Nelson Tasman region, and in 2023 with the two ex-tropical cyclones in Tairāwhiti.

We believe that NES-CF should be aligned with the proposed National Policy Statement on Natural Hazards (NPS-NH) drawing from the table below extracted from that consultation document.

Ernslaw notes that the proposed NPS-NH is not intended to apply to primary production, but we are very supportive of the intent NPS-NH given it aims to constrain or stop subdivision and development on flood plains. Recognising that rivers draining steep forested catchments inevitably transport woody debris (a fact long recognised in Western Europe, but apparently not so in recent times in NZ), we welcome the emerging ethos in many of our Regional Councils that “Rivers need room to flood”.<sup>10</sup> Our regret is that this National Direction was not promulgated soon after the Resource Management Act was legislated in 1991.

Likelihood level	Annual exceedance probability (AEP)	Average recurrence interval (ARI) or 'return period'
Almost certain	10% or more	Up to and including 10 years
Very likely	10% to 5%	Over 10 and up to and including 20 years
Likely	5% to 2%	Over 20 and up to and including 50 years
Possible	2% to 1%	Over 50 and up to and including 100 years
Unlikely	1% to 0.2%	Over 100 and up to and including 500 years
Rare	0.2% to 0.02%	Over 500 and up to and including 5,000 years
Very rare	Less than 0.02%	More than 5,000 years

In the context of rural landscapes, we believe that NES-CF should certainly require forest owners to actively manage for events that are deemed “Very likely”, and to anticipate and plan for events that are “Likely” as opposed to those that are “possible” at the scale of third order <sup>11</sup>. We request Policy Makers keep in mind that closed canopy plantation forest provide a very high level of catchment protection for at least 20 years of a typical 27-year rotation in Pinus Radiata, and typically 60 years of a typical 70-year rotation in Douglas-fir.

Separately

<sup>10</sup> <https://www.horizons.govt.nz/HRC/media/Media/Flood%20protection/Tukua-Nga-Awa-Kia-Rere-Making-Room-For-Rivers.pdf?ext=.pdf>

<sup>11</sup> NIWA’s River Environment Classification (REC) defines stream order for all streams and rivers across NZ, at a scale of 1:20,000

## PART C. Responses to specific questions asked by policy makers

Officials have asked 11 questions in relation to the NES-CF, as follows:

### Stringency

Question	
10.	Does the proposed amendment to 6(1)(a) enable management of significant risks in your region?
Questions	
11.	Does the proposal provide clarity and certainty for local authorities and forestry planning?
12.	How would the removal of 6(4A) impact you, your local authority or business?

### Slash Provisions

Questions	
13.	Do you support amendments to regulations 69(5-7) to improve their workability?
14.	Do you support a site-specific risk-based assessment approach or a standard that sets size and/or volume dimensions for slash removal?
15.	Is the draft slash mobilisation risk assessment template (provided in attachment 2.2.1 to this document) suitable for identifying and managing risks on a site-specific basis?
16.	Should a slash mobilisation risk assessment be required for green-zoned and yellow-zoned land? If so, please explain the risks you see of slash mobilisation from the forest cutover that need to be managed in those zones?
17.	If a risk-based approach is adopted which of the two proposed options for managing high-risk sites, do you prefer (ie, requiring resource consent or allowing the removal of slash to a certain size threshold as a condition of a permitted activity)?
18.	For the alternative option of setting prescriptive regulations for slash management, is the suggested size and/or volume threshold appropriate?
19.	Do you support the proposed definition of cutover to read " <i>cutover means the area of land that has been harvested</i> "?

### Afforestation and Replanting

Question	
20.	Do you support the proposed removal of the requirement to prepare afforestation and replanting plans?

### General amendments

Question	
21.	Do you support the proposed minor text amendments?

Ernslaw's response to those key questions are as follows:

**Q10. Does the proposed amendment to 6(1)(a) enable management of significant risks in your region?**

**Response (R)10.** Ernslaw operates across multiple regions where the risk of landslides mobilising slash vary from very high to very low, Gisborne being highest and our South Island regions (inland Marlborough, Otago and Southland) all being very low – a function of geology and climate. We agree that the proposed amendment to 6(1)(a) would enable better management of significant risks, but note that residual risk always remains, especially in the North Island where previous (and now again current) Government policies steer or relegate commercial forestry onto some very high-risk terrain.

**Q11: Does the proposal provide clarity and certainty for local authorities and forestry planning?**

**R11:** It is not appropriate that a forest grower respond in detail, other than to note the paucity of Government advice on how best to assess Residual Slash volumes for efficient administration of Regulation 69.

**Q12: How would the removal of 6(4A) impact you, your local authority or business?**

**R12:** While there is no immediate impact to our business, as, to date, no plan changes have been notified in the areas where we operate, in the medium-term removal of 6(4A) will save \$10s of thousands in professional fees for engaging in plan change processes.

**Q13: Do you support amendments to regulations 69(5-7) to improve their workability?**

**R13:** The current regulation is unworkable in Orange ESC zoned land and has thrown us into a Council consenting regime where the compliance officers do not understand our cable harvest contractors' real world constraints, the implied worker Health and Safety trade-off, nor how best to monitor or enforce the regulation.

**Q14: Do you support a site-specific risk-based assessment approach or a standard that sets size and/or volume dimensions for slash removal?**

**R14:** We support the introduction of a site-specific risk-based assessment methodology, (which we understand is the option strongly favoured by those operating in highly porous pumice geology of the central North Island but that utterly fails to solve the regulatory challenges in Tairāwhiti / Gisborne).

In concert with that, we need a defensible but achievable permitted activity standard for use in regulating cable harvesting in Orange ESC zoned settings including in Tairāwhiti / Gisborne, outside of the problematic Tolaga Bay mudstone geology. We submit that the current 15m<sup>3</sup>/ha permitted baseline could reasonably be increased to 30 to 35m<sup>3</sup>/ha on land where shallow landslide modelling or mapping by a **Suitably Competent Person** skilled in geomorphological

process interpretation (at 1:10,000 scale or better) shows slopes not to be directly connected to streams without taking on significant extra risk.

We point to Harvey & Vissers 2022 figure 2 (as inserted as evidence above) which shows that 30m<sup>3</sup>/ha represents the upper quartile of good industry practice in 2022, meaning that threshold represents a considerable stretch target for three quarters of the operations surveyed. It is not a low bar but at least it is achievable in most circumstances with extra effort.

Our analysis of high-resolution drone imagery flown in cut overs, generally two or more months after the completion of harvest (refer Appendix one) shows conclusively that the proposed changes in length from 2 to 3m and in how diameter is measured (LED versus SED) makes only a small difference to the total volume of residual slash assessed in ESC orange and red zoned cutover. Put simply, there is very little cumulative volume in short, small diameter slash pieces. The residual slash threshold specified in Regulation (15 m<sup>3</sup>/ha) needs to be increased, in addition to the adjustment of the small piece dimensions if cable harvest contractors are to achieve the NES-CF's Permitted Activity baseline .

**Q15. Is the draft slash mobilisation risk assessment template (provided in attachment 2.2.1 to this document) suitable for identifying and managing risks on a site-specific basis?**

**R15.** We feel that that question is better asked of the regulators, Gisborne District Council in particular. We suspect that assessments, effectively self-assessments, undertaken using the proposed assessment method will be highly contentious. There is potential for very clear conflicts of interest where assessments are undertaken by unscrupulous or ill-informed small operators. We are keenly aware of the vocal criticism of industry self-assessment of wilding conifer spread risk<sup>12</sup>, without independent peer review, so we caution officials from creating further fodder for critics.

If officials pursue this particular draft assessment method, then we submit that the regulations should limit the application of the method to a **Suitably Competent Person** and then define that skill set in terms of both training and experience. Precedent for that approach sits in Regulation 11-2 and 5, and 97-6.

We suggest that guidance promoting registration as a professional member of the NZ Institute of Forestry (NZIF) with scope of practice defined to include 3 or more years of experience in assessment of slash mobilisation risk, plus a short professional course in geomorphology and terrain interpretation in order, to stem the inevitable public criticism of industry capture and to ensure robust and effective risk assessment prevails. NZIF members are bound by a strict Code of Ethics<sup>13</sup>.

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<sup>12</sup>

<https://www.wildingpines.nz/assets/Documents/MWLR-wilding-conifers-report-SRDM-2023-for-MPI-2023.12.06.pdf>

<sup>13</sup>

<https://nzif.org.nz/assets/Governance/NZIF-Code-of-Ethics-Guidance-Note-1-January-2022-1.pdf>

There are clear problems in the draft methodology. Being the owner (licence holder) of the Mangatu Forest CFL, we very familiar with the Tarndale and Mangatu “slips” which are extremely active and very large (by world scale) amphitheatre gullies, we fail to understand the rationale for officials introducing consideration of Gully erosion processes (point 3a) in a slash management regulation. Harvest slash is never introduced into these large active gullies.

### **Specific matters of concern in the Draft Slash Mobilisation Risk Assessment Template**

Point 3a. We submit that Gully erosion is better addressed with a replanting setback, not in a slash regulation.

Point 8. We do agree that (8) Rainfall – high intensity or extended rainfall is far too complex a matter to consider in a simple decision matrix.

Point 9. We are advised by experts at Landcare Research that *Melton’s Ratio* should not be used in a regulatory context in New Zealand, but if it were, the assessment work should only be undertaken by a **Suitably Competent Person with both training and experience in quantitative geomorphology** (which clearly rules out almost all farm foresters, woodlot owners and many others). An immediate problem arises in that there simply aren’t enough trained practitioners in New Zealand (the same problem has arisen with Gisborne Districts Council’s new requirement for certification of harvest areas and earthworks by a **Suitably Qualified AND Experienced Person** – they currently don’t exist.

Such training gaps can be backfilled by Universities but from the experience in British Columbia in the 1990s when post-graduate courses in terrain mapping and Terrain Stability Field Assessments were created and run at UBC to satisfy new requirements of the then BC Forest Practices Code Act for professional assessments to be undertaken by persons registered as P. Eng and P. Geos, it takes about 5 years to supply the demand.

The closest appropriate tertiary programme in NZ was the University of Canterbury’s School of Earth and Environment’s one-semester full-time post-graduate diploma or Masters of Science course in Engineering Geology, but that programme is currently suspended after their senior lecturer retired.

Refer <https://www.canterbury.ac.nz/study/academic-study/subjects/engineering-geology-pg>

Point 10. We submit that methodology in point 10 (Slope features that indicate increased risk), is in our view highly flawed as many of the listed features will universally be present in Orange and Red zoned land, citing the question:

Are any of these features present: • gully with headwall • slope break • gully that could intercept and channel landslide to waterway • convex slope • convergent slope .

Furthermore, we sincerely question whether presence of a • concave slope indicates decreased risk.

We submit that geomorphological interpretation should not be “dumbed down” to a check list or GIS mapping exercise, but our concern is this proposed methodology stands to do exactly that.

**Q16. Should a slash mobilisation risk assessment be required for green-zoned and yellow-zoned land? If so, please explain the risks you see of slash mobilisation from the forest cutover that need to be managed in those zones?**

**R16.** Put simply, we believe No, because ESC green and yellow zoned land is by definition not susceptible to broad scale shallow landsliding, which is the key process that transports slash off slopes and delivers it into the stream channel system at times of flood. We submit that full compliance with Regulation 69 (1 - 3) is both effective and sufficient.

**Q17. If a risk-based approach is adopted which of the two proposed options for managing high-risk sites, do you prefer (ie, requiring resource consent or allowing the removal of slash to a certain size threshold as a condition of a permitted activity)?**

**R17.** We strongly favour a Regulation allowing the removal of slash to a certain size threshold as a condition of a permitted activity, where safe and practicable to do so, along with an expansion of Regulation 97 (Discharges) to specifically allow discharges of pine cones and small pieces slash beyond the forest boundary, where the effect in streams and downstream stakeholders would be no more than minor.

But, as per our Response to Q16, above, we have significant concerns about just how the proposed risk-based approach might work and might be implemented by Councils, small generalist forestry consultants, farm foresters and woodlot owners alike. We much prefer that National Direction identify particularly high-risk geological assemblages such as the **Tolaga Bay mudstones** alongside the **Separation Point Granites** in Regulation 6(3A) and delegate authority for control to the relevant Regional Councils.

With regard to the Tolaga Bay mudstones, Ernslaw has retained NZ expert geomorphologist Dr Mike Marden, retired from Landcare Research, to undertake detailed geomorphological risk mapping. While expensive, we believe this is both valuable and cost-effective for assessing larger areas of ESC Orange and Red zoned land (> 5000 ha).

Dr Marden’s mapping commences with understand the underlying geology and then progresses to terrain interpretation; refer to Appendix 2.

We do not think national direction should rely on risk assessments undertaken by persons without appropriate qualifications or experience, which includes witnessing the impact of ex-tropical cyclones or other short duration very high intensity storms in steep ESC red and orange zoned land.

**Q18. For the alternative option of setting prescriptive regulations for slash management, is the suggested size and/or volume threshold appropriate?**

**R18** We support the suggested change in size thresholds (<3m and SED > 10 cm). Evidence from our analysis of cutover residues indicates that localised hotspots occur so we recommend that residuals volume is assessed over an area of at least one hectare (NZFOA recommend two hectares).

In our forests on the Tolaga Bay mudstone geology, we support retention of 15 m<sup>3</sup>/ha for ESC orange and red zoned slopes modelled (from 1:10,000 scale mapping or evidence from other professional geomorphological assessment methods\*), as having direct connectivity to streams, should landslides occur. In slopes on the Tolaga bay mudstones modelled as not having direct connectivity to streams we we recommend that 30 to 35 m<sup>3</sup>/ha is a reasonable threshold.

In other geologies we recommend that 30 to 35 m<sup>3</sup>/ha is a reasonable threshold.

**Q19. Do you support the proposed definition of cutover to read “cutover means the area of land that has been harvested”?**

**R19.** Clearly Yes.

**Q20. Do you support the proposed removal of the requirement to prepare afforestation and replanting plans?**

**R20.** We absolutely support the proposed removal of the requirement to prepare replanting plans. However we see no escape from the present obligation to prepare afforestation plans in the context of management of wilding conifer spread risk, and if we are going to that effort then preparing a broader plan is not onerous, there being merit in identifying mapped significant natural areas (SNAs), downstream drinking water intakes and similar.

Certainly there are some onerous requirements which are at best speculative guesses at the afforestation stage that could usefully be ‘pruned’ out of Schedule 3 to reduce burden, especially the arguably nonsensical and onerous monitoring requirements (noting no farmer with hill country pasture has to *maintain records relating to erosion and sedimentation*). We suggest removal of potentially hugely expensive whole-of-lifecycle erosion and sedimentation monitoring in section 3, in addition to removal of all references to Replanting in Schedule 3, as below:

[~~delete all of 3~~] The plan must include a description of—

- (a) the erosion and sedimentation effects of afforestation ~~and replanting~~, including those effects that arise over the lifecycle of the forest or until a subsequent forest planning requirement is triggered; and
- (b) the measures to be used to—
  - (i) monitor the erosion and sedimentation effects of afforestation ~~and replanting~~; and
  - (ii) maintain records relating to erosion and sedimentation.

We know of no Council nor any national regulation that requires hill country pastoral farmers to undertake erosion and sedimentation monitoring in perpetuity. Section 3 of Schedule 3 breaches fairness and equity in Primary Sector regulation.

**Q21. Do you support the proposed minor text amendments?**

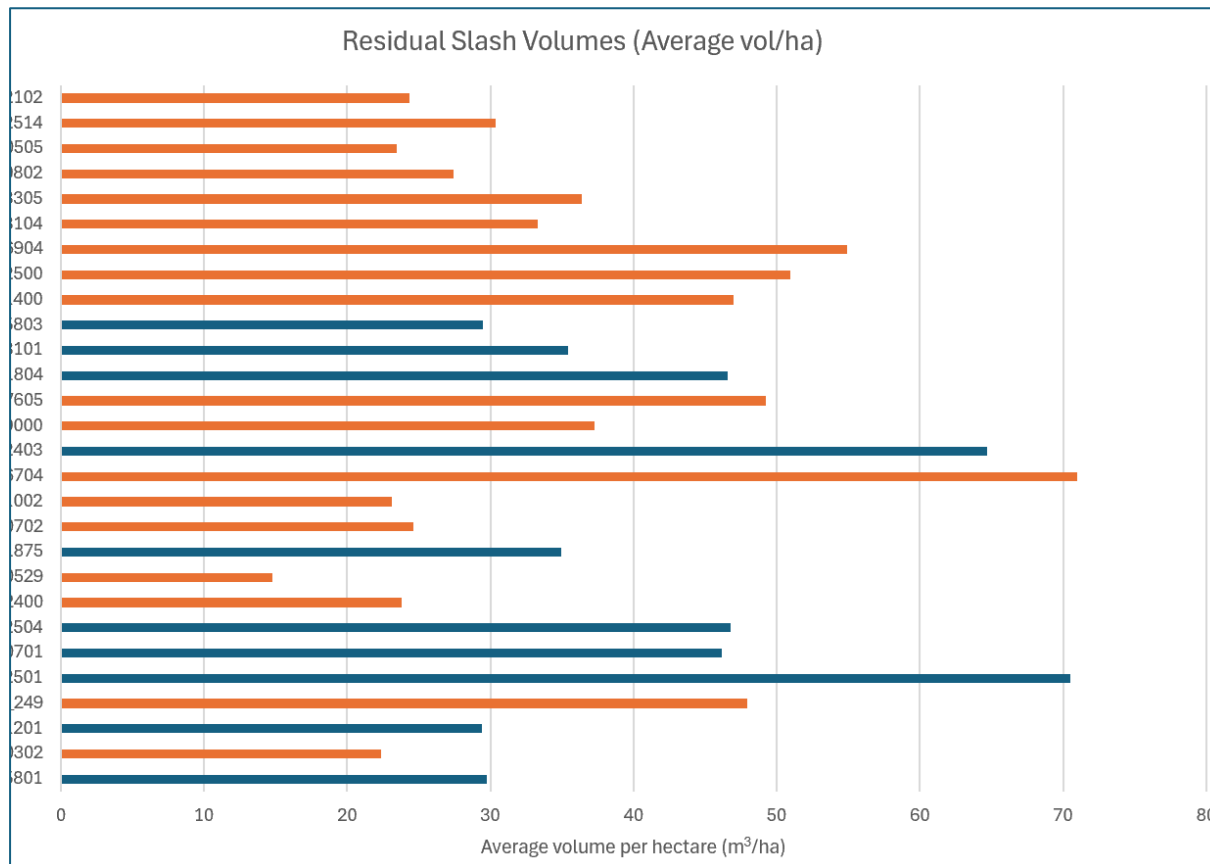
**R21.** Clearly Yes

Appendices follow.

## Appendix 1 – Residual Slash - Evidence: Spatial analysis of post-harvest drone captured imagery

Ernslaw used UAVs (drones) to low-level fly both Orange and Red zoned harvest settings two to 3 months after harvest to capture very high-resolution imagery.

The graph below summaries our slash surveys to date of cable harvested Orange and Red zoned settings where stems are removed using grapples to maximise worker health and safety by not having persons on the slopes. Our service providers (Skylab Global) method is to use AI to identify slash from high resolution (2cm pixels) that is longer than 2m and larger than 7cm midpoint (as a proxy for 10cm LED).



Refer <https://skylabglobal.com>

Note that the assessments as graphed are not corrected for “unsound” wood or windthrow.

Our 33 assessments to date account identified around 151,000 pieces of slash across just over 560 ha in settings ranging in size from 4 to 40 hectares. Once corrected for “unsound” wood and windthrow, estimates of residual slash range from 4 m³/ha to 38 m³/ha across the whole setting, but each setting invariably has one or more (one hectare) “hot spots” where the NES-CF residual slash threshold of 15 m³/ha is exceeded.

NB Bar colours denote slash assessments made in each of our two North Island regions in the past 18 months.

Our South Island region grows forests predominantly on Green & Yellow zoned land, with a very small proportion of Orange but no Red zoned land (LUC classes 3 to 6).

The 2023 NES-CF amendment has required us to regularly “contract out” of Regulation 69 by seeking resource consents to exceed the 15 m<sup>3</sup>/ha Permitted Activity thresholds. Despite our cable harvest contractors best endeavours, we have found that achieving what amounts to a virtually clear cutover, at a considerable cost burden, is unattainable.

### Methodology

Skylab’s AI (Machine learning) method identifies residual slash from high resolution images captured by drone in recent harvest settings, and assess the length and (mid-point) diameter of each piece as shown in the annotated photo below (refer teal blue & brown arrows on logs).



**Timing:** We found that the live green foliage masks underlying slash if we capture imagery with UAVs (drones) immediately after harvest, hence we typically impose a two-month delay. By implication the contractor has almost always moved his log hauler from the site by the time we fly it for assessment, making any rework extremely expensive as machinery would need to be moved back (especially when machinery is trucked off-site as opposed to being ‘walked’ to an adjacent work site).

**The complication of wind thrown trees in assessing residual harvest slash (debris not arising from harvest):**

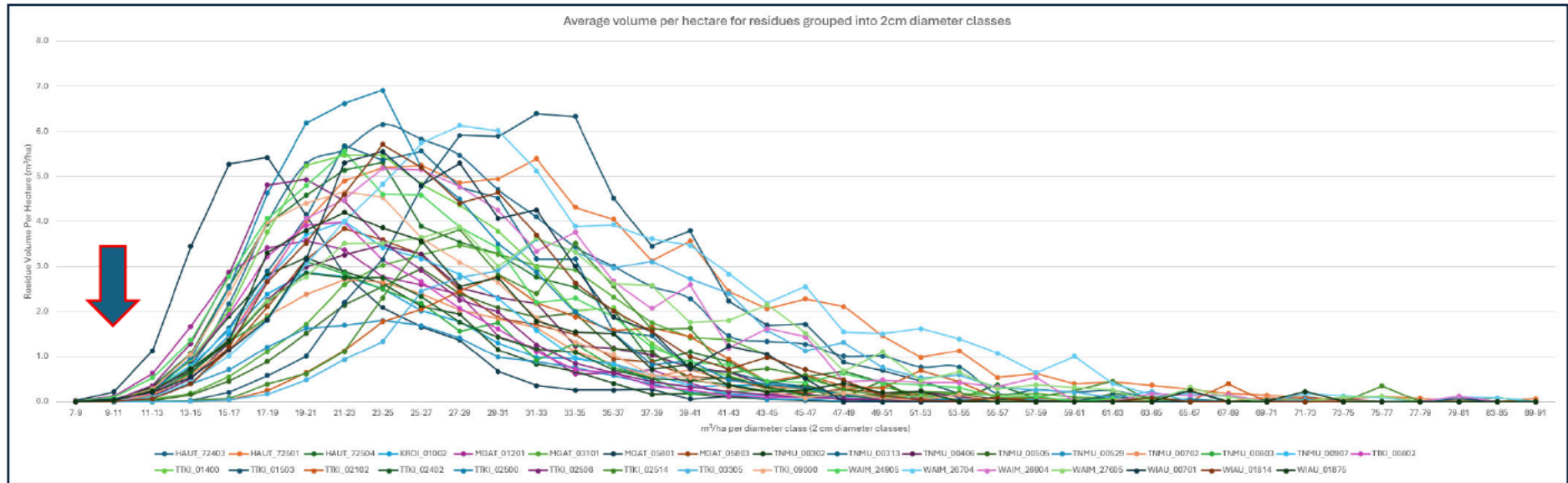
Root-balls on some of stems below indicate wind throw, but to date Skylab's AI method has not been able to discriminate stems with or without attached root-balls



**Piece Size analysis (data from Skylab Global)**

**Total Residue Volumes by diameter classes (2cm increments):**

(Nb Skylab’s analysis includes both residual slash and windthrow, filtered for pieces where LED > 10cm. It is currently not possible to filter for ‘Sound wood’)



Legend: X axis: Diameter class - 0 to 99 cm (Note: Skylab uses a slash mid-point diameter of 7cm as a proxy for a 10cm LED)

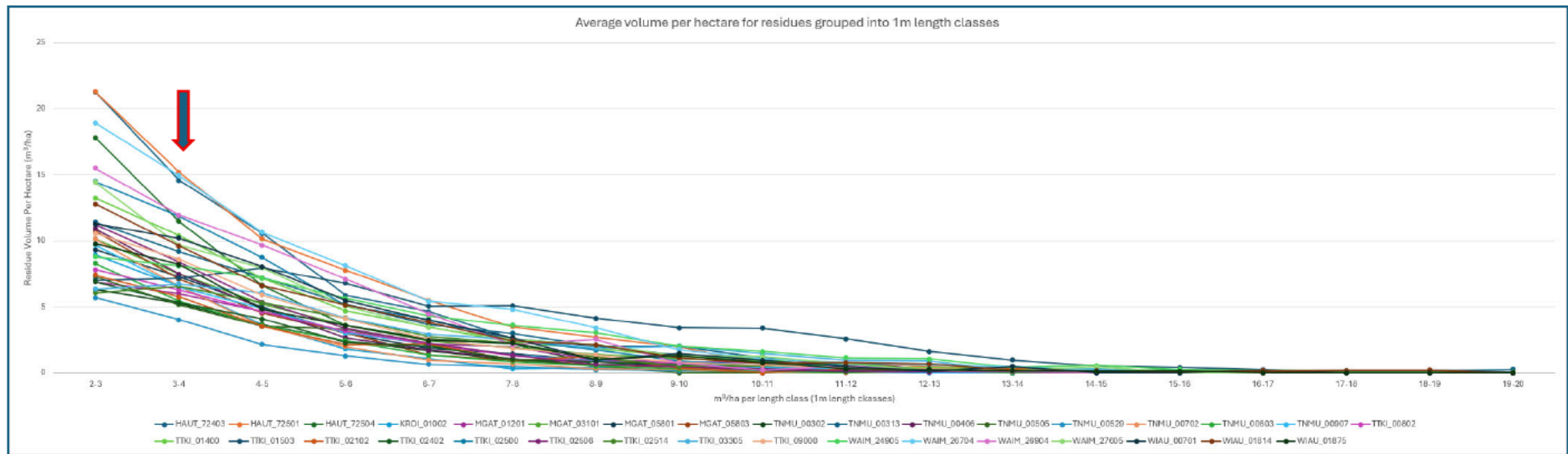
Y Axis: Residual volume per hectare in each diameter class is 0.1 to 7 m³ per ha.

The largest volume is in the 25 to 26 cm diameter class, with a secondary peak at 19 to 20 cm, with 10cm arrowed

### Total Residue Volumes by Length classes (1m increments):

(Nb. Skylab's analysis includes both residual slash and windthrow, filtered for pieces where LED > 10cm. Not filtered for 'Sound wood').

**Important:** note that these are not cumulative graphs. It is necessary to sum the average volume in each length class volumes to establish the total residual per hectare.



X axis: Length class - 0 to 20m (1m increments)

Y Axis: Residual volume per hectare in each Length class ( 0 to 25 m³ )

Note that the largest volume per hectare sits in the 2 to 3m length class

Our assessments indicate a total residual of **no more than 35m³/ha when slash 3m or longer is considered (arrowed) is achievable.**

#### **Diameters:**

- if Skylab were to change the a mid-point diameter to 15cm (as a proxy for a 10cm SED), very little volume is removed from the total volume measured across the setting.

**Conclusion:** The current 2-3m length class represent a significant proportion of total residue volume. A change in lower bound from 2 to 3m lengthly would have a very noticeable effect on total residue volumes measured.

Ernslaw would be pleased to make of data set available to officials upon request. We recommend that sensitivity analysis is undertaken on both the length and dimension parameters, and our assumption that the mid-point is a reasonable surrogate for SED or LED when accounting for taper (small piece sizes not being perfect cylinders).

### **Guidance required on spatial assessment methods**

Neither the NES-CF nor its supporting documents contains Guidance on how to undertake spatial assessments of residual slash. We submit that guidance is urgently required.

Ernslaw benefits for having in-house expertise in spatial assessments. We evaluated a simple 1 ha grid method, but eventually settled on a “heat map” approach fitting a one-hectare semi-circular polygon over high concentrations of slash and then summing the volume of each identified stem within that polygon.

Given the lack of guidance for Residual Slash measurement in Regulation 69, is it reasonable to averaging volumes across the total harvest setting as opposed to focusing on terrain where slash preferentially accumulates during harvest (generally incised gullies and similar “hot spots”)? For avoidance of doubt, we do not game the regulation by sending bushmen out onto cutover slopes to cut slash pieces into pieces to avoid triggering the minimum length dimensions.

We are concerned that a harvest setting could be described as non-compliant by a Council Compliance and Enforcement Officer if a single 20m or 40m-long transect (ie the measurement strategy embedded in the traditional Wagner Waste Assessment methodology, as used for evaluating forest fire fuel loads), or if a 10 to 20m radius plot was applied over an areas where harvest slash is concentrated.

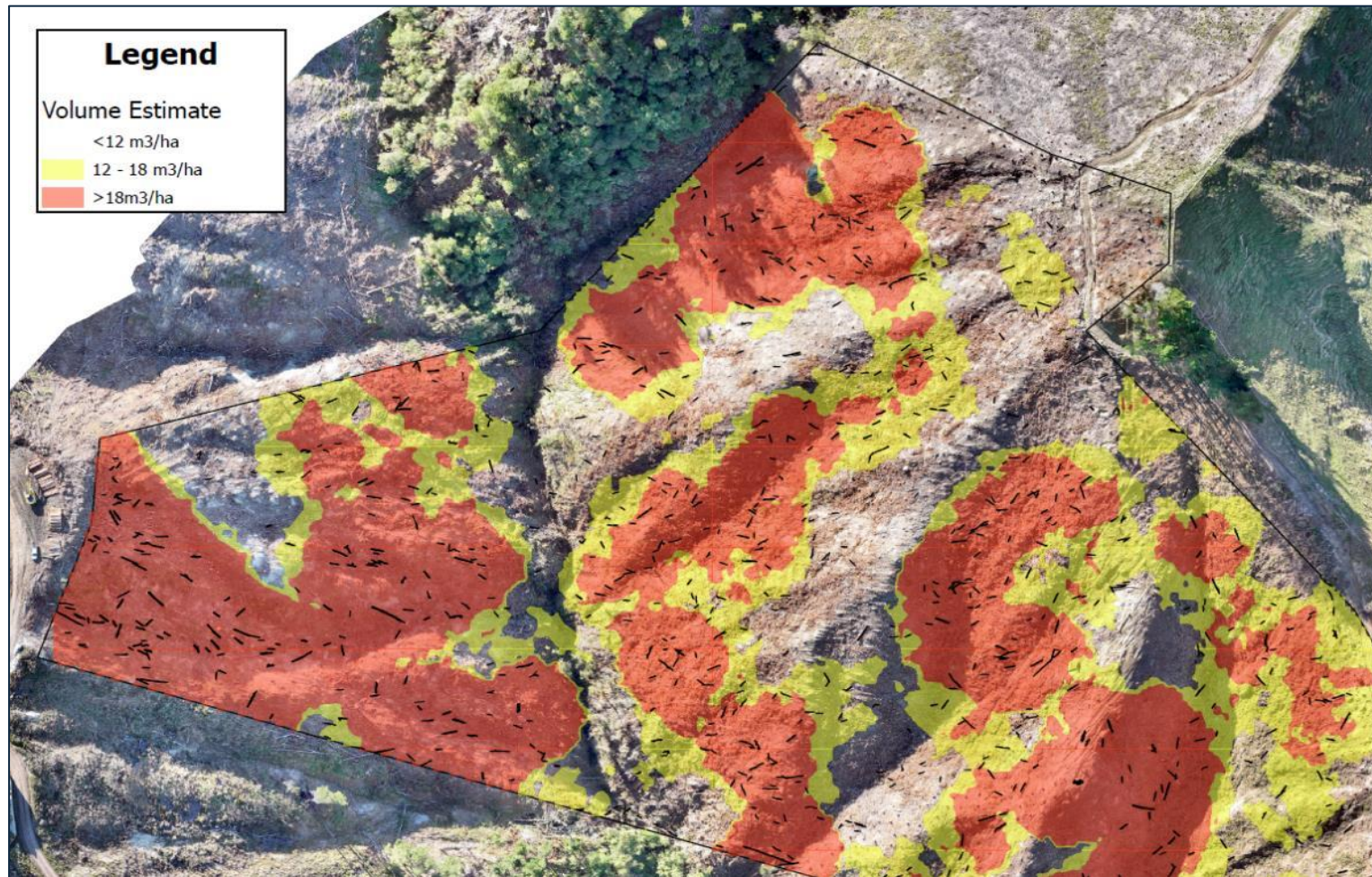
**Recommendation:** Government needs to give clear advice as to the area over which residual slash should be assessed – We recommend a one hectare minimum sized area.

**Images -** Pictorial representations from Interpine NZ and German Skylab’s AI Analysis of residual slash (note that the latter analysis is not corrected for windthrow not associated with harvesting) are given below. Both examples show areas of greater than one hectare where the NES-CF Regulation 69’s 15 m<sup>3</sup>/ha threshold is exceeded.

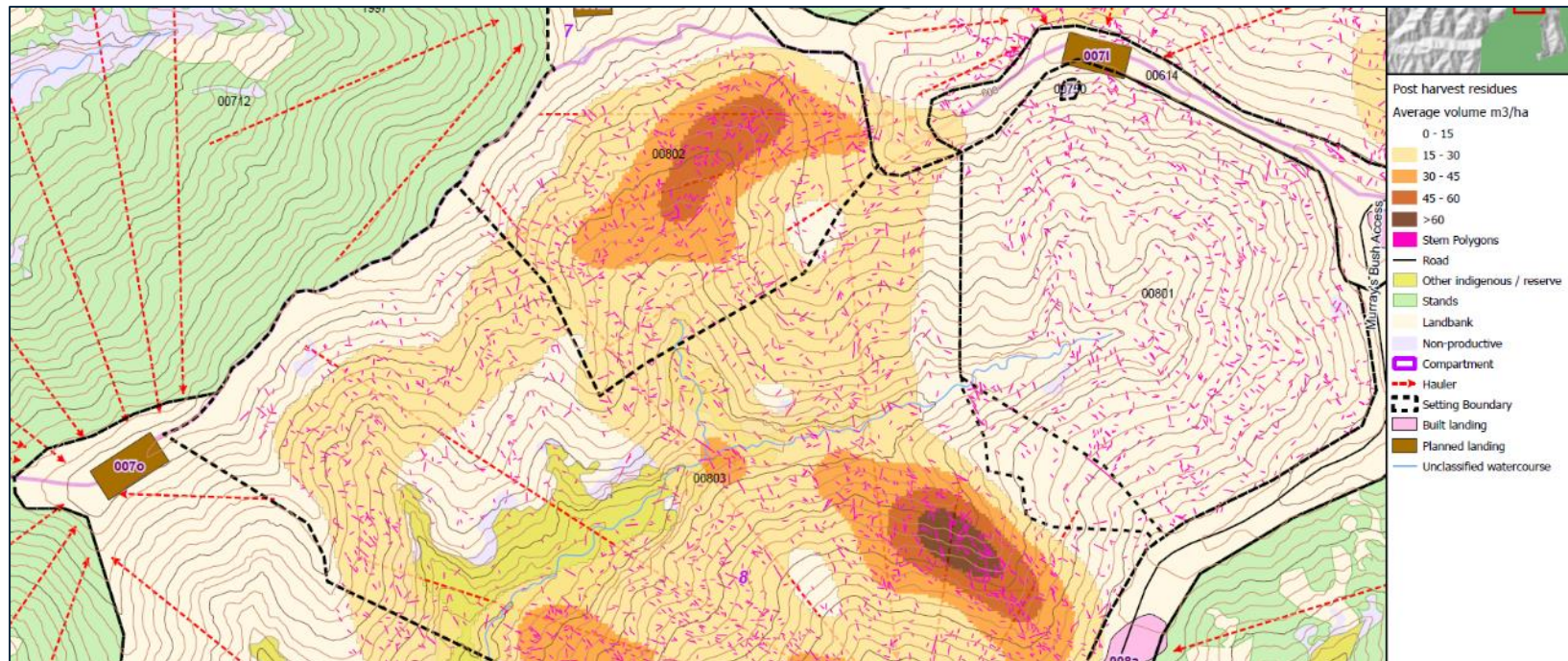
### Interpine NZ proprietary method

We understand that a person experienced in assessing slash after harvest uses the piece colour in drone captured images to make a call as to whether piece is fresh and therefore likely to be “sound wood” or older (bleached whiter, without bark) and likely “unsound” (aka rotting).

Refer <https://interpine.nz/woody-debris-assessment>

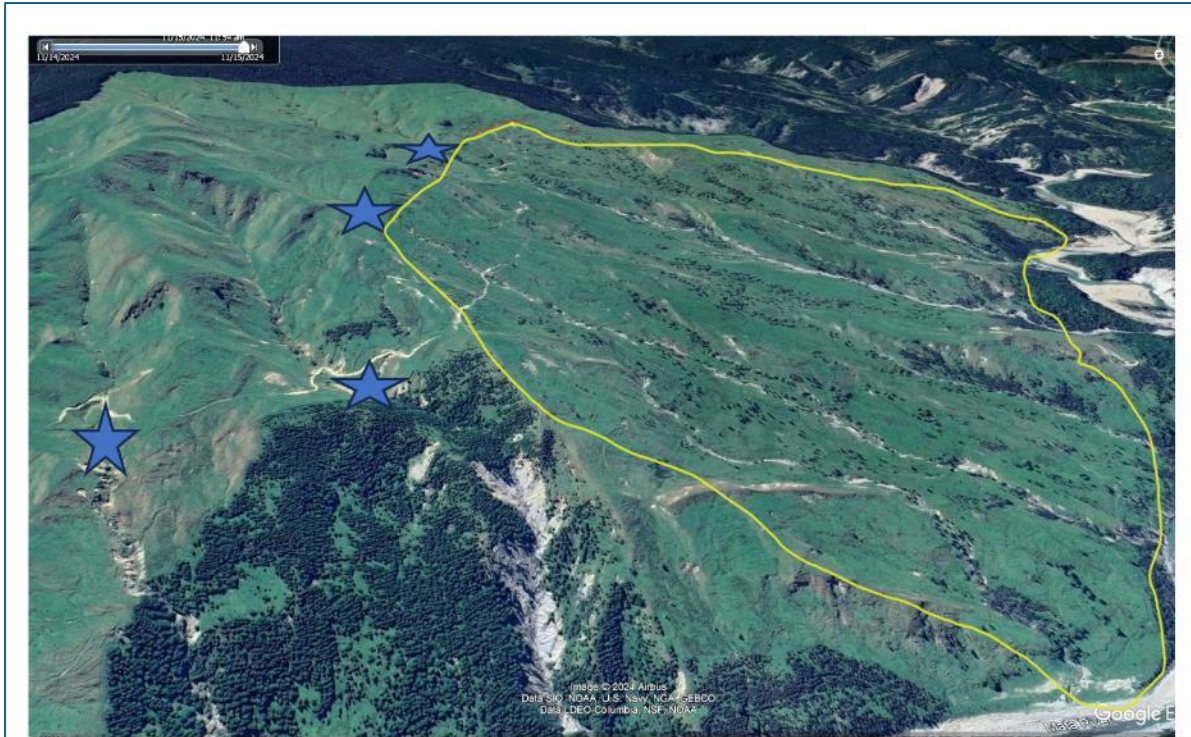


## Skylab Global AI method

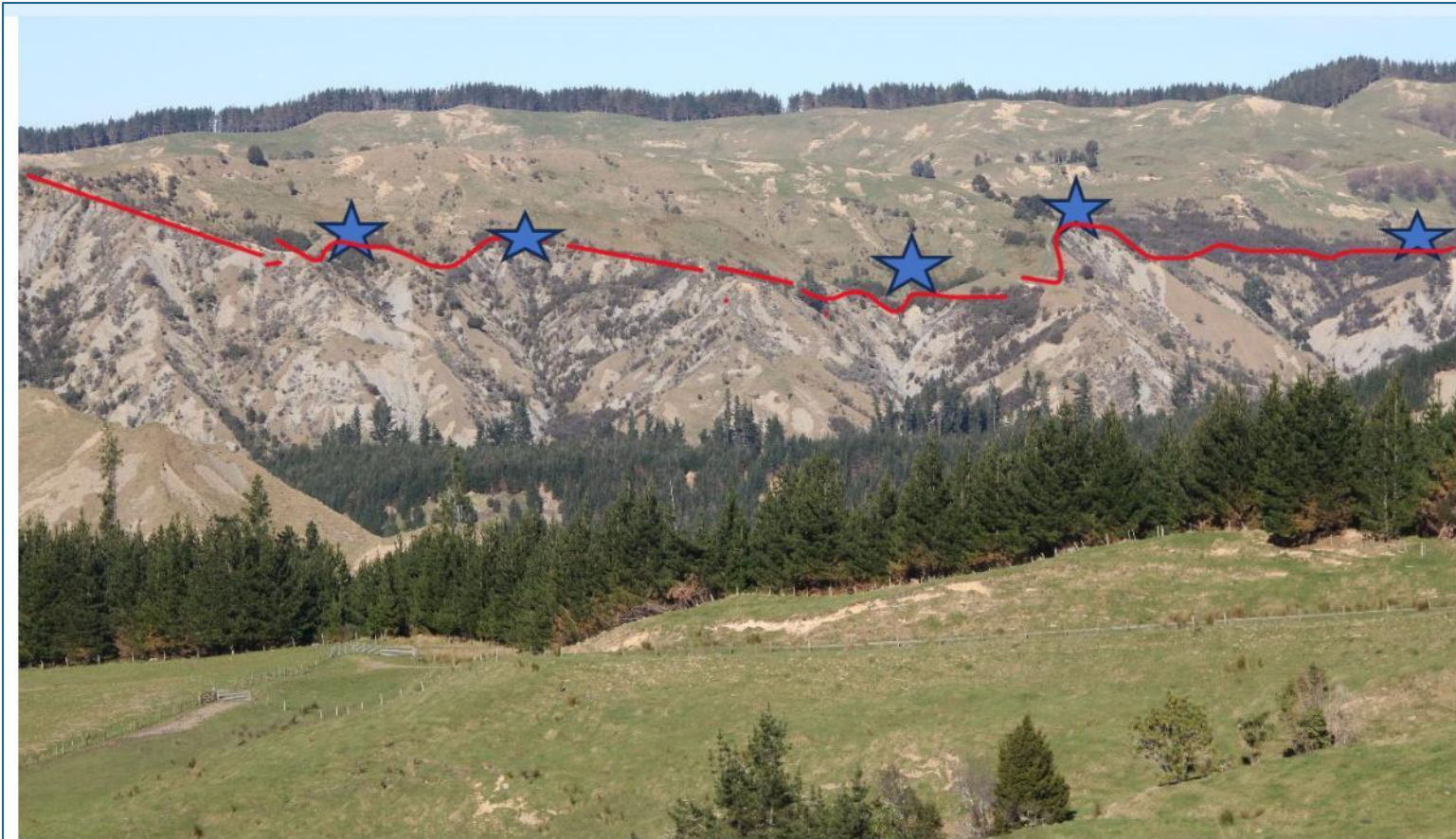


Typical heat map from image analysis – Two “hot spots” identified, one where residual slash loads exceed 60 m<sup>3</sup>/ha and one where loading exceeds 45 m<sup>3</sup>/ha. About one third of the area (shaded light yellow) has a residual load of 15 to 30 m<sup>3</sup>/ha about half of the area has a load of less than 15 m<sup>3</sup>/ha.

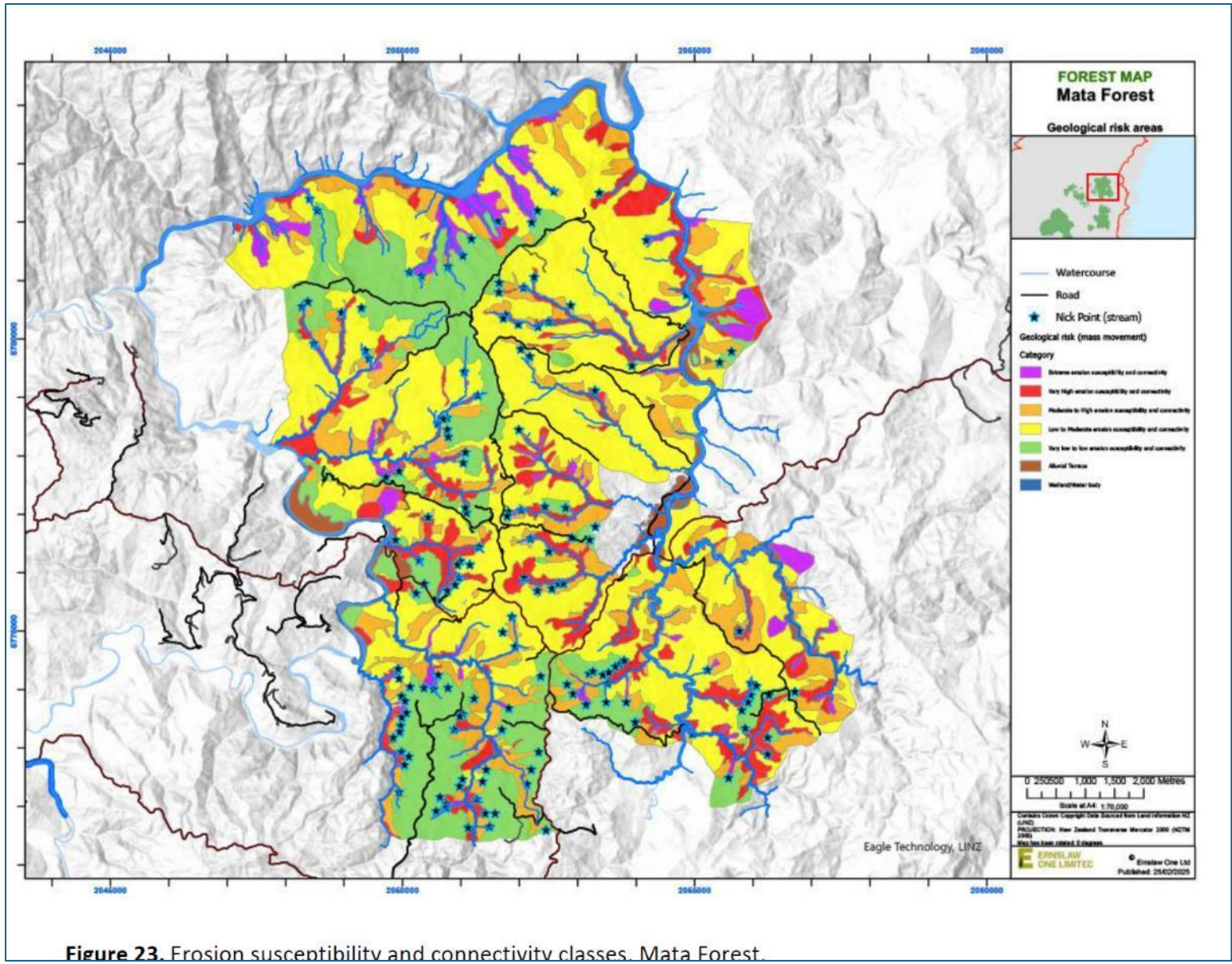




**Figure 8.** Complex series of earthflows and slumps within Cretaceous terrain (within yellow outline). The vegetation cover comprising sedges and weeds, a reflection of wet ground conditions and where farmers plant poplar and willow plantings (also see figure 19) to both de-water the earthflows and to improve the stability of slopes through root reinforcement. Blue stars are nickpoints separating 'relict' landscape from landscape that has continuously adjusted to a change in stream base level as the Mata River down-cut into the weak underlying Cretaceous-aged bedrock.



**Figure 11.** Storm-initiated shallow landslides on otherwise gentle ( $<25^\circ$  upper slopes) distanced from a stream channel where the bulk of any displaced soil and/or vegetation likely remains on-slope. Cf. shallow landslides on more vulnerable and steeper slopes ( $>25^\circ$ ) in proximity to a stream channel where the bulk of displaced soil and vegetation (if present) has a high probability of entering a stream channel. Red line marks boundary between slopes with 'low connectivity' to the stream (above red line) and slopes with 'high connectivity' (below red line). Blue stars represent the head of the incised drainage channels referred to as 'nickpoints'. Their relevance is discussed in section 3.2.1



**Figure 23.** Erosion susceptibility and connectivity classes. Mata Forest.

#### 4.3.4 Very high erosion susceptibility and connectivity (Red, 963 ha)

- Short, very steep slope segments located below the point where slopes steepen markedly (downslope of areas in orange), often  $>35^\circ$ , and all are aligned along existing and predominantly perennial streams and rivers (**ie. very high erosion susceptibility and very high connectivity**) (Fig. 11, 13, 16, 20, 21).
- The steepest slopes within this erosion susceptibility class are located downslope of nickpoints where slumps and shallow landslides are the most common of the mass movement types and, together with small scale gullying, are likely the main sources of sediment, for example along Te Poro and Mangahoui Streams draining Compartments 39 to 44.
- Several very large-scale slumps in Compartments 7 and 8 failed at some unknown time before 1996 and have remained active since.

#### 4.3.5 Extreme erosion susceptibility connectivity (Purple, 405 ha)

- Very steep slope segments aligned along the margins of rivers/streams where bank undercutting has triggered slumps and shallow landslides resulting in the removal of the cover bed materials to expose the underlying bedrock (Figs. 13, 16, 21).
- Due to the proximity of these sites to perennial streams, a large proportion of the displaced material is delivered directly to the stream channel. The volume of sediment delivered to streams from these locations will inevitably increase following forest removal.
- Gullies have in the past and will continue to be the dominant source of sediment and conduit for the delivery of sediment and woody debris to the larger river network (**ie. extreme erosion susceptibility and extreme connectivity**). Gullies are more common in areas of this forest underlain by Cretaceous-aged lithologies (Fig. 14, Compartments 1 to 6) but the largest of them occur within areas underlain by Tertiary-aged lithologies (Fig. 15, Compartment 23 and 25).

In conclusion, we draw Policy Makers attention to Dr Marden's important caution (the last para in his contract report's Executive Summary):

17. Mass movement and gullying have been part of the natural landscape-forming process within Mata Forest for many millennia and, irrespective of the species, maturity, density and health of the forest cover, the parts of this forest identified as 'very high' and 'extreme erosion susceptibility and connectivity' will always be susceptible to rain-triggered landslides and gully expansion, and will remain the main source of sediment and woody material delivered to the major perennial streams, more so during major storms of the magnitude experienced within the past three decades.