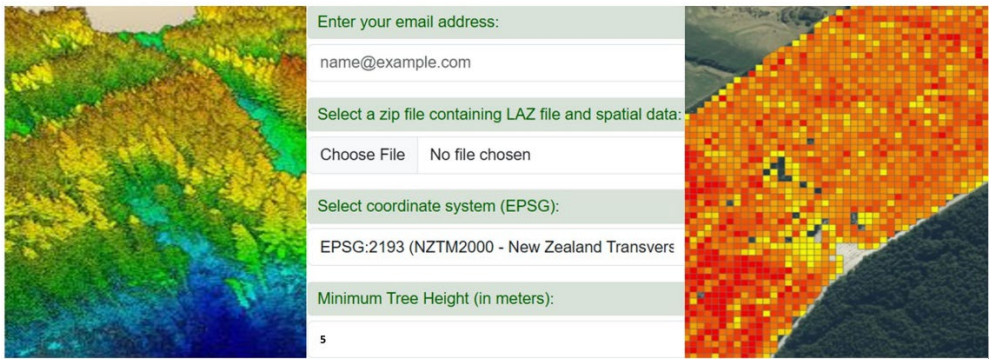
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Delivery Report – VirtualPlot and SilvaCloud updates





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Milestone Number: 4.6.3

Report Number: PSP-T051

Date: 13 June 2026

INFORMATION SHEET

Report Title	**Delivery Report – Beta Prototype Development**
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Client Contract No:	**FGR472 PSP_Interpine Real Time Thinning Assessment Enhancements**
Date	**13 June 2026**
Confidentiality Requirement	
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OBJECTIVES

The objective of the beta prototype phase was to enhance and operationalise advanced forestry tools developed during the alpha phase. This included improving analytical accuracy, expanding functionality, and increasing usability across both VirtualPlot and SilvaCloud platforms.

Key objectives were to:

- Develop and refine machine learning models for thinning, regeneration, and nursery assessment.
- Enhance LiDAR-based analytical capabilities for improved forest insights.
- Integrate new tools with existing forestry workflows and data formats.
- Improve user flexibility and reporting outputs to better support operational decision-making.

METHODOLOGY

The development approach combined machine learning, LiDAR data processing, and UAV-derived imagery to deliver scalable and robust solutions.

- Model Development:
  Machine learning models were developed and trained using labelled datasets provided by the industry to support chemical thinning detection, regeneration assessment, and nursery evaluation.

- LiDAR Analysis Enhancements:
  SilvaCloud functionality was extended through advanced processing of LiDAR datasets, enabling automated detection of canopy gaps and estimation of regeneration metrics. Algorithms were designed to delineate areas without tree cover and extract meaningful stand-level insights.

- System Integration:
  New tools were integrated into existing platforms (VirtualPlot and SilvaCloud), ensuring compatibility with operational workflows. This included the ability to import user-provided shapefiles and incorporate externally developed AI models.

- User Functionality Improvements:
  Enhancements were made to improve usability, including enabling manual selection of plot sizes and incorporating thinning prescription values into reporting outputs.

- Validation and Testing:
  All tools and models were tested across a range of datasets and forest conditions to assess their reliability, consistency, and practical applicability. The core workflow involved processing the data, reviewing the outputs, and incorporating feedback from users.

RESULTS

The beta prototype successfully delivered a suite of enhanced tools and capabilities:

VirtualPlot

Chemical Thinning Model

The development of the Chemical Thinning Model, supported by a comprehensive labelled dataset, represents a significant advancement in automating thinning decision processes within forest management. This model was designed to accurately identify trees that have been chemically thinned by leveraging machine learning techniques trained on carefully curated and annotated data provided by two forest companies who signed the data sharing agreement. Over 3000 images were provided and a subset was labelled for modelling training purposes. The labelled dataset plays a critical role in this process, providing the model with examples of tree conditions, spatial arrangements, and competition dynamics that influence thinning decisions. By incorporating variables derived from UAV data—such as canopy structure, and relative position—the model is able to assess stand conditions at a high level of detail and consistency. This reduces reliance on manual interpretation and field-based assessments, which are often time-consuming and subject to variability. As a result, the tool enables more efficient and standardised thinning prescriptions, improving operational planning and supporting better resource allocation. Furthermore, while not included as part of this work, there is an opportunity for future model improvement if clients choose to provide additional data. This could help further refine the model, improve its accuracy, and increase its applicability across different forest types and management scenarios.

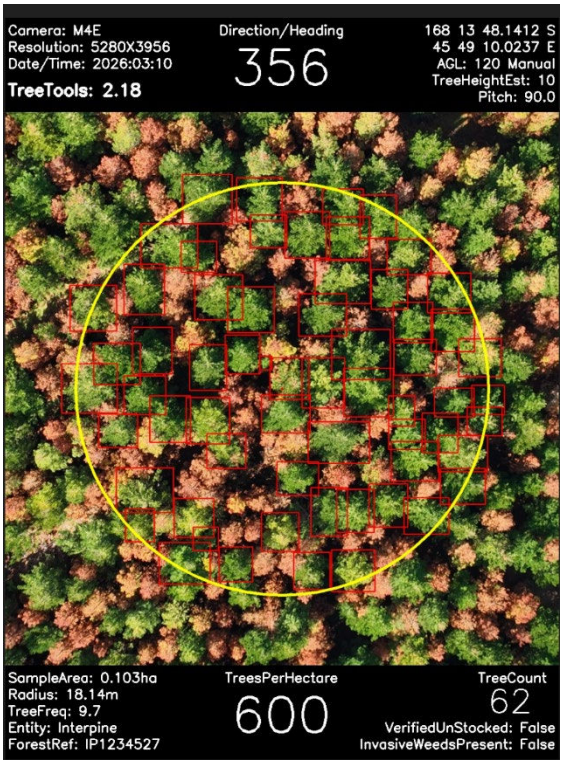


Figure 1 Chemical Thinning example

AI model for nursery assessment

Evaluation of seedling performance from the previous “PSP-T043: Autonomous Tree Stock monitoring platform”. The model was updated to YOLO 11 but lacks robustness across varying scenarios and requires further improvement to enhance its detection performance.

The training results indicate that the nursery detection model converged well. Both training and validation losses decreased consistently, while precision, recall, and mean Average Precision at 50% Intersection over Union (mAP50) increased rapidly before stabilising at high values. The final mAP50 above 0.9 indicates strong detection performance, while the mAP50-95 score shows reasonable localisation accuracy under stricter overlap thresholds. Overall, the model appears suitable for detecting nursery objects within the current RGB raster. However, because the model was trained and applied on the same area, its performance on other areas of interest remains uncertain. Further validation using independent imagery is required to confirm generalisation.

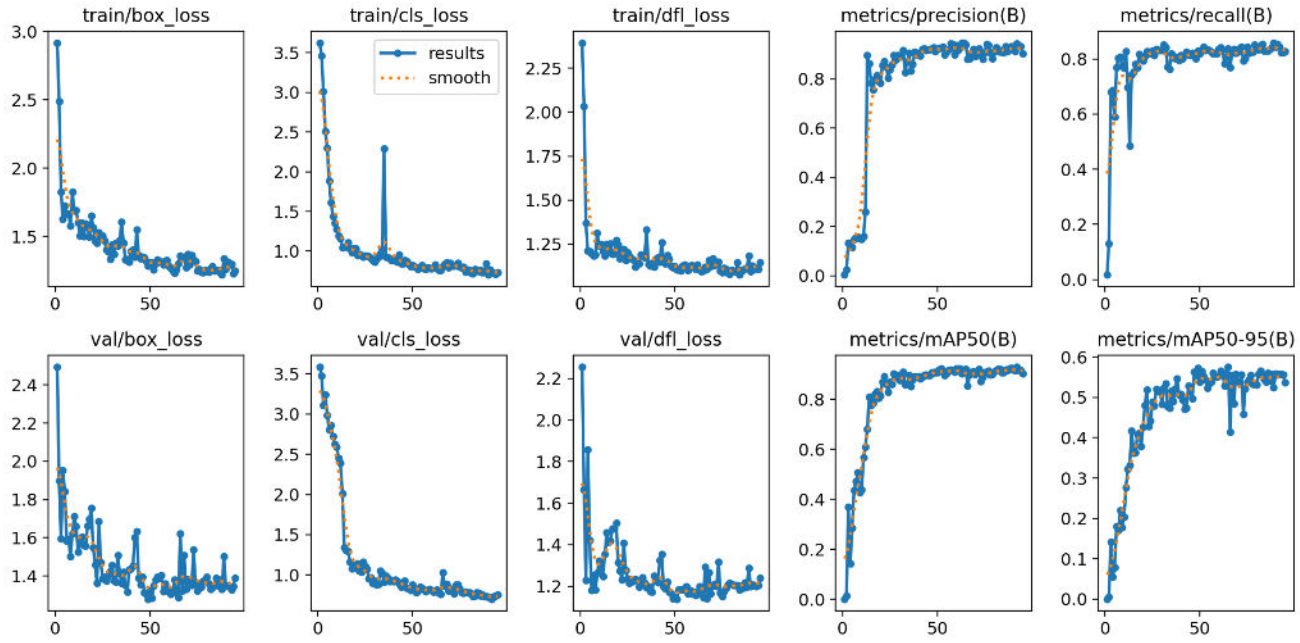


Figure 2. Training plot

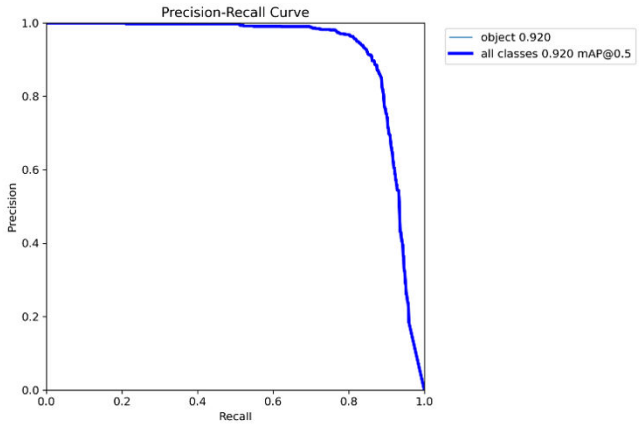


Figure 3. The final mAP50 above 0.92 indicates strong detection performance

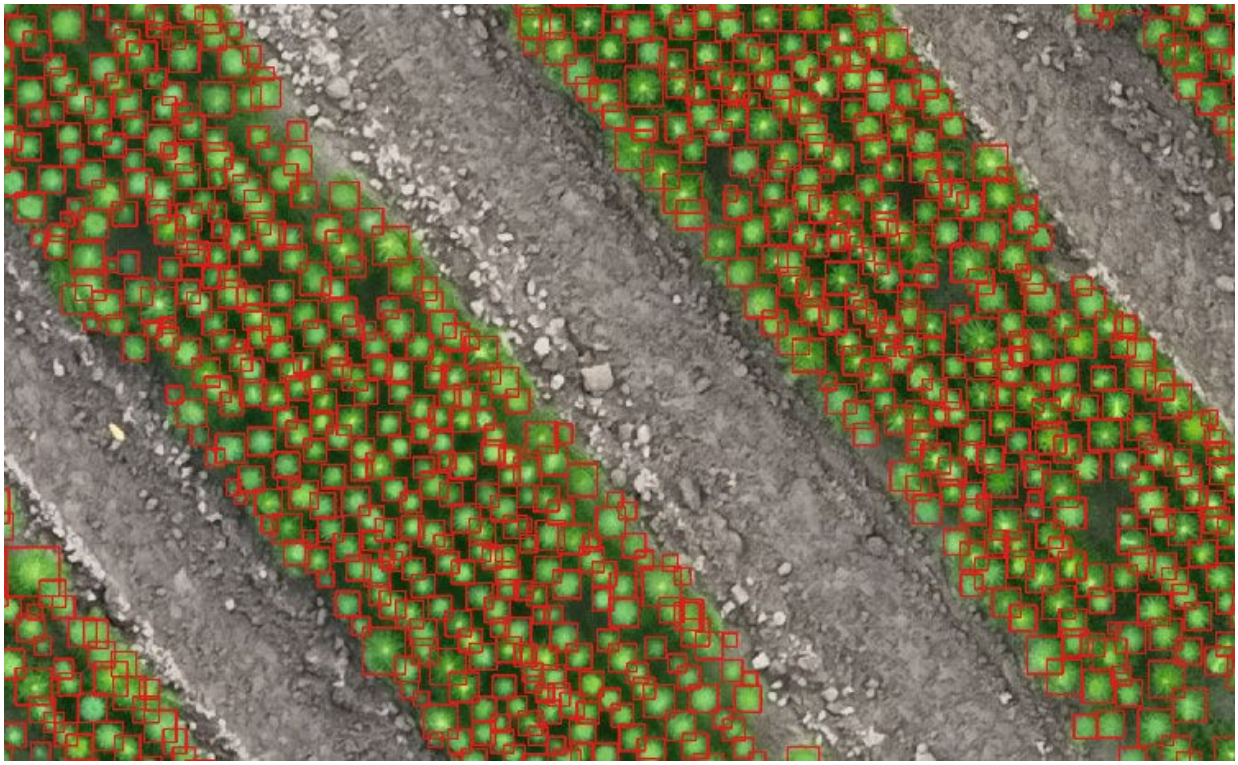


Figure 4. Output demo of the model trained (source: TreeCanopy)

Stand stocking calculation from shapefiles

The introduction of stand stocking calculation from shapefiles represents an important enhancement in aligning analytical capabilities with standard GIS-based forestry workflows. This functionality enables users to input their own spatial data, such as stand boundaries or plot layouts, directly into the system and derive accurate stocking metrics without the need for data reformatting or manual processing. By leveraging shapefiles as a primary input format, the tool seamlessly integrates with widely used GIS platforms, such ArcPro and QGIS, ensuring compatibility with existing datasets and operational processes. The system processes these spatial inputs alongside LiDAR and/or UAV-derived data to calculate key stocking indicators, such as stems per hectare and spatial distribution of trees within defined areas. This approach not only improves efficiency by automating what has traditionally been a manual and time-intensive task, but also enhances consistency and repeatability in stocking assessments. Additionally, it provides greater flexibility for users to define custom analysis areas that reflect real-world management units, rather than relying on fixed plot designs. Overall, this development strengthens the interoperability of the platform and supports more precise, scalable, and user-driven forest inventory and planning.

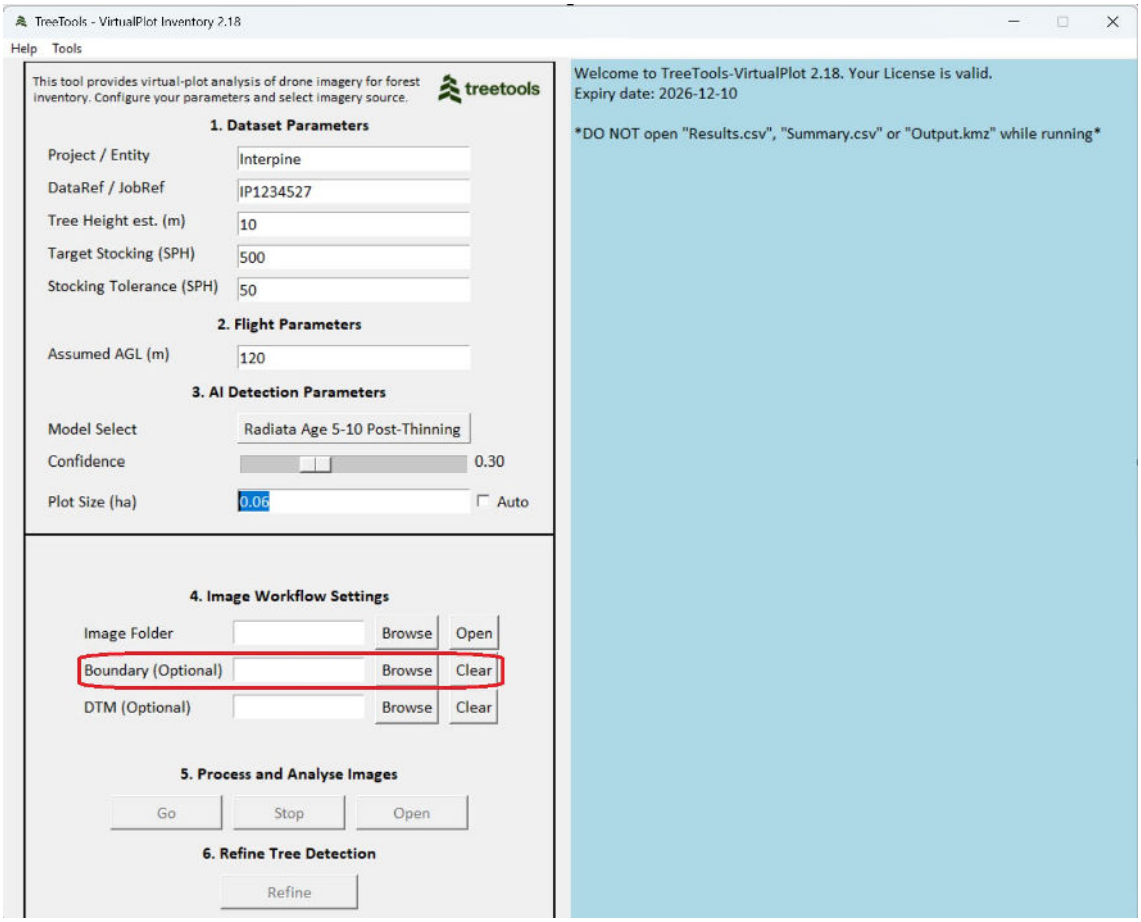


Figure 5. Upload area of interest in VirtualPlot

User-defined plot sizing

The addition of user-defined plot sizing introduces a significant improvement in the flexibility and adaptability of the analysis workflow within the platform. This functionality allows users to manually specify the dimensions and spatial extent of plots used for forest inventory and assessment, rather than being restricted to predefined or fixed plot configurations. By enabling custom plot sizing, the system can better accommodate a wide range of operational requirements, including different inventory methodologies, management objectives, and site-specific conditions. This is particularly valuable in heterogeneous forest environments where stand structure, density, and terrain variability may require tailored sampling approaches to ensure accurate representation of forest conditions. The feature enhances the practical applicability of the tool by aligning it more closely with real-world field practices and organisational standards. It also improves analytical consistency by allowing users to replicate exact plot definitions across multiple assessments, supporting comparative analysis over time. Overall, this development increases the usability and versatility of the platform, ensuring it can support both standardised inventory protocols and more flexible, project-specific forestry assessments.

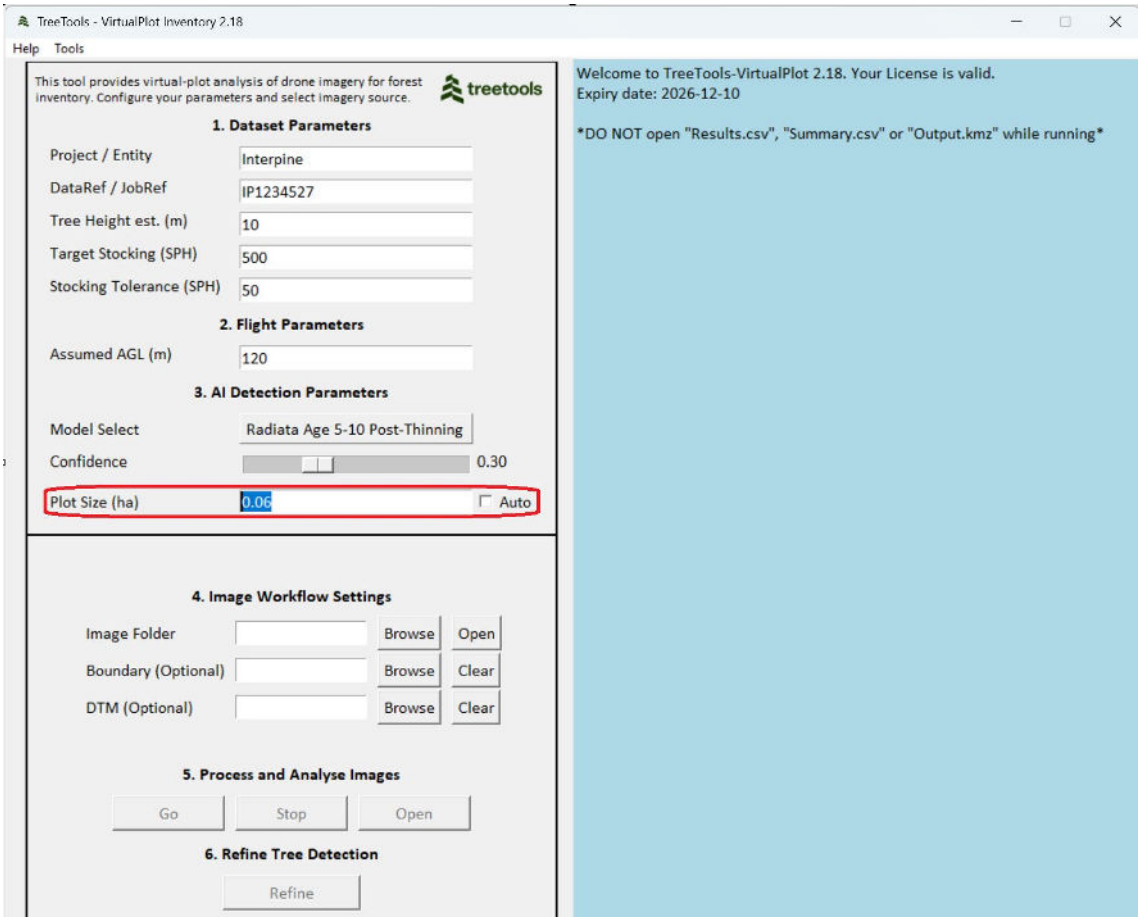


Figure 6. Enabling custom plot sizing

Regeneration Assessment Model

The development of a Regeneration Assessment Model using remote sensing data provides a scalable, data-driven solution for estimating and monitoring forest regeneration across managed stands. By utilising RGB imagery, the model evaluates early-stage forest development through indicators such as canopy density, and spatial distribution patterns associated with regenerating areas. These metrics enable the identification of successfully regenerating zones as well as areas with insufficient, delayed, or uneven regrowth.

The approach reduces reliance on intensive field surveys by delivering consistent and repeatable assessments across large or difficult-to-access areas. It also supports proactive forest management by highlighting areas that may require replanting, release treatments, or additional silvicultural intervention.

The current outputs include:

- Model focused on early-stage stands, approximately 1–3 years old and onwards.
- Total stocking estimation, including both planted trees and natural regeneration.
- Spatial distribution of regeneration across the site.
- Regeneration density heatmaps to identify understocked or problem areas.
- Identification of areas requiring potential intervention or follow-up management

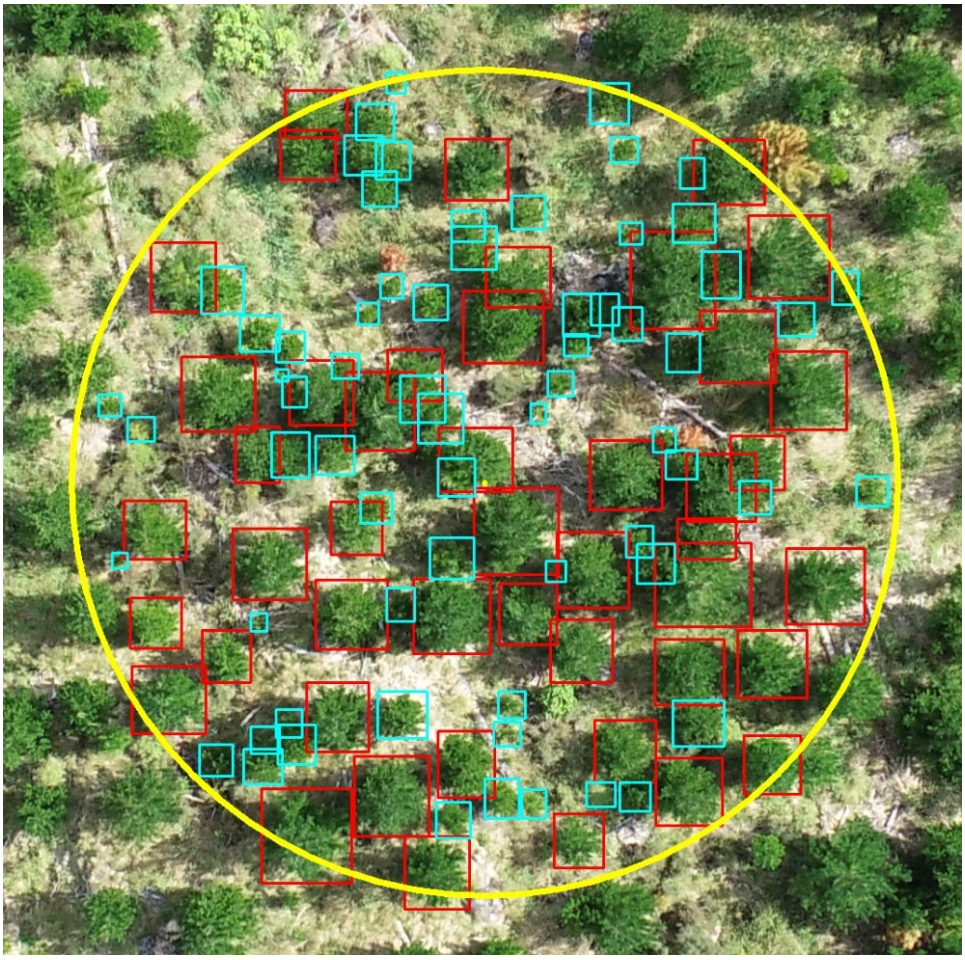


Figure 7. Regeneration Assessment Example

SilvaCloud (LiDAR Online)

Automated Gap Analysis Polygon Creation

The Automated Gap Analysis Polygon Creation functionality provides an advanced method for identifying and delineating areas of missing or sparse forest cover directly from remote sensing data. This tool is specifically based on the detection of gaps visible within the canopy height model (CHM) raster, where lower or zero-height values indicate the absence of tree canopy. By analysing the spatial distribution of these gaps, the system automatically generates polygon features that accurately outline unstocked or low-density areas within a stand. This eliminates the need for manual digitisation and significantly improves the speed and consistency of gap mapping across large forested landscapes. The resulting

polygons can then be used for further analysis, reporting, or integration into forest management planning workflows, such as replanting prioritisation or stocking assessments. In addition, the automation of this process ensures a repeatable and objective approach to gap detection, reducing operator bias and improving comparability across datasets and time periods. Overall, this development enhances the ability to translate raw LiDAR-derived canopy height information into actionable spatial insights for forest structure and productivity assessment.

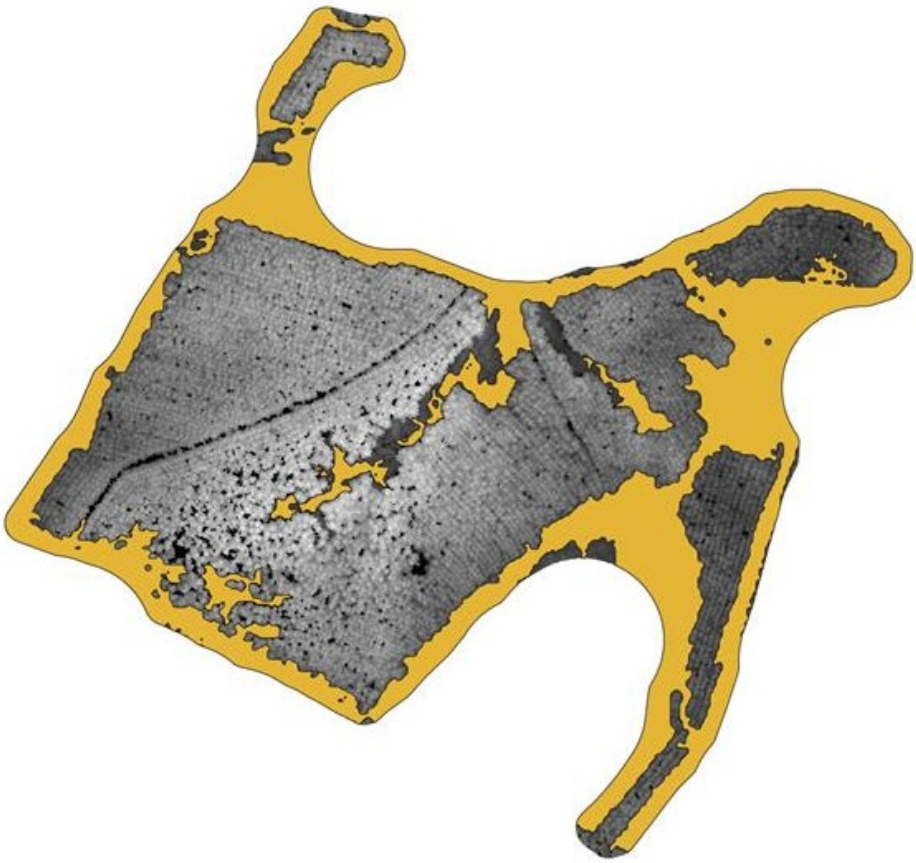


Figure 8. Automated Gap in yellow over CHM raster

Thinning prescription

The integration of thinning prescription values into reporting outputs enhances the practical value of the analytical results by directly linking model outputs to operational forest management decisions. This functionality embeds prescribed thinning parameters—such as recommended removal intensity, spacing guidelines, or stand-level treatment thresholds—into the reporting layer of the system. As a result, users are no longer required to interpret raw analytical outputs separately from management guidelines, as the reports now present clear, actionable recommendations derived from the underlying data. This integration ensures that insights generated from LiDAR and remote sensing analyses are immediately usable in planning and operational contexts, reducing the gap between data processing and field implementation. It also improves consistency in decision-making by standardising how thinning prescriptions are applied across different stands and datasets. Furthermore, by embedding these values directly into automated reports, the system supports more efficient communication between analysts, planners, and field teams. Overall, this development strengthens the link between advanced analytics and operational forestry practice, enabling more informed, consistent, and timely thinning decisions.

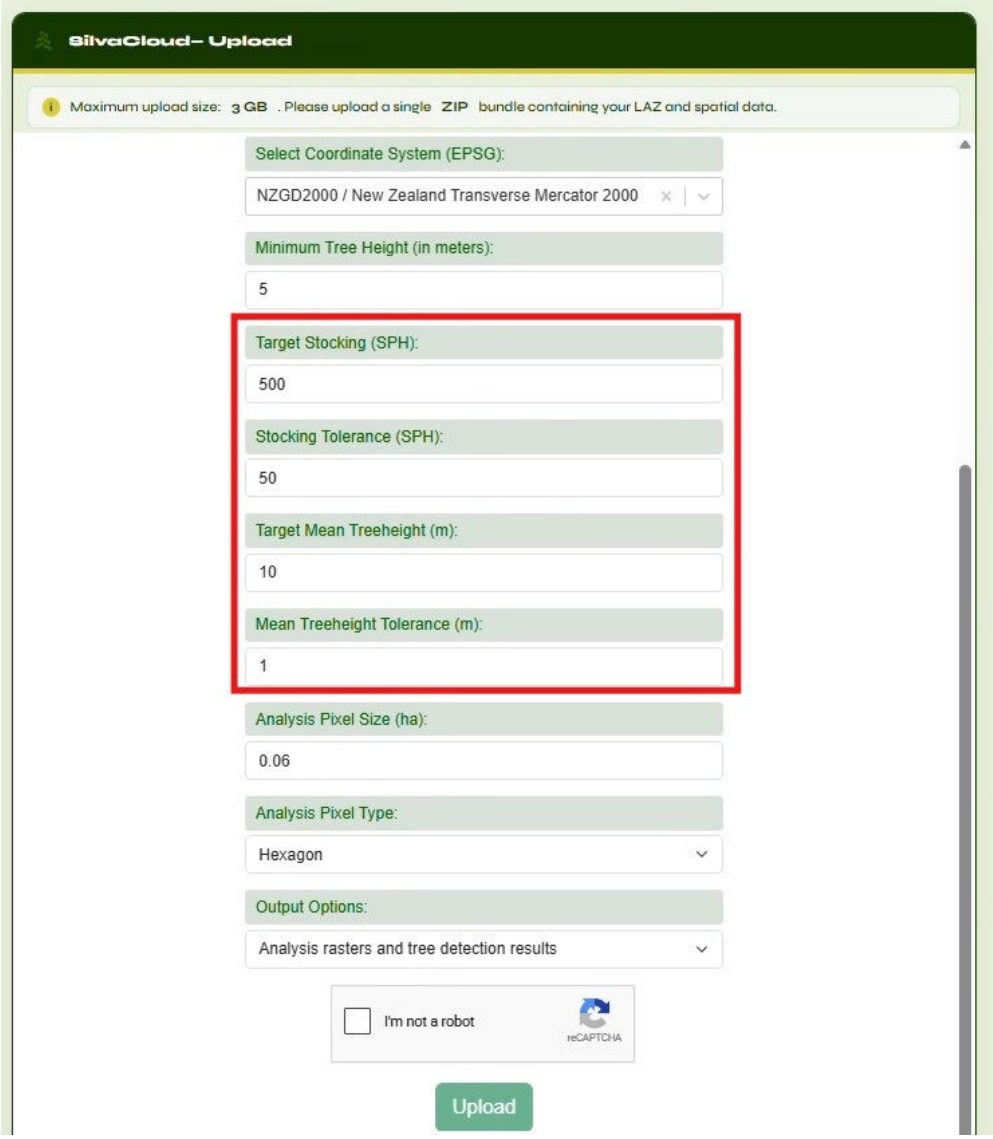


Figure 9. Thinning prescription values in the red box

Refinement tool

The addition of a refinement tool to support user-created remapped areas or tree location revisions provides an important enhancement to data correction and iterative analysis workflows within the platform. This tool allows users to manually adjust or update spatial representations of stands and individual tree locations where initial automated outputs may require correction due to data noise, misclassification, or changes identified during field validation. By enabling the remapping of areas and the revision of tree positions, the system supports a more flexible and interactive approach to data management, ensuring that analytical outputs can be aligned more closely with ground-truth observations and user expertise. This capability is particularly valuable in complex forest environments where remote sensing data may be affected by terrain variability, canopy overlap, or sensor limitations. The refinement process improves overall data accuracy and ensures that subsequent analyses—such as stocking estimates, thinning prescriptions, and gap detection—are based on the most reliable spatial information available. Additionally, it supports an iterative workflow where users can progressively improve dataset quality over time, enhancing confidence in decision-making outputs. Overall, this tool strengthens the robustness, usability, and practical applicability of the platform by bridging the gap between automated detection and expert user validation. Development of this tool is outside of the scope of the current contract, however it has proved to be a worthwhile addition.

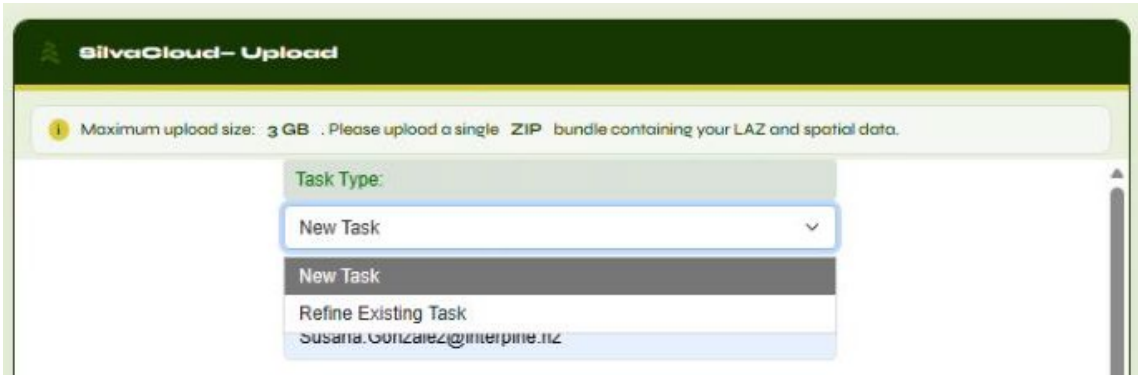


Figure 10. Refinement tool to support user-created remapped areas

CONCLUSION

The beta prototype phase has successfully advanced the capabilities of both VirtualPlot and SilvaCloud by integrating machine learning, LiDAR, and UAV-based technologies into practical forestry tools. The delivered features enhance forest assessment accuracy, improve operational efficiency, and provide actionable insights for decision-making. These developments represent a significant progression towards fully operational, scalable solutions for precision forestry and establish a strong foundation for future improvements and wider deployment.