

# Western Ringtail Possum habitat modification calculations

Documentation of spatial analyses and calculations.  
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## 1. Purpose

The purpose of this workflow is to create spatial data layers that allow for the visualisation and quantification of vegetation most critical for Western Ringtail Possum (WRP) habitat, based on the:

- A. pre-development status (baseline)
- B. post-development tree canopy
- C. post-development tree canopy connected by canopy bridges;

within the development envelope of the proposed development, taking into account:

- A. Suitable habitat types (primary (Peppermint forest) and secondary habitat (Banksia and Marri forests) values;
- B. Relevant vegetation strata within the suitable habitat types: using Bushfire APZ classifications, these have been determined to be the 'trees' layer - >5 m<sup>2</sup> in height, and the taller part of the 'shrubs' layer, 2-5 m<sup>2</sup> in height.
- C. Proposal elements: full clearing, partial modification, conservation, and public open space areas;
- D. Bushfire risk management modifications to vegetation (Asset protection zones: high, medium and low)

Note 1: for the current exercise, it is the trees and taller part of the shrubs category that are considered to be the key habitat for WRPs and therefore quantification is based only on the 'tree' layer and the 2-5 m vegetation (including important foraging species such as Basketbush (*Spyridium globulosum*), Christmas tree (*Nuytsia floribunda*) or *Acacia* species).

Note 2: Connectivity at the shrub and groundcover layers at the base of trees is also important for when WRPs need to go to ground to shelter in cool vegetation at ground level and/or travel to locations where canopy connectivity is lacking. This is not captured in the current analysis but will need to be incorporated to the maximum extent possible in other aspects of planning and implementation.

## 2. Methodology

### 2.1 Datasets utilised

1. Development proposal elements
2. Proposed Bushfire Risk Mitigation asset protection zones and guidelines for their implementation
3. Fauna habitat types
4. Lidar-derived vegetation layers (likely from 2021 capture)
  - a. 0.2m-1m\_SmithsStratification\_APZ.shp
  - b. 1m-2m\_SmithsStratification\_APZ.shp
  - c. 2m-5m\_SmithsStratification\_APZ.shp

d. Above5m\_SmithsStratification\_APZ.shp

Note all layers were reprojected to GDA 2020 MGA z50 (EPSG:7850).

## 2.2 Software utilised

Analyses were carried out in:

- QGIS version, version 3.34.9-Prizren, including with a series of native tools and processing functionalities, as well as external plugins ('Group Stats' and 'Select Within'); and
- R software environment for statistical computing and graphics version 4.4.1 accessed with RStudio 2024.09.1 Build 394 for Windows.

## 2.3 Trees (canopy height >5 m): creation of baseline layer

1. Within the bounds of the Lidar-derived >5 m canopy extent, a 'tree centroid' point layer was manually created to approximately represent individual trees, to be used to partition the existing canopy into segments. Centroids were placed roughly where it was estimated that a tree trunk may be located based on visual inspection of aerial and satellite imagery.
2. Tree centroids were buffered by 5 m with non-overlapping (Voronoi) buffers using the "Non\_overlapping\_buffer\_from\_points\_tSVLfml.model3" macro model in QGIS.
3. The output of the above step was clipped by the existing canopy layer; any parts from the canopy layer that lay outside of the centroid buffer layer were extract using st\_difference() tool and merged with the buffer layer to make the baseline tree canopy layer.
4. For the baseline tree canopy layer, multi-part polygons were converted to single part for efficiency and accuracy of analyses.
5. Small sliver polygons were dissolved with the adjacent polygon with the largest shared boundary.
6. The following attributes were calculated based on greatest proportion overlay and/or centroid location of each polygon relative to each definition layer (centroid overlay determined using the 'Select Within' QGIS plugin; majority overlay determined using the 'overlay intersects' field calculator tool with sorting by intersection size):
  - a. Proposal element ("Proposal"): 'Clearing', 'Conservation / POS' or 'Vegetation modification'.
  - b. Bushfire threat mitigation zone (Asset protection zones) ("APZ"): '0 - No fire risk modification required', '1 - Low level of modification required', '2 - Medium level of modification required', '3 - High level of modification required'.
  - c. FaunaHabitat type ("FaunaHab"): 'Open Peppermint Forest' (Primary habitat), 'Open Banksia Forest' (secondary habitat), 'Closed Low Marri Forest surrounded by open shrubland areas' (secondary habitat).

Note: canopies frequently are situated over the boundary of definition polygons – the attribute value was determined based on centroid location or greatest overlay area.

Plate 1 shows the > 5 m tree polygons classified by Bushfire threat mitigation zone. Plate 2 shows the same, zoomed in on the WRP Possum habitat.

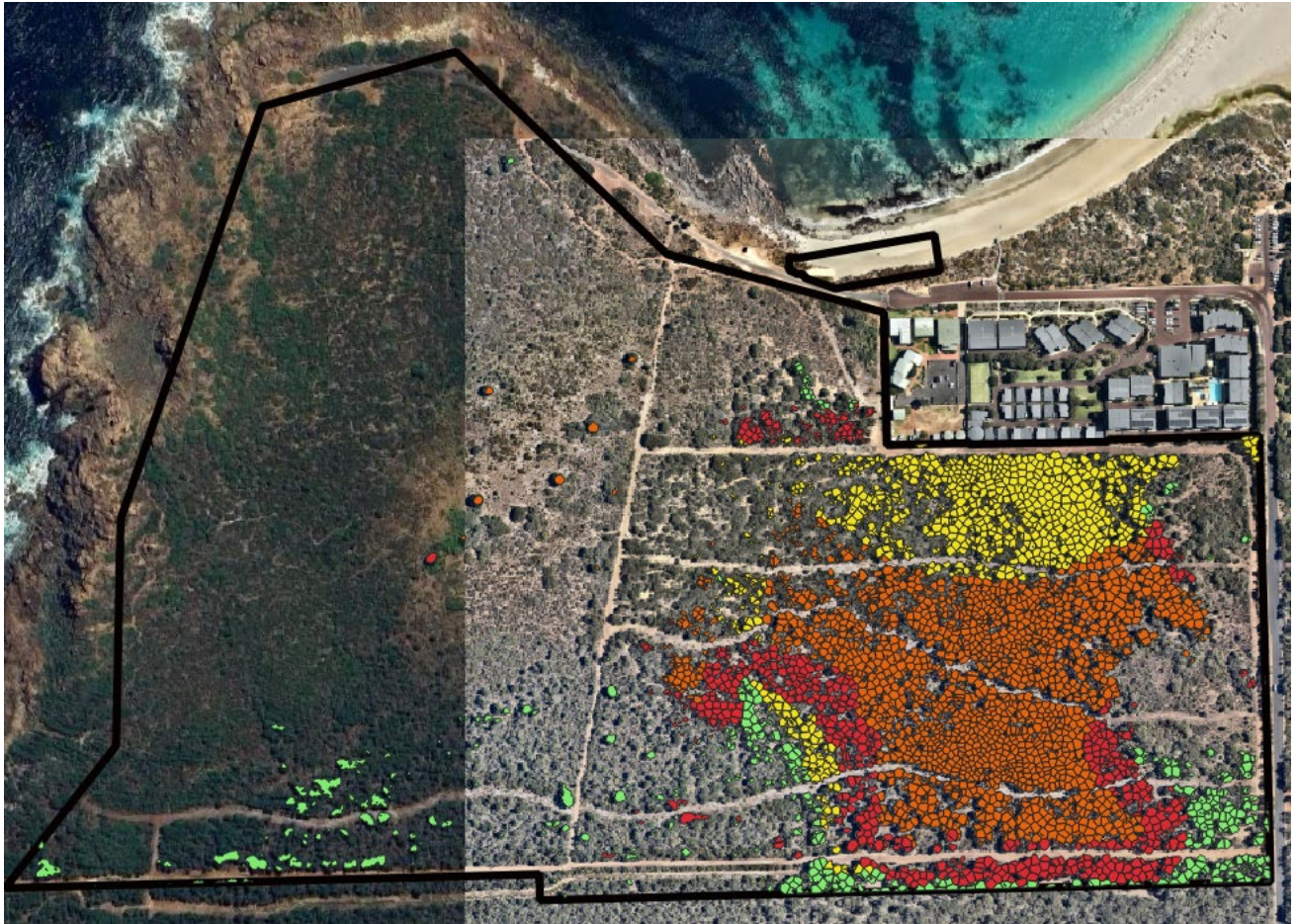


Plate 1: Tree polygons classified by Bushfire threat mitigation zones (Asset protection zones) (“APZ”) for the entire Development Envelope: Green = ‘0 - No fire risk modification required’, yellow = ‘1 - Low level of modification required’, orange = ‘2 - Medium level of modification required’, red = ‘3 - High level of modification required’.

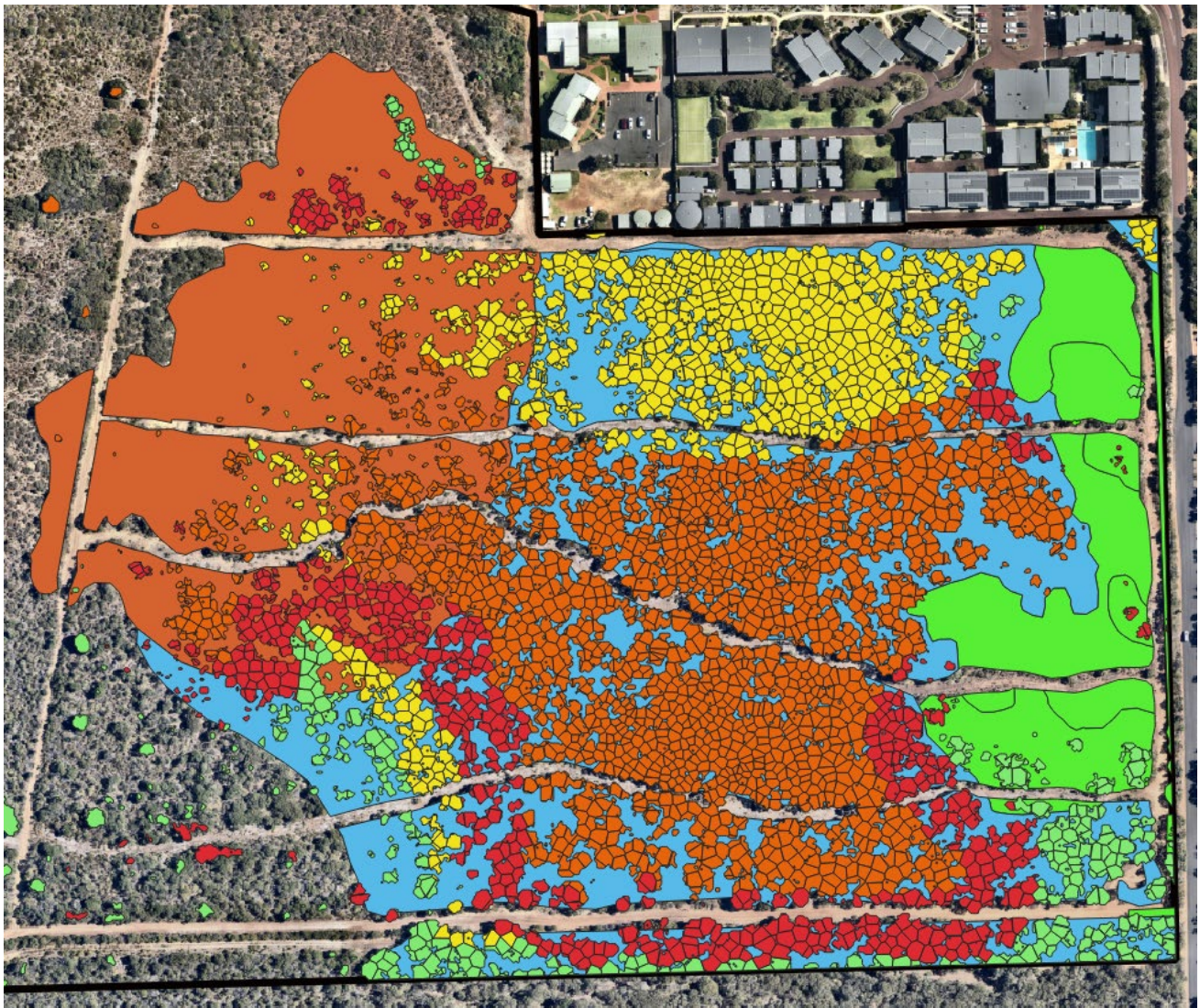
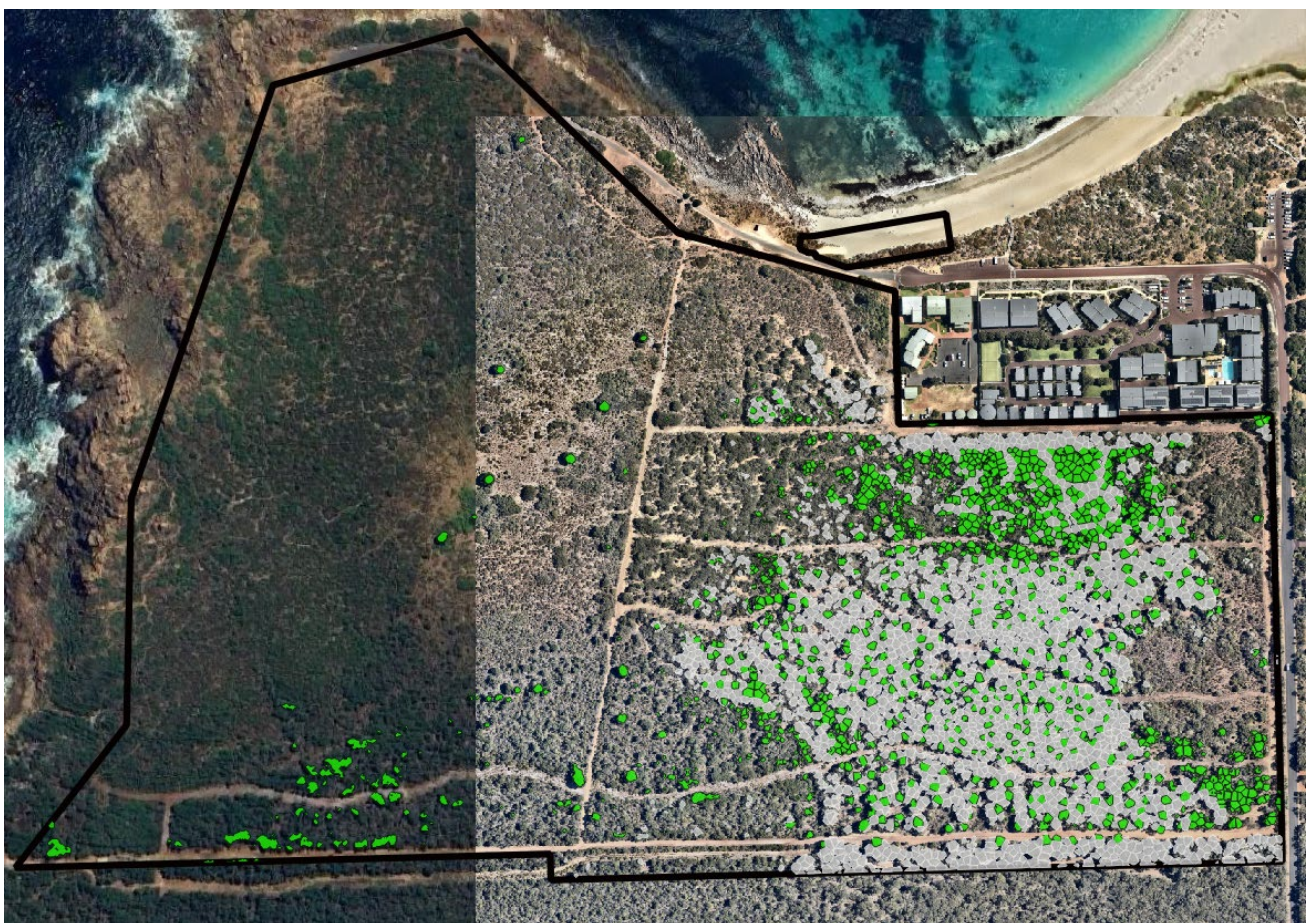


Plate 2: Tree polygons classified by Bushfire threat mitigation zones (Asset protection zones) (“APZ”) for the possum habitat: Green = ‘0 - No fire risk modification required’, yellow = ‘1 - Low level of modification required’, orange = ‘2 - Medium level of modification required’, red = ‘3 - High level of modification required’. The habitat types shown in the background are: blue = Open Peppermint Forest; brown = Open Banksia Forest, green = Closed Low Marri Forest surrounded by open shrubland.

## 2.4 Creation of modified tree scenario

1. In order to calculate the area of various landscape parts, to inform the selection of tree polygons for retention versus removal, a multi-attribute area layer was first created by dissolving and merging: a) Bushfire threat mitigation zones layer by APZ zone; b) Proposal elements layer by element; and c) fauna habitat layer by fauna habitat. A multiple union process was then run for all of the above layers and the attribute table was populated with the relevant attributes for each polygon, as well as polygon areas.
2. Tree polygons were then ‘marked’ for removal or retention based on a combination of proposal element, bushfire management zone, and habitat type.
  - For the ‘cleared’ proposal element, all tree polygons are considered ‘removed’.

- For the 'conservation / POS' elements, all tree polygons are considered 'retained' unless there is overlap with a low, medium or high asset protection zone; in which case the requirements of that zone take precedence.
- For the 'modified vegetation' element, tree polygons were selectively retained versus being removed according to bushfire mitigation classifications, i.e. individual trees separated by > 5 m gaps in the medium and high modification zones, with a maximum of 20% and 15% tree canopy cover allowed for the medium and high modification zones, respectively.
- For the 'low modification' bushfire threat mitigation zone, groupings of trees were allowed, separated by > 5 m gaps and with a maximum of 40% tree canopy cover allowed.
- Total areas for the different APZ categories were calculated for the areas within the modified vegetation zone and possum habitat as well as for the whole development envelope.
- Total allowed canopy was calculated for each APZ category based on the percentage foliage cover allowed in each zone
- Trees were marked for retention based on the rules of each APZ (i.e. >5 m gap between trees/patches of trees required; individual trees in 'high-risk' and 'moderate risk' zones and intermittent groupings of trees in the 'low risk' zones).
- Total canopy retained for each APZ within the modified area were calculated using the 'group stats' QGIS plug-in.
- The two steps above were repeated in an iterative manner for each APZ with trees included and/or removed until the 'total allowed canopy' was reached and not exceeded.



**Plate 3 Trees to be retained (green) and removed (grey)**

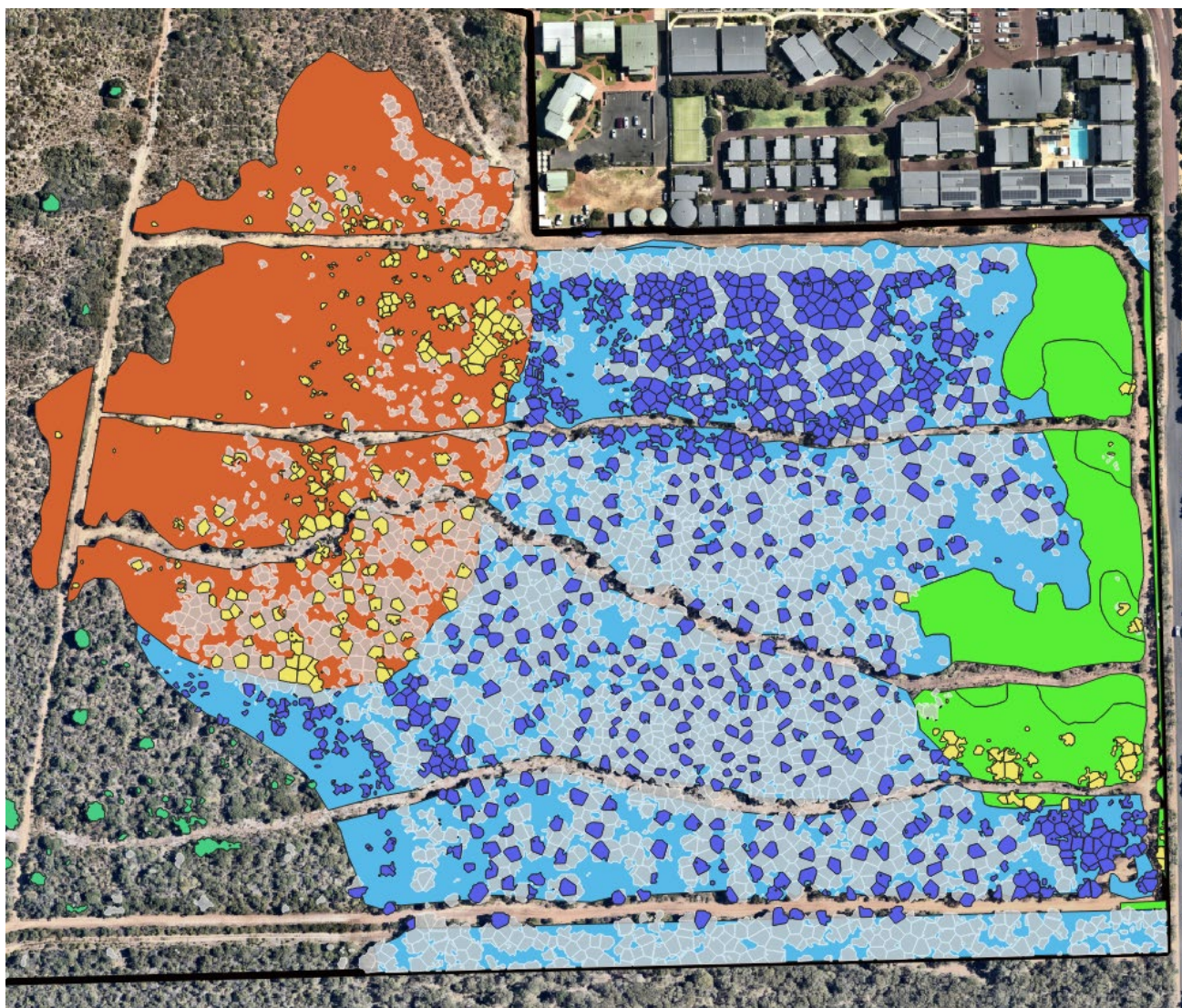
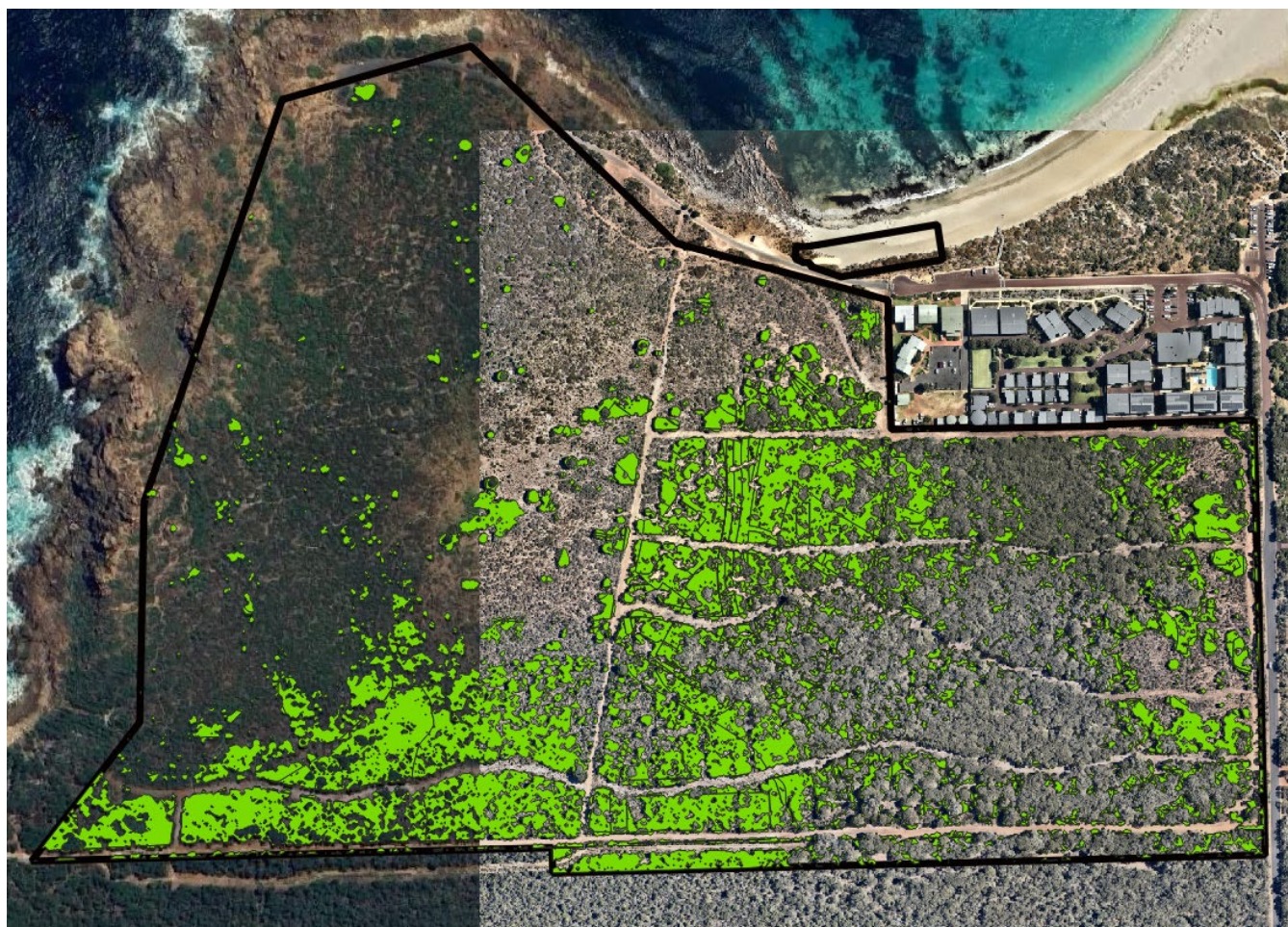


Plate 4 Trees to be retained and removed, by habitat classification.

Trees_above5m retained by habitat category		JBSG 2F FaunaHabitat 240627 possums only	
<input checked="" type="checkbox"/>	Primary	<input checked="" type="checkbox"/>	Open Peppermint Forest
<input checked="" type="checkbox"/>	Secondary	<input checked="" type="checkbox"/>	Open Banksia Forest
<input checked="" type="checkbox"/>	N/A	<input checked="" type="checkbox"/>	Closed Low Marri Forest surrounded by open shrublan
<input checked="" type="checkbox"/>	Remove		

## 2.5 Tall shrubs (i.e. vegetation with maximum height of 2-5 m height) baseline

The tall shrubs layer was derived from the Lidar-derived 2-5 m vegetation height layer and only represents areas where the maximum vegetation height is 2-5 m; any shrubs or lower trees under tall trees are not considered. Some overlaps did exist between the >5 m layer and the 2-5 m layer and these were removed using the Difference tool. Plate 3 shows the resulting layer.



**Plate 5: Tall shrubs baseline**

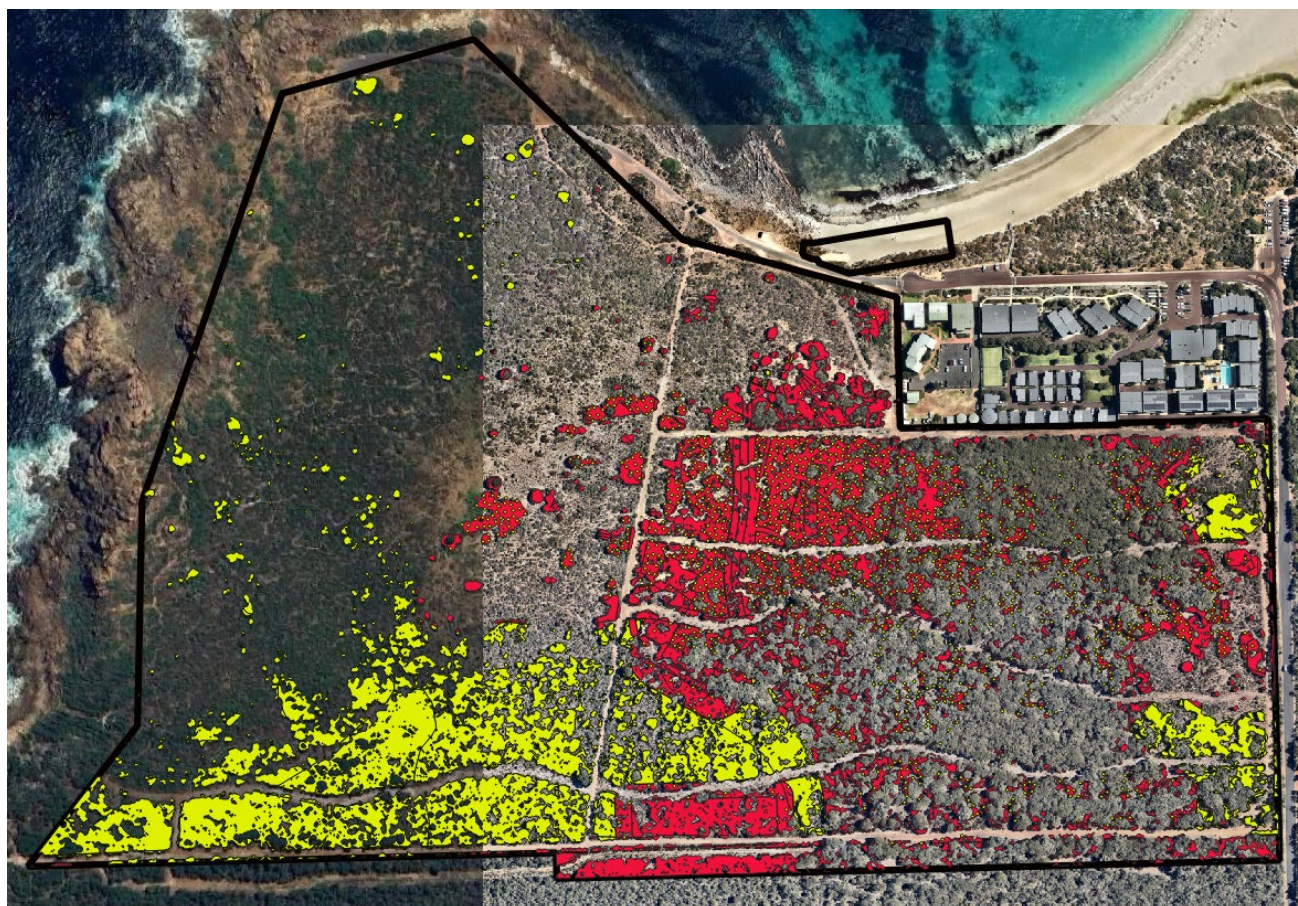
A multiple union process was then run between this layer and the simplified, dissolved versions of the a) bushfire threat mitigation zones; b) proposal elements layer; and c) fauna habitat layer and the attribute table was populated with the relevant attributes for each polygon.

## 2.6 Tall shrubs (i.e. vegetation with maximum height of 2-5 m height) modification

A subset of the tall shrubs baseline layer was created that included only areas proposed to be 'Vegetation modification' and/or 'Conservation / POS' under the proposal elements, and fell within one of the three bushfire mitigation zones.

Within the extent of this 'tall shrubs for modification' layer, random points were generated at spacings aimed to provide shrub patches with 3 m gaps in between them (for low and moderate modification areas), and 10 m gaps for high modification areas. These spacings were based on a shrub patch radius of 1.2616 m which would give the maximum allowable shrub patch area of 5 m<sup>2</sup> under the bushfire mitigation rules, and with the 'tall shrubs for modification' layer shrunk by that same shrub patch radius to avoid shrubs extending beyond the allowed area edge. Initially a higher number of points was generated based on an estimate of how many such patches (with required spacing) could fit into the total area using the `st_sample()` tool in R 'sf' package and then an iterative process was employed to filter the points with a maximum distance constraint by checking distances between new candidate points and previously selected points using `st_distance()`. Only those points with greater than 10 or 3 meters, plus the shrub patch radius, between them. A total of 283 points were created at 10 m spacing and 1638 points were created for the 3 m spacing. Each point was then buffered by the shrub patch radius.

The buffered points were then extracted as per the relevant fire management zone – 3 m-spaced points for the low and high modification areas and 10 m-spaced points for the high modification areas. These points were then merged into one layer and this was merged with a layer representing the parts of the original baseline layer that were determined to be retained.



**Plate 6: Tall shrubs to be retained (yellow) and removed (red). Note the many very small points of yellow within the red areas – these are the 5 m<sup>2</sup> shrub patches created as per the bushfire requirements.**

## 2.7 Creation of mitigation features (possum bridges)

Line features drawn between key parts of the possum habitat to provide connectivity within these parts and between these and the National Park to the south. The current rendition reflects a compromise between a) more bridges that provide connectivity between more individual trees, particularly within the high and moderate APZs where only individual trees are retained (not patches of trees), and b) feasibility and cost considerations combined with the presumed lower likelihood of individual trees representing critical habitat resources.



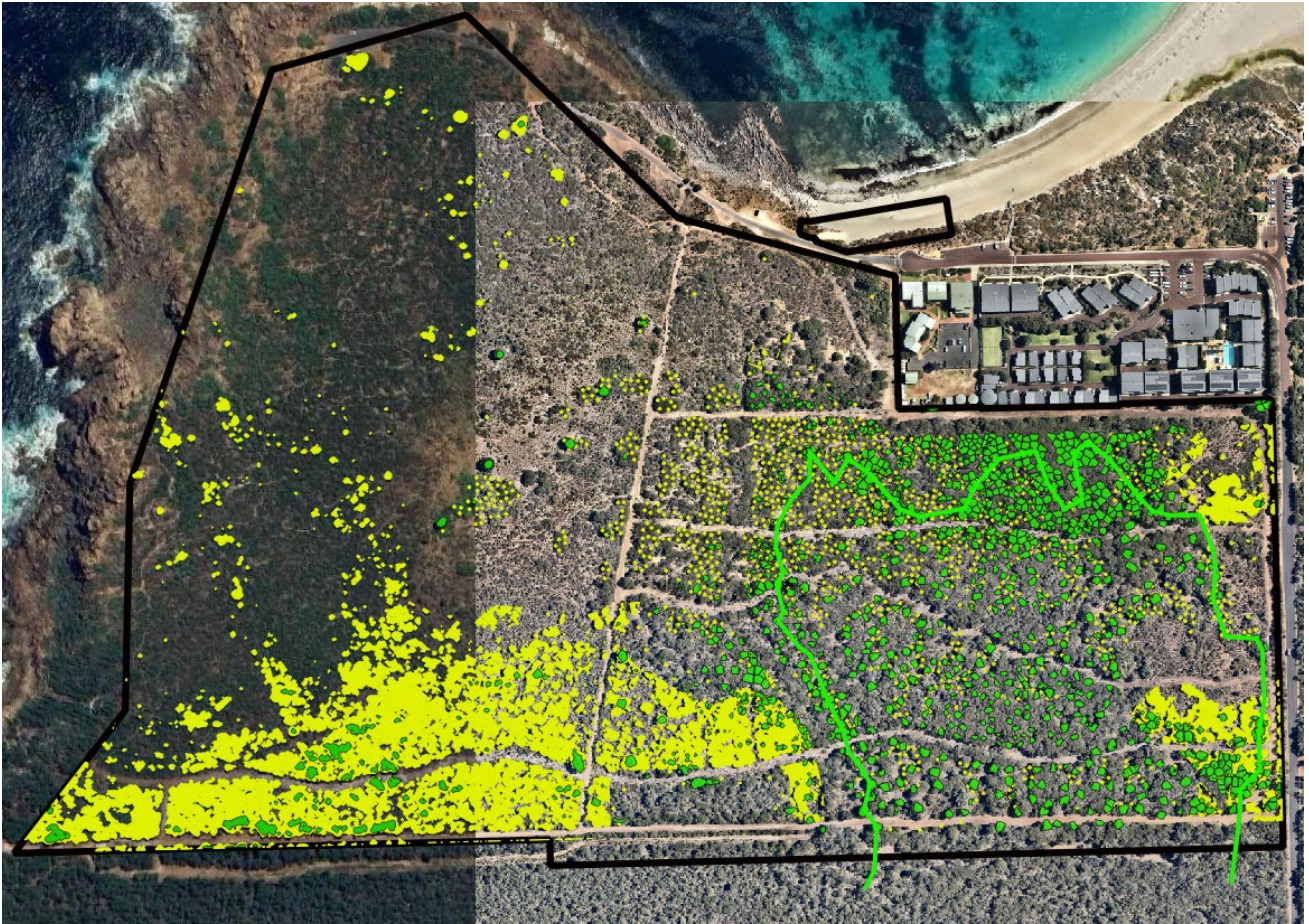


Plate 7 The post-development scenario: yellow = shrubs, green = trees over 5 m, with revised possum bridge.

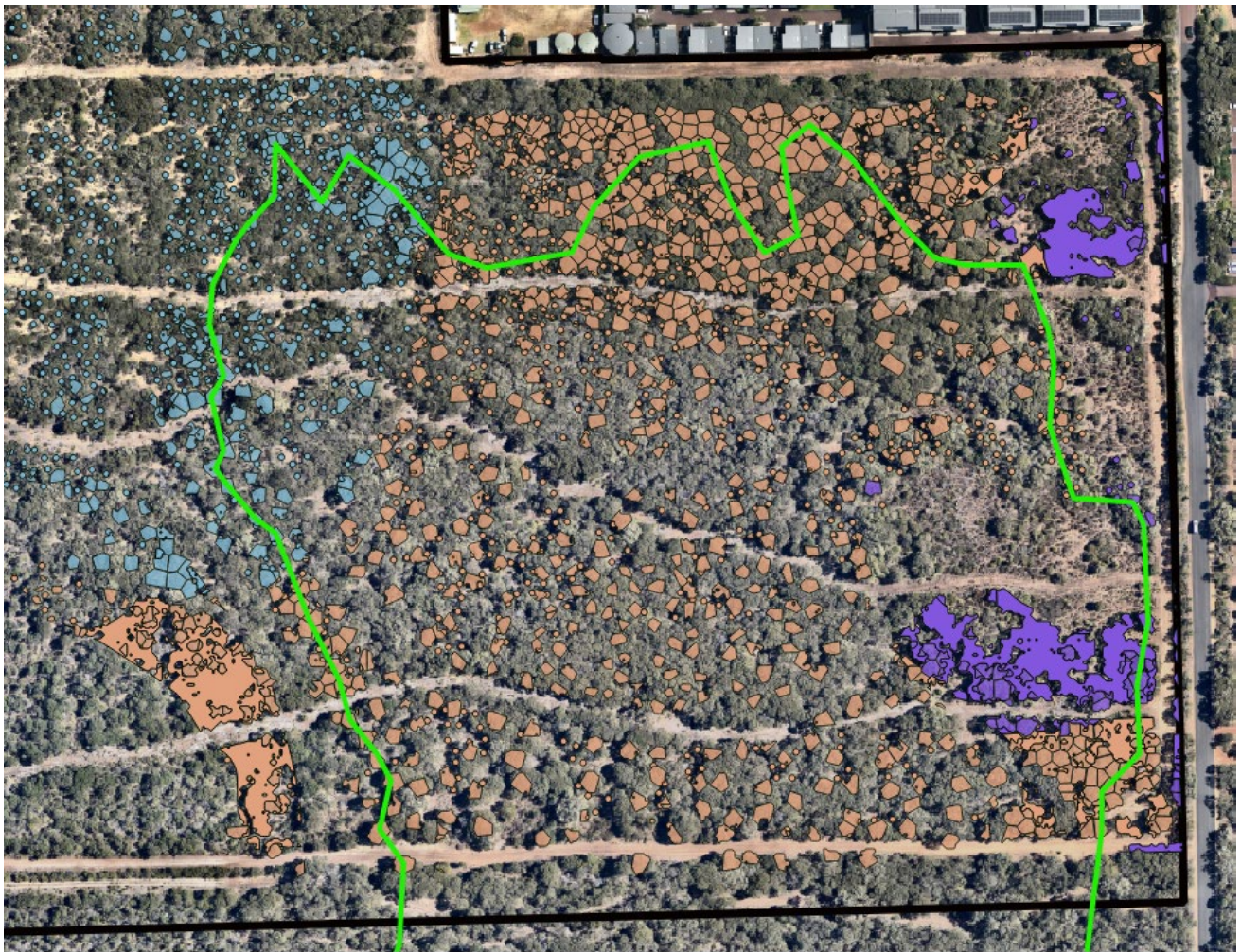


Plate 8 trees and tall shrubs to be retained, by habitat type, with possum bridge.

- Trees above 5m by fauna habitat**
  - Open Peppermint Forest
  - Open Banksia Forest
  - Closed Low Marri Forest surrounded by open shrubland areas
  - Other (not possum habitat)
  - Cleared/ Disturbed
- Shrubs\_modified**
  - Open Peppermint Forest
  - Open Banksia Forest
  - Closed Low Marri Forest surrounded by open shrubland areas
  - Other (not possum habitat)
  - Cleared/ Disturbed
  -



**Plate 9** The post-development scenario: yellow = shrubs, green = trees over 5 m, with revised possum bridge.

### 3. Limitations, clarifications and outstanding matters to address

1. Canopies have not been clipped to the various boundaries used for calculations above – rather they have been assigned to boundaries based on location of centroid or the polygon with which they have the largest

Clarification on interpretation of APZ rules: It appears that there may be an oversight in the APZ guidelines in that many small patches of tall shrubs (2-5 m height) are allowed in the 'medium risk' zone, but no shrubs of that height at all seem to be allowed in the 'low risk' zone. This seems inconsistent; for the current analysis it has been assumed that the same shrub guidelines apply to the low risk zone as they do to the medium risk zone; however if this is incorrect, the layer can be filtered very easily to exclude all retained shrubs in the low risk zone.

2. Canopy cover for testing of criteria exceedance has been calculated for the entire areas falling under each APZ, not by section.
3. For the 'low threat' APZ – *"Trees are to be grouped intermittently to avoid continuous canopy throughout the entire area, by creating 5 m gaps between canopies of group of trees"*. It is understood that there is no defined limit to the size of the intermittent groupings, however size of groups of trees has been limited, with >5 m gaps separating, to ensure alignment with bushfire considerations. The exact degree of this can be adjusted.