Appendix F Banksia Woodland Community Assessment (Patch 5)

Morley-Ellenbrook Line Planning

Banksia Woodland Community Assessment – Patch 5

PUBLIC TRANSPORT AUTHORITY OF WESTERN AUSTRALIA

JULY 2020

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Morley-Ellenbrook Line Planning Banksia Woodland Community -Patch 5

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1. INTRODUCTION

1.1 Project Overview

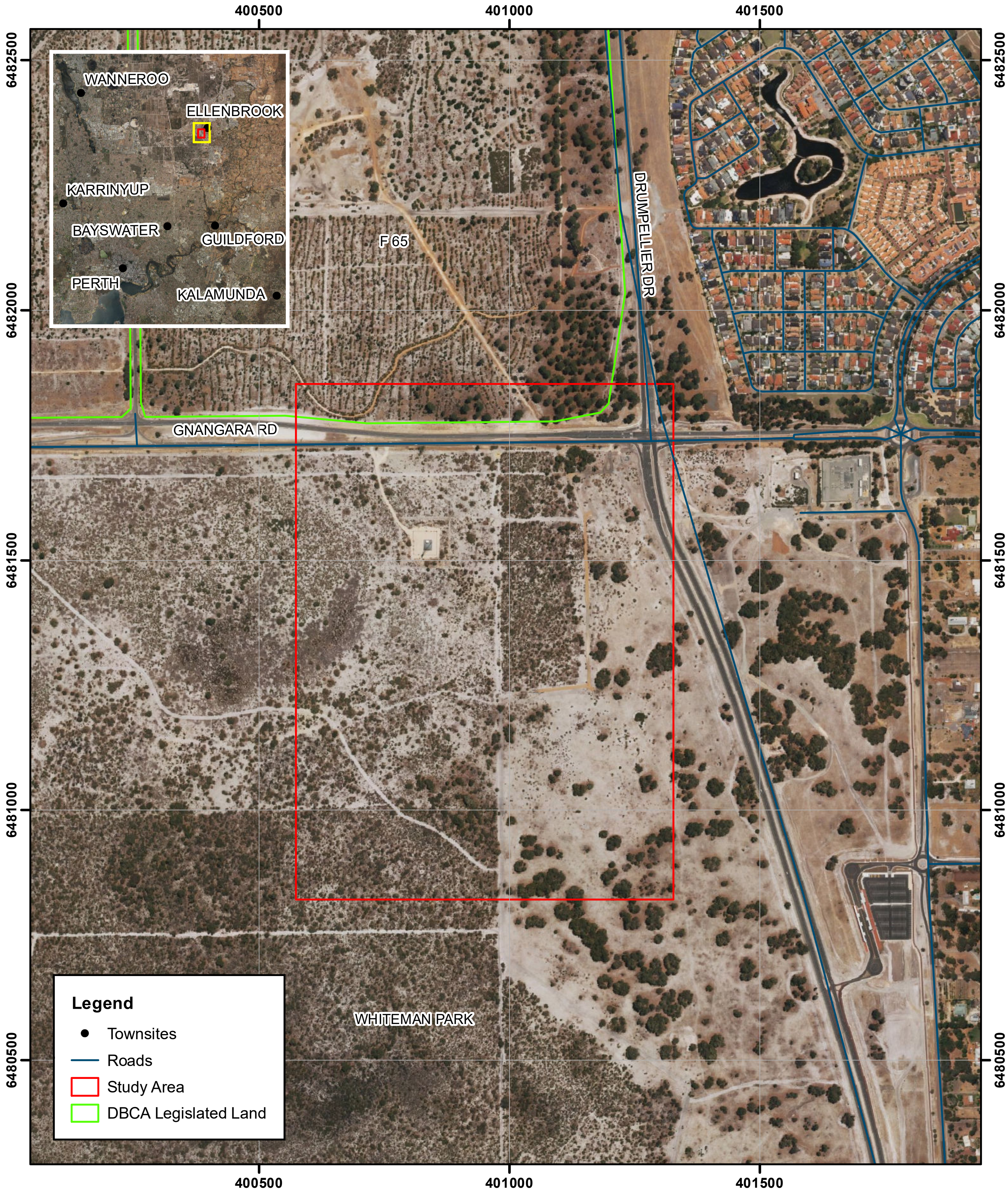
Metronet is responsible for delivering construction of the Metronet light rail development on behalf of the Public Transport Authority of Western Australia (PTA). The Metronet light rail development includes the Morley-Ellenbrook Line which runs from Bayswater to Malaga, then east through Whiteman Park to Bennett Springs East Station, then north to Ellenbrook running adjacent to Drumpellier Drive (the Project). The line spans a distance of approximately 21 km.

Flora and vegetation surveys of the Morley-Ellenbrook Line indicative development envelope undertaken by RPS Australia West Pty Ltd (RPS) (RPS 2020) identified and mapped an area of the Banksia Woodlands of the Swan Coastal Plain TEC (Endangered) ('Banksia Woodlands TEC') (referred to as Patch 5) at Ellenbrook adjacent to (south of) Gnangara Road.

Metronet commissioned Woodman Environmental Consulting Pty Ltd (Woodman Environmental) to review flora and vegetation information relating to the Project and identify and map areas of ecological importance, including areas mapped as the Banksia Woodlands of the Swan Coastal Plain TEC to support the approvals process.

1.2 Study Area Definition

Metronet has provided the Project Study Area (the Study Area), as shown on Figure 1. The Study Area is 77.81 ha in size, located approximately 19 km north-east of Perth City, south of Gnangara Road and west of Drumpellier Drive. The majority of the Study Area is comprised of freehold land. There are also small areas of road, Unallocated Crown Land (UCL) and Gnangara-Moore River State Forest.



Study Area Location	Author: David Coultas	
	WEC Ref: PTA20-48-01	
WOODMAN ENVIRONMENTAL	Filename: PTA20-48-01-f01	**Figure**
	Scale: 1:10,000 (A4)	1
	Projection: GDA 1994 MGA Zone 50	
This map should only be used in conjunction with WEC report PTA20-48-01.	Revision: A - 7 July 2020	

1.3 Aim and Objectives

The primary aim of this assessment was to identify and map areas of ecological importance within the Study Area, including the assessment of the extent of the Commonwealth listed Banksia Woodland TEC, to the current regulatory standard. This assessment was conducted as per the Scope of Works (SoW) provided by Metronet (Appendix A).

The overall objectives of the assessment were to:

- Undertake a desktop review of available vegetation information relating to the Study Area;
- Field verify the existing site condition and vegetation mapping and determine the potential distribution of significant vegetation (including the Banksia Woodlands TEC);
- Map the extent of significant vegetation (including the Banksia Woodlands TEC);
- Undertake an analysis of the existing quadrat data from the Study Area with the original Swan Coastal Plain (SCP) dataset (Gibson *et al.* 1994) and amended SCP dataset (Keighery *et al.* 2012), to determine SCP FCTs present within the Study Area;
- Undertake a desktop review of available survey information related to *Caladenia huegelii* (Threatened) in the Study Area;
- Determine the suitability of *Caladenia huegelii* (Threatened) Habitat within the Study Area.

The survey and reporting works comply with the following documents:

- Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016a);
- Environmental Factor Guideline – Flora and Vegetation (EPA 2016b);
- Approved Conservation Advice for the Banksia Woodlands of the Swan Coastal Plain TEC as described in the formal listing advice (Threatened Species Scientific Community (TSSC) 2016);
- Grand Spider Orchid (*Caladenia huegelii*) Recovery Plan.

2. METHODS

2.1 Desktop Review

A review of all publicly available flora and vegetation data relevant to the Project was undertaken to identify all known information with regard to Banksia TEC, and its presence in the Study Area. This included obtaining and reviewing copies of reports of previous biological surveys carried out within the Study Area, and interrogation of relevant databases and other sources as listed in Table 1.

Table 1: Sources of Information Reviewed for the Desktop Study

Report / Dataset	Source	Purpose
Swan Coastal Plain (SCP) dataset	Gibson *et al.* (1994) (extracted from *NatureMap* (DBCA 2007-))	• Physical location of SCP quadrats relevant to this assessment • Species composition SCP quadrats relevant to this assessment
Native and Weed Flora of the Southern Swan Coastal Plain: 2005 Dataset	Keighery *et al.* (2012) (extracted from *NatureMap* (DBCA 2007-))	• Physical location of SCP quadrats relevant to this assessment • Species composition SCP quadrats relevant to this assessment
A Floristic Survey of the southern Swan Coastal Plain report	Gibson *et al.* (1994)	• Summary of relevant significant vegetation, including 'typical taxa', 'other common taxa' and mean species richness • Differences between related community types
Detailed Flora and Vegetation Assessment Metronet Morley-Ellenbrook line.	RPS (2020)	• Location of quadrats in the Study Area • Species composition of quadrats • Vegetation type mapping and condition mapping of Study Area • Method and results of statistical analysis
Flora, Vegetation, Fauna and Targeted Black Cockatoo Survey	AECOM Australia Pty Ltd (AECOM) (2020) - Data provided by PTA)	• Location of quadrat in the Study Area • Species composition of quadrat
DBCA TEC and PEC lists	Review of current DBCA TEC and PEC lists (DBCA 2018, 2020)	• Identify any DBCA listed TECs or PECs which could occur within the Study Area

2.2 Personnel and Licensing

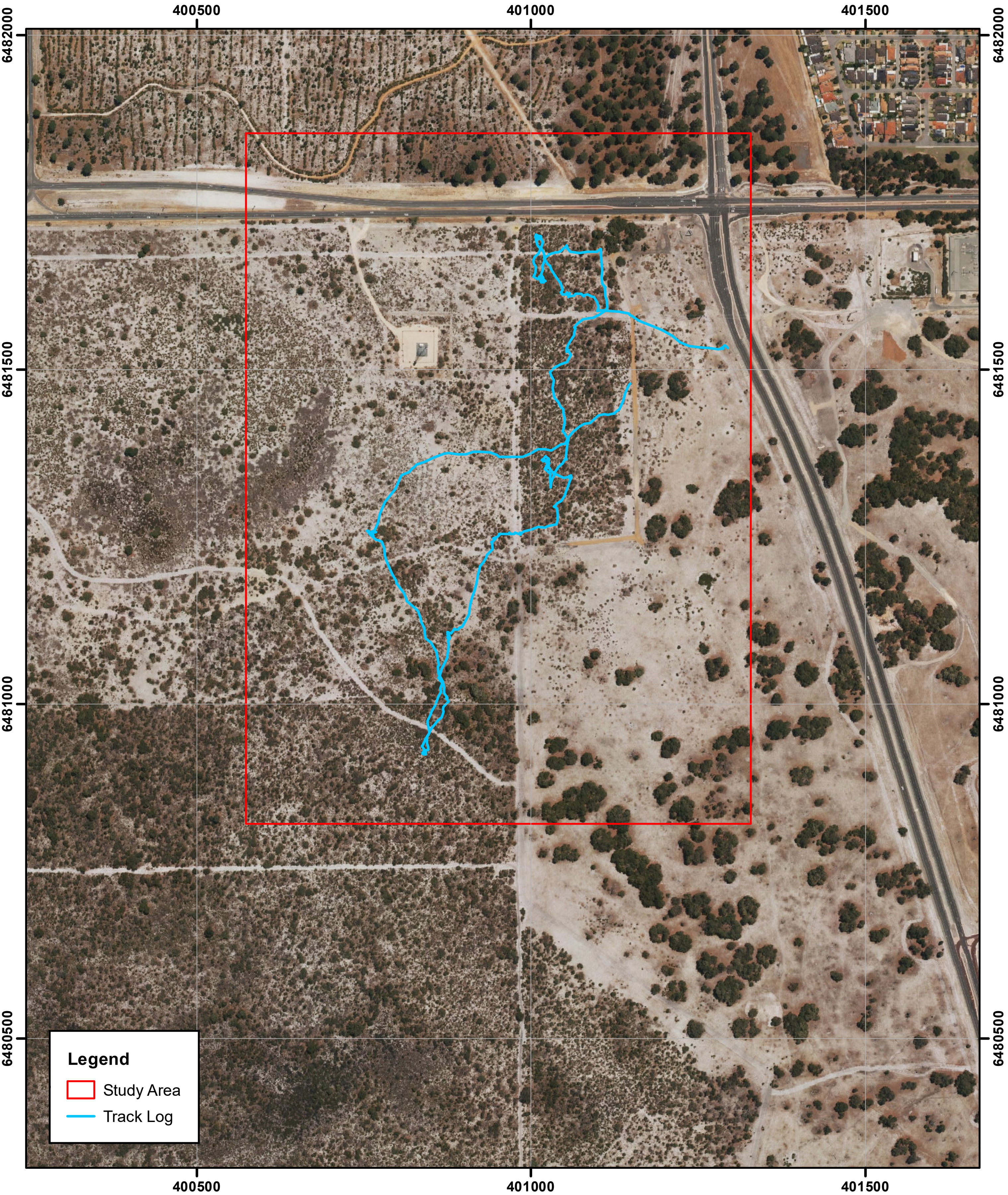
Table 2 lists the personnel involved in fieldwork for the survey. All field personnel have had extensive previous experience (David Coultas >10; Years; Alison Saligari >7 years) in conducting similar flora surveys in the SCP bioregion. All plant material was collected under the *Flora Taking (Biological Assessment) licences* and *Authorisation to Take or Disturb Threatened Species* pursuant to the *Biodiversity Conservation Act* 2016, sections 40, 274 and 275, as listed in Table 2.

Table 2: Personnel and Licensing Information

Personnel	Flora Collecting Permit (BC Act/WC Act)	Role
Alison Saligari	FB62000048 TFL25-1819	Field survey / Project Manager
David Coultas	FB62000051 TFL 23-1819	Field survey

2.3 Field Survey Methods

The field survey was undertaken on the 7th of July 2020. The field survey involved traversing the Study Area to verify the presence and boundary of significant vegetation, including the Banksia Woodlands TEC. This included reviewing previously mapped vegetation boundaries and vegetation condition (Section 2.6). The field survey involved recording data and observations based on the diagnostic process for the Banksia Woodlands TEC as described in the Approved Conservation Advice (TSSC 2016), including the key diagnostic characteristics and vegetation condition. The Study Area was also assessed for the suitability of *Caladenia huegelii* (Threatened) habitat (as per the *Caladenia huegelii* Recovery Plan (DBCA 2009)). Traverses in the Study Area are mapped as track logs in Figure 2.



Track Logs in the Study Area	Author: David Coultas	
	WEC Ref: PTA20-48-02	
WOODMAN ENVIRONMENTAL	Filename: PTA20-48-01-f02	Figure
	Scale: 1:7,500 (A4)	2
	Projection: GDA 1994 MGA Zone 50	
This map should only be used in conjunction with WEC report PTA20-48-01.	Revision: A - 8 July 2020	

2.4 Pattern Analysis

Classification analysis methods generally followed those presented in Gibson *et al.* (1994). As per Gibson *et al.* (1994), singletons (i.e. any taxon occurring only once in the quadrat dataset) were removed from the dataset prior to analysis. Hybrids were also excluded, as well as taxa whose identification was unclear because of poor available material, except when such a taxon (with multiple records in the dataset) was known to be unique in the dataset (i.e. although not identifiable to species level, there was enough material to indicate a unique taxon). As per Gibson *et al*. (1994), introduced taxa were included in the dataset.

As per Gibson *et al.* (1994), a single-layer data matrix (i.e. presence/absence data only) was used in the classification analysis, with PATN (V3.12) (Belbin and Collins 2009) utilised to perform the classification and ordination analysis of the data matrix. Also as per Gibson *et al.* (1994), the Bray-Curtis coefficient was used to generate an association matrix for the classification analysis. This association matrix consisted of pairwise coefficients of similarities between quadrats based on floristic data. Agglomerative hierarchical clustering, using flexible Unweighted Pair Group Method with Arithmetic Mean (UPGMA) (ß=-0.1), was used to generate a quadrat classification dendrogram (Sneath and Sokal 1973).

Classification analyses were conducted using; the three RPS / AECOM quadrats located in the Study Area and DBCA's amended SCP floristic quadrat dataset ('amended SCP dataset') (Keighery *et al.* 2012), as well as the three RPS / AECOM quadrats and DBCA's original SCP dataset (Gibson *et al.* 1994). The amended SCP dataset contains those quadrats established by Gibson *et al.* (1994), as well as over 500 additional sites (quadrats and relevés) established by the DBCA subsequent to that survey. Analyses were conducted using the three Study Area quadrats as a group and also as single quadrat insertions into the larger datasets. The analyses were conducted with the aim of examining the relationship of the three RPS / AECOM quadrats (METQ08, METQ09 and Site 03) to those in the SCP quadrat datasets, and therefore their relationships to the vegetation of the wider southern SCP. The resultant dendrogram and taxon group matrices were examined; of particular focus was whether the quadrat groups produced by the first classification analysis were maintained in the subsequent classification analysis dendrograms.

2.5 Significant Vegetation Definition, Mapping and Description

Vegetation Types (VTs) were not defined as part of this survey as this did not form part of the scope for this assessment (Appendix A). Significant vegetation was defined and mapped within the Study Area based on the data from quadrats previously established in the Study Area by RPS (2020) and AECOM (data provided by PTA), as well as observations recorded in the field from the current survey. Therefore, significant vegetation was defined using a combination of floristic composition classification (i.e. via a floristic classification analysis as outlined in Section 2.4), and structural vegetation classification undertaken in the field, as defined in the technical guidance for flora and vegetation surveys (EPA 2016a). Significant vegetation was mapped and described based on the diagnostic characteristics for the Banksia Woodlands TEC as described in the Approved Conservation Advice (TSSC 2016).

The locations of previously established quadrats were used in conjunction with aerial photograph interpretation and field notes taken during the current survey to develop significant vegetation mapping polygon boundaries. These mapping polygon boundaries were then digitised using Geographic Information System (GIS) software.

2.6 Vegetation Condition Mapping

Vegetation condition was described using the vegetation condition scale presented in the Approved Conservation Advice for the Banksia Woodlands TEC (TSSC 2016). (see Table 3). The condition scale descriptions presented in the conservation advice have some minor differences to those presented in the Technical Guidance for vegetation surveys (EPA 2016a). Vegetation condition was recorded during the field survey via foot traverses undertaken within the Study Area. Vegetation condition category polygon boundaries were developed using this information and were digitised using GIS software as for VT polygon boundaries.

Table 3: Vegetation Condition Categories and Indicative Measures/Thresholds for Assessment (TSSC 2016)

Condition Ranking	Description	Indicative condition measures/thresholds	
		Typical native vegetation composition	Typical weed cover
Pristine	No obvious signs of disturbance.	Native plant species diversity fully retained or almost so[5]	Zero or almost so weed cover / abundance
Excellent	Vegetation structure intact; Disturbance only affecting individual species; Weeds are non-aggressive species.	High native plant species diversity[5]	Less than 10%.
Very Good	Vegetation structure altered; Obvious signs of disturbance eg: from repeated fires, dieback, logging, grazing. Aggressive weeds present.	Moderate native plant species diversity[5]	5 – 20%
Good	Vegetation structure altered but retains basic vegetation structure or ability to regenerate it. Obvious signs of disturbance, e.g. from partial clearing, dieback, logging, grazing. Presence of very aggressive weeds.	Low native plant species diversity[5]	5 – 50%
Degraded	Basic vegetation structure severely impacted by disturbance. Requires intensive management. Disturbance evident such as partial clearing, dieback, logging and grazing. Presence of very aggressive weeds at high density	Very low native plant species diversity[5]	20 – 70%
Completely Degraded	Vegetation structure is no longer intact and the area is completely or almost completely without native flora. Equivalent to 'Parkland Cleared'.	Very low to no native species diversity[5]	Greater than 70%

[5]Relative to expected natural range of diversity for that vegetation unit (e.g. Floristic Community Type), where comparative data exists.

2.7 Significant Vegetation

As per EPA (2016b), vegetation may be significant for a range of reasons, including, but not limited to the following:

- Being identified as a TEC or PEC (formally listed significant vegetation – includes vegetation listed under Commonwealth legislation, endorsed as a TEC by the Western Australian Government, or classified as a PEC by DBCA);
- Having restricted distribution;
- Degree of historical impact from threatened processes;
- A role as a refuge; and
- Providing an important function required to maintain ecological integrity of a significant ecosystem.

The vegetation described by the study of the southern SCP by Gibson *et al.* (1994), together with supplementary vegetation description to this study published in Government of Western Australia (2000), as well as formal lists of TECs and PECs, is the current baseline used when assessing the significance of vegetation on the southern SCP. The vast majority of terrestrial TECs and PECs that occur on the southern SCP are Floristic Community Types (FCTs) described by this Study; the Study also provides information on the distribution of all FCTs described, as well as their conservation status.

Consequently, floristic analyses were undertaken to determine relationships between quadrats previously established in the Study Area and SCP FCTs defined by Gibson *et al.* (1994), with the aim of aligning these quadrats with SCP FCTs. However, as there is no formal guidance available on the most appropriate way to undertake this process, several different analytical approaches were employed, to build supporting evidence for aligning quadrats with SCP FCTs. These were:

- Analysis of the three RPS / AECOM quadrats in the Study Area with the original SCP dataset (Gibson *et al.* 1994);
- Analysis of the three RPS / AECOM quadrats in the Study Area with the amended SCP dataset (Keighery *et al.* 2012), which includes more than 500 additional survey sites;
- Single site insertion analysis of the three RPS / AECOM quadrats in the Study Area, with the original SCP dataset (Gibson *et al.* 1994); and
- Single site insertion analysis of the three RPS / AECOM quadrats in the Study Area, with the amended SCP dataset (Keighery *et al.* 2012).

It should be noted that the metadata for the amended SCP dataset explicitly states that it is not suitable for FCT analysis due to “inconsistencies in the grouping and splitting of some species compared to that used in the Gibson *et al.* (1994) analysis”. However, the exact dataset that DBCA used which included the more than 500 additional sites established on the SCP subsequent to the Gibson *et al.* (1994) study, which is referred to in the aforementioned metadata, does not appear to be publicly available. Therefore, the amended SCP dataset was used for analysis by this assessment, as the alternative of not using this dataset, and hence not considering a significant volume of data, was considered inappropriate in the absence of formal guidance on analysis methods. The argument that “inconsistencies in the grouping and splitting of some species compared to that used in the Gibson *et al.* (1994) analysis” is not considered to be reason enough to discount the dataset in this context; such issues are likely to frequently arise when a historical dataset is only periodically updated to reflect current taxonomic concepts. However, it considered unlikely that such issues would have a significant bearing on analysis results in this current context.

Further to this, as noted above, a dataset similar to the amended SCP dataset has been re-analysed by the DBCA on behalf of the former Department of Environmental Protection (Government of Western Australia 2000), with supplementary SCP FCT descriptions published as a result; however, the methods of this analysis are not documented in Government of Western Australia (2000), and apparently were never fully documented (V. English *pers. comm.* 2015). It is apparent that DBCA used the ALOC non-hierarchical classification technique, whereby the groups of quadrats that formed the basis of the original SCP FCTs were 'locked' in place, and additional quadrats were allocated to these groups or to new groups via analysis (V. English *pers. comm.* 2015). It is assumed, although there is no documented evidence, that the single site insertion approach was then used, whereby quadrats were added singly to the locked dataset. FCTs were then assigned to the additional survey sites contained in the amended SCP dataset based on the results of the analyses (Keighery *et al.* 2012). It is assumed that these methods were used as re-analysis of the entire amended SCP dataset would have caused significant disruption (based on previous unpublished analyses conducted by Woodman Environmental) to the original quadrat groupings that were used to define FCTs in Gibson *et al.* (1994), given such a large volume of data was added. The original FCTs described by Gibson *et al.* (1994) could not have been maintained using this approach. The ALOC analysis approach does not appear to be widely used; the DBCA does not appear to have published any studies that have used this method, with recent studies published by the DBCA using the classification methods outlined in Section 2.4.

Analysis methods and parameters were the same as used for the analysis of the quadrats in the Study Area as outlined in Section 2.4; these are the same methods utilised by Gibson *et al.* (1994).

The resultant analysis dendrograms were then reviewed to determine the position of quadrats in the Study Area in relation to quadrats from the SCP quadrat datasets; from this, FCT relationships were inferred. It should be noted that there is inherent uncertainty in the inferences made, as all of the analytical approaches outlined above do not maintain the original quadrat groupings that formed the basis for the original FCTs defined by Gibson *et al.* (1994) in resultant dendrograms. Taxon lists of the three RPS / AECOM quadrats in the Study Area were also compared to the typical species lists for SCP FCTs presented in Gibson *et al.* (1994), as well as quadrat taxon lists, soils, topography and geographical distribution data from this study; this was to provide further support for the inferences made following dendrogram examination. Note that quadrats from the amended SCP dataset were not considered as part of this process.

With regard to other TECs and PECs listed in Western Australia that were not described in the Gibson *et al.* (1994) study, only broad descriptions generally are provided in the respective TEC and PEC lists published by the DBCA to allow for diagnosis. The vegetation of the Study Area was therefore manually compared to such descriptions to determine whether any vegetation may represent such a TEC or PEC. A similar process was followed for TECs listed under the EPBC Act, with the vegetation of the Study Area assessed against the appropriate listing and conservation advice for any TECs likely to occur in the Study Area.

3. LIMITATIONS OF SURVEY

This assessment did not include an audit of the data collected by RPS (2020) and AECOM (data provided by PTA). The taxa listed in the quadrats are assumed to be correct and the analysis has been undertaken on the supplied data. Conclusions drawn therefore are wholly based on this data. Additionally, portions of the Study Area not containing quadrats could not be assessed against the SCP datasets to determine likely SCP FCTs.

In terms of the field assessment undertaken by Woodman Environmental for the Project, the timing was outside the recommended survey timing for vegetation surveys for the south-west province (spring) (EPA 2016a). An out of season survey was considered adequate given the purpose of the current survey was primarily to determine the condition and boundary extent of the Banksia Woodland TEC. However, it is recognised that weed cover in early July (when the survey was undertaken) would be much lower than weed cover levels present in spring, which is an important factor to consider when assigning condition rankings to vegetation. To mitigate this, searching for all signs of weeds (including old dead weeds and emerging weed seedlings) was undertaken and this issue was taken into consideration when assigning condition categories.

The description of vegetation condition category rankings presented in the EPA Technical Guidance (EPA 2016a) differ slightly between the categories presented in the approved conservation advice for the Banksia Woodland TEC (TSSC 2016). Condition rankings of the Study Area presented in the flora and vegetation assessment by RPS (2020) was undertaken as per the current Technical Guidance as recommended for flora and vegetation surveys (EPA 2016a). In the current assessment the condition scale from the conservation advice was used TSSC 2016) as the focus of this assessment was on the presence and condition of the Banksia Woodland TEC. As a result, variations in condition rankings between this assessment and the RPS (2020) assessment may be influenced by differences between the two condition scales.

4. RESULTS AND DISCUSSION

4.1 Review of Local Flora and Vegetation Surveys

Three flora and vegetation surveys which are relevant to this assessment, have been undertaken within the Study Area. A brief overview of these survey reports is provided below (Table 4). Data from two quadrats assessed by RPS (2020) and one quadrat assessed by AECOM (AECOM 2020) was used in the analysis undertaken for this assessment.

Table 4: Summary of Flora and Vegetation Surveys Previously Conducted in the Local Area

Report Title and Author	Location and Scope	Key Findings (Flora and Vegetation only)
Detailed Flora and Vegetation Assessment Metronet Morley-Ellenbrook line (RPS 2020)	Detailed and Targeted Survey – 1,358.61 ha - overlaps the Study Area	• Recorded 374 taxa from 74 families and 211 genera • 32 quadrats (10 x 10 m) and 16 relevés - 19 quadrats were surveyed twice with the remaining 13 quadrats proposed for re-survey in Autumn 2020 • Field survey was conducted in spring 2017, spring 2018, autumn 2019 and spring 2019 • Three significant taxa were recorded including *Cyathochaeta teretifolia* (P3), *Anigozanthos humilis* subsp. *chrysanthus* (P4) and *Tetraria* sp. Chandala (G.J. Keighery 17055) (P2) • Recorded 84 introduced taxa • 21 vegetation units were mapped within the survey area • Three listed significant vegetation communities were identified and mapped during the survey including Banksia woodlands of the Swan Coastal Plain ecological community TEC (Endangered);, FCT21c – Low-lying *Banksia attenuata* woodlands or shrublands PEC (P3) and FCT23b - Swan Coastal Plain *Banksia attenuata* - *Banksia menziesii* woodlands (P3)
Flora, Vegetation, Fauna and Targeted Black Cockatoo Survey (AECOM 2020)	Detailed and Targeted Survey – eastern survey area polygon overlaps northern part of the Study Area	• Recorded 122 taxa from 35 families and 92 genera • Eight quadrats (10 x 10 m) and three relevés were assessed • Field survey was conducted in September / October 2019 • One significant taxon was recorded being *Styphelia filifolia* (P3) • Recorded 18 introduced taxa • Eight vegetation units were mapped within the survey area • One listed significant vegetation community was identified and mapped during the survey including Banksia woodlands of the Swan Coastal Plain ecological community TEC (Endangered)
Biological Assessment Ellenbrook Bus Rapid Transit (AECOM 2016)	Level 1 Flora and Vegetation survey (now a Reconnaissance and Targeted Survey) – 190.22 ha - overlaps the northern part of the Study Area	• Recorded 129 taxa from 43 families and 103 genera • Relevés (number of relevés not specified) • Field survey was conducted in October 2015 • No significant taxa were recorded. • Recorded 49 introduced taxa • Nine vegetation units were mapped within the survey area • No significant vegetation communities were identified during the survey

4.2 Review of Existing Vegetation Mapping

Field observations indicated that the existing vegetation mapping within the Study Area was generally appropriate, with two discrete vegetation types observed (described as Ba.Bm.Si.Po and Bi.Bm.Ms.Xb), generally corresponding to the existing mapping boundaries (RPS 2020). Minor modifications have been made to these boundaries, including the removal of an area consisting of remnant *Corymbia calophylla* over introduced species in the north-west corner of the polygon mapped as Ba.Bm.Si.Po, which is clearly observable on aerial photography (Figure 3). The vegetation condition mapping was also found to be generally appropriate. However, some refinements were made to the existing vegetation condition mapping (Figure 3), as shown on Figure 3; this included determination of areas of Very Good and Good vegetation where such areas were mapped as combined Very Good-Good, as it was found that relatively clear boundaries between areas of these conditions ratings could be observed. Vegetation condition is discussed further below in Section 4.3.

4.3 Assessment of Presence of the Banksia Woodlands of the Swan Coastal Plain TEC (Endangered)

The Approved Conservation Advice (TSSC 2016) for the Banksia Woodlands TEC stipulates a four-step process for identifying this community. These steps are followed in the context of identifying whether vegetation of the Study Area represents this TEC, as outlined below. The first step involves key diagnostic characteristics (location and physical environment, soils and landform, structure, and composition). The Study Area contains vegetation meeting the description of Banksia Woodland (referred to as a Patch in the Approved Conservation Advice) that satisfies all four key diagnostic characteristics, as it:

- Occurs within the Swan Coastal Plain IBRA bioregion (Commonwealth of Australia 2012));
- Occurs on well drained, low nutrient soils on a sandplain landform; and
- Has a basic structure of a low woodland; and
- Is dominated by *Banksia attenuata* and *Banksia menziesii*, over a relatively diverse understorey.

Examples of such vegetation that represents the Banksia Woodlands TEC are presented in Plates 1 and 2 below.

The second and third steps of the identification process for this TEC are condition and minimum patch size thresholds. The Approved Conservation Advice for this TEC specifies that a patch of the TEC must meet the Good vegetation condition category as per Table 3 in the Conservation Advice for the community (TSSC 2016) to be considered a Patch of the TEC under the EPBC Act. A total of 9.68 ha of vegetation considered to meet the key diagnostic characteristics of the Banksia Woodlands TEC was rated as Very Good, with 10.02 ha rated as Good. These areas appear to have been impacted by historical grazing, as well as ongoing grazing and trampling by kangaroos and rabbits. A total of 17.05 ha of such vegetation was rated as Degraded condition; these areas have apparently been partially or completely cleared and left to re-grow, and are now very open and contain numerous weed species at relatively high covers. Although discrete areas of vegetation in Degraded condition cannot be patches of the TEC (TSSC 2016), Step 4 of the Approved Conservation Advice for this TEC stipulates that a patch can vary in condition, and can include vegetation with a lower condition rating than Good; such areas may still retain important natural values and may be critical to protecting those patches that meet the condition threshold. In this case, the area of vegetation mapped as Degraded condition clearly represents vegetation analogous to the Banksia Woodlands TEC, and provides continuity from the less degraded areas of this TEC in the north-east (the patch previously mapped as Patch 5 by RPS 2020) to similarly less degraded areas in the south-western corner of the Study Area (Figure 3).

Therefore, a total of 36.75 ha of vegetation that meets the key diagnostic characteristics of the Banksia Woodlands TEC (Figure 3). Because a reasonable part of this area was rated as Very Good condition, it is considered appropriate to use this condition rating in the context of assessing minimum patch size. The minimum patch size for an area of vegetation that meets the key diagnostic characteristics of the TEC is 1 ha; therefore, the 36.75 ha of vegetation in the Study Area that meets the key diagnostic characteristics is considered to be a patch of Banksia Woodlands TEC (Figure 3). It should also be noted that this area almost certainly does not represent the total size of this patch of the Banksia Woodlands TEC, as vegetation that meets the key diagnostic characteristics was observed to extend outside the Study Area to the south.

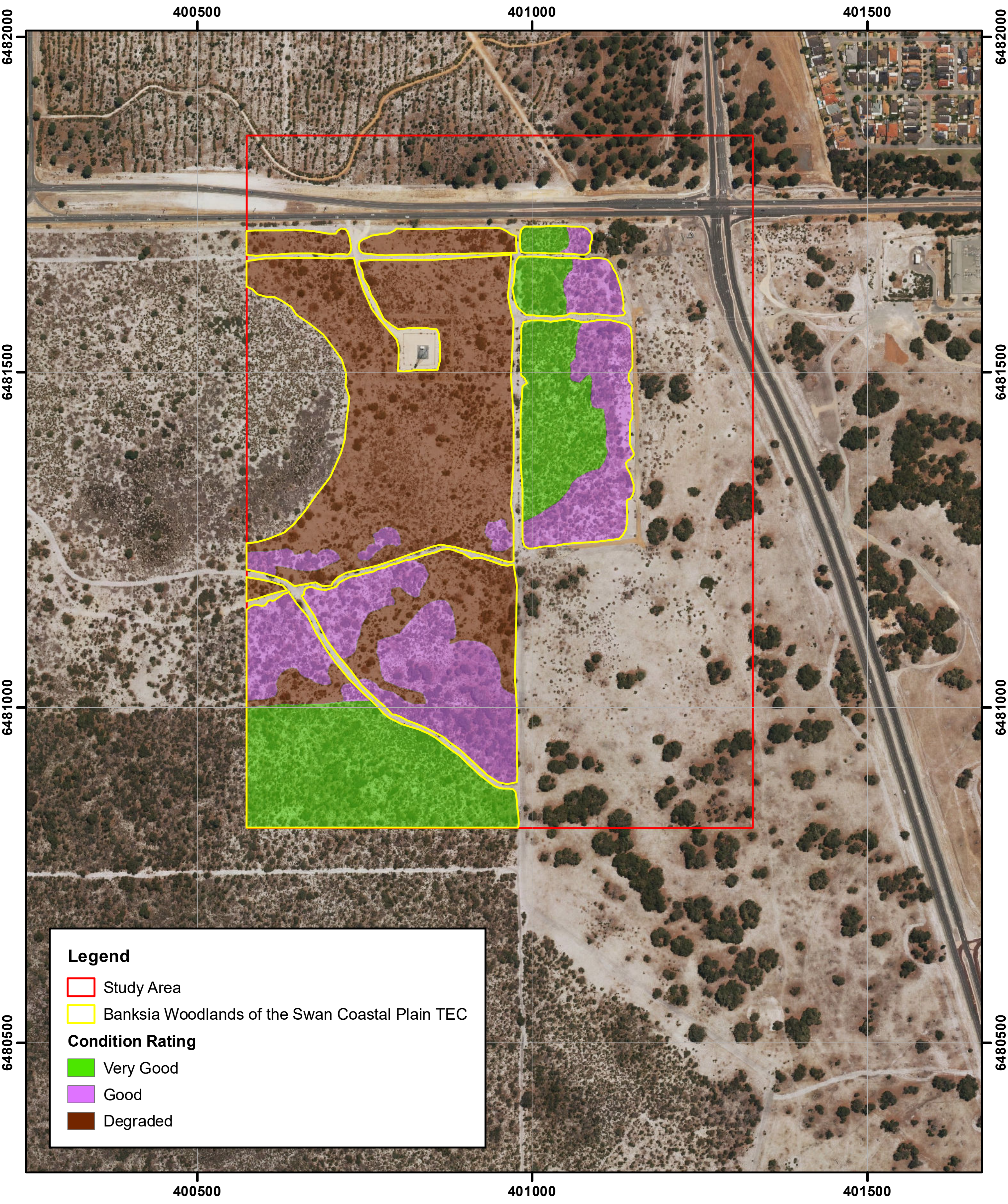
With regard to the area of vegetation considered to represent the Banksia Woodlands TEC in the Study Area by RPS (2020), the area considered to represent the TEC by this current survey is larger than that presented by RPS, and reflects modifications to vegetation condition boundaries, as well as inclusion of areas rated as Degraded within the area considered to represent a patch of the TEC. However, it is also considered worthy of note that RPS (2020) indicated that areas of vegetation mapped as Bi.Bm.Ms.Xb, which occurs in the Study Area, met the key diagnostic characteristics for the Banksia Woodlands TEC. However, they did not recognise the area of Bi.Bm.Ms.Xb as a patch of the TEC, and made no justification as to why it did not represent a patch of the TEC. It is possible that it was discounted because of the small area mapped, however, because it is contiguous with a much larger area of vegetation considered to represent the TEC to the west and south, it clearly meets the patch size requirements for the TEC.

Plate 1: **Banksia Woodlands TEC (Very Good condition) within the Northern Section of the Study Area**

Plate 2: **Banksia Woodlands TEC (Very Good condition) within the South-Western Section of the Study Area**

Plate 3: Banksia Woodlands TEC (Degraded condition) in Southern Part of Study Area between areas of Very Good/Good Condition

Plate 4: Banksia Woodlands TEC (Degraded condition) in Northern Part of Study Area



Banksia Woodlands of the Swan Coastal Plain TEC - Patch Condition Ratings	Author: David Coultas	
	WEC Ref: PTA20-48-03	
WOODMAN ENVIRONMENTAL	Filename: PTA20-48-01-f03	**Figure**
	Scale: 1:7,500 (A4)	3
	Projection: GDA 1994 MGA Zone 50	
This map should only be used in conjunction with WEC report PTA20-48-01.	Revision: A - 8 July 2020	

4.4 Relationships of Quadrats to SCP FCTs

As described in Section 2.4, classification and ordination analysis was undertaken to determine relationships between quadrats assessed in the Study Area and SCP FCTs defined by Gibson *et al.* (1994), with the aim of aligning quadrats with SCP FCTs. Several different analytical approaches were employed to build supporting evidence for aligning quadrats with SCP FCTs. Additionally, taxon lists of RPS / AECOM quadrats were also compared to the typical species lists for SCP FCTs presented in Gibson *et al.* (1994), as well as soils, topography and geographical distribution data from this study. Table 5 presents a summary of the results of this process.

Excerpts from classification analysis dendrograms are presented in appendices as follows:

- Analysis of the RPS / AECOM quadrats with the original SCP dataset (Gibson *et al.* 1994) – Appendix B;
- Analysis of the RPS / AECOM quadrats with the amended SCP dataset (Keighery *et al.* 2012) – Appendix C;
- Single site insertion analysis of RPS / AECOM quadrats, with the original SCP dataset (Gibson *et al.* 1994) – Appendix D; and
- Single site insertion analysis of RPS / AECOM quadrats, with the amended SCP dataset (Keighery *et al.* 2012) – Appendix E.

As discussed in Section 2.7, because of the lack of formal guidance regarding the appropriate methodology for aligning vegetation with SCP FCTs, and also the lack of information regarding how new quadrats contained in the amended SCP dataset were assigned to SCP FCTs, the quadrat-FCT alignment determinations presented in Table 5 cannot be considered absolutely conclusive. However, the determinations were generally supported by the results of multiple analyses, including analyses that follow DBCA's standard analysis methods. Comparisons of quadrat taxon lists also supported the determinations in all cases. There were a few cases where the results of one or a few of the analyses did not entirely support the final determination made. These are discussed in Table 5.

It should also be noted that Study Area quadrats were often classified into groups with a subset of quadrats from SCP FCTs, rather than all quadrats. This was expected; quadrat groupings usually change, sometimes significantly, when data is added to or removed from a dataset and analysed, particularly where the base dataset is not a comprehensive sample of the area sampled and even if exactly the same parameters are used. Further to this, many quadrats that were originally classified together can be re-classified in completely different groups when such changes are made. However, it is not considered appropriate to 'lock' existing groups in place prior to adding data to a dataset in this context; this results in the relationships between all quadrats in the data not being fully considered, as the assumption is made that the quadrats within the existing groups must be most similar to each other. This therefore eliminates the scenario that some quadrats in the group may be better classified in other groups following the addition of new data to a more comprehensive dataset. In the case of SCP FCTs, the original SCP study (Gibson *et al.* 1994) defined the FCTs with what is considered to be a limited dataset of only around 500 quadrats across a very large spatial extent, and within an area renowned for high endemism and β diversity. To 'lock' the original groups, prior to essentially doubling the size of the dataset for the analysis of the amended

SCP dataset, does not seem particularly appropriate, as it essentially assumes a complete understanding of the characteristics of the original FCTs.

Overall, the results of the analyses undertaken combined with a review of the quadrat data and FCT vegetation descriptions and distributions indicate that all three quadrats likely represent FCT 23a (Table 5). However, as mentioned in Section 4.3, the vegetation sampled by these quadrats is degraded to an extent (vegetation rated as Very Good condition); all three quadrats have been impacted by disturbances associated with large populations of kangaroos and rabbits, as well as potential historical stock grazing and other related disturbances, and consequently have low native species diversity and relatively high weed diversity and cover. These factors have likely contributed to the inconclusive analyses results. FCT 23a is not considered to be of significance in the context of the Swan Coastal Plain floristic survey (Gibson *et al.* 1994), and is not listed as a TEC or PEC in WA or by the Commonwealth, except as a component of the Banksia Woodlands TEC.

In the context of the existing vegetation mapping, it is considered that all vegetation mapped as Ba.Bm.Si.Po represents FCT 23a. However, the status of the vegetation mapped as Bi.Bm.Ms.Xb in the context of SCP FCTs is unclear. No data from this polygon was provided for review, and therefore it is not possible to align this vegetation type with any SCP FCT at this stage. However, a quadrat was established within this polygon, with this quadrat determined to represent FCT 21c (RPS 2020). This vegetation type is clearly wetter than the upland-occurring Ba.Bm.Si.Po, as it occurs on a flat at the base of the large dunes where Ba.Bm.Si.Po occurs. However, it is unclear whether the presence of *Banksia attenuata* and *Banksia menziesii*, as well as *Eucalyptus marginata*, is because of its proximity to the Ba.Bm.Si.Po vegetation type; Bi.Bm.Ms.Xb would likely have occurred east of the Study Area, however this area has been cleared. Field observations confirmed that this area is relatively degraded (vegetation condition rated Very Good); because of this, it is unclear as to whether analysis of quadrat data using the methods presented within this current report will resolve the relationships of this vegetation type with SCP FCTs.

Table 5: Summary of Analyses and Comparisons to Determine Relationships of Quadrats to SCP FCTs

Quadrat	Analysis with all Study Area Quadrats and amended SCP dataset	Analysis with all Study Area Quadrats and original SCP dataset	Single insertion – amended SCP dataset	Single insertion – original SCP dataset	Final determination
METQ08	**FCT 23a** Quadrat classified in small group with the other Study Area quadrats, two SCP quadrats that represent FCT 21c and two which represent 23c; this group is sister to a larger group of quadrats that predominantly represent FCT 23a.	**FCT 23** Quadrat classified in small group with the other Study Area quadrats, a number of SCP quadrats that represent FCT 21c, and two which represent FCT 6; this group is sister to a larger group of quadrats that predominantly represent FCTs 23a and 23b.	**Inconclusive** Quadrat classified within a large group of quadrats that represent a number of SCP FCTs including FCTs 23c, 23b, 28, S09, and S16.	**FCT 23** Quadrat classified within a large group of SCP quadrats that predominantly represent FCTs 23a and 23b.	**FCT 23a** The results of the analyses broadly support this determination, as does comparison of quadrat data with typical and common taxa for this FCT, as well as location of the crest of a Bassendean dune. This quadrat is also located within the known distribution of this FCT, with two SCP quadrats which represent FCT 23a located in close proximity; the distribution of FCT 23b is further to the north of this quadrat. This quadrat is in vegetation that is degraded to an extent, and is consequently relatively species poor (well below the average species richness for quadrats that represent FCT 23a according to Gibson *et al.* (1994)); this likely explains the somewhat inconclusive results of some of the analyses conducted.

Quadrat	Analysis with all Study Area Quadrats and amended SCP dataset	Analysis with all Study Area Quadrats and original SCP dataset	Single insertion – amended SCP dataset	Single insertion – original SCP dataset	Final determination
METQ09	**FCT 23a** Quadrat classified in small group with the other Study Area quadrats, two SCP quadrats that represent FCT 21c and two which represent 23c; this group is sister to a larger group of quadrats that predominantly represent FCT 23a.	**FCT 23** Quadrat classified in small group with the other Study Area quadrats, a number of SCP quadrats that represent FCT 21c, and two which represent FCT 6; this group is sister to a larger group of quadrats that predominantly represent FCTs 23a and 23b.	**Inconclusive** Quadrat classified within a large group of quadrats that represent a number of SCP FCTs including FCTs 23c, 23b, 28, S09, and S16.	**FCT 23** Quadrat classified within a large group of SCP quadrats that predominantly represent FCTs 23a and 23b.	**FCT 23a** The results of the analyses broadly support this determination, as does comparison of quadrat data with typical and common taxa for this FCT, as well as location of the crest of a Bassendean dune. This quadrat is also located within the known distribution of this FCT, with two SCP quadrats which represent FCT 23a located in close proximity; the distribution of FCT 23b is further to the north of this quadrat. This quadrat is in vegetation that is degraded to an extent, and is consequently relatively species poor (well below the average species richness for quadrats that represent FCT 23a according to Gibson *et al.* (1994)); this likely explains the somewhat inconclusive results of some of the analyses conducted.

Quadrat	Analysis with all Study Area Quadrats and amended SCP dataset	Analysis with all Study Area Quadrats and original SCP dataset	Single insertion – amended SCP dataset	Single insertion – original SCP dataset	Final determination
Site 03	**FCT 23a** Quadrat classified in small group with the other Study Area quadrats, two SCP quadrats that represent FCT 21c and two which represent 23c; this group is sister to a larger group of quadrats that predominantly represent FCT 23a.	**FCT 23** Quadrat classified in small group with the other Study Area quadrats, a number of SCP quadrats that represent FCT 21c, and two which represent FCT 6; this group is sister to a larger group of quadrats that predominantly represent FCTs 23a and 23b.	**Inconclusive** Quadrat classified within a large group of quadrats that represent a number of SCP FCTs including FCTs 23c, 23b, 28, S09, and S16 including FCTs 23b, 20a, S09, 21c and 20c.	**FCT 21a/21c** Quadrat classified in small group with a number of SCP quadrats that represent FCT 21c, and two which represent FCT 6; this group is sister to a larger group of quadrats that predominantly represent FCTs 21a and 21c.	**FCT 23a** The results of the analyses broadly support this determination, as does comparison of quadrat data with typical and common taxa for this FCT, as well as location of the crest of a Bassendean dune. This quadrat is also located within the known distribution of this FCT, with two SCP quadrats which represent FCT 23a located in close proximity; the distribution of FCT 23b is further to the north of this quadrat. This quadrat is in vegetation that is degraded to an extent, and is consequently relatively species poor (well below the average species richness for quadrats that represent FCT 23a according to Gibson *et al.* (1994)); this likely explains the somewhat inconclusive results of some of the analyses conducted. Although the results of some of the analyses indicated relatively close similarity between this quadrat and a number of quadrats that represent FCT 21c, this is also likely to be a result of the degraded condition of the vegetation sampled by this quadrat; this quadrat is located on a dune crest, in contrast to the low-lying position occupied by quadrats that represent FCT 21c.

4.5 *Caladenia huegelii* (Threatened) Habitat Assessment

The Recovery Plan for *C. huegelii* (DBCA 2009), provides the following habitat description:

- Mixed woodland of *Eucalyptus marginata*, *Banksia attenuata*, *B. ilicifolia* and *B. menziesii* with scattered *Allocasuarina fraseriana* and *Corymbia calophylla* over dense shrubs of *Stirlingia latifolia*, *Hypocalymma robustum*, *Hibbertia hypericoides*, *H. subvaginata*, *Xanthorrhoea preissii*, *Adenanthos cuneatus* and *Conostylis* species.
- Tends to favour areas of dense undergrowth.
- Soil is usually deep grey-white sand associated with the Bassendean sand-dune system.

The Recovery Plan states the critical habitat to be the area of occupancy of important populations, areas of similar habitat surrounding important populations, and additional occurrences of similar habitat (DEC 2009).

Hoffman, Brown and Brown (2019) states that *C. huegelii* grows in deep sandy soil in mixed *E. marginata*, *Banksia* woodland on the Swan Coastal Plain.

The advice of native orchid experts Andrew Brown (DBCA) and Kingsley Dixon (Botanic Gardens and Parks Authority (BGPA)) has previously been sourced to obtain detailed descriptions of *C. huegelii* habitat preferences.

Andrew Brown (pers. comm. 2015) indicated that *C. huegelii* occurs on Bassendean sands of the Swan Coastal Plain in *Banksia* woodland anywhere in undulating land. *C. huegelii* can grow in association with *C. arenicola, C. paludosa* and *C. longicauda* subsp. *calcigena*.

Kingsley Dixon (pers. comm. 2015) indicated that in the northern part of its range the habitat that *C. huegelii* occurs in tends to be woodland, varying from open to fairly closed *Banksia* dominated woodland. Plants may be found anywhere within the landscape of this habitat type. Vegetation types that can conclusively be excluded as potential habitat are lowland (damp land) vegetation communities, where the vegetation composition is composed of species that are not normally associated with *C. huegelii*.

Woodman Environmental has conducted numerous searches for *C. huegelii* over the past 17 years and has a thorough understanding of the variable vegetation and topographical habitat preferences of the orchid, including the recording of plants within degraded vegetation.

The nearest record of this taxon to the Study Area is located approximately 2.5 km to the west within Whiteman Park, with another located approximately 3.7 km to the North near Ellenbrook, within similar habitats to those present in the Study Area. Despite Targeted previous surveys of the Study Area (RPS 2020) for this taxon not identifying any *C. huegelii* individuals, the Banksia Woodland portion of the site meets the definition and is of suitable condition to be regarded as critical habitat for *C. huegelii.*

The Interim Recovery Plan defines Critical Habitat for this species as "Habitat critical to the survival of the species includes the area of occupancy of important populations; areas of similar habitat surrounding important populations (i.e. Jarrah/Banksia woodland on

Bassendean sands), as these areas provide potential habitat for natural range extension and are necessary to support viable populations of the associated mycorrhizal fungus and pollinating wasp species crucial to the orchid's survival, and to allow pollinators to move between populations; and additional occurrences of similar habitat that may contain important populations of the species or be suitable sites for future translocations or other recovery actions intended to create important populations".

The Study Area contains vegetation and soils typical of known habitat for this species however, the site has considerable pressures from grazing, physical disturbance and weeds that significantly reduce the potential for the site to host a population of the orchid into the future without substantial management inputs. It is currently unknown whether the symbiotic mycorrhizal fungus or pollinating wasp (necessary for pollination and survival of the orchid) are present on the site and this would be a significant issue to resolve prior to establishing the potential for the site to be a suitable translocation site in future.

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Appendix A: Scope of Works

This survey was undertaken as per the following SoW provided by Metronet, as listed below:

1. Banksia Woodland TEC Extent (Patch 5)
    - Undertake a desktop review of available flora and vegetation information (AECOM (2020) and RPS (2020)) relating to the Study Area (known Banksia Woodland TEC Patch 5)
    - If required, field verify the existing site condition and vegetation mapping and determine the potential distribution of significant features such as the Commonwealth Threatened Ecological Community (TEC) Banksia Woodlands of the Swan Coastal Plain.
    - Map the extent of significant ecological features (primarily the Commonwealth Threatened Ecological Community (TEC) Banksia Woodlands of the Swan Coastal Plain) and provide digital data in an IBSA compliant data package.

2. FCT Review of Banksia Woodland (Patch 5)
    - Analyse RPS and AECOM Quadrat / Relevé data associated with the Banksia Woodland TEC (Patch 5) against DBCA SCP datasets, utilising PATN and selecting multiple analysis pathways (or alternatives as suggested by Woodman Environmental based on the available data)
    - Interpret the analysis outputs to determine which FCT is present and map the extent of the determined FCT (if possible)

3. Vegetation Unit/Types
    - Review and map the extent of the vegetation units within previously surveyed extents within the Study Area (aligning with the RPS (2020) Vegetation Units and Descriptions) and provide digital data in an IBSA compliant data package.

4. *Caladenia huegelii* habitat assessment (Patch 5)
    - Undertake a desktop review of available *Caladenia huegelii* survey information (RPS (2018) and ELA (2019)) relating to the Study Area (known Banksia Woodland TEC Patch 5)
    - Determine the suitability of *Caladenia huegelii* (Threatened) Habitat within the Study Area (as per Recovery Plan for *C. huegelii*, DEC 2009)

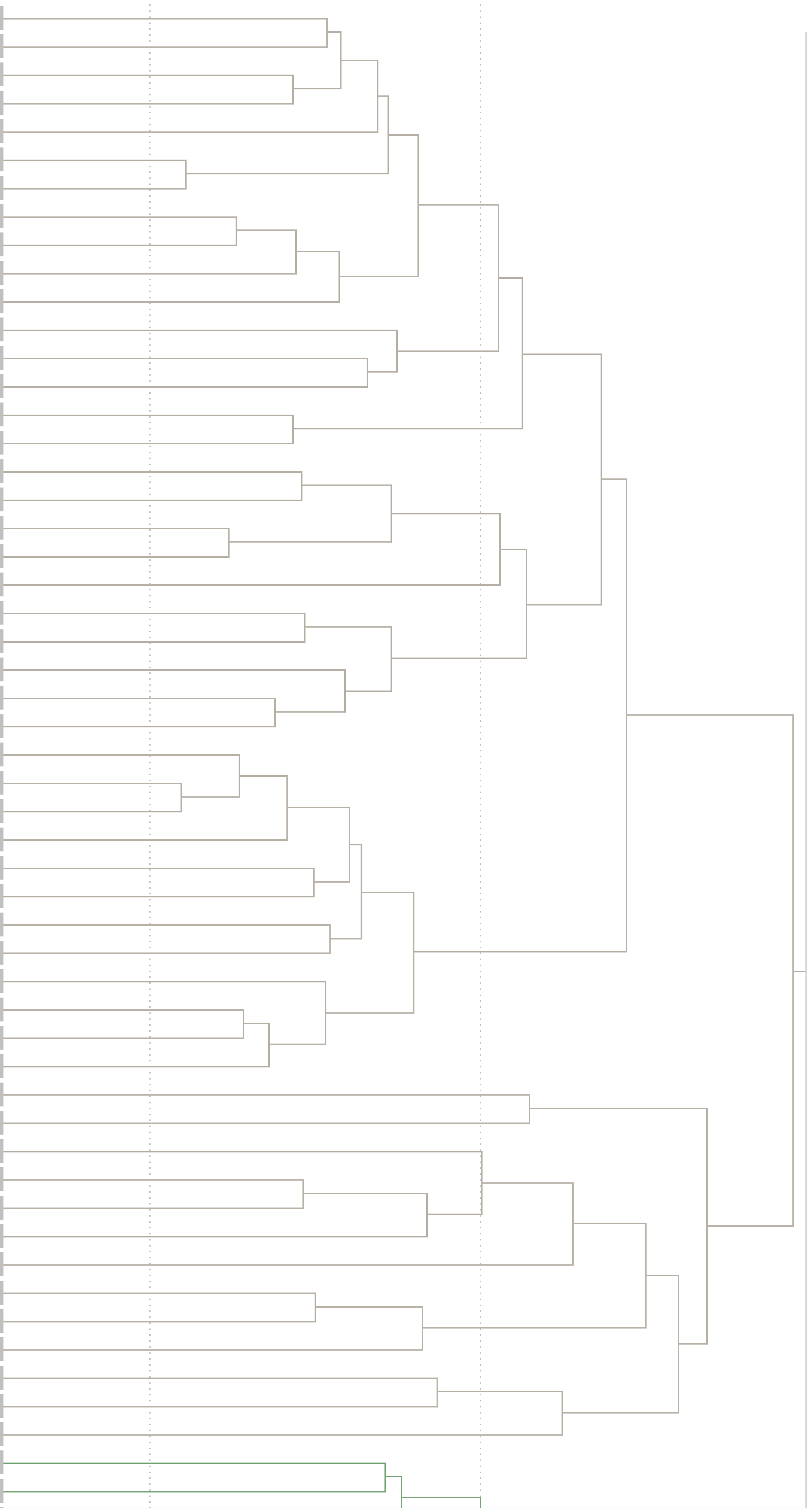
Appendix B: Classification Analysis Dendrogram (Excerpts) of the RPS / AECOM Quadrat Dataset from the Study Area with the Original SCP Quadrat Dataset (Gibson *et al.* 1994)

Note:

- SCP quadrats are labelled with their corresponding SCP FCT, as per Gibson *et al.* (1994); and
- Yellow shading denotes RPS / AECOM quadrats from the Study Area.

Dendrogram Excerpt: Quadrat METQ08, METQ09 and Site 3

FCT	Quadrat
23a	BULL-3
23a	WHITE-1
23a	hurst03
23a	MODO-4
23b	MELA-9
23a	YULE-1
23a	YULE-2
23a	WARB-1
23a	WIRR-1
23a	WIRR-2
23a	WARB-3
23a	hurst01
23a	hurst02
23a	hurst04
23b	MPK01
23b	MPK03
20a	GOLF-1
20a	LAND-1
20a	KOON-1
20a	KOON-2
20a	M53
23b	RAAF-2
23b	RAAF-3
23b	SINT-1
23b	YAN-19
23b	YAN-20
23b	ELDO-1
23b	MILT-7
23b	RAAF-1
23b	MELA-3
23b	MILT-8
23b	PLINE-2
23b	MILT-3
23b	PLINE-1
23b	MELA-2
23b	MELA-6
23b	MELA-8
23b	MELA-7
6	card11
6	card4
21c	DEJONG02
21c	FL-5
21c	FL-6
21c	hymus03
21c	hymus04
	METQ08
	METQ09
	Site 3
21c	TWIN-7
21c	TWIN-8
21c	YULE-3
24	BOLD-1
24	BOLD-2



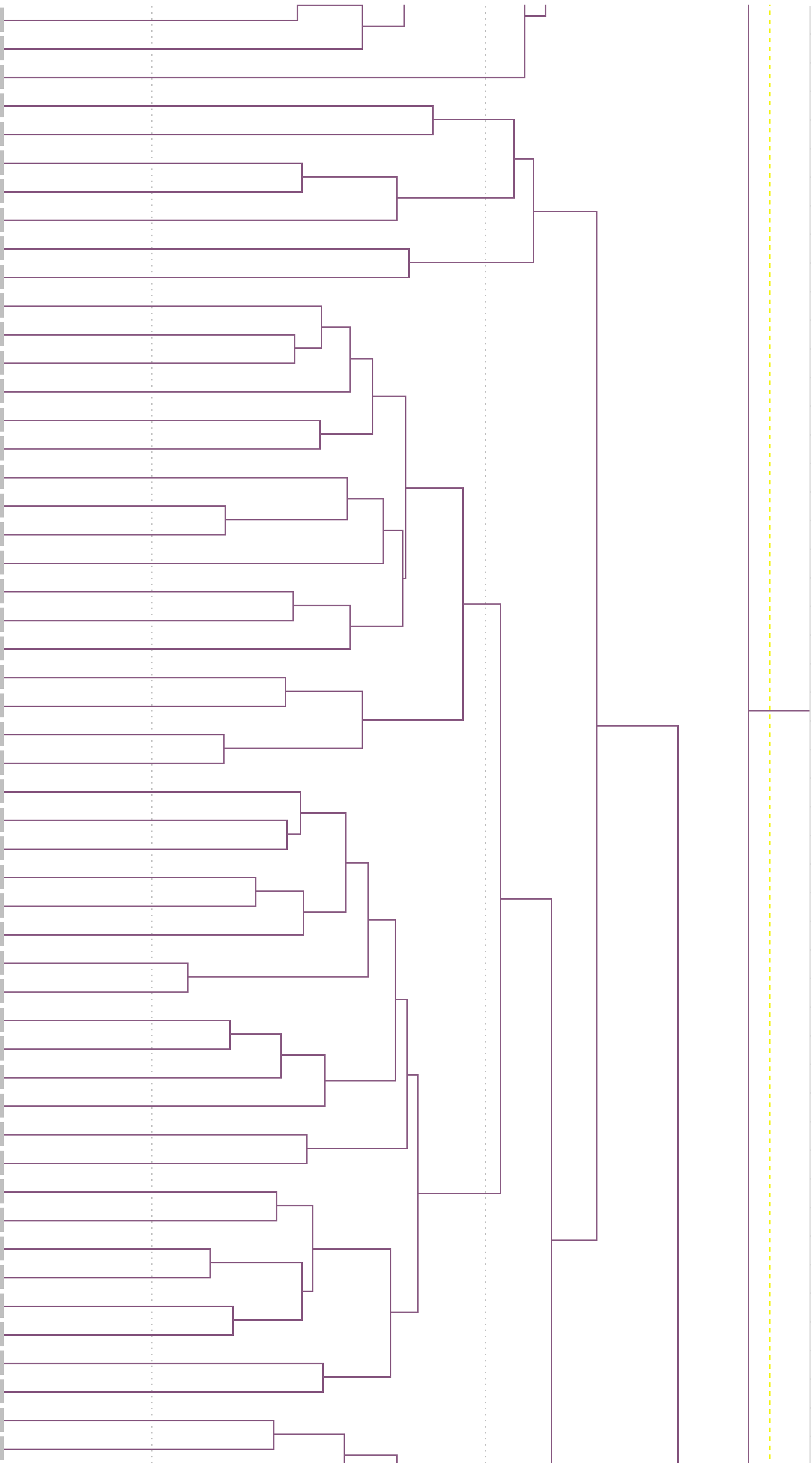
Appendix C: Classification Analysis Dendrogram (Excerpts) of the RPS / AECOM Quadrat Dataset from the Study Area with the Amended SCP Quadrat Dataset (Keighery *et al.* 2012)

Note:

- SCP quadrats are labelled with their corresponding SCP FCT, as per Gibson *et al.* (1994) and
- Yellow shading denotes RPS / AECOM quadrats from the Study Area.

Dendrogram Excerpt – Quadrats METQ08, METQ09 and Site 3

FCT	Quadrat
23b	WN093HED
23b	WN100WNR
S09	WN101WNR
21c	5C07
21c	DEJONG02
	METQ08
	METQ09
	Site 3
23c	zYAN2
23c	zYAN6
23a	bibra01
23a	Kens01
23a	Tele01
23a	jand01
23a	Cresw01
23a	gill01
23a	gnan03
23a	Light01
23a	Light02
23a	hart04
23a	perth04
20a	perth07
23a	perth08
20a	GOLF-1
20a	LAND-1
20a	KOON-1
20a	KOON-2
23a	BULL-3
23a	hurst03
23a	WHITE-1
23a	jand02
23a	jand08
23a	jand07
23a	YULE-1
23a	YULE-2
23a	WARB-1
23a	WIRR-1
23a	WIRR-2
23a	WARB-3
23a	pinj08
23a	pinj14
23a	cas03
23a	MODO-4
23a	gosn02
23a	gosn12
23a	kailis02
23a	yang02
23a	perth06
23a	perth09
28	MILT-4
28	SHE-2



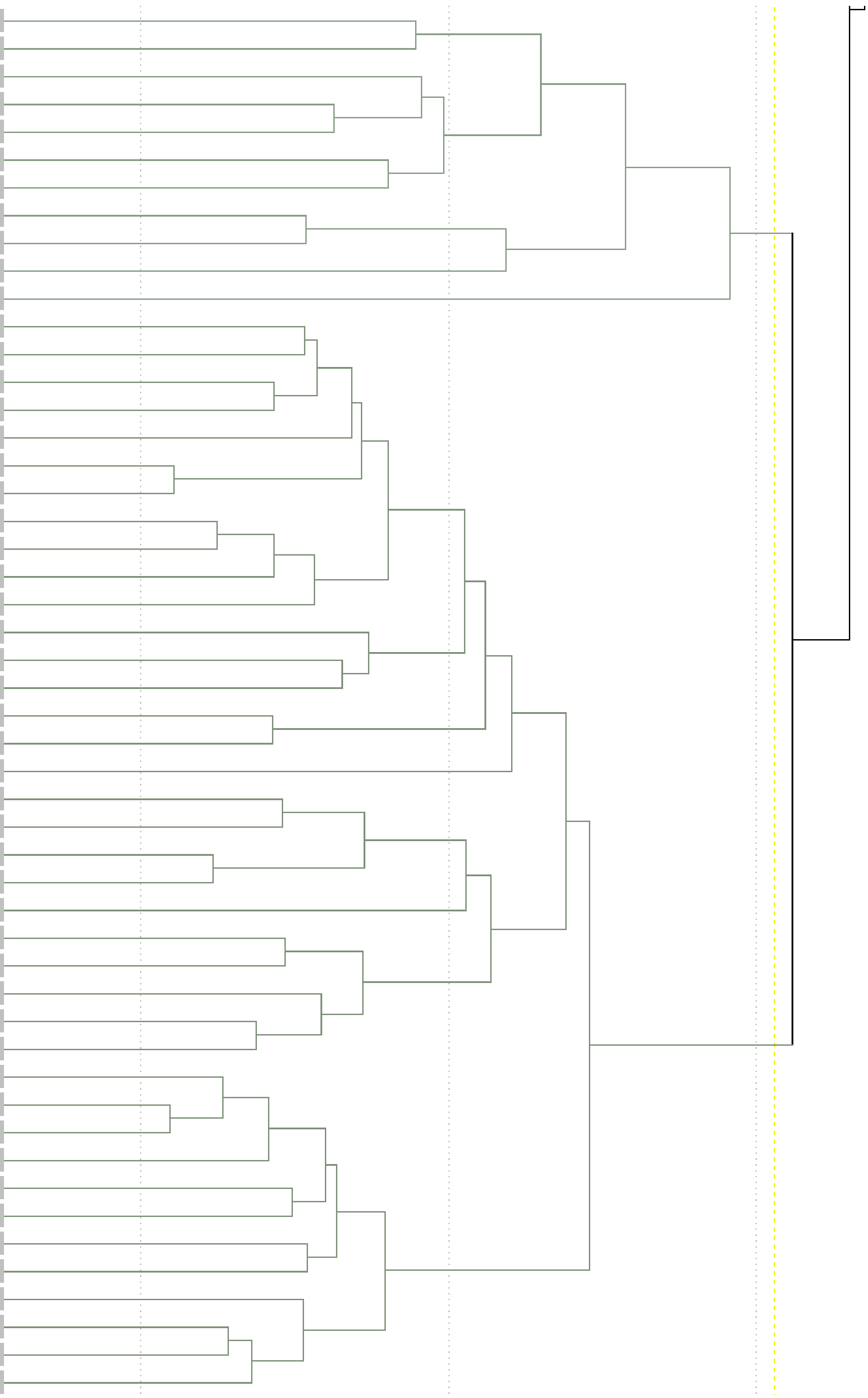
Appendix D: Single Site Insertion Classification Analysis Dendrograms (Excerpts) of RPS / AECOM Quadrats from the Study Area with the Original SCP Quadrat Dataset (Gibson *et al.* 1994)

Note:

- SCP quadrats are labelled with their corresponding SCP FCT, as per Gibson *et al.* (1994); and
- Yellow shading denotes RPS / AECOM quadrats from the Study Area.

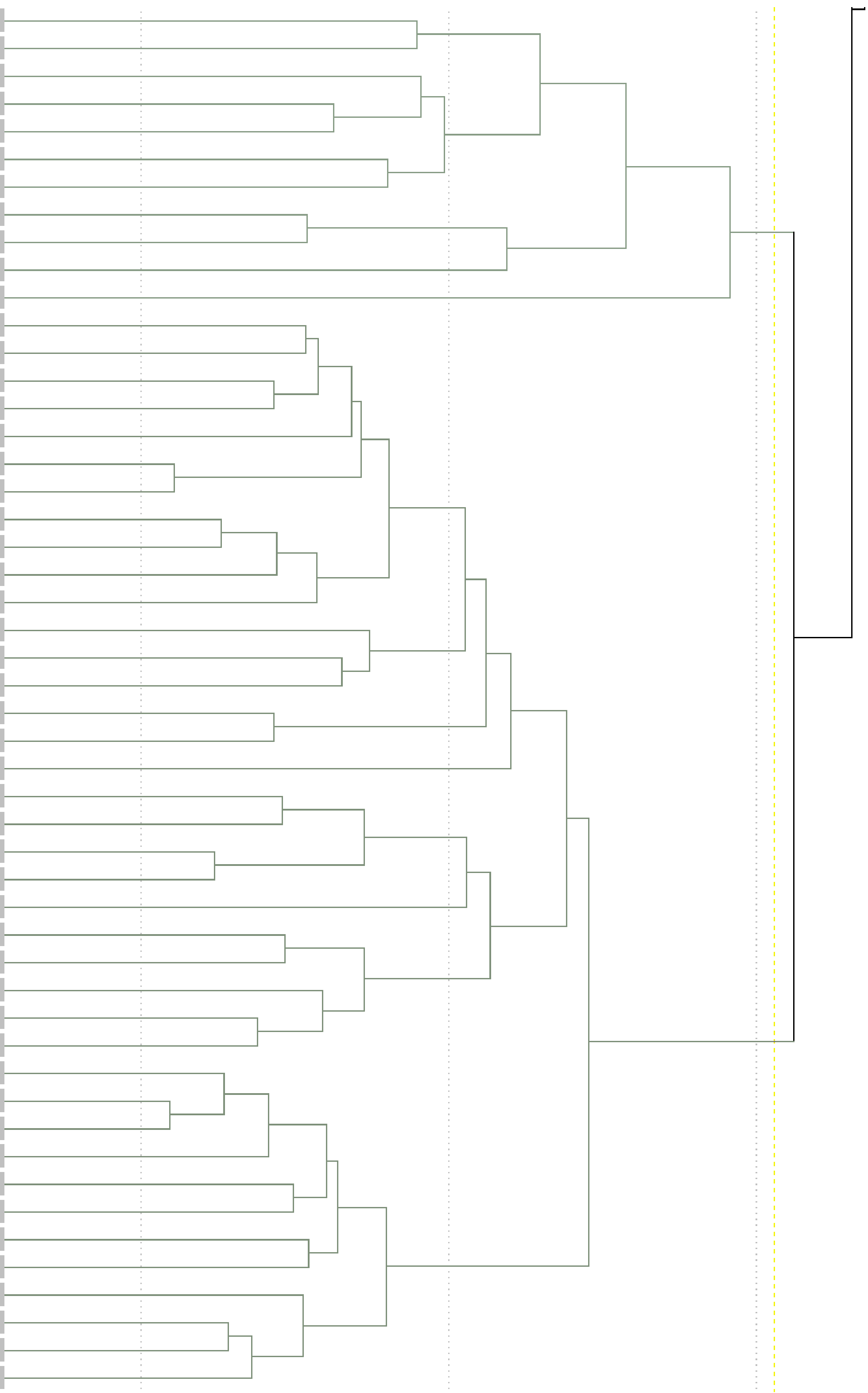
Dendrogram Excerpt: Quadrat METQ08

FCT	Quadrat
22	BANK-1
22	DEJONG01
22	MELA-10
22	WARB-2
22	WARB-4
22	MELA-5
22	MPK02
22	YAN-17
22	YAN-22
22	YAN-18
22	PLINE-6
23a	BULL-3
23a	WHITE-1
23a	hurst03
23a	MODO-4
23b	MELA-9
23a	YULE-1
23a	YULE-2
23a	WARB-1
23a	WIRR-1
23a	WIRR-2
23a	WARB-3
23a	hurst01
23a	hurst02
23a	hurst04
23b	MPK01
23b	MPK03
	METQ08
20a	GOLF-1
20a	LAND-1
20a	KOON-1
20a	KOON-2
20a	M53
23b	RAAF-2
23b	RAAF-3
23b	SINT-1
23b	YAN-19
23b	YAN-20
23b	ELDO-1
23b	MILT-7
23b	RAAF-1
23b	MELA-3
23b	MILT-8
23b	PLINE-2
23b	MILT-3
23b	PLINE-1
23b	MELA-2
23b	MELA-6
23b	MELA-8
23b	MELA-7



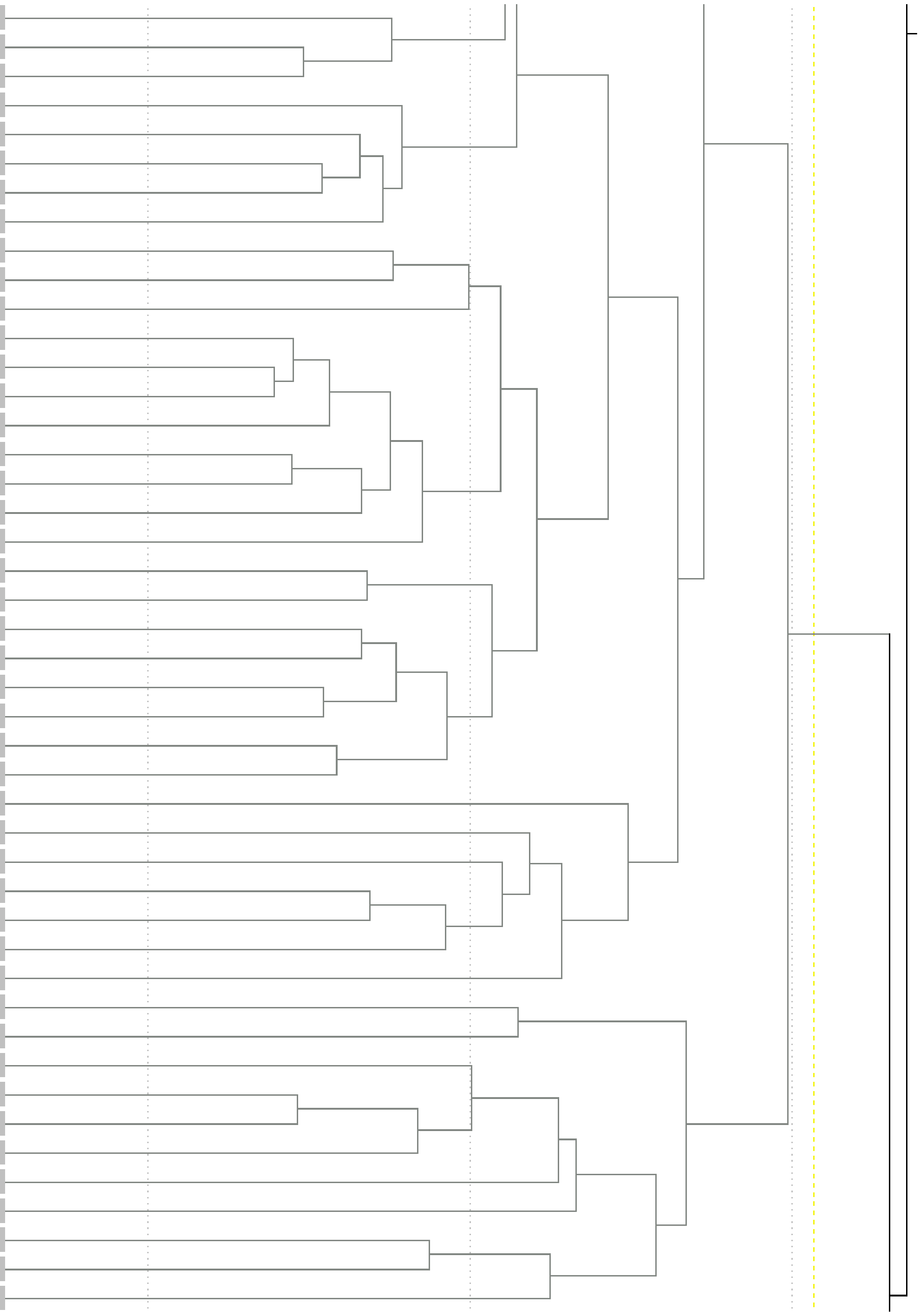
Dendrogram Excerpt: Quadrat METQ09

FCT	Quadrat
22	BANK-1
22	DEJONG01
22	MELA-10
22	WARB-2
22	WARB-4
22	MELA-5
22	MPK02
22	YAN-17
22	YAN-22
22	YAN-18
22	PLINE-6
23a	BULL-3
23a	WHITE-1
23a	hurst03
23a	MODO-4
23b	MELA-9
23a	YULE-1
23a	YULE-2
23a	WARB-1
23a	WIRR-1
23a	WIRR-2
23a	WARB-3
23a	hurst01
23a	hurst02
23a	hurst04
23b	MPK01
23b	MPK03
	METQ09
20a	GOLF-1
20a	LAND-1
20a	KOON-1
20a	KOON-2
20a	M53
23b	RAAF-2
23b	RAAF-3
23b	SINT-1
23b	YAN-19
23b	YAN-20
23b	ELDO-1
23b	MILT-7
23b	RAAF-1
23b	MELA-3
23b	MILT-8
23b	PLINE-2
23b	MILT-3
23b	PLINE-1
23b	MELA-2
23b	MELA-6
23b	MELA-8
23b	MELA-7



Dendrogram Excerpt: Quadrat Site 3

FCT	Quadrat
21a	low10a
21a	low12a
21a	low12b
21c	low01
21a	low04
21c	low06b
21c	low07
21c	low06a
21a	C71-2
21a	CAPEL-7
21a	MANEA-2
21a	CLIFT01
21a	GUTHR-5
21a	KEME-2
21a	REDL-1
21a	CRAMPT-1
21a	CRAMPT-2
21a	GUTHR-3
21a	DRAIN-1
21a	C71-3
25	MINN-3
21a	HARRY-5
21a	WELL-2
21a	PAGA-4
21a	PAGA-7
21a	TAM-1
21a	WELL-1
11	C71-1
3b	DUNS-1
21a	KOOLJ-2
21a	KOOLJ-3
21a	KOOLJ-4
3b	KOOLJ-5
21a	FL-4
6	card11
6	card4
21c	DEJONG02
21c	FL-5
21c	FL-6
21c	hymus03
	Site 3
21c	hymus04
21c	TWIN-7
21c	TWIN-8
21c	YULE-3



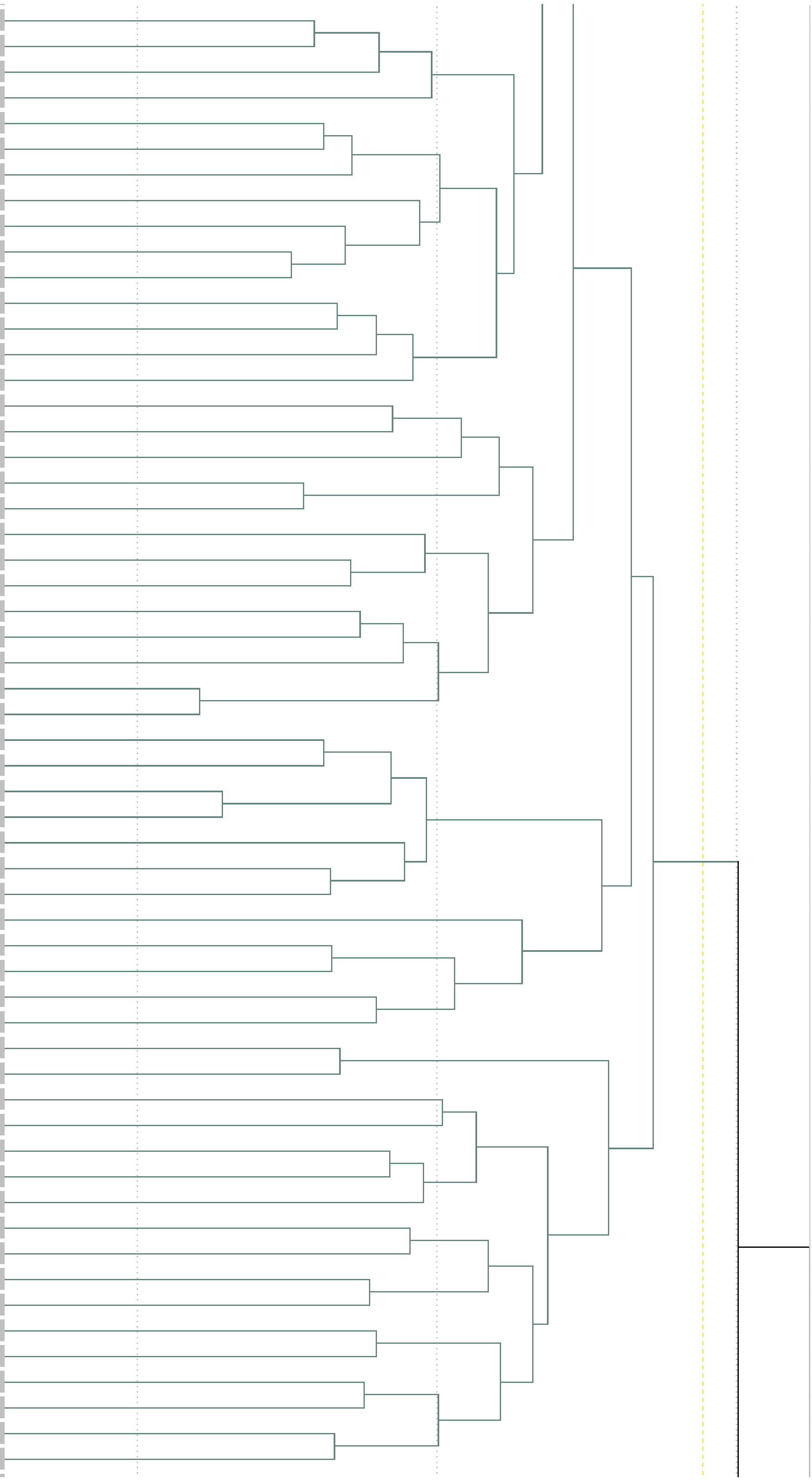
Appendix E: Single Site Insertion Classification Analysis Dendrograms (Excerpts) of RPS / AECOM Quadrats from the Study Area with the Amended SCP Quadrat Dataset (Keighery *et al.* 2012)

Note:

- SCP quadrats are labelled with their corresponding SCP FCT, as per Gibson *et al.* (1994) and
- Yellow shading denotes RPS / AECOM quadrats from the Study Area.

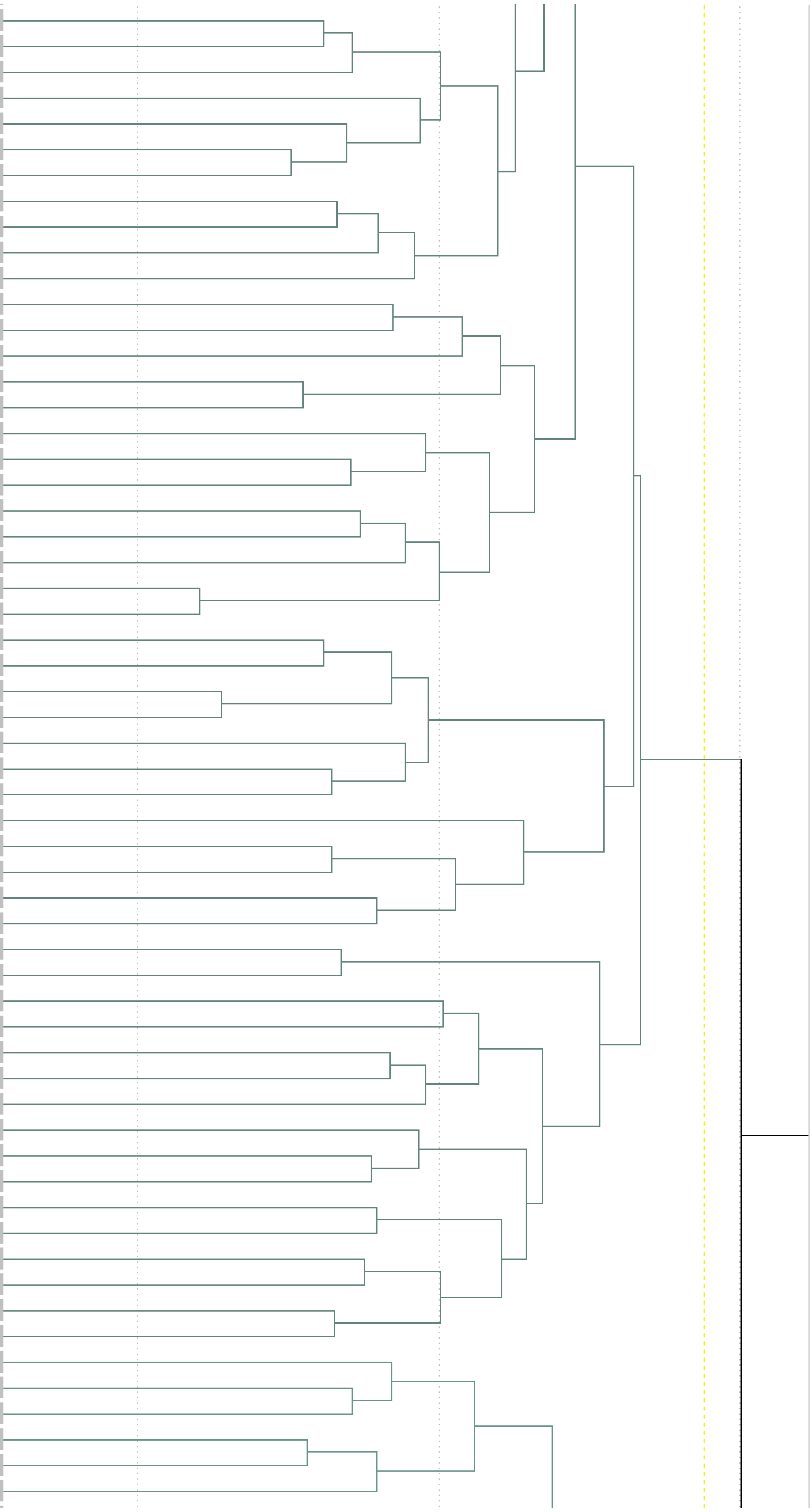
Dendrogram Excerpt: Quadrat METQ08

FCT	Quadrat
23b	5A01
23b	5C02
20a	5C03
S09	BNR25
23b	BNR19
20d	BNR22
S10	BNR21
S09	BNR23
23b	MHR01
S06	MWR03
S09	RGR05
20d	quinn03
23c	quinn05
20d	quinn09
23c	quinn06
S10	BNR02
S10	BNR06
S09	BNR07
S16	BW01
S09	BW05
S10	C 98PU.R
S06	MWR06
S09	MWR07
S09	MNP03
20d	RGR06
20d	MWR01
S09	MOOR 01
S09	MOOR 02
20d	BC1
20d	BC6
23b	BC3
20d	BC4
S10	BC2
S18	BC5
20d	BC7
S09	CH050CUL
S09	CH055ASH
S09	CH157TEE
S10	CH057ASH
S09	CH058ASH
28	4M03
S09	4M04
23c	BNR28
S09	WN102MNR
S09	BW02
23b	MR05
S16	WN107MNR
	METQ08
23c	yuri03
23c	zYAN2
23c	zYAN6
S09	MR14
23c	zBEER 03
23c	YUR01
23c	YUR02
23c	yuri01
28	yuri02



Dendrogram Excerpt: Quadrat METQ09

FCT	Quadrat
23b	BNR19
20d	BNR22
S10	BNR21
S09	BNR23
23b	MHR01
S06	MWR03
S09	RGR05
20d	quinn03
23c	quinn05
20d	quinn09
23c	quinn06
S10	BNR02
S10	BNR06
S09	BNR07
S16	BW01
S09	BW05
S10	C 98PU.R
S06	MWR06
S09	MWR07
S09	MNP03
20d	RGR06
20d	MWR01
S09	MOOR 01
S09	MOOR 02
20d	BC1
20d	BC6
23b	BC3
20d	BC4
S10	BC2
S18	BC5
20d	BC7
S09	CH050CUL
S09	CH055ASH
S09	CH157TEE
S10	CH057ASH
S09	CH058ASH
28	4M03
S09	4M04
23c	BNR28
S09	WN102MNR
S09	BW02
23b	MR05
S16	WN107MNR
	METQ09
23c	zYAN2
23c	zYAN6
S09	MR14
23c	zBEER 03
23c	YUR01
23c	YUR02
23c	yuri01
28	yuri02
S09	MI002MOR
S09	WN115MOR
S09	WN116MOR
S16	WN112MOR
S16	WN117MOR
S16	WN113MOR



Dendrogram Excerpt: Quadrat Site 3

FCT	Quadrat
23c	4M01
S09	4M02
23b	5C06
S09	MSF01
23c	MSF03
S09	MSF02
S09	5E02
S09	FYR01
S09	5G01
S09	MHR02
S09	BNR01
S09	BNR14
S09	BNR18
S09	BNR20
23b	BNR19
20d	BNR22
S10	BNR21
S09	BNR23
23b	MHR01
S06	MWR03
S09	RGR05
20d	quinn03
23c	quinn05
20d	quinn09
23c	quinn06
23b	5A01
23b	5C02
20a	5C03
S09	BNR25
21c	5C07
	Site 3
20c	Bushm02
S10	BNR02
S10	BNR06
S09	BNR07
S16	BW01
S09	BW05
S10	C 98PU.R
S06	MWR06
S09	MWR07
S09	MNP03
20d	RGR06
20d	MWR01
S09	MOOR 01
S09	MOOR 02
28	4M03
S09	4M04
23c	BNR28
S09	WN102MNR
S09	BW02
23b	MR05
S16	WN107MNR
S09	MR14
23c	zBEER 03
23c	YUR01
23c	YUR02
23c	yuri01
28	yuri02
23c	zYAN2
23c	zYAN6
20d	BC1
20d	BC6
23b	BC3
20d	BC4