

MARIANTHUS AQUILONARIS LANDFORM MONITORING: SPRING 2018

1 Objectives

The objective of the study is to characterize the ecological/edaphic factors of the Bremer Range (*M. aquilonaris* habitat) and classify the habitats of the existing sub-populations. Studies will assist in determining suitable habitat and identifying/ mapping potential direct and indirect impacts on *M. aquilonaris* sub-populations and habitat.

2 Methodology

The location of the landform monitoring transect were determined based on:

- Presence of suitable habitat/vegetation for *M. aquilonaris* identified during flora and vegetation surveys (Regrowth mid open mallee woodland *Eucalyptus livida* over mid open shrubland of *Hakea pendens* and open low shrubland of *Goodia medicaginea* on hillslope);
- Presence/ absence of *M. aquilonaris* to ensure at least one transect was established within occupied area of each sub-population¹ and at least one transect was established within un-occupied area for each sub-population to allow for comparison of occupied and un-occupied habitat for each sub-population; and
- Elevation-to ensure at least one transect was located in the upper slope and lower slope of each *M. aquilonaris* sub-population¹;

A total of fourteen monitoring transects (100m length) were established extending down the length of the hillslope:

- six transects outside of the *M. aquilonaris* populations (NMT1-6)
- eight transects within the *M. aquilonaris* populations (Pop 1a-Pop 1e)

At 25m intervals along each landform transect, a 3m X 3m quadrat was established. The parameters measured within each quadrat are listed in Table 1. Location maps of the transects are provided in Figure 1. The location of each transect was recorded using a handheld GPS (Transect coordinates provided in Appendix 1) and the ends of the transect were marked with metal fence droppers. Raw data for the Spring 2018 monitoring is provided in Appendix 2. A photographic record was taken for each transect (Appendix 3). A summary of the range and mean values for each sub-population for each parameter measured (landform and biological properties) is provided in Appendix 4.

Descriptive variables related to landform properties listed in Table 1 (morphological type, landform type, substrate type and loose rocks or gravel size) were assessed using standard techniques described by McDonald *et al.* (1990).

Elevation was measured using hand held GPS, surface soil depth was measured using a ruler (mm) and the local slope was measured using a level. Percentage cover of each stratum was classified in accordance with the NVIS foliage cover categories (DotEE, 2018). Percentage cover of bedrock and bare ground/ plant litter were estimated based on coverage within the 3m X 3m quadrat.

¹ Excluding Population 1f which comprises of a single plant.

Table 1: Landform Monitoring Quadrat Parameters

| Landform Properties |
|---|
| Morphological Type |
| Landform Type |
| Substrate type |
| Elevation |
| Aspect |
| Loose rocks or gravel: % and size |
| % Bedrock |
| Surface Soil depth |
| Surface resistance (LFA classification) |
| Local slope (degrees) |
| Biological Properties |
| No. <i>Marianthus aquilonaris</i> |
| Condition rating of <i>M. aquilonaris</i> |
| Dominant species per each stratum |
| % cover per each stratum |
| Full sun/part sun/shade |
| % cover of bare ground |
| % cover of plant litter |

Principal Components Analysis (PCA) and factor analysis was conducted using the statistical program PAST3 were conducted to determine the environmental variables which accounted for most of the variance in the set of observed variables (listed in Table 1). The analysis was conducted for all quadrats (total of 70 quadrats; 37 *Marianthus* absent and 33 *Marianthus* present). Patterns of dissimilarity among environmental variables (those identified in PCA to account for most the variance) between *Marianthus* present and *Marianthus* absent sites were assessed using non-metric multi-dimensional scaling (nMDS). The significance of dissimilarities in the composition of those variables between *Marianthus* present and *Marianthus* absent sites was tested using ANOSIM.

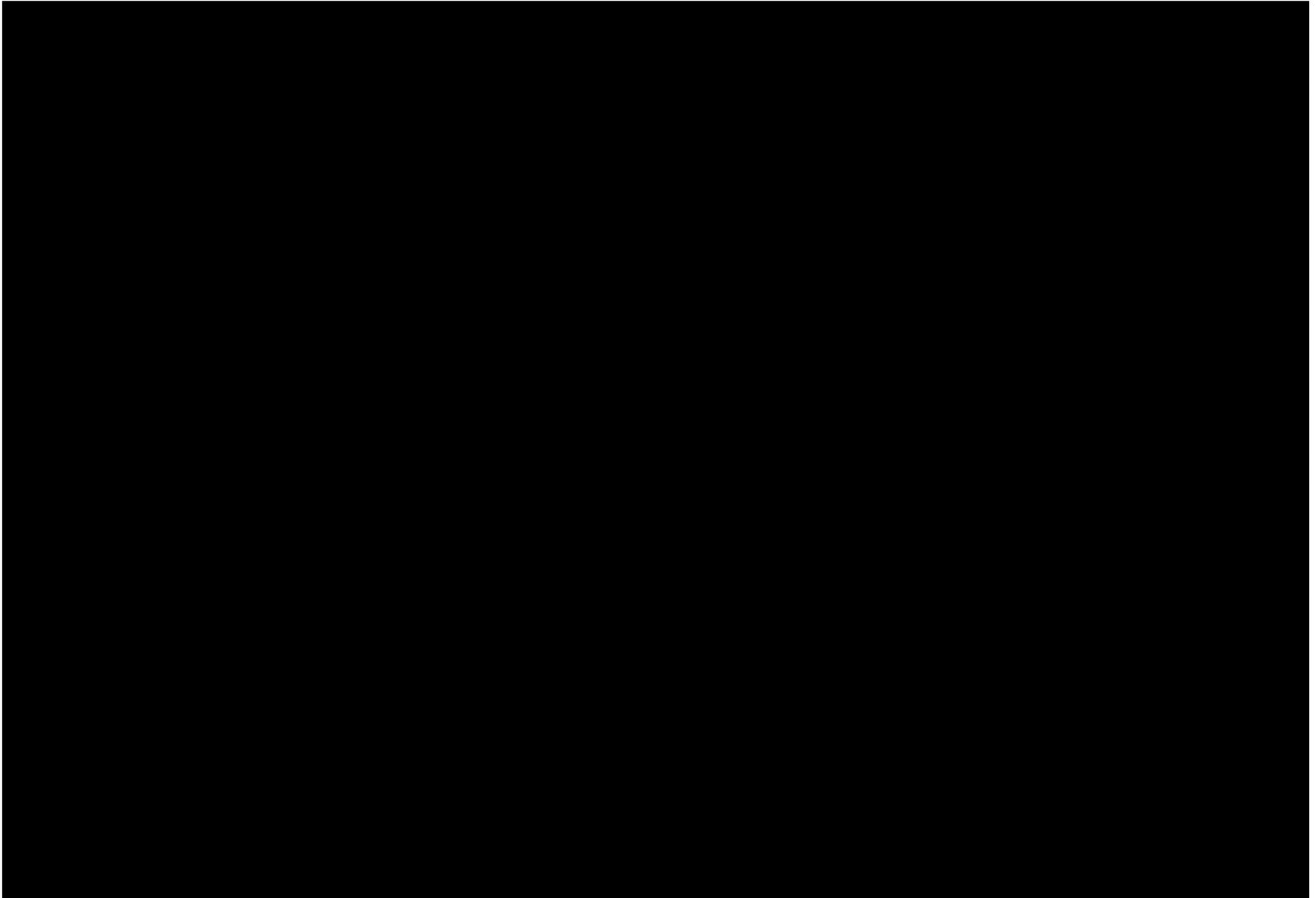


Figure 1: Location of landform monitoring transects

3 Results

Principal Components Analysis and factor analysis results show that the environmental variables which account for the greatest variability between the *Marianthus* present and *Marianthus* absent sites were surface soil depth, percentage cover of bare ground, plant litter and exposed bedrock (Table 2, Figure 2 & 3). The *Marianthus* present quadrats had shallower surface soils (ranging from 18-58mm), higher percentage bare ground (ranging from 53-72%), higher percentage plant litter (ranging from 21-41%) and higher percentage bedrock (8-36%) compared to the *Marianthus* absent quadrats.

Table 2: Dissimilarity and mean values of *Marianthus* present and *Marianthus* absent sites for each variable

| Environmental Variable | Av. dissimilarity | Contribution % | Mean (<i>Marianthus</i> Present) | Mean (<i>Marianthus</i> Absent) |
|---|-------------------|----------------|-----------------------------------|----------------------------------|
| Surface Soil depth (mm) | 3228 | 46.75 | 40 | 70.6 |
| % cover of bare ground | 1322 | 19.15 | 63.2 | 57.8 |
| % cover of plant litter | 812.4 | 11.76 | 41 | 29 |
| Bedrock % | 725.1 | 10.5 | 17.5 | 5.28 |
| % Loose rocks/ gravel | 463.4 | 6.71 | 84.7 | 82.8 |
| Elevation (m) | 295.5 | 4.279 | 399 | 403 |
| Local slope (degrees) | 26.08 | 0.3776 | 5.7 | 6.28 |
| Aspect | 7.961 | 0.1153 | 3.38 | 2.69 |
| % Cover-upper stratum | 7.34 | 0.1063 | 2.44 | 2.36 |
| % Cover-lower stratum | 5.418 | 0.07846 | 2.85 | 3.31 |
| % Cover-mid stratum | 4.041 | 0.05851 | 3.29 | 2.92 |
| Morphological Type | 2.121 | 0.03071 | 2.85 | 3.19 |
| Rocky Type | 1.944 | 0.02816 | 1.12 | 1.78 |
| Size Loose rocks/ gravel | 1.717 | 0.02487 | 2 | 2.19 |
| Surface resistance (LFA classification) | 1.212 | 0.01756 | 3.56 | 3.22 |
| Soil Type | 0.7549 | 0.01093 | 2.62 | 2.67 |
| Soil Colour | 0.2647 | 0.003833 | 1.76 | 1.94 |
| Landform Type | 0.0817 | 0.001183 | 1.03 | 1.06 |

The two-dimensional nMDS plots (Figure 3 & 4) shows the *Marianthus* absent sites generally occur on deeper soils and had lower plant litter. The stress of the ordination for the biological variables (% bare ground and % plant litter) was low 0.02 and moderate for the landform (0.11). The ANOSIM results showed the differentiation in the environmental variables between the *Marianthus* absent and *Marianthus* present sites were low ($R=0.13$; $P=0.0003$).

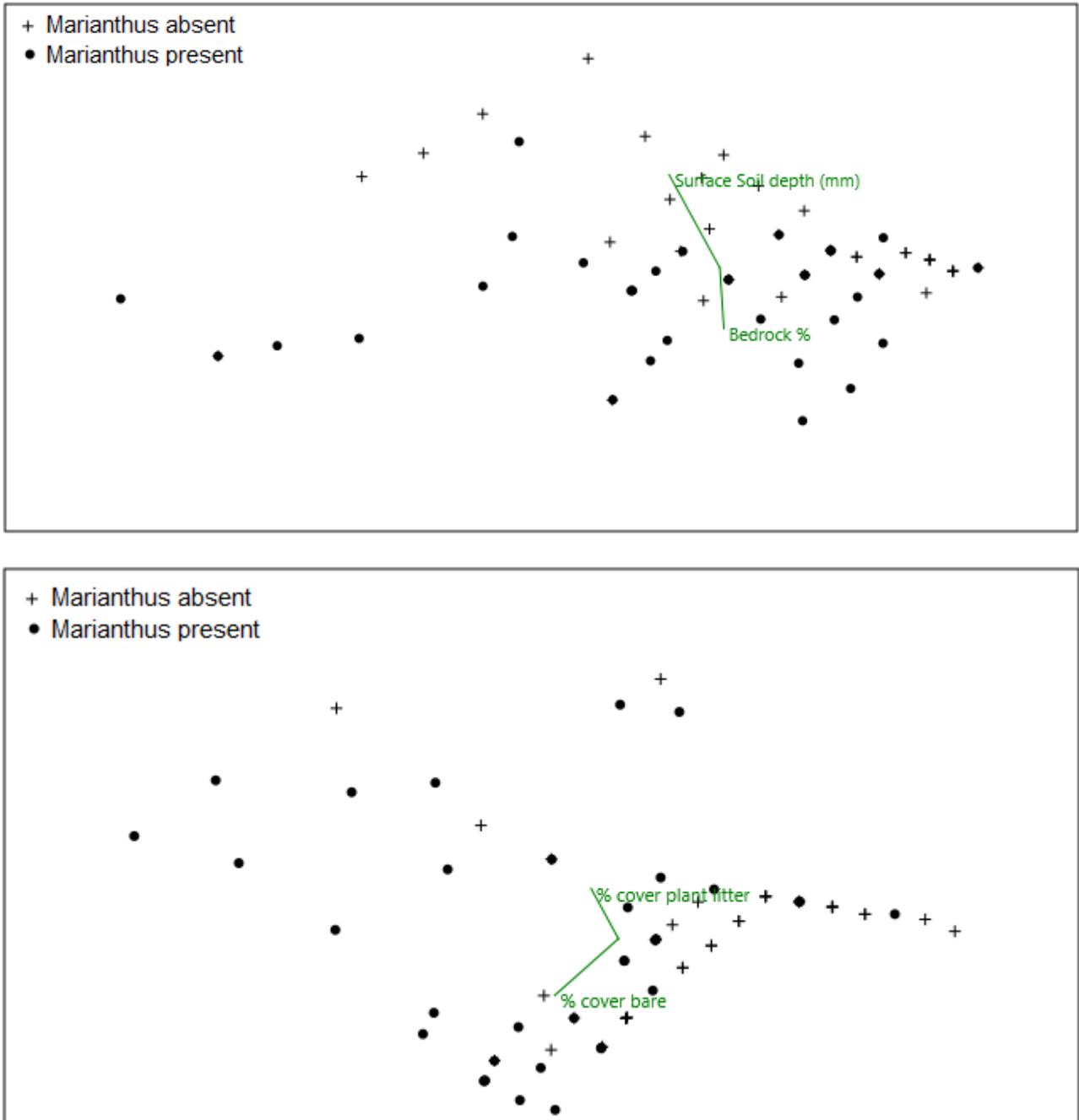
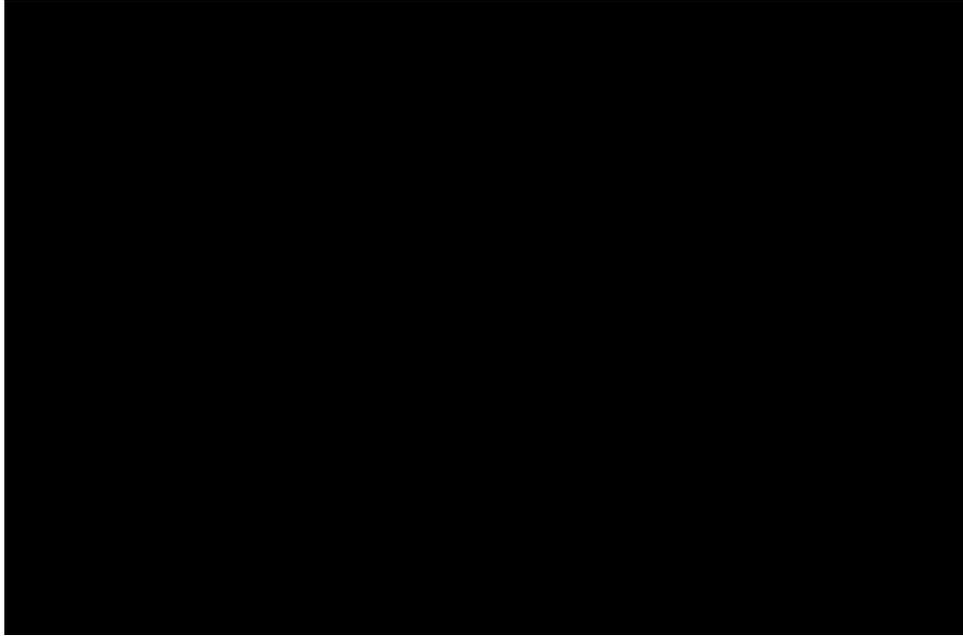


Figure 4: Non-metric multi-dimensional scaling (nMDS) ordination of the main environmental attributes of the *Marianthus* absent and *Marianthus* present quadrats.

4 Discussion

Whilst the differentiation in environmental variables between the *Marianthus* absent and *Marianthus* present sites were low, depth of soil, percentage of bedrock, plant litter and bare ground were found to be the main factors contributing to where *Marianthus aquilonaris* occurs. The sites where *M. aquilonaris* was present comprised of low soil surface depth ($\leq 58\text{mm}$), high percentage plant litter ($\geq 20\%$), bare ground ($\geq 53\%$) and exposed bedrock ($\geq 8\%$). Difference in morphology, landform and elevation had little influence on the habitat preferences for *M. aquilonaris*.

Appendix 1: Landform Monitoring Transects GPS Coordinates



Appendix 2: Landform Monitoring Data (Spring 2018)

| | | | | | |
|---|--------------------------------|----------------------------------|------------------------------------|------------------------------------|-------------------------------|
| Transect ID: | Pop 1a - T1 | Transect WP: | 2 | Transect Photo (Start/End): | 226S/ 239E |
| Quadrat ID: | Q1 | Q2 | Q3 | Q4 | Q5 |
| Quadrat WP: | 2 | 3 | 4 | 5 | 6 |
| Quadrat Photo: | 225 | 227 | 228 | 229 | 238 |
| Morphological Type: | crest | upper slope | upper slope | mid slope | mid slope |
| Landform Type: | hill slope | hill slope | hill slope | hill slope | hill slope |
| Substrate type (rock): | Limonite | Limonite | Limonite | Limonite | Limonite |
| Substrate type (soil): | clay-sand brown | clay-sand brown | clay-sand brown | clay-sand brown | clay-sand brown |
| Elevation: | 399 m | 398 m | 390 m | 386 m | 384 m |
| Aspect: | W | W | W | W | W |
| Loose rocks or gravel: % and size: | >90% Cobbles | >90% Cobbles | >90% Coarse Gravel | >90% Coarse Gravel | >90% Coarse Gravel |
| Bedrock %: | <10% | <10% | <10% | 20% | 5% |
| Surface Soil depth (mm): | 5mm | 5mm | 5mm | 5mm | 5mm |
| Surface resistance (LFA classification): | 2 | 3 | 2 | 4 | 4 |
| Local slope (degrees): | 3.4 | 5.3 | 6.4 | 9.4 | 4.4 |
| Biological Properties | Q1 | Q2 | Q3 | Q4 | Q5 |
| No. <i>Marianthus aquilonaris</i>: | 2 | 4 | 1 | 7 | 7 |
| Condition rating of <i>M. aquilonaris</i>: | good | good | good | good | good |
| Dominant species-upper stratum: | <i>Eucalyptus livida</i> | <i>Allocasuarina</i> sp. sterile | <i>Eucalyptus livida</i> | <i>Eucalyptus livida</i> | <i>Eucalyptus livida</i> |
| % Cover-upper stratum | 0-5 | 0-1 | 10-30 | 10-30 | 5-10 |
| Dominant species-mid stratum: | <i>Dodonaea viscosa</i> | <i>Marianthus aquilonaris</i> | <i>Dodonaea viscosa</i> | <i>Marianthus aquilonaris</i> | <i>Marianthus aquilonaris</i> |
| % Cover-mid stratum | 0-5 | 0-5 | 10-30 | 10-30 | 5-10 |
| Dominant species-lower stratum: | <i>Conospermum</i> sp. sterile | <i>Astroloma serratifolium</i> | <i>Lepidosperma sanguinolentum</i> | <i>Westringia cephalantha</i> | N/A |
| % Cover-lower stratum | 0-1 | 5-10 | 5-10 | 5-10 | 0 |
| Full sun/part sun/shade: | Full Sun | Full Sun | Full Sun | Full Sun | Full Sun |
| % cover of bare ground | 80% | 70% | 70% | 50% | 90% |
| % cover of plant litter | <10% | <10% | <10% | 30% | 30% |

| Transect ID: | Pop 1a - T2 | Transect WP: | 10 S/16 E | Transect Photo (Start/End): | 264 S / |
|---|-------------------------------|-------------------------------|-------------------------------|-----------------------------|--|
| Quadrat ID: | Q1 | Q2 | Q3 | Q4 | Q5 |
| Quadrat WP: | 10 | 11 | 13 | 14 | 15 |
| Quadrat Photo: | 263 | 266 | 274 | 276 | 278 |
| Morphological Type: | Mid slope | Mid slope | Low slope | Low slope | Valley |
| Landform Type: | Hill slope | Hill slope | Hill slope | Hill slope | Valley |
| Substrate type (rock): | Limonite | Limonite | No bedrock | No bedrock | No bedrock |
| Substrate type (soil): | clay-loam brown | clay-loam brown | clay-loam brown | clay-loam brown | clay-loam brown |
| Elevation: | 376 m | 378 m | 375 m | 375 m | 371 m |
| Aspect: | W | W | W | W | SW |
| Loose rocks or gravel: % and size: | >90% Coarse gravel | >90% Coarse gravel | 20-50% Medium gravel | >90% Cobbles | >90% Fine gravel |
| Bedrock: | <10% | 0% | 0% | 0% | 0% |
| Surface Soil depth (mm): | 10mm | 10mm | 100mm | 140mm | 60mm |
| Surface resistance (LFA classification): | 3 | 4 | 4 | 4 | 3 |
| Local slope (degrees): | 4.8 | 4.5 | 4.1 | 4.6 | 2 |
| Biological Properties | Q1 | Q2 | Q3 | Q4 | Q5 |
| No. <i>Marianthus aquilonaris</i> : | 7 | 3 | 4 | 0 | 0 |
| Condition rating of <i>M. aquilonaris</i> : | good | good | good | N/A | N/A |
| Dominant species-upper stratum: | <i>Eucalyptus livida</i> | Nil | Nil | Nil | <i>Eucalyptus</i> sp. sterile |
| % Cover-upper stratum | 10-30 | 0 | 0 | 0 | 0-5 |
| Dominant species-mid stratum: | <i>Marianthus aquilonaris</i> | <i>Marianthus aquilonaris</i> | <i>Marianthus aquilonaris</i> | <i>Santalum acuminatum</i> | <i>Davesia argillacea</i> / <i>Westringia cephalantha</i> |
| % Cover-mid stratum | 30-70 | 0-5 | 30-70 | 0-5 | 5-10 |
| Dominant species-lower stratum: | Nil | Nil | Nil | <i>Wilsonia humilis</i> | <i>Wilsonia humilis</i> |
| % Cover-lower stratum | 0 | 0 | 0 | 10-30 | 10-30 |
| Full sun/part sun/shade: | Full sun | Full sun | Full sun | Full sun | Full sun |
| % cover of bare ground | 60% | 95% | 60% | 85% | 70% |
| % cover of plant litter | 50% | <5% | 35% | <5% | 10% |

| | | | | | |
|---|-------------------------------|--|-------------------------------|------------------------------------|-------------------------------|
| Transect ID: | NM-T1 | Transect WP: | 17 S/ 22 E | Transect Photo (Start/End): | 281/287 |
| Quadrat ID: | Q1 | Q2 | Q3 | Q4 | Q5 |
| Quadrat WP: | 17 | 18 | 19 | 20 | 21 |
| Quadrat Photo: | 280 | 282 | 283 | 285 | 286 |
| Morphological Type: | Upper slope | Upper slope | Mid slope | Mid slope | Mid slope |
| Landform Type: | Hill slope | Hill slope | Hill slope | Hill slope | Hill slope |
| Substrate type (rock): | No bedrock | Limonite | Limonite | No bedrock | No bedrock |
| Substrate type (soil): | clay-loam red-brown | clay-loam red-brown | clay-loam red-brown | clay-loam red-brown | clay-loam red-brown |
| Elevation: | 388 m | 387 m | 386 m | 383 m | 383 m |
| Aspect: | NE | NE | NW | W | W |
| Loose rocks or gravel: % and size: | >90% Coarse gravel | >90% Coarse gravel | 70-90% Cobbles | 20% Fine gravel | 20-50% Fine gravel |
| Bedrock: | 0% | 5% | 10% | 0% | 0% |
| Surface Soil depth (mm): | 90mm | 66mm | 30mm | 150mm | 60mm |
| Surface resistance (LFA classification): | 3 | 4 | 4 | 2 | 2 |
| Local slope (degrees): | 0.2 | 8 | 4 | 4.4 | 7 |
| Biological Properties | Q1 | Q2 | Q3 | Q4 | Q5 |
| No. <i>Marianthus aquilonaris</i>: | Nil | Nil | Nil | Nil | Nil |
| Condition rating of <i>M. aquilonaris</i>: | Nil | Nil | Nil | Nil | Nil |
| Dominant species-upper stratum: | <i>Eucalyptus ?eremophila</i> | <i>Eucalyptus livida</i> | <i>Eucalyptus livida</i> | <i>Eucalyptus salmonophloia</i> | <i>Eucalyptus livida</i> |
| % Cover-upper stratum | 10-30 | 30-70 | 10-30 | 5-10 | 0-5 |
| Dominant species-mid stratum: | <i>Dodonaea stenozyga</i> | <i>Trymalium myrtillus</i> subsp. <i>myrtillus</i> | Nil | <i>Santalum acuminatum</i> | <i>Melaleuca pauperiflora</i> |
| % Cover-mid stratum | 5-10 | 5-10 | | 10-30 | 10-30 |
| Dominant species-lower stratum: | <i>Acacia erinaceae</i> | <i>Acacia erinaceae</i> | <i>Westringia cephalantha</i> | <i>Dodonaea stenozyga</i> | <i>Dodonaea stenozyga</i> |
| % Cover-lower stratum | 0-1 | 0-5 | 0-5 | 70-100 | 0-5 |
| Full sun/part sun/shade: | Full sun | Full sun | Full sun | Full sun | Full sun |
| % cover of bare ground | 80% | 60% | 90% | 20% | 70% |
| % cover of plant litter | 10% | 25% | <10% | 20% | 20% |

| | | | | | |
|---|------------------------------------|------------------------------|------------------------------|------------------------------------|---------------------------|
| Transect ID: | Pop 1b-T1 | Transect WP: | 29 S/34E | Transect Photo (Start/End): | 298 S / 308 E |
| Quadrat ID: | Q1 | Q2 | Q3 | Q4 | Q5 |
| Quadrat WP: | 29 | 30 | 31 | 32 | 33 |
| Quadrat Photo: | 297 | 299 | 300 | 306 | 307 |
| Morphological Type: | Mid slope | Mid slope | Mid slope | Mid slope | Mid slope |
| Landform Type: | Hill slope | Hill slope | Hill slope | Hill slope | Hill slope |
| Substrate type (rock): | Limonite | Limonite | Limonite | Limonite | Limonite |
| Substrate type (soil): | Sandy clay-loam red-brown | Sandy clay-loam red-brown | Sandy clay-loam red-brown | Sandy clay-loam red-brown | Sandy clay-loam red-brown |
| Elevation: | 404 m | 404 m | 401 m | 400 m | 397 m |
| Aspect: | NW | NW | NW | N | NE |
| Loose rocks or gravel: % and size: | >90% Coarse gravel | >90% Coarse gravel | >90% Cobbles | 70-90% Cobbles | 70-90% Coarse gravel |
| Bedrock % | 0% | <5% | 20% | 30% | 0% |
| Surface Soil depth (mm): | 110mm | 60mm | 10mm | 30mm | 40mm |
| Surface resistance (LFA classification): | 4 | 4 | 3 | 4 | 4 |
| Local slope (degrees): | 5 | 6.6 | 6.7 | 10.1 | 14.6 |
| Biological Properties | Q1 | Q2 | Q3 | Q4 | Q5 |
| No. <i>Marianthus aquilonaris</i>: | Nil | Nil | 8 | 9 | Nil |
| Condition rating of <i>M. aquilonaris</i>: | Nil | Nil | Good | Good | Nil |
| Dominant species-upper stratum: | <i>Eucalypus livida</i> | <i>Eucalypus livida</i> | <i>Eucalypus livida</i> | Nil | Nil |
| % Cover-upper stratum | 10-30 | 5-10 | 0-5 | 0 | 0 |
| Dominant species-mid stratum: | <i>Westringia cephalantha</i> | <i>Davesia</i> sp. (sterile) | <i>Mananthus aquilonaris</i> | <i>Mananthus aquilonaris</i> | <i>Alyxia buxifolia</i> |
| % Cover-mid stratum | 10-30 | 30-70 | 5-10 | 5-10 | 0-5 |
| Dominant species-lower stratum: | <i>Lepidosperma sanguinolentum</i> | <i>Gahnia ancistrophylla</i> | Nil | Nil | Nil |
| % Cover-lower stratum | 30-70 | 70-100 | 0 | 0 | 0 |
| Full sun/part sun/shade: | Part shade | Full sun | Part Shade | Full sun | Full sun |
| % cover of bare ground | 30% | 20% | 85% | 50% | 5% |
| % cover of plant litter | 40% | 30% | 40% | 25% | <5% |

| | | | | | |
|---|------------------------------------|------------------------------------|-------------------------------|------------------------------------|-------------------------------|
| Transect ID: | NM-T2 | Transect WP: | 23 S/ 28 E | Transect Photo (Start/End): | 288 S/ 296 E |
| Quadrat ID: | Q1 | Q2 | Q3 | Q4 | Q5 |
| Quadrat WP: | 23 | 24 | 25 | 26 | 27 |
| Quadrat Photo: | 289 | 291 | 293 | 294 | 295 |
| Morphological Type: | Upper slope | Upper slope | Upper slope | Mid slope | Mid slope |
| Landform Type: | Hill slope | Hill slope | Hill slope | Hill slope | Hill slope |
| Substrate type (rock): | Limonite | Limonite | Limonite | Limonite | Limonite |
| Substrate type (soil): | clay-loam red-brown | clay-loam red-brown | clay-loam red-brown | clay-loam red-brown | clay-loam red-brown |
| Elevation: | 419 m | 418 m | 412 m | 405 m | 400 m |
| Aspect: | N | N | N | N | N |
| Loose rocks or gravel: % and size: | >90% Coarse gravel | >90% Coarse gravel | >90% Coarse gravel | >90% Coarse gravel | >90% Coarse gravel |
| Bedrock % | 0% | <5% | 20% | 30% | 0% |
| Surface Soil depth (mm): | 70mm | 75mm | 50mm | 90mm | 40mm |
| Surface resistance (LFA classification): | 3 | 3 | 3 | 3 | 3 |
| Local slope (degrees): | 6.3 | 10.3 | 22.2 | 15.8 | 14.2 |
| Biological Properties | Q1 | Q2 | Q3 | Q4 | Q5 |
| No. <i>Marianthus aquilonaris</i>: | Nil | Nil | Nil | Nil | Nil |
| Condition rating of <i>M. aquilonaris</i>: | Nil | Nil | Nil | Nil | Nil |
| Dominant species-upper stratum: | <i>Melaleuca hamata</i> | <i>Melaleuca hamata</i> | <i>Eucalyptus</i> sp. sterile | <i>Eucalyptus</i> sp. sterile | <i>Eucalyptus</i> sp. sterile |
| % Cover-upper stratum | 0-5 | 0-5 | 10-30 | 10-30 | 70-100 |
| Dominant species-mid stratum: | <i>Acacia colletioides</i> | <i>Westringia cephalantha</i> | <i>Westringia cephalantha</i> | <i>Westringia cephalantha</i> | Nil |
| % Cover-mid stratum | 10-30 | 10-30 | 10-30 | 10-30 | 0 |
| Dominant species-lower stratum: | <i>Lepidosperma sanguinolentum</i> | <i>Lepidosperma sanguinolentum</i> | <i>Gahnia ancistrophylla</i> | <i>Gahnia ancistrophylla</i> | <i>Gahnia ancistrophylla</i> |
| % Cover-lower stratum | 0-5 | 10-30 | 10-30 | 10-30 | 10-30 |
| Full sun/part sun/shade: | full sun | full sun | full sun | full sun | shade |
| % cover of bare ground | 60% | 40% | 50% | 50% | 20% |
| % cover of plant litter | 20% | 5% | 15% | 5% | 80% |

| | | | | | |
|---|------------------------------------|------------------------------|------------------------------------|------------------------------------|------------------------------|
| Transect ID: | Pop 1c- T1 | Transect WP: | 43 S/48 E | Transect Photo (Start/End): | 324S/332E |
| Quadrat ID: | Q1 | Q2 | Q3 | Q4 | Q5 |
| Quadrat WP: | 43 | 44 | 45 | 46 | 47 |
| Quadrat Photo: | 323 | 325 | 326 | 327 | 331 |
| Morphological Type: | Mid slope | Mid slope | Mid slope | Mid slope | Mid slope |
| Landform Type: | Hill slope | Hill slope | Hill slope | Hill slope | Hill slope |
| Substrate type (rock): | Limonite | Limonite | Limonite | Limonite | Limonite |
| Substrate type (soil): | Sandy-clay loam red-brown | Sandy-clay loam red-brown | Sandy-clay loam red-brown | Sandy-clay loam red-brown | Sandy-clay loam red-brown |
| Elevation: | 417 m | 416 m | 414 m | 410 m | 405 m |
| Aspect: | NW | NW | NW | NW | NW |
| Loose rocks or gravel: % and size: | >90% Cobbles | >90% Coarse gravel | >90% Coarse gravel | >90% Coarse gravel | >90% Coarse gravel |
| Bedrock %: | 0% | 25% | <5% | 30% | 40% |
| Surface Soil depth (mm): | 50mm | 90mm | 60mm | 80mm | 40mm |
| Surface resistance (LFA classification): | 3 | 4 | 4 | 4 | 4 |
| Local slope (degrees): | 10 | 10.5 | 6.7 | 3.3 | 6.8 |
| Biological Properties | Q1 | Q2 | Q3 | Q4 | Q5 |
| No. <i>Marianthus aquilonaris</i>: | 1 | 16 | 14 | 20 | 12 |
| Condition rating of <i>M. aquilonaris</i>: | Good | Good | Good | Poor | Good |
| Dominant species-upper stratum: | <i>Eucalyptus livida</i> | <i>Eucalyptus livida</i> | <i>Eucalyptus livida</i> | Nil | Nil |
| % Cover-upper stratum | 30-70 | 10-30 | 30-70 | 0 | 0 |
| Dominant species-mid stratum: | <i>Beyeria brevifolia</i> | <i>Beyeria brevifolia</i> | <i>Westringia cephalantha</i> | <i>Mananthus aquilonaris</i> | <i>Mananthus aquilonaris</i> |
| % Cover-mid stratum | 30-70 | 30-70 | 10-30 | 10-30 | 10-30 |
| Dominant species-lower stratum: | <i>Lepidosperma sanguinolentum</i> | <i>Gahnia ancistrophylla</i> | <i>Lepidosperma sanguinolentum</i> | <i>Lepidosperma sanguinolentum</i> | <i>Gahnia ancistrophylla</i> |
| % Cover-lower stratum | 30-70 | 0-5 | 0-5 | 10-30 | 5-10 |
| Full sun/part sun/shade: | Part shade | Part shade | Part shade | Full sun | Full sun |
| % cover of bare ground | 25% | 25% | 20% | 20% | <5% |
| % cover of plant litter | 30% | 60% | 70% | 80% | 85% |

| | | | | | |
|---|------------------------------------|------------------------------------|------------------------------------|------------------------------------|-----------------------------|
| Transect ID: | NM-T3 | Transect WP: | 37 S | Transect Photo (Start/End): | 317S/322E |
| Quadrat ID: | Q1 | Q2 | Q3 | Q4 | Q5 |
| Quadrat WP: | 37 | 38 | 39 | 40 | 41 |
| Quadrat Photo: | 316 | 318 | 319 | 320 | 321 |
| Morphological Type: | Upper slope | Upper slope | Upper slope | Upper slope | Upper slope |
| Landform Type: | Hill slope | Hill slope | Hill slope | Hill slope | Hill slope |
| Substrate type (rock): | Limonite | Limonite | Limonite | Limonite | Limonite |
| Substrate type (soil): | Sandy clay-loam red-brown | Sandy clay-loam red-brown | Sandy clay-loam red-brown | Sandy clay-loam red-brown | Sandy clay-loam red-brown |
| Elevation: | 430 m | 427 m | 425 m | 424 m | 421 m |
| Aspect: | N | NW | NW | NW | NW |
| Loose rocks or gravel: % and size: | >90% Cobbles | >90% Coarse gravel | 70-90% Coarse gravel | >90% Cobbles | >90% Cobbles |
| Bedrock %: | <5% | <5% | <5% | 60% | 30% |
| Surface Soil depth (mm): | 30mm | 20mm | 60mm | 40mm | 40mm |
| Surface resistance (LFA classification): | 4 | 3 | 2 | 2 | 3 |
| Local slope (degrees): | 4.4 | 5.8 | 6.3 | 5.7 | 8.2 |
| Biological Properties | Q1 | Q2 | Q3 | Q4 | Q5 |
| No. <i>Marianthus aquilonaris</i>: | Nil | Nil | Nil | Nil | Nil |
| Condition rating of <i>M. aquilonaris</i>: | Nil | Nil | Nil | Nil | Nil |
| Dominant species-upper stratum: | Nil | Nil | <i>Eucalyptus livida</i> | <i>Eucalyptus livida</i> | <i>Eucalyptus livida</i> |
| % Cover-upper stratum | 0 | 0 | 30-70 | 0-5 | 0-5 |
| Dominant species-mid stratum: | <i>Westringia cephalantha</i> | <i>Melaleuca hamata</i> | Nil | <i>Beyeria</i> sp. (sterile) | <i>Santalum murrayanum</i> |
| % Cover-mid stratum | 30-70 | 0-5 | 0 | 0-5 | 0-5 |
| Dominant species-lower stratum: | <i>Lepidosperma sanguinolentum</i> | <i>Lepidosperma sanguinolentum</i> | <i>Lepidosperma sanguinolentum</i> | <i>Lepidosperma sanguinolentum</i> | <i>Phebalium filifolium</i> |
| % Cover-lower stratum | 10-30 | 10-30 | 10-30 | 10-30 | 30-70 |
| Full sun/part sun/shade: | Full sun | Full sun | Shade | Full sun | Full sun |
| % cover of bare ground | 70% | 70% | 40% | 50% | 50% |
| % cover of plant litter | 15% | 10% | 30% | 30% | 30% |

| | | | | | |
|---|----------------------------------|----------------------------------|--|--|----------------------------------|
| Transect ID: | Pop 1c-T2 | Transect WP: | 49 S/55 E | Transect Photo (Start/End): | 334 S/340 E |
| Quadrat ID: | Q1 | Q2 | Q3 | Q4 | Q5 |
| Quadrat WP: | 49 | 50 | 52 | 53 | 54 |
| Quadrat Photo: | 333 | 336 | 337 | 338 | 339 |
| Morphological Type: | Low slope | Low slope | Low slope | Low slope/ wash out | Low slope/ wash out |
| Landform Type: | Hill slope | Hill slope | Hill slope | Hill slope | Hill slope |
| Substrate type (rock): | Limonite | Limonite | Limonite | Limonite | Limonite |
| Substrate type (soil): | Sandy-clay loam red-brown | Sandy-clay loam red-brown | Sandy-clay loam red-brown | Sandy-clay loam red-brown | Sandy-clay loam red-brown |
| Elevation: | 405 m | 404 m | 401 m | 400 m | 399 m |
| Aspect: | NW | NW | NW | NW | NW |
| Loose rocks or gravel: % and size: | >90% Coarse gravel | >90% Coarse gravel | >90% Coarse gravel | >90% Fine gravel | 70-90% Coarse gravel |
| Bedrock %: | <5% | <5% | 5% | 10% | 5% |
| Surface Soil depth (mm): | 50mm | 15mm | 80mm | 70mm | 50mm |
| Surface resistance (LFA classification): | 3 | 3 | 4 | 4 | 4 |
| Local slope (degrees): | 1.3 | 5.1 | 4.1 | 1.5 | 9 |
| Biological Properties | Q1 | Q2 | Q3 | Q4 | Q5 |
| No. <i>Marianthus aquilonaris</i>: | 11 | 5 | 2 | 9 | 20 |
| Condition rating of <i>M. aquilonaris</i>: | Good | Good | Good | Good | Good |
| Dominant species- upper stratum: | <i>Eucalyptus livida</i> | Nil | <i>Eucalyptus livida</i> | Nil | <i>Eucalyptus livida</i> |
| % Cover-upper stratum | 30-70 | 0 | 0-5 | 0 | 30-70 |
| Dominant species-mid stratum: | <i>Mananthus aquilonaris</i> | <i>Mananthus aquilonaris</i> | <i>Mananthus aquilonaris</i> | <i>Mananthus aquilonaris</i> | <i>Mananthus aquilonaris</i> |
| % Cover-mid stratum | | 0-5 | 0-5 | 10-30 | 10-30 |
| Dominant species- lower stratum: | <i>Gahnia ancistrophylla</i> | <i>Gahnia ancistrophylla</i> | <i>Lepidosperma sanguinolentum</i> | <i>Lepidosperma sanguinolentum</i> | Nil |
| % Cover-lower stratum | 0-5 | 5-10 | 5-10 | 0-5 | 0 |
| Full sun/part sun/shade: | Part shade | Full sun | Full sun | Full sun | Part shade |
| % cover of bare ground | 60% | 90% | 80% | 90% | 70% |
| % cover of plant litter | 50% | <5% | 10% | <5% | 10% |

| | | | | | |
|---|---------------------------|---|---|------------------------------------|---|
| Transect ID: | NM-T4 | Transect WP: | WP56 S/61 E | Transect Photo (Start/End): | 342 S/347 E |
| Quadrat ID: | Q1 | Q2 | Q3 | Q4 | Q5 |
| Quadrat WP: | WP56 | WP57 | WP58 | WP59 | WP60 |
| Quadrat Photo: | 341 | 343 | 344 | 345 | 346 |
| Morphological Type: | Low slope | Low slope | Low slope | Low slope | Low slope |
| Landform Type: | Hill slope | Hill slope | Hill slope | Hill slope | Hill slope |
| Substrate type (rock): | Limonite | Limonite | No bedrock | Limonite | Limonite |
| Substrate type (soil): | Sandy clay loam red-brown | Sandy clay loam red-brown | Sandy clay loam red-brown | Sandy clay loam red-brown | Sandy clay loam red-brown |
| Elevation: | 405 m | 404 m | 403 m | 402 m | 400 m |
| Aspect: | NW | NW | NW | NW | NW |
| Loose rocks or gravel: % and size: | >90% Fine gravel | >90% Fine gravel | 50% Fine gravel | 90% Fine gravel | >90% Fine gravel |
| Bedrock %: | 0% | 0% | 0% | 0% | 0% |
| Surface Soil depth (mm): | 100mm | 30mm | 30mm | 110mm | 100mm |
| Surface resistance (LFA classification): | 4 | 4 | 4 | 4 | 3 |
| Local slope (degrees): | 5.4 | 6.7 | 2.4 | 4.5 | 4.6 |
| Biological Properties | Q1 | Q2 | Q3 | Q4 | Q5 |
| No. <i>Marianthus aquilonaris</i>: | Nil | Nil | Nil | Nil | Nil |
| Condition rating of <i>M. aquilonaris</i>: | Nil | Nil | Nil | Nil | Nil |
| Dominant species-upper stratum: | Nil | <i>Eucalyptus</i> sp. (Sterile) | Nil | Nil | Nil |
| | 0 | 0-5 | 0 | 0 | 0 |
| Dominant species-mid stratum: | Nil | Nil | <i>Dodonaea stenozyga</i> | Nil | <i>Exocarpos aphyllus</i> |
| | 0 | 0 | 10-30 | 0 | |
| Dominant species-lower stratum: | <i>Wilsonia humilis</i> | <i>Acacia erinacea/ Acacia poliochroa</i> | <i>Acacia erinacea/ Acacia poliochroa</i> | <i>Wilsonia humilis</i> | <i>Acacia erinacea/ Acacia poliochroa</i> |
| | 0-5 | 5-10 | 10-30 | 10-30 | 10-30 |
| Full sun/part sun/shade: | Full sun | Full sun | Full sun | Full sun | Full sun |
| % cover of bare ground | 95% | 90% | 60% | 85% | 75% |
| % cover of plant litter | <5% | <5% | 10% | <5% | 10% |

| | | | | | |
|---|------------------------------|------------------------------------|---|------------------------------------|------------------------------|
| Transect ID: | Pop1d-T1 | Transect WP: | 63 S/ 67 E | Transect Photo (Start/End): | 353 S/ 359 E |
| Quadrat ID: | Q1 | Q2 | Q3 | Q4 | Q5 |
| Quadrat WP: | 63 | 64 | 65 | 66 | 67 |
| Quadrat Photo: | 352 | 353 | 354 | 356 | 358 |
| Morphological Type: | Crest | Crest | Crest | Mid slope | Mid slope |
| Landform Type: | Hill slope | Hill slope | Hill slope | Hill slope | Hill slope |
| Substrate type (rock): | Limonite | Limonite | Limonite | Limonite | Limonite |
| Substrate type (soil): | Sandy clay loam red-brown | Sandy clay loam red-brown | Sandy clay loam red-brown | Sandy clay loam red-brown | Sandy clay loam red-brown |
| Elevation: | 402 m | 402 m | 402 m | 400 m | 399 m |
| Aspect: | S | N | N | N | N |
| Loose rocks or gravel: % and size: | 90% Coarse gravel | 90% Coarse gravel | 90% Coarse gravel | 90% Coarse gravel | 30% Coarse gravel |
| Bedrock %: | 70% | 50% | 40% | 10% | 0% |
| Surface Soil depth (mm): | 20mm | 30mm | 10mm | 60mm | 100mm |
| Surface resistance (LFA classification): | 4 | 4 | 4 | 4 | 4 |
| Local slope (degrees): | 10.7 | 5.8 | 4.5 | 2 | 4.1 |
| Biological Properties | Q1 | Q2 | Q3 | Q4 | Q5 |
| No. <i>Marianthus aquilonaris</i>: | 16 | 4 | 15 | 3 | 1 |
| Condition rating of <i>M. aquilonaris</i>: | Good | Good | Good | Good | Good |
| Dominant species-upper stratum: | <i>Eucalyptus livida</i> | Nil | <i>Eucalyptus livida</i> | Nil | <i>Eucalyptus livida</i> |
| % Cover-upper stratum | 10-30 | 0 | 10-30 | 0 | 10-30 |
| Dominant species-mid stratum: | <i>Mananthus aquilonaris</i> | <i>Mananthus aquilonaris</i> | <i>Mananthus aquilonaris</i> | <i>Dodonaea stenozyga</i> | <i>Mananthus aquilonaris</i> |
| % Cover-mid stratum | 10-30 | 5-10 | 10-30 | 5-10 | 0-5 |
| Dominant species-lower stratum: | <i>Gahnia ancistrophylla</i> | <i>Lepidosperma sanguinolentum</i> | <i>Dampiera angulata</i> subsp. Peak Charles (K.R. Newbey 5402) | <i>Gahnia ancistrophylla</i> | <i>Dodonaea stenozyga</i> |
| % Cover-lower stratum | 10-30 | 10-30 | 5-10 | 10-30 | 10-30 |
| Full sun/part sun/shade: | Full sun | Full sun | Full sun | Full sun | Shade |
| % cover of bare ground | 76% | 90% | 60% | 80% | 50% |
| % cover of plant litter | 5% | 20% | 20% | 20% | 20% |

| | | | | | |
|---|---------------------------------|---------------------------------|-------------------------------|--|----------------------------|
| Transect ID: | Pop1d-T2 | Transect WP: | 69 S/ 73 E | Transect Photo (Start/End): | 361 S/ 367 E |
| Quadrat ID: | Q1 | Q2 | Q3 | Q4 | Q5 |
| Quadrat WP: | 69 | 70 | 71 | 72 | 73 |
| Quadrat Photo: | 362 | 363 | 364 | 365 | 366 |
| Morphological Type: | Crest | Crest | Mid slope | Valley | Low slope |
| Landform Type: | Hill slope | Hill slope | Hill slope | Hill slope | Hill slope |
| Substrate type (rock): | Limonite | Limonite | Limonite | Limonite | Limonite |
| Substrate type (soil): | Sandy clay loam red-brown | Sandy clay loam red-brown | Sandy clay loam red-brown | Sandy clay loam red-brown | Sandy clay loam red-brown |
| Elevation: | 405 m | 404 m | 402 m | 400 m | 403 m |
| Aspect: | N | N | N | N | SE |
| Loose rocks or gravel: % and size: | 90% Coarse gravel | 90% Coarse gravel | 70% Coarse gravel | 50% Coarse gravel | >90% Coarse gravel |
| Bedrock %: | 80% | 60% | 10% | 0% | 0% |
| Surface Soil depth (mm): | 10mm | 10mm | 20mm | 30mm | 130mm |
| Surface resistance (LFA classification): | 4 | 4 | 4 | 4 | 3 |
| Local slope (degrees): | 7.9 | 7.9 | 8.7 | 6.4 | 4.8 |
| Biological Properties | Q1 | Q2 | Q3 | Q4 | Q5 |
| No. <i>Marianthus aquilonaris</i>: | 12 | 4 | 11 | 15 | Nil |
| Condition rating of <i>M. aquilonaris</i>: | Good | Good | Good | Good | Nil |
| Dominant species-upper stratum: | <i>Eucalyptus</i> sp. (sterile) | <i>Eucalyptus</i> sp. (sterile) | Nil | <i>Eucalyptus livida</i> | Nil |
| % Cover-upper stratum | 10-30 | 10-30 | 0 | 30-70 | 0 |
| Dominant species-mid stratum: | <i>Mananthus aquilonaris</i> | <i>Mananthus aquilonaris</i> | <i>Mananthus aquilonaris</i> | <i>Trymalium myrtillus</i> subsp. <i>myrtillus</i> | <i>Santalum acuminatum</i> |
| % Cover-mid stratum | 5-10 | 5-10 | 5-10 | 5-10 | 5-10 |
| Dominant species-lower stratum: | <i>Dodonaea stenozyga</i> | Nil | <i>Leptosema daviesioides</i> | <i>Acacia poliochroa</i> | <i>Acacia erinacea</i> |
| % Cover-lower stratum | 10-30 | 0 | 10-30 | 10-30 | 5-10 |
| Full sun/part sun/shade: | Full sun | Part Sun | Part Sun | Shade | Full sun |
| % cover of bare ground | 80% | 60% | 80% | 10% | 60% |
| % cover of plant litter | 15% | 40% | 30% | 20% | <10% |

| | | | | | |
|---|--|---------------------------|--|------------------------------------|-------------------------------|
| Transect ID: | NM-T5 | Transect WP: | 75S/ | Transect Photo (Start/End): | 369s/374 |
| Quadrat ID: | Q1 | Q2 | Q3 | Q4 | Q5 |
| Quadrat WP: | 76 | 77 | 78 | 79 | 80 |
| Quadrat Photo: | 368 | 371 | 372 | 373 | 375 |
| Morphological Type: | Low slope | Low slope | Low slope | Low slope | Low slope |
| Landform Type: | Hill slope | Hill slope | Hill slope | Hill slope | Hill slope |
| Substrate type (rock): | Limonite | Limonite | Quartz | Ironstone | Ironstone |
| Substrate type (soil): | Sandy clay loam red-brown | Sandy clay loam red-brown | Sandy clay loam red-brown | Sandy clay loam red-brown | Sandy clay loam red-brown |
| Elevation: | 409 m | 407 m | 406 m | 403 m | 403 m |
| Aspect: | NE | NE | NE | NE | NE |
| Loose rocks or gravel: % and size: | 50% Cobbles | >90% Coarse gravel | >90% Coarse gravel | >90% Coarse gravel | >90% Coarse gravel |
| Bedrock %: | <10% | 0% | 0% | 0% | 0% |
| Surface Soil depth (mm): | 10mm | 40mm | 120mm | 120mm | 90mm |
| Surface resistance (LFA classification): | 4 | 4 | 3 | 2 | 2 |
| Local slope (degrees): | 2.5 | 4.1 | 2.5 | 4.8 | 2.9 |
| Biological Properties | Q1 | Q2 | Q3 | Q4 | Q5 |
| No. <i>Marianthus aquilonaris</i>: | Nil | Nil | Nil | Nil | Nil |
| Condition rating of <i>M. aquilonaris</i>: | Nil | Nil | Nil | Nil | Nil |
| Dominant species-upper stratum: | <i>Eucalyptus</i> sp. (sterile) | Nil | <i>Eucalyptus</i> sp. (sterile) | <i>Santalum acuminatum</i> | Nil |
| % Cover-upper stratum | 10-30 | 0 | 10-30 | 10-30 | 0 |
| Dominant species-mid stratum: | <i>Trymalium myrtillus</i> subsp. <i>myrtillus</i> | <i>Davesia argillacea</i> | <i>Melaleuca pauperiflora</i> | <i>Dodonaea stenozyga</i> | <i>Melaleuca pauperiflora</i> |
| % Cover-mid stratum | 5-10 | 5-10 | 10-30 | 10-30 | 5-10 |
| Dominant species-lower stratum: | Nil | <i>Acacia poliochroa</i> | <i>Acacia sulcata</i> / <i>Davesia argillacea</i> | <i>Davesia argillacea</i> | <i>Acacia sulcata</i> |
| % Cover-lower stratum | 0 | 10-30 | 10-30 | 10-30 | 30-70 |
| Full sun/part sun/shade: | Part shade | Full sun | Full sun | Full sun | Full sun |
| % cover of bare ground | 80% | 80% | 60% | 70% | 40% |
| % cover of plant litter | 5% | <5% | <5% | 15% | 10% |

| | | | | | |
|---|-------------------------------|------------------------------|------------------------------|------------------------------------|--------------------------------------|
| Transect ID: | Pop1e-T1 | Transect WP: | 81 | Transect Photo (Start/End): | 377 |
| Quadrat ID: | Q1 | Q2 | Q3 | Q4 | Q5 |
| Quadrat WP: | 81 | 82 | 83 | 84 | 85 |
| Quadrat Photo: | 376 | 379 | 380 | 383 | 384 |
| Morphological Type: | Upper slope | Mid slope | Mid slope | Low slope/ Valley | Low slope/ Valley |
| Landform Type: | Hill slope | Hill slope | Hill slope | Valley | Valley |
| Substrate type (rock): | Limonite | Limonite | Limonite | Ironstone | Ironstone |
| Substrate type (soil): | Sandy clay loam red-brown | Sandy clay loam red-brown | Sandy clay loam red-brown | Sandy clay loam red-brown | Sandy clay loam red-brown |
| Elevation: | 402 m | 402 m | 397 m | 396 m | 393 m |
| Aspect: | NE | NE | NE | NE | NE |
| Loose rocks or gravel: % and size: | >90% Coarse gravel | >90% Coarse gravel | >90% Coarse gravel | >90% Fine gravel | 20-50% Fine gravel |
| Bedrock %: | 20% | 5% | >5% | 0% | 0% |
| Surface Soil depth (mm): | 50mm | 60mm | 30mm | 30mm | 80mm |
| Surface resistance (LFA classification): | 4 | 2 | 4 | 2 | 2 |
| Local slope (degrees): | 5.9 | 5 | 1.6 | 1 | 2.4 |
| Biological Properties | Q1 | Q2 | Q3 | Q4 | Q5 |
| No. <i>Marianthus aquilonaris</i>: | 5 | 12 | 8 | 2 | Nil |
| Condition rating of <i>M. aquilonaris</i>: | Good | Good | Good | Good | Nil |
| Dominant species-upper stratum: | <i>Eucalyptus livida</i> | <i>Eucalyptus livida</i> | <i>Eucalyptus livida</i> | <i>Eucalyptus livida</i> | <i>Eucalyptus transcontinentalis</i> |
| % Cover-upper stratum | 10-30 | 10-30 | 10-30 | 5-10 | 10-30 |
| Dominant species-mid stratum: | <i>Mananthus aquilonaris</i> | <i>Mananthus aquilonaris</i> | <i>Mananthus aquilonaris</i> | <i>Mananthus aquilonaris</i> | <i>Melaleuca pauperiflora</i> |
| % Cover-mid stratum | 5-10 | 10-30 | 10-30 | 10-30 | 10-30 |
| Dominant species-lower stratum: | <i>Westringia cephalantha</i> | <i>Gahnia ancistrophylla</i> | <i>Gahnia ancistrophylla</i> | <i>Gahnia ancistrophylla</i> | <i>Acacia erinacea</i> |
| % Cover-lower stratum | 5-10 | 5-10 | 10-30 | 70-100 | 30-70 |
| Full sun/part sun/shade: | Full sun | Part Sun | Part Sun | Full sun | Full sun |
| % cover of bare ground | 70% | 70% | 60% | 30% | 40% |
| % cover of plant litter | 15% | 25% | 20% | 40% | 15% |

| | | | | | |
|---|--------------------------------|------------------------------|---------------------------------|------------------------------------|---------------------------------|
| Transect ID: | NM-T6 | Transect WP: | 86S/ | Transect Photo (Start/End): | 386S/391 |
| Quadrat ID: | Q1 | Q2 | Q3 | Q4 | Q5 |
| Quadrat WP: | 86 | 87 | 88 | 89 | 90 |
| Quadrat Photo: | 385 | 387 | 388 | 389 | 390 |
| Morphological Type: | Upper slope | Upper slope | Mid slope | Low slope | Low slope |
| Landform Type: | Hill slope | Hill slope | Hill slope | Hill slope | Hill slope |
| Substrate type (rock): | Ironstone | Ironstone | Ironstone | Ironstone | Ironstone |
| Substrate type (soil): | Sandy clay loam red-brown | Sandy clay loam red-brown | Sandy clay loam red-brown | Sandy clay loam red-brown | Sandy clay loam red-brown |
| Elevation: | 405 m | 402 m | 401 m | 399 m | 397 m |
| Aspect: | NE | NE | NE | NE | NE |
| Loose rocks or gravel: % and size: | >90% Cobbles | >90% Cobbles | >90% Cobbles | >90% Cobbles | >90% Cobbles |
| Bedrock %: | 0% | 0% | 0% | 0% | 0% |
| Surface Soil depth (mm): | 110mm | 90mm | 70mm | 80mm | 40mm |
| Surface resistance (LFA classification): | 4 | 4 | 3 | 2 | 4 |
| Local slope (degrees): | 6.4 | 4.9 | 4.5 | 6.8 | 5 |
| Biological Properties | Q1 | Q2 | Q3 | Q4 | Q5 |
| No. <i>Marianthus aquilonaris</i>: | Nil | Nil | Nil | Nil | Nil |
| Condition rating of <i>M. aquilonaris</i>: | Nil | Nil | Nil | Nil | Nil |
| Dominant species-upper stratum: | Nil | Nil | <i>Eucalyptus</i> sp. (sterile) | <i>Eucalyptus</i> sp. (sterile) | <i>Eucalyptus</i> sp. (sterile) |
| % Cover-upper stratum | 0 | 0 | 10-30 | 10-30 | 0-5 |
| Dominant species-mid stratum: | <i>Dodonaea bursariifolia</i> | <i>Melaleuca hamata</i> | <i>Dodonaea bursariifolia</i> | <i>Melaleuca pauperiflora</i> | <i>Melaleuca hamata</i> |
| % Cover-mid stratum | 30-70 | 30-70 | 10-30 | 10-30 | 10-30 |
| Dominant species-lower stratum: | <i>Stenanthemum bremerense</i> | <i>Gahnia ancistrophylla</i> | <i>Westringia cephalantha</i> | <i>Westringia cephalantha</i> | <i>Westringia cephalantha</i> |
| % Cover-lower stratum | 30-70 | 10-30 | 10-30 | 10-30 | 5-10 |
| Full sun/part sun/shade: | Full sun | Full sun | Part shade | Part shade | Full sun |
| % cover of bare ground | 25% | 50% | 75% | 40% | 85% |
| % cover of plant litter | 10% | 20% | 10% | 25% | 5% |

Appendix 3: Landform Monitoring-Transect Photographs

Pop 1a-T1



Start



End

Pop 1a-T2



Start



End

NM-T1



Start



End

Pop 1b-T1



Start



End

NM-T2



Start



End

Pop 1c-T1



Start



End

NM-T3



Start



End

Pop 1c-T2



Start



End

NM-T4



Start



End

Pop 1d-T1



Start



End

Pop 1d-T2



Start



End

NM-T5



Start



End

Pop 1e-T1



Start



End

NM-T6



Start



End

Appendix 4: Landform Monitoring-Summary Data

| Population | Marianthus (Present/Absent) | | Morphological Type | Landform Type | Rocky Type | Soil Type | Soil Colour | Elevation (m) | Aspect | % Loose rocks/gravel | Size Loose rocks/gravel | Bedrock % | Surface Soil depth (mm) | Surface resistance (LFA classification) | Local slope (degrees) |
|------------|-----------------------------|-------|-----------------------|-------------------|---------------------|---------------------------|-----------------|---------------|--------|----------------------|---------------------------|-----------|-------------------------|---|-----------------------|
| 1a | P | Range | Crest-Low Slope | Hill slope | Limonite-No bedrock | Clay-loam | Brown | 375-399 | W | 35-90 | Cobbles-Medium Gravel | 0-20% | 5-100 | 2-4 | 3.4-9.4 |
| | | Mean | Mid slope | Hill slope | Limonite | Clay-loam | Brown | 385 | W | 83 | Coarse Gravel | 8% | 18 | 3 | 5.3 |
| | A | Range | Upper Slope-Valley | Hill Slope-Valley | Limonite-No bedrock | Clay-loam | Brown-Red brown | 371-388 | SW-NE | 20-90 | Cobbles-Fine Gravel | 0-10% | 30-140 | 2-4 | 0.2-8 |
| | | Mean | Mid slope | Hill slope | No bedrock | Clay-loam | Red-Brown | 381 | W | 71 | Coarse Gravel | 2% | 85 | 3 | 4.3 |
| 1b | P | Range | Mid slope | Hill slope | Limonite | Sandy-clay loam | Red-Brown | 400-401 | N-NW | 80-90 | Cobbles | 20-30% | 10-30 | 3-4 | 6.7-10.1 |
| | | Mean | Mid slope | Hill slope | Limonite | Sandy-clay loam | Red-Brown | 401 | N-NW | 85 | Cobbles | 25% | 20 | 4 | 8.4 |
| | A | Range | Upper Slope-Mid Slope | Hill slope | Limonite | Clay loam-Sandy clay loam | Red-Brown | 397-419 | NW-NE | 80-90 | Coarse Gravel | 0-30% | 40-110 | 3-4 | 5-22.2 |
| | | Mean | Mid slope | Hill slope | Limonite | Clay-loam | Red-Brown | 407 | N | 89 | Coarse Gravel | 8% | 67 | 3 | 11.8 |
| 1c | P | Range | Mid Slope-Low Slope | Hill Slope | Limonite | Sandy clay loam | Red-Brown | 399-417 | NW | 70->90% | Cobbles-Fine Gravel | 0-40% | 15-90 | 3-4 | 1.3-10.5 |
| | | Mean | Mid slope | Hill slope | Limonite | Sandy-clay loam | Red-Brown | 407 | NW | 89 | Coarse Gravel | 13% | 58 | 4 | 5.8 |
| | A | Range | Upper Slope-Low Slope | Hill Slope | Limonite-No bedrock | Sandy clay loam | Red-Brown | 400-430 | N-NW | 50->90% | Cobbles-Fine Gravel | 0-60% | 20-110 | 2-4 | 2.4-8.2 |
| | | Mean | Upper Slope | Hill slope | Limonite | Sandy-clay loam | Red-Brown | 414 | NW | 85 | Fine Gravel | 11% | 56 | 3 | 5.4 |
| 1d | P | Range | Crest-Valley | Hill slope | Limonite | Sandy-clay loam | Red-Brown | 399-405 | N-S | 30-90 | Coarse Gravel | 0-80% | 10-100 | 4 | 2-10.7 |
| | | Mean | Crest | Hill slope | Limonite | Sandy-clay loam | Red-Brown | 402 | N | 77 | Coarse Gravel | 36% | 32 | 4 | 6.4 |
| | A | Range | Low slope | Hill slope | Limonite-Ironstone | Sandy-clay loam | Red-Brown | 403-409 | SE-NE | 50-90 | Cobbles-Coarse Gravel | 0-10% | 10-130 | 2-4 | 2.5-4.8 |
| | | Mean | Low slope | Hill slope | Limonite | Sandy-clay loam | Red-Brown | 405 | NE | 83 | Coarse Gravel | 2% | 85 | 3 | 3.6 |
| 1e | P | Range | Upper Slope-Low Slope | Hill slope-Valley | Limonite-Ironstone | Sandy-clay loam | Red-Brown | 396-402 | NE | 90 | Coarse Gravel-Fine Gravel | 0-20% | 30-60 | 3-4 | 1-5.9 |
| | | Mean | Mid slope | Hill slope | Limonite | Sandy-clay loam | Red-Brown | 399 | NE | 90 | Coarse Gravel | 19% | 42 | 3 | 3.4 |
| | A | Range | Upper slope-Low slope | Hill slope | Ironstone | Sandy-clay loam | Red-Brown | 393-405 | NE | 35-90 | Cobbles-Fine gravel | 0% | 40-110 | 3-4 | 2.4-6.8 |
| | | Mean | Low slope | Hill slope | Ironstone | Sandy-clay loam | Red-Brown | 399 | NE | 81 | Cobbles | 0% | 78 | 3 | 5 |

| Population | Marianthus (Present/ Absent) | | No. <i>Marianthus aquilonaris</i> | % Cover-upper stratum | % Cover-mid stratum | % Cover-lower stratum | % cover of bare ground | % cover of plant litter |
|------------|------------------------------|-------|-----------------------------------|-----------------------|---------------------|-----------------------|------------------------|-------------------------|
| 1a | P | Range | 1-7 | 0-30 | 0-70 | 0-10 | 50-90 | <5-50 |
| | | Mean | 4 | 9 | 21 | 3 | 72 | 23 |
| | A | Range | 0 | 0-70 | 0-30 | 0-100 | 20-90 | <5-25 |
| | | Mean | 0 | 15 | 9 | 19 | 68 | 14 |
| 1b | P | Range | 8-9 | 0-5 | 5-10 | 0 | 50-85 | 25-40 |
| | | Mean | 9 | 1 | 8 | 0 | 68 | 33 |
| | A | Range | 0 | 0-100 | 0-70 | 0-100 | 5-60 | <5-80 |
| | | Mean | 0 | 20 | 20 | 28 | 34 | 29 |
| 1c | P | Range | 1-20 | 0-70 | 0-70 | 0-70 | <5-90 | <5-85 |
| | | Mean | 11 | 24 | 22 | 11 | 53 | 41 |
| | A | Range | 0 | 0-70 | 0-70 | 5-70 | 40-95 | <5-30 |
| | | Mean | 0 | 6 | 8 | 21 | 69 | 15 |
| 1d | P | Range | 1-16 | 0-70 | 0-30 | 5-30 | 10-90 | 5-40 |
| | | Mean | 9 | 17 | 10 | 16 | 65 | 21 |
| | A | Range | 0 | 0-30 | 5-30 | 5-70 | 40-80 | <5-15 |
| | | Mean | 0 | 10 | 12 | 20 | 65 | 8 |
| 1e | P | Range | 2-12 | 5-30 | 5-30 | 5-100 | 30-70 | 15-40 |
| | | Mean | 7 | 17 | 17 | 30 | 58 | 25 |
| | A | Range | 0 | 0-30 | 10-70 | 5-70 | 25-85 | 5-25 |
| | | Mean | 0 | 10 | 32 | 30 | 53 | 14 |