



Western
Botanical

Paracaleana dixonii Targeted Regional
Surveys, December 2013

Tronox Management Pty. Ltd

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Executive Summary

Project Background

Tronox Management Pty. Ltd. (Tronox) has operated the Cooljarloo mineral sands mine between Cataby and Badgingarra, in the northern sandplains region of Western Australia, since 1989. Exploration adjacent to Cooljarloo has occurred since 2005.

In December of 2012 a specimen of *Paracaleana dixonii* was recorded during a drill-line clearance search in the Tronox proposed Development Envelope (DE) to the west of the current Cooljarloo mine (Astron 2012).

P. dixonii is a conservation-significant orchid from the northern Swan Coastal Plain region of Western Australia. Classified as a Threatened species and listed as Vulnerable in Western Australia, this species is also classified as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) where it is named as *P dixonii* Hopper and A.P.Br. *nom. inval.* (Department of Environment, 2008).

Following the December 2012 discovery, Tronox decided to enhance its search strategy for *P. dixonii* and conduct searches at a later time of year than previous. Tronox commissioned Western Botanical to carry out these searches.

Included in the Scope of Work were searches for a Priority 1 species *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88), one unconfirmed record of which was known in the Development Envelope. *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) is otherwise known from only a few locations close to the Cooljarloo minesite.

Initial searches were conducted from the 9th to 14th December 2013. Sections of the Tronox proposed Development Envelope were searched as well as sections of Nambung National Park, Eneminga Nature Reserve and Reserve 40916, an un-named reserve adjoining the DE southern border.

No *P. dixonii* were recorded during these surveys. No *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) was identified in the field, however, another conservation significant species, *Baeckea* sp. Perth Region (R.J. Cranfield 444), a Priority 3 species, was recorded at numerous sites. Further examination revealed that the disjunct northern population of this taxon appeared slightly different to the southern population around the Perth area, and a review of the taxonomy of this species is currently being undertaken by Mr Malcolm Trudgen of the Western Australian Herbarium.

As *P. dixonii* was not recorded during the December survey, and discussion with Orchid expert Andrew Brown (Department of Parks and Wildlife) suggested the optimal assessment time for this species was October – November, a decision was made to suspend further planned searches for this species in the 2013-14 season. To inform any future surveys, two botanists visited known *P. dixonii* sites in January of 2014 near Dongara and the site of the Astron 2012 record to collect data on soil stratigraphy and better define potential habitat types.

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1 Introduction

1.1 Project Background

Tronox Management Pty. Ltd. (Tronox) has operated the Cooljarloo mineral sands mine between Cataby and Badgingarra, in the northern sandplains region of Western Australia, since 1989. Exploration adjacent to Cooljarloo has occurred since 2005.

In December of 2012 a specimen of *Paracaleana dixonii* was recorded during a drill-line clearance search in the Tronox Development Envelope to the west of the current Cooljarloo mine.

P. dixonii is a conservation-significant orchid from the northern Swan Coastal Plain region of Western Australia. Classified as a Threatened species and listed as Vulnerable in Western Australia, this species is also classified as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) where it is named as *P dixonii* Hopper and A.P.Br. *nom. inval.* (Department of Environment, 2008).

Records show that *P. dixonii* can flower later than associated orchids (Western Australian Herbarium, 2013), but the species had not previously been recorded in the area so late in the season. This occurrence prompted a program of searches later in the year hoping to take advantage of the potential later flowering time for this species. Following the December 2012 discovery, Tronox decided to enhance its search strategy for *P. dixonii* and conduct searches at a later time of year than previous assessments.

Western Botanical was commissioned by Tronox Management Pty Ltd to conduct targeted searches for *P. dixonii* in the Development Envelope and in conservation reserves around the Cooljarloo Mine during December of 2013 and January of 2014. Also of interest was the Priority ranked species *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) (P1), known to occur in the area in similar habitat to *P. dixonii*. This report describes the searches conducted in December 2013 and their results.

1.2 Previous surveys

Astron (2012) reported the discovery in December 2012 of one individual of *P. dixonii* during searches conducted for conservation-significant flora on proposed exploration drill lines and associated access tracks immediately west of the Cooljarloo West mine site. The species has not been recorded in other surveys in the Cooljarloo area.

1.3 Physical Environment

1.3.1 Location

The Tronox Cooljarloo mine site is located approximately 150 km north of Perth, Western Australia, on the Brand Highway. Figure 1 shows the regional context of the mine site and the areas surveyed for this report.

1.3.2 Climate

The Cooljarloo area has a warm semi-arid to Mediterranean climate with 400-500 mm of rainfall annually (Mitchell *et al*, 2002) mostly occurring in winter, with hot dry summers.

1.4 Interim Biogeographic Regionalisation of Australia

The Interim Biogeographic Regionalisation for Australia classifies Australian landscapes into geographically distinct bioregions based on common factors of climate, geology, landform, native vegetation and species information (DoE, 2013). Eighty-nine bioregions are defined and are further refined into 419 subregions, which are more localised and homogenous geomorphological units within each bioregion. The Cooljarloo mine site and surrounds lie within the Swan Coastal Plain 2 subregion.

The Swan Coastal Plain is a low-lying coastal plain mainly vegetated with woodlands, dominated by *Banksia* or Tuart on sandy soils, *Casuarina obesa* on outwash plains and paperbark (*Melaleuca* spp.) in swampy areas. The SWA2 subregion is composed of colluvial and Aeolian sands supporting *Banksia* and Jarrah-*Banksia* or Marri woodlands, alluvial river flats supporting Sheoak and Marri and coastal limestone supporting heath and Tuart woodlands. The Cooljarloo minesite lies within an area of *Banksia attenuata* – *B. menziesii* woodlands on deep Aeolian sands, low Myrtaceous and Proteaceous heaths on duplex soils and low heaths and thickets of *Banksia telmatiaea*, Myrtaceae spp. and a range of Proteaceous shrubs in ephemeral wetlands which are inundated following high rainfall events and are generally not connected to groundwater.

1.5 Beard Pre-European Vegetation

J. S. Beard (1979) mapped the pre-European disturbance vegetation types for Western Australia at 1:250,000 for selected areas. As described by Beard, the survey area is comprised of the Bassendean Vegetation System. Figure 1 shows the Bassendean Vegetation System in context to the survey areas.

The Bassendean system stretches intermittently for the entire length of the Swan Coastal plain, with a general cover of *Banksia* low woodland over a dense understorey of sclerophyllous shrubs.

2 Methods

2.1 Desktop Survey

Two botanists engaged in the survey visited the Western Australian Herbarium to familiarise themselves with the species of interest. The report produced by Astron Environmental Services (Astron) describing the discovery of the specimen of *P. dixonii* in 2012 was also reviewed for background information, and Hoffman and Brown (2011) was consulted for background information regarding *P. dixonii*. Discussions on the preferred habitat and flowering period for the species were also held with Andrew Brown from the Department of Parks and Wildlife. Woodman Environmental Consulting (2014) provided further information post-survey.

Bureau of Meteorology (BoM) records were consulted to provide a background to climatic conditions preceding the Astron 2012 record compared to those at the time of the current survey.

2.2 Field Survey

2.2.1 *Paracaleana dixonii* and *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) Survey

The scope of the survey work included searches in the Tronox Development Envelope and Department of Parks and Wildlife (DPaW) regionally managed lands in the vicinity of the Cooljarloo mine site. These Reserves are shown in Figure 1 below and include:

- A north-eastern portion of Nambung National Park, to the north-west of the mine site. Examination of aerial photography indicated that only one section showed the same vegetation signature as that encompassing the Development Envelope vegetation units;
- The unnamed reserve R40916 adjacent to the southern boundary of the Development Envelope. This Reserve shares vegetation types with the Development Envelope on its northern and southern sides; and
- Eneminga Nature Reserve to the south-east of the Cooljarloo mine site. This Reserve is bisected by the Eneminga Creek, and vegetation on the southern/western sides of the creek was chosen for surveying as it bore the greatest apparent similarity to the DE in aerial photographs.

These search areas all occur in the Bassendean 1030 Pre-European Vegetation System Association. It was proposed that searches be conducted by transect in suitable habitat in these locations.

Astron Environmental Services (2013) conducted a risk assessment exercise combining recorded survey effort and habitat suitability to show suitable areas for future survey. Western Botanical was provided with figures produced from this analysis and was directed to use them to plan surveys for suitable habitat appropriately. Figures of the risk assessment/survey intensity for

Paracaleana dixonii and *Malleostemon* sp. Cooljarloo are included as Figure 2 and Figure 3 respectively.

Field survey was conducted from the 9th to 14th December 2013 by a team of four experienced botanists. Transects were walked in suitable locations at distances apart ranging from 20 to 50m.

2.2.2 Soil Sampling Survey

Following the December survey and its failure to record any *P. dixonii* individuals, the scope was modified to assess some known *P. dixonii* sites near Dongara and to the site of the Astron (2012) *Paracaleana* recording at Cooljarloo West also to assess soil stratigraphy. This was designed to narrow down likely habitat characteristics to inform this and future surveys.

As the soil was too dry to use an auger, pits were dug by shovel at three locations near Dongara and one location at Cooljarloo. Photographs were taken of soil profiles and samples taken for future analysis if required. A description of the vegetation and notes of soil characteristics were also taken.

Table 1 identifies the specimens selected for soil characterisation. Locations are not specified, rather Tronox ID numbers are provided. Specific locations can be provided on request.

Table 1 *Paracaleana dixonii* records used for soil sampling

Tronox ID	Survey ID	Source	No Plants	General Location
4734	PD1	Tronox Iluka Priority Species <i>Paracaleana dixonii</i> 20131025	6	Mt Adams Road, Dongara
4735	PD2	Tronox Iluka Priority Species <i>Paracaleana dixonii</i> 20131025	7	Mt Adams Road, Dongara
4741	PD8	Tronox Iluka Priority Species <i>Paracaleana dixonii</i> 20131025	2	Mt Adams Road, Dongara
6444	PD9	Tronox Iluka Priority Species <i>Paracaleana dixonii</i> 20131025	1	Cooljarloo West, Tronox Development Envelope

2.3 Personnel Involved

Geoff Cockerton	SOPP Licence No. SL010714
Martin Henson	SOPP Licence No. SL010715
	Permit to take Declared Rare Flora 51-1314
Alice Quarmby	SOPP Licence No. SL010717
Jonathan Warden	SOPP Licence No. SL010719

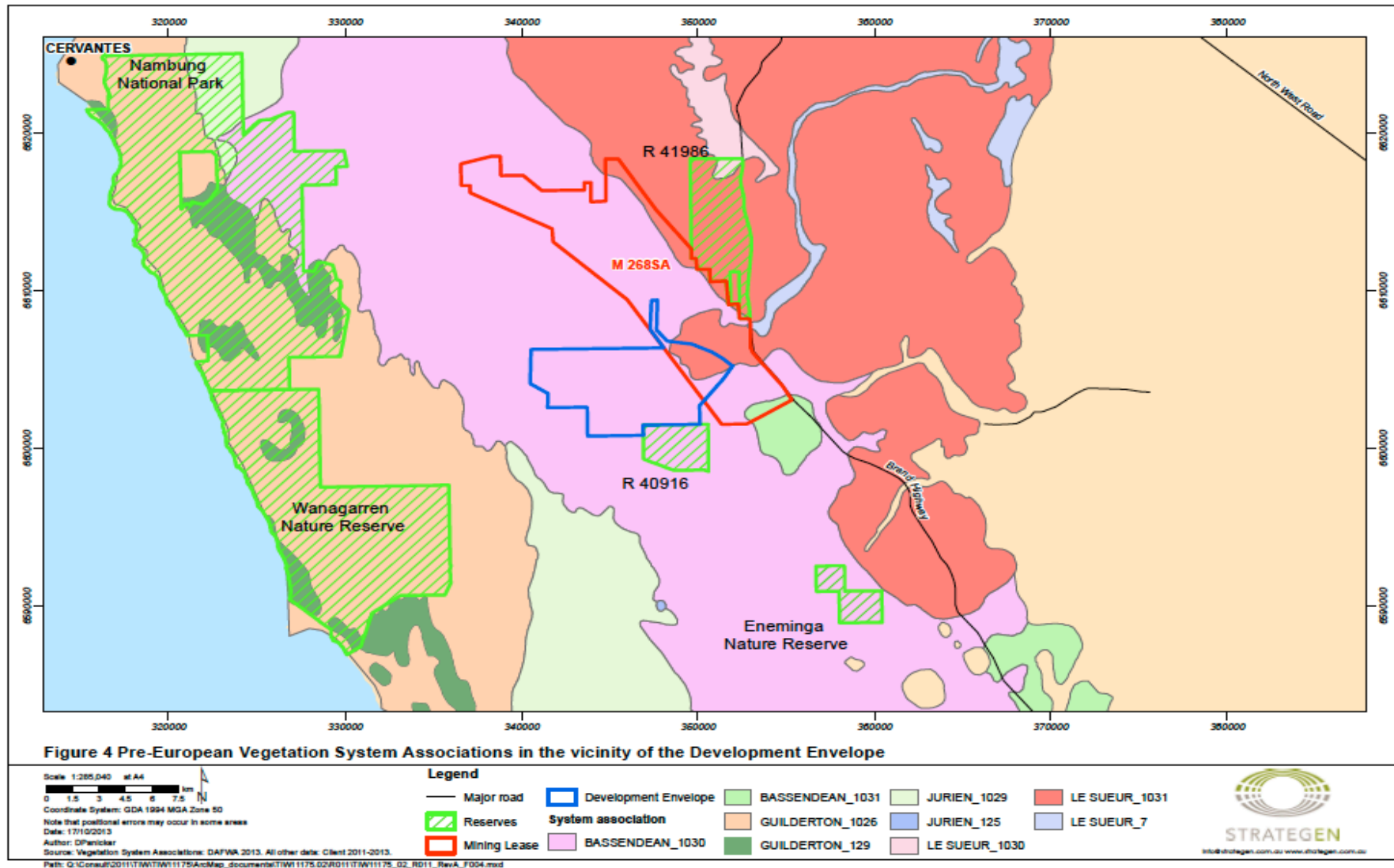


Figure 1 Bassendean Vegetation System Association 1030 extent in relation to Cooljarloo mine site

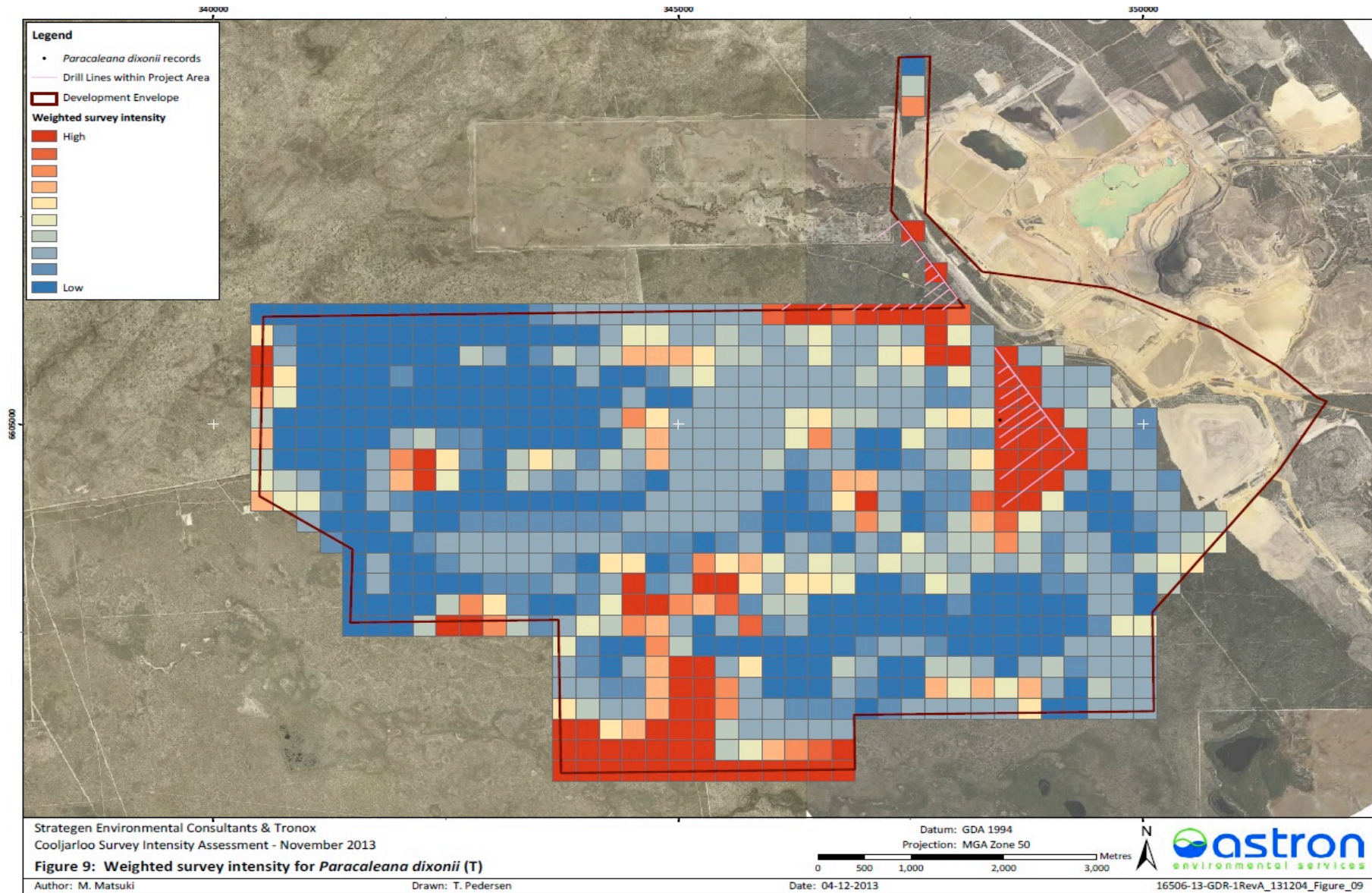


Figure 2 Weighted survey intensity for *Paracaleana dixonii* in Tronox Development Envelope

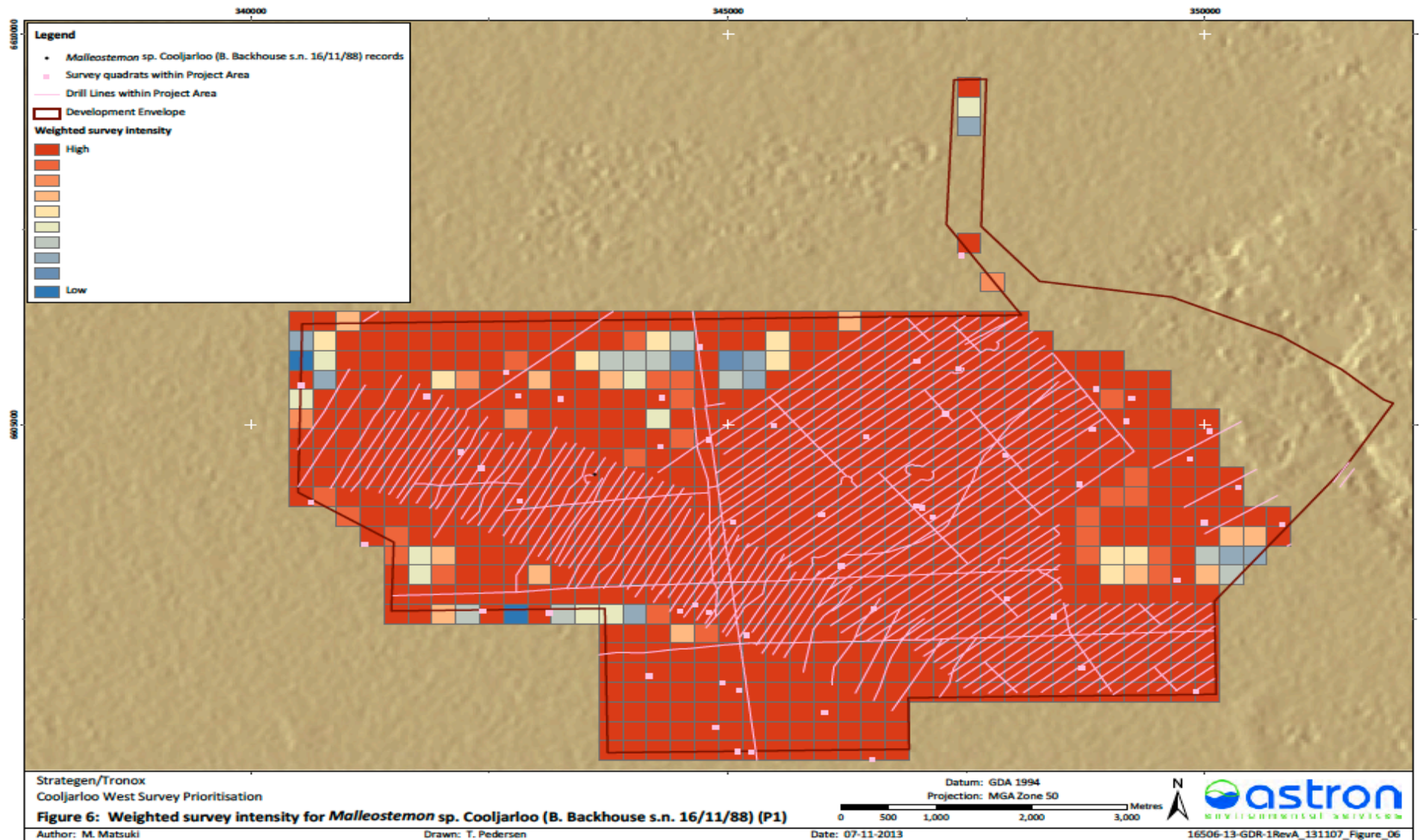


Figure 3 Weighted survey intensity for *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) in Tronox Development Envelope

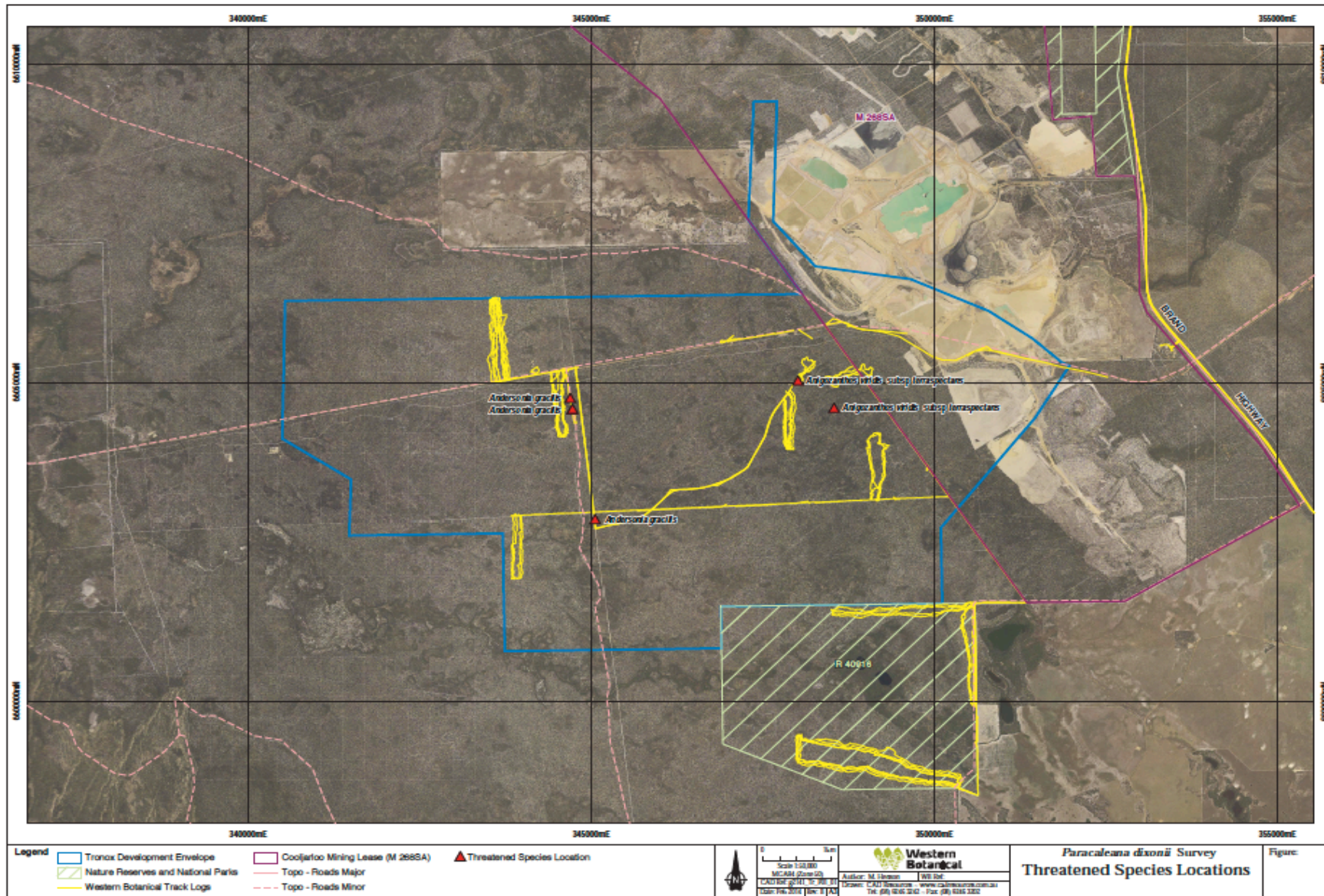


Figure 4. Survey Effort and Threatened Species Locations in Development Envelope

3 Results

3.1 Desktop Assessment

3.1.1 Climatic Conditions

Bureau of Meteorology (BoM) records (Table 2) indicate that 2012 experienced more rainfall in the fourth quarter period than 2013. These records are taken from the Badgingarra Research Station, approximately 37 km from the Cooljarloo survey area, which provided data for both rainfall and temperature.

Table 2 BoM Climate Records

Month	Rainfall mm	Long Term Rainfall Mean	Mean Temp °C	Long Term Temp Mean
Oct 2013	25.0	29.1	29.6	24.4
Nov 2013	3.2	19.9	32.9	28.3
Dec 2013	0.6	9.6	35.7	32.0
Oct 2012	5.0	29.9	25.6	24.4
Nov 2012	96.8	19.9	27.1	28.3
Dec 2012	14.6	9.6	32.9	32.0

3.1.2 Conservation Significant Species

Paracaleana dixonii (T)

Paracaleana dixonii (T) is a conservation-significant orchid from the northern Swan Coastal Plain region of Western Australia. Classified as a Threatened species and listed as Vulnerable in Western Australia, this species is classified as Endangered under the EPBC Act where it is named as *P. dixonii* Hopper and A.P.Br. *nom. inval.* (Department of Environment 2008).

The species is a member of the Family Orchidaceae, with the common name Sandplain Duck Orchid, and was named after Dr Kingsley Dixon (Director of Science, Botanic Gardens and Parks Authority) who first recognised it as a new species. It is a terrestrial orchid growing to 18cm tall, with a linear leaf 2-3cm tall and 4-6mm wide and one or two greenish-brown flowers 20-25mm long and 12-16mm wide (Department of Environment, 2008). Flowering is reported as occurring between November and January (Western Australian Herbarium, 2014).

P. dixonii is represented by 10 population records on *Florabase* (Western Australian Herbarium, 2013), however, the specimen recorded in December of 2012 by Astron is not currently included here. Hoffman and Brown (2011) give its range as between Arrowsmith and Cataby, a distance of approximately 125 km. Department of Environment (2008) estimates a range of 1169.82 km², an area that includes previously known populations that have not been sighted since the 1990's on a mix of road verges, Unallocated Crown Land (UCL) and National Parks.

The species is known to grow in deep sandy soils in dense shrubland dominated by *Banksia*, or in shallow sandy soil over laterite in heathland (Hoffman and Brown, 2011).

The distribution of the species is not known to overlap any EPBC Act listed Threatened Ecological Community (TEC).

The main potential threat to *P. dixonii* is given as dieback (*Phytophthora cinnamomi*), an introduced fungus, although its susceptibility to the pathogen is unknown. Identified threats are fire (at inappropriate times of year), land clearing and mining (Department of Environment, 2008).

***Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) (P1) is**

Malleostemon sp. Cooljarloo (B. Backhouse s.n. 16/11/88) (P1) is an erect shrub to around 40 cm, growing in low-lying areas. It displays pink flowers in November. Five populations are recorded on *Florabase* (Western Australian Herbarium 2013), the most recently lodged in 2004. One unconfirmed population, not recorded in *Florabase*, has been recorded in the Tronox Development Envelope (Fig 3). It grows on low flats and in winter-wet areas.

3.1.3 Vegetation Units and Mapping

Woodman Environmental had previously mapped the vegetation of the Development Envelope. The vegetation description given to the unit in which the single *P. dixonii* plant was recorded in 2012 is:

VT17: Low Isolated Clumps of Trees to Low Open Forest of *Banksia attenuata*, *Banksia menziesii* and *Eucalyptus todtiana* occasionally over Tall Isolated Clumps of Shrubs to Tall Shrubland of *Adenanthos cygnorum* subsp. *cygnorum*, over Mid Isolated Clumps of Shrubs to Mid Shrubland of *Adenanthos cygnorum* subsp. *cygnorum*, *Eremaea pauciflora*, *Jacksonia floribunda*, *Jacksonia nutans*, *Stirlingia latifolia* and *Xanthorrhoea preissii* over Low Isolated Clumps of Shrubs to Low Shrubland of *Bossiaea eriocarpa*, *Dasyopogon obliquifolius*, *Eremaea asterocarpa* subsp. *asterocarpa*, *Eremaea pauciflora*, *Hibbertia crassifolia*, *Hibbertia hypericoides*, *Jacksonia nutans*, *Melaleuca clavifolia*, *Patersonia occidentalis* var. *?occidentalis* and *Petrophile linearis* over Low Isolated Clumps of Sedges to Mid Open Sedgeland of *Mesomelaena pseudostygia* on white or grey sand on undulating plains and low dunes

This unit is very similar to the often adjacent unit **VT18** (below), and they are often difficult to separate in the field, differing chiefly in substrate preference and minor understorey composition:

Low Isolated Clumps of Trees to Low Open Forest of *Banksia attenuata* and *Banksia menziesii* (sometimes with *Eucalyptus todtiana*) occasionally over Tall Isolated Clumps of Shrubs to Tall Open Shrubland of *Xanthorrhoea preissii*, over Mid Isolated Clumps of Shrubs to Mid Shrubland of *Allocasuarina humilis*, *Conospermum stoechadis* subsp. *stoechadis*, *Eremaea pauciflora*, *Hakea costata* and/or *Xanthorrhoea preissii* over Low Isolated Clumps of Shrubs to Low Closed Shrubland of *Bossiaea eriocarpa*, *Calothamnus sanguineus*, *Dasyopogon obliquifolius*, *Eremaea pauciflora*, *Hibbertia hypericoides*, *Jacksonia nutans* and/or *Melaleuca clavifolia* over Low Isolated Clumps of

Sedges to Mid Open Sedgeland of *Mesomelaena pseudostygia* on grey to yellow grey/brown sand on undulating plains and low dunes or yellow grey to grey brown sandy loam to sandy clay loam in open depression or flats within undulating plains.

3.2 Field Survey

3.2.1 Threatened Species

No *Paracaleana dixonii* were recorded during this survey.

The Threatened species *Andersonia gracilis* and *Anigozanthos viridis* subsp. *terraspectans* were recorded during this survey, within the Tronox Development Envelope. Table 1 presents the locations of these records and Figure 4 presents their locations in the context of the Development Envelope.

Table 3 Threatened species recorded

Species	Zone	Easting	Northing	No.
<i>Andersonia gracilis</i>	50J			10
<i>Andersonia gracilis</i>	50J			1
<i>Andersonia gracilis</i>	50J			1
<i>Andersonia gracilis</i>	50J			2
<i>Anigozanthos viridis</i> subsp. <i>terraspectans</i>	50J			1
<i>Anigozanthos viridis</i> subsp. <i>terraspectans</i>	50J			1

3.2.2 Priority Species

No *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) was recorded during this survey.

One species, *Baeckea* sp. Perth Region (R.J. Cranfield 444), a Priority 3 species, was recorded commonly in wetland communities in the study area and was initially thought to be *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88). The taxonomy of this species was clarified by specialists in the genus, Dr Barbara Rye (WA Herbarium) and Mr Malcolm Trudgen.

Baeckea sp. Perth Region (R.J. Cranfield 444) is found in two disjunct populations, one in the Perth region and one at Cooljarloo. Examination of specimens held by the Western Australian Herbarium indicates that there is some reason to believe that the Cooljarloo population may differ sufficiently to be distinguished as a separate taxon at the sub species level. This review is currently being undertaken by Mr. Malcolm Trudgen.

Locations of the *Baeckea* recorded during this survey are given in Appendix B.

3.2.3 Soil Sampling

Photographs of soil profiles are presented in Appendix B

PD1 (= Tronox 4734)

Vegetation: Scattered *Xylomelum angustifolium* over *Eremaea beaufortioides*, *Calothamnus blepharospermus*, *Beaufortia elegans* very open shrubland over *Mesomelaena pseudostygia* scattered sedges.

Soil Characterisation:

Surface: crusted grey sand with Aeolian yellow sand mantle.

0-200mm: grey sand, paler with depth.

200-800mm: Pale yellow sand, hard-packed.

800-1000mm: Pale yellow sand with increasing lateritic gravel.

PD2 (= Tronox 4735)

Vegetation: Scattered *Xylomelum angustifolium* over *Eremaea beaufortioides*, *Calothamnus blepharospermus*, *Beaufortia elegans* very open shrubland over *Mesomelaena pseudostygia* scattered sedges.

Soil Characterisation:

Surface: crusted grey sand with Aeolian yellow sand mantle.

0-200mm: grey sand, paler with depth.

200-600mm: hard-packed bleached yellow sand.

600-900mm: pale yellow sand with lateritic gravel.

PD8 (=Tronox 4741)

Vegetation: Low Myrtaceous/Proteaceous Heath over *Mesomelaena pseudostygia*, *Lyginia barbata*.

Soil Characterisation:

Surface: crusted grey sand with Aeolian grey/white sand mantle.

0-150mm: grey sand, paler with depth.

150-400mm: bleached compact sand.

400mm: bleached sand with lateritic gravel.

PD9 (=Tronox 6444)

Vegetation: *Calothamnus quadrifidus*, *Acacia pulchella*, *Hakea incrassata*, *H. costata*, *Allocasuarina humilis* low heath over *Mesomelaena pseudostygia* scattered sedges. Adjacent to the shallow depression this site is in, *Nuytsia floribunda* scattered low trees over *Banksia attenuata* scattered shrubs occur over the same vegetation type.

Soil characterisation:

Surface: compact grey sand.

0-150mm: grey sand, paler with depth.

150-600mm: bleached yellow sand.

600mm: bleached yellow sand with lateritic gravel.

4 Discussion

4.1 Climatic Conditions

Table 2 shows that prior to the Astron (Dec 2012) record of *P. dixonii* in the Cooljarloo area the rainfall had been higher than the long-term average, especially in November, while temperatures were around average. In 2013, prior to the current survey, rainfall had been below the long-term average while temperatures were above average. Neither season, therefore, was an ‘average’ season.

This may indicate that *P. dixonii* only appears in years with adequate (or greater than average) rainfall and average temperatures, although that conclusion cannot be firmly drawn from the information presented here. Woodman Environmental Consulting (2014) has established a low correlation between *P. dixonii* habitat and rainfall, although this does not appear to draw any correlation between rainfall and likelihood of *P. dixonii* flowering.

4.2 Flora of Conservation Significance

4.2.1 Threatened Flora

The failure of this survey to record either *Paracaleana dixonii* or *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) may be attributed to any one of a number of factors.

Paracaleana dixonii

P. dixonii is recorded as flowering later than the other *Paracaleana* species known from the area, *P. nigrata*. However, it could be that this search was conducted at a time of year not optimal for the orchid flowering, the Astron 2012 record notwithstanding. Even if the survey occurred at a theoretically optimum flowering time, environmental factors such as rainfall may not have provided the required conditions. While the orchid is recorded as flowering later than many others, this does not mean that it will flower later at all times.

The habitat preferences as described for *P. dixonii* are broad, ranging from deep sandy soils in *Banksia* shrubland to Myrtaceous and Proteaceous heath on shallow soils over lateritic gravel. This lack of finer detailed definition presents difficulty in targeting correct habitats for targeted searches. The Woodman vegetation description in which the Astron record was collected is of a very broad unit, and because of the diverse nature of the vegetation on the Northern Sandplains, this presented difficulties targeting suitable habitat during searching. As a result, a broad range of habitats were searched within the project area in the interest of being thorough.

Tronox have surveyed within the Development Envelope over successive years (N. Sibbel, *pers comm.*; Astron, 2012), without records of *P. dixonii* being made, although as Figure 2 shows the survey effort for *P. dixonii* itself has been low over most of the Development Envelope. With the lack of further records, it is impossible to determine whether the Astron (2012) record represents a solo outlier or is part of a larger population.

Andersonia gracilis

Fourteen individuals of *Andersonia gracilis* were recorded opportunistically during this survey, from four populations. Locations and numbers of these will be lodged with the Department of Parks and Wildlife via the *Threatened and Priority Flora Report Form*. All records were within low-lying ephemeral wetlands.

Anigozanthos viridis* subsp. *terraspectans

Two individuals of the Threatened species *Anigozanthos viridis* subsp. *terraspectans* were recorded in a depression adjacent to the site of the Astron (2012) recording. Locations and numbers recorded will be lodged with the Department of Parks and Wildlife via the *Threatened and Priority Flora Report Form*. All records were within low-lying ephemeral wetlands.

4.2.2 Priority Flora***Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) P1**

Unconfirmed records of *Malleostemon* sp. Cooljarloo (B. Backhouse s.n. 16/11/88) P1 had been reported within the DE in previous surveys, however, this species was not recorded during this survey either in the DE or the Reserves searched.

Confusion initially occurred between this species and *Baeckea* sp. Perth Region (R.J. Cranfield 444) as they are very closely related and have very similar habitat preferences, growth habits and flowers. They differ significantly in their fruits (*Malleostemon* is indehiscent unilocular and *Baeckea* is dehiscent trilocular), a reliable character for differentiation of the two. Mature fruit was not available at the time of the survey, and determination was made on other features at a later time from current and subsequent collections.

***Baeckea* sp. Perth Region (R.J. Cranfield 444) P3**

Baeckea sp. Perth Region (R.J. Cranfield 444) P3 was commonly found in many wetland communities surveyed within the study area. It occurred in small (fewer than 10 plants) to large (over 2,000 plants estimated) populations. The taxonomy of this species, with two disjunct populations some 200 km apart, is now under review, with the possibility that the taxon will be split into two separate sub-species. If this occurs, the current southern population will be seen as at higher risk because of its proximity to the Perth metropolitan area, with habitat loss from development in that area leaving small remnants in less secure tenure. The current northern population at Cooljarloo will likely retain the current P3 ranking as it is the larger, and is still in relatively undisturbed vegetation. However, DPaW may review the Priority status based on perceived threat to the species from any proposed development.

Soil Sampling

Soil sampling in known *P. dixonii* habitat revealed a similar soil structure between the different sites. Each is on shallow sand over lateritic gravel at varying depth although less than one metre in each case.

Soil preference for *P. dixonii* is given in literature as either deep sandy soil in dense shrubland amongst scattered *Banksia*, or shallow sand over laterite in heathland (Hoffman and Brown 2011). The sites surveyed fall into the latter category. Examination of notes accompanying Florabase records (WAH, 2014) shows that five from ten records mention laterite while two mention deep sand although it is not clear if this description is backed by soil profile investigations. Records held by Tronox or made by its consultants have yet to be lodged with the Western Australian Herbarium, and until lodgement occurs there remains some uncertainty with respect to this species' habitat preference from publicly available information.

5 References

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Appendix A *Baeckea* sp. Perth Region (R.J. Cranfield 444) Locations

Appendix A as been omitted due to confidentiality requirements

Appendix B Soil Sampling Photographs

Plate 1 PD1 Vegetation



Plate 2 PD1 Soil profile to 1m



Plate 3 PD2 Vegetation



Plate 4 PD2 Soil at surface



Plate 5 PD2 Soil profile to 900mm



Plate 6 PD3 Vegetation



Soil surface and profile photographs for PD3 were of inferior quality due to lighting problems.

Plate 7 PD9 Vegetation



Plate 8 PD9 Soil profile to 400mm





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