BFS 386

Proposed Clearing
Perth Airport
Aerial 2000

Map Ident: plot010629_1	DATE: 29 Jun 2001
Prepared By: Sean Collingwood	Prepared For: SPC
Scale 1:5000	MFP INTERNAL USE ONLY

0 250 m

Cadastre with Lot Numbers Blue - Overlay Images

Bushplan Sites Draft (Boundaries)

Bush Forever 2000 - Site Boundaries

BFS 386
&
BFS 306

Department for Planning and Infrastructure
Environmental Planning
Bush Forever

Government of Western Australia

SITE VISIT REPORT SUMMARY

Date of Site Visit: 20 July 2005
Location: Guildford and Midland Cemeteries
Officers Present: Carissa Lloyd - Bush Forever Office, DPI
Bec Ryan - Terrestrial Ecosystem Branch, DoE
Rob Thomson - Metropolitan Cemeteries Board
Helen Grimes - Metropolitan Cemeteries Board
Time: 11am - 2pm
Comments

Lot 2

The site visit commenced at Lot 2. Lot 2 adjoins Guildford Cemetery. This Lot is owned freehold by the Commonwealth Government and leased to Westralia Airports Corporation. It is part of Perth Airport and is identified in the *Perth Airport Master Plan 2004* as Precinct 1c, which is assigned the following land uses:

- aviation commercial;
- general commercial;
- industrial;
- warehouse/showroom; and
- recreational uses.

A racing track at Lot 2 is used by the WA Trotting Association.

The land between the racing track and Guildford Cemetery (approximately 1.2 hectares) was identified at a meeting on 30 June 2005 between the Minister for Planning and Infrastructure, the Minister for Local Government and Regional Development, the Metropolitan Cemeteries Board and the Bush Forever Office for possible addition to Guildford Cemetery. This portion of Lot 2 is included in Bush Forever Site 386. The vegetation complex is Guildford of which only 6% of the original extent remains in the Perth Metropolitan Area. Only 3% is identified for protection by Bush Forever.

The bushland between the western boundary of Guildford Cemetery and the access road to the racing track was assessed. Approximately 40 minutes was spent traversing the bushland on foot by Carissa Lloyd (DPI) and Bec Ryan (DOE). A search for significant flora (DRF, priority, range restricted flora etc) was not undertaken.

The predominant vegetation structural unit was a *Eucalyptus marginata* subsp. *elegantella* and *Allocasuarina fraseriana* Low Woodland over *Banksia menziesii* and *Banksia attenuata* Tall Shrubland over *Adenanthos cygnorum* and Jacksonia *floribunda* Shrubland over mixed Open Low Heath over Sedgeland of *Desmocladus flexuosa.*

The vegetation was Very Good in small patches but was predominantly of Good condition (Keighery 1994) because despite a diverse structure, there was very high density of weeds and low cover of native annuals at the time of site inspection. However, vegetation condition assessments are subject to revision on a mid/late spring inspection.

Weeds of concern included:
- **Chasmanthe floribunda* (African Cornflag)
- **Chamelaucium uncinatum* (Geraldton Wax)
- **Ehrharta calycinna* (Perennial Veldtgrass)
- **Oxalis pes-caprae* (Soursob)
- **Oxalis purpurea* (Purple Wood Sorrel)

The bushland of Lot 2 would fulfil the *Bush Forever* criteria for regional significance because it is representative of the Guildford complex.

Negotiation with Westralia Airports Corporation and the Commonwealth Government for the purchase of this land could be undertaken by the Western Australian Planning Commission in conjunction with current negotiations on the purchase of Commonwealth land to the east of Perth Airport. Further discussion is required with the Western Australian Planning Commission to request that it negotiate the purchase of Part Lot 2.

Lot 56

This Lot (approximately 0.74 hectares) is owned freehold by the Commissioner of Main Roads. It adjoins a Closed Road, which abuts Guildford Cemetery.

The bushland at this Lot is included in Bush Forever Site 386. The vegetation complex is Guildford of which only 6% of the original extent remains in the Perth Metropolitan Area. Only 3% is identified for protection by Bush Forever.

Approximately 20 minutes was spent traversing the bushland on foot by Carissa Lloyd (DPI) and Bec Ryan (DOE). A search for significant flora (DRF, priority, range restricted flora etc) was not undertaken.

The predominant vegetation structural unit was a *Eucalyptus calophylla* and *Allocasuarina fraseriana* Low Woodland over *Banksia menziesii* and *Banksia grandis* Tall Shrubland. There was also a small area of *Melaleuca preissiana* Woodland surrounding a cleared, sandy wetland.

The vegetation was of Degraded condition (Keighery 1994) because there was little intact understorey, a very high density of weeds and low cover of native annuals at the time of site inspection. However, vegetation condition assessments are subject to revision on a mid/late spring inspection.

Weeds of concern included:

- **Chamaecytisus palmensis* (Tagasaste)
- **Ehrharta calycinna* (Perennial Veldtgrass)
- **Oxalis pes-caprae* (Soursob)
- **Solanum nigrum* (Black Berry Nightshade)

The bushland of Lot 56 would be unlikely to fulfil the *Bush Forever* criteria for regional significance because of its poor condition.

Senior Transport Officers at the Department for Planning and Infrastructure advised me recently that Lot 56 is required to accommodate works associated with the development of a grade separated intersection between Kalamunda Road and Great Eastern Highway Bypass. Four grade separated intersections are proposed along Kalamunda Road between Great Eastern Highway and Roe Highway. It is, however, unlikely that all of Lot 56 would be required to accommodate the works (if in fact they occur). I advised Rob and Helen that further discussion is required with Main Roads to confirm this information.

In addition, Senior Transport Officers at the Department for Planning and Infrastructure also advised that Kalamunda Road is proposed to be widened. However, it will likely be limited to the current Road Reserve (Lot 55) which abuts Lot 56. Further discussion is also required with Main Roads to confirm this information.

Guildford Cemetery

Bec and I met Rob Thomson and Helen Grimes from the Metropolitan Cemeteries Board at Guildford Cemetery. Both Rob and Helen work in the Planning Branch.

The bushland on-site was not assessed. Discussion took place at the entrance to the Cemetery.

Rob and Helen advised us of the urgency for the identification of land at Guildford Cemetery, and elsewhere, for cemetery purposes.

Approximately 15 hectares is required in the short-term for Jewish burials. Such burials require coffins to be buried at approximately 1.4 metres underground. The Jewish religion only allows one coffin to be buried at each grave site (apparently two coffin burials are common and require a depth of approximately 2.5 metres).

Rob and Helen showed us maps of the Metropolitan Cemeteries Board preferred Bush Forever boundary at Guildford Cemetery. The Bush Forever Office has a copy of this map. It shows a reduced area for Bush Forever (over the majority of the Conservation Category Wetland), an area for which a management plan is proposed to be prepared and three areas for purchase.

I advised Rob and Helen that we have a copy of the map and that we understood that the Minister for Planning and Infrastructure had previously advised the Metropolitan Cemeteries Board that the boundaries were not supported (refer to Ministerial Ref: 028429 dated 8 June 2004 on file 805-2-1-32P16V1).

I also advised that the areas identified for purchase by the State Government are already owned by the State Government (Guildford Cemetery is a Class C Crown Reserve vested in the Metropolitan Cemeteries Board).

We discussed the ecological values of Guildford Cemetery, including the under represented vegetation complex, the inferred floristic community type (a State listed endangered threatened ecological community) and the Conservation Category Wetland (now also identified by the EPA as an Environmental Protection Policy Wetland).

Rob queried the bushland on the western boundary of Guildford Cemetery, which is located between the existing graveyard and Lot 2. I indicated that the Bush Forever Agencies are supportive of the purchase of a portion of Lot 2, Lot 56 and the Closed Road and for their removal from Bush Forever. I noted that if the purchase is successful, that consideration will be given to removing the bushland between the existing graveyard and Lot 2 from Bush Forever (bushland in the northern and southern areas), noting that regionally significant bushland on this boundary has already been cleared by the Metropolitan Cemeteries Board.

We talked about the wetland and the buffer zone and identified its extent on an aerial photograph. I advised that development would not be supported in this area.

We talked about the land previously identified as a car park. Bec advised that even though the bushland is fragmented by a track and that it may not appear to be in excellent condition, it is an important buffer to the wetland. I mentioned that the Environmental Protection Authority had put a stop to the realignment of the Kalamunda Road through Guildford Cemetery based on the environmental value of the vegetation, the fauna habitat and the wetlands of the site and that any development that may impact on these values would likely be considered environmentally unacceptable by the Environmental Protection Authority.

We then talked about the bushland outside the buffer zone in the north eastern portion of Guildford Cemetery. I advised that it is an inferred engendered threatened ecological community and that a spring survey would likely need to be undertaken to confirm its presence or otherwise. Rob asked who should undertake that survey. Bec suggested the WA Threatened Species and Communities Unit at CALM. Bec explained the significance of threatened ecological communities and I advised Rob and Helen of the agreement between the State and Commonwealth Government, which specifies that there should be no further clearing of such communities.

I also highlighted the advice provided by the Environmental Protection Authority (in a letter dated 26 October 2001) on the proposed car park at this site. It stated that it would be difficult for the Environmental Protection Authority to find the car park proposal environmentally acceptable given the proposal did not meet its objectives for the protection of threatened ecological communities, conservation category wetlands, nor Bush Forever Sites. This is an interesting example given that the Bush Forever Agencies advised the Environmental Protection Authority in writing that it was willing to remove this portion of land from Bush Forever. Ultimately the Metropolitan Cemeteries Board submitted a revised plan for the car park, which subsequently obtained approval for development by the Environmental Protection Authority.

We talked about the Metropolitan Cemeteries Board's frustrations with respect to the clearing of regionally significant bushland by Westralia Airports Corporation at Perth Airport (particularly when the Metropolitan Cemeteries Board is restricted from using the majority of Guildford Cemetery for its assigned purpose). Bec and I explained that Perth Airport is governed by Commonwealth legislation. I forgot to mention the positive action by the Minister for Planning and Infrastructure and the Minister for the Environment to address this.

Ron and Helen advised that although the Metropolitan Cemeteries Board will welcome the addition of a portion of Lot 2 and Lot 56, it will not be sufficient for its short-term requirements.

In response to this I discussed the formation of the Metropolitan Cemeteries Working Group in September 2000 to identify additional sites that were unconstrained for cemetery purposes. We talked about the Working Report, which lists such areas and also cabinet's endorsement of the Western Australian Planning Commission purchasing this land on behalf of the Metropolitan Cemeteries Board.

I also advised Rob and Helen of the progress of negotiations between the Western Australian Planning Commission with Westralia Airports Corporation and the Commonwealth Government for a portion of the Westaviate Golf Course. They are aware that the site now suitable for purchase is 12.9 hectares and that only 5 hectares will be available for cemetery purposes given regionally significant bushland (Bush Forever Site 386) also exists on this land. They advised that this will not be sufficient to meet the Board's requirements.

We mentioned the agreement for the Crown Reserves leased by the City of Swan to a gun club and the Swan Animal Haven to end in 2009 so that they could be included in Guildford Cemetery. However, Rob told us that the City of Swan recently advised the Metropolitan Cemetery Board that it would extend the leases to the gun club and the Swan Animal Haven for an additional 10 years. This means that these land uses will not be evacuated until 2019. Rob agreed to provide a copy of the correspondence to the Bush Forever Office for referral to Tim Hillyard.

I also mentioned the negotiations for the purchase of Whitby Falls and Bushmead Rifle Range. The Board is not convinced that these negotiations will be successful.

Ron and Helen were persistent that land needs to be identified for use at Guildford Cemetery in the near future.

Midland Cemetery

Before driving to Midland Cemetery we discussed the significance of the floristic community types present (both State and Commonwealth listed threatened ecological communities) and that it is one of only two examples of the Ridge Hill Shelf vegetation type in the Perth Metropolitan Area (Bushmead Rifle Range is the other).

Rob and Helen again reiterated the urgency to identify land at Midland Cemetery for both memorials (associated with cremations) and burials.

When we arrived at Midland Cemetery we first looked at the bushland on the western boundary were memorials for cremations take place. Only a small portion of this land has been utilised for this purpose. A brick path exists with small memorials placed on either side. Clearing of regionally significant bushland to enable the extension of this path has recently occurred. There is no damage to the upper storey of the bushland, only the understorey. Helen advised that the pathway has been located along an existing 'natural track' and that vegetation was removed by hand to avoid unnecessary disturbance. The Metropolitan Cemeteries Board would like to extend the path in this area to the south.

Approximately 20 minutes was spent traversing the bushland on foot by Carissa Lloyd (DPI) and Bec Ryan (DOE).

A search for significant flora (DRF, priority, range restricted flora etc) was not undertaken. However, *Isopogon drummondii* a Priority 3 taxa listed by CALM and known to occur to the east of the graveyard, was recorded.

The predominant vegetation structural unit was a *Eucalyptus marginata* and *E. calophylla* Low Woodland over *Xanthorrhoea acanthostachya, X. preissii* and *Hakea ruscifolia* Shrubland over a Mixed Low Shrubland over a Mixed Sedgeland.

The vegetation was of Very Good to Excellent condition (Keighery 1994) because there was intact structural diversity and a low cover of weeds at the time of site inspection. However, vegetation condition assessments are subject to revision on a mid/late spring inspection.

Weeds observed included:
- **Briza maxima* (Blowfly Grass)
- **Chasmanthe floribunda* (African Comflag)
- **Ehrharta longiflora* (Annual Veldt Grass)
- **Ursinia anthemoides* (Ursinia)

The bushland in this section is known to be of floristic community type (FCT) 3c, which is a critically endangered threatened ecological community (TEC) listed under State and Commonwealth legislation (*Wildlife Conservation Act 1950* and *Environmental Protection and Biodiversity Conservation Act 1999*, respectively).

The bushland in this section of Midland Cemetery would fulfil the *Bush Forever* criteria for regional significance because it is representative of the Guildford complex and the rarity of FCT 3c .

Helen advised us of FESA's recent decision to expand the width of firebreaks and that it had requested the Board revisit firebreaks on-site.

We assessed the bushland along the southern boundary of Midland Cemetery, which is where the Metropolitan Cemeteries Board wish to expand their burial area. Bec asked whether the Board has a policy on buffer requirements to the adjoining residential land. If firebreaks are required to be widened, there may be little value in expanding the burial area south. Helen and Rob agreed a buffer would be required, but they were not certain of the width. They queried the long-term viability of the bushland along the southern boundary given it is so elongated and subject to edge effects. The land most wanted in this area by the Board is the bushland that is fragmented by a track directly to the south of the existing graveyard. A portion of this bushland has been burnt in the past. While the bushland has been impacted by the fire, it appeared to be regenerating well. Vegetation condition (Keighery 1994) could not be determined with certainty at the time of inspection due to the fire. However, it would be expected that the bushland would regenerate following rains (expect both reseeders and resprouters to regenerate well since topsoil not greatly disturbed and some plants survived fire, and no artificial fertilising or watering has taken place) to be of Very Good to Excellent condition as observed directly to this area. The condition of the bushland would need to be reassessed after regrowth in spring.

We next looked at the site that has been cleared by the Board, to the east of the Chinese assigned burial area. The cleared portion will enable the expansion of the

Chinese burial area. It appeared that this area had been recently cleared, with only a few remnant *Banksia attenuata* trees remaining. Helen and Rob stated that this area had been cleared in the past, and the recent activities were only to 'tidy' the area.

We walked along the track that leads to the unused quarry on the eastern side of Midland Cemetery. The bushland on either side of the track is of Very Good condition (Keighery 1994) and of regional significance.

The quarry is a fairly large area of land (approximately 2.4 hectares) that is extremely degraded and infested with weeds. It was of Completely Degraded condition (Keighery 1994). This area would not fulfil the *Bush Forever* criteria for regional significance.

Weeds of concern included:

- **Arundo donax* (Giant Reed)
- **Chamaecytisus palmensis* (Tagasaste)
- **Chasmanthe floribunda* (African Cornflag)
- **Ehrharta calycinna* (Perennial Veldt Grass)
- **Lupinus cosentinii* (Western Australian Blue Lupin)
- **Lupinus luteus* (Yellow Lupin)
- **Melia azedarach* (Cape Lilac)
- **Oxalis pes-caprae* (Soursob)
- **Raphanus raphanistrum* (Wild Radish)
- **Ricinus communis* (Castor Oil Plant)

Helen thought that the old car bodies and other rubbish would need to be removed from the quarry before it could be compacted and backfilled with sand (to approximately 2 metres) before it could be used by the Board. However, it is considered a suitable area for burials.

The *Talbot Road Bushland Management Plan* (Safstrom, R. and Tamin, L. 1999) recommends that the unused quarry be developed for cemetery use in a manner which is compatible with the preservation of the surrounding bushland given the task of rehabilitating the site is enormous.

It should also be noted that in an attempt to finalise the Bush Forever boundary at Midland Cemetery the Bush Forever Interagency Technical Coordinating Group (at a meeting on 7 March 2002) indicated that it was willing to support the development of a portion of the gravel pit with access for pedestrians and vehicles along the existing track (recognising the need to minimally widen the track). This was based on the MCB agreeing to rehabilitate the northern and eastern sides of the gravel pit to strengthen the linkage between well vegetated areas to the north and east and also provide a buffer between the new burial area and residences on Natham Square.

If development by the Board is supported in this area it is recommended that a site assessment be undertaken to identify the boundary for development and the areas requiring rehabilitation to maintain bushland linkages.

We assessed the bushland on the western boundary of Midland Cemetery to the north of the entry that is included in Bush Forever. This area has previously been identified by the Bush Forever Interagency Technical Coordinating Group (at a meeting on 7 March 2002) as having potential for development.

The bushland of this western portion was predominatly a *Eucalyptus calophylla* Low Woodland over *Banksia attenuata* Tall Shrubland *Xanthorrhoea acanthostachya* and *X. preissii* Shrubland over a Mixed Low Shrubland over a Mixed Sedgeland. A search for significant flora (DRF, priority, range restricted flora etc) was not undertaken.

The vegetation was of Very Good to Excellent condition (Keighery 1994) because there was intact structural diversity and a low cover of weeds at the time of site inspection. However, vegetation condition assessments are subject to revision on a mid/late spring inspection.

Weeds observed included:
- **Briza maxima* (Blowfly Grass)
- **Ehrharta longiflora* (Annual Veldt Grass)
- **Ursinia anthemoides* (Ursinia)

The bushland in this section is inferred to be of FCT 3c.

The bushland in this section of Midland Cemetery would fulfil the *Bush Forever* criteria for regional significance because it is representative of the Guildford complex and the rarity of FCT 3c .

At the end of the meeting Rob and Helen asked for examples on the way in which we negotiate Bush Forever on private property. I gave various examples, including rural lands and urban negotiated planning solutions, such as Burns Beach. Bec and I noted that Guildford and Midland Cemeteries are Crown Reserves owned by the State government. It is therefore in a difficult situation. It is restricted in agreeing to support the development of regionally significant bushland that is identified as threatened ecological communities when it hasn't done so during negotiations with private land holders.

I advised that I would record our discussion and brief my Director. Rob indicated that he would speak to Peter Deague and that he would provide us with a copy of the correspondence from the City of Swan regarding the extension of its leases, a copy of ATA Environmental's flora survey for Guildford and Midland Cemetries and figures on the land requirements at each.

Action

Brief Rob Griffiths on the discussions and outcomes of this site meeting (proposed for 9.30am on 21 July 2005).

Request that Rob discuss with Tim Hillyard the urgency of finalising negotiations for the purchase of land for cemetery use and ensure that Tim will be in attendance at the meeting with the Ministers scheduled for 25 August 2005.

Advise Tim Hillyard of the City of Swan's decision to extend the gun club and Swan Animal Haven lease for 10 years and refer to him a copy of the City of Swan's correspondence.

Provide a copy of this site visit record to Bec Ryan, Tim Hillyard and Sue Woolhouse.

Signed _____

EXTRACT of additional vegetation and flora information from: "Synopsis of Bush Forever Comment on Draft Major Development Plan for part Precinct 2C – Warehousing and Distribution Park in Bush Forever Site 386 (Perth Airport Bushland)
Departments of Environment and Planning and Infrastructure 15th August 2003"

Natural values of Precinct 2C Bushland
The area of Precinct 2C proposed for development contains areas of bushland identified in Bush Forever (Government of Western Australia 2000a&b) as depicted in Map 1 (hereafter referred to as the Precinct 2C bushland).

All known information on the natural values of the Precinct 2C bushland has been collated (Alan Tingay and Associates 1994, Keighery 1995, Robson and Charter 1989, Kuchling, and Burbidge 1996, DEP 1997-1998, DEP 1998, How and Dell 1994, How 1995, Harvey *et al.* 1997, Trudgen 1995, Ecologia 1998&1999, Biota 2002, Bennett 2002, ENV Australia 2003, WRC 2003 and DoE 2003 field observations). This information has been used to compare the Precinct 2C bushland with bushland in the broader area of Bush Forever Site Perth Airport bushland, Bush Forever Sites within the same landform unit and other areas of this landform unit on the Swan Coastal Plain. This comparison has confirmed the regional/national significance of the Precinct 2C bushland. These particular values are briefly listed below.

- Representative of the upland and wetland units of the Southern River Complex containing significant elements the interface between the Pinjarra Plain/Foothills and the Bassendean Dunes, forming part of a west-east transect of this interface;
- Contains significant areas of upland/wetland interface which are important fauna and flora habitat;
- Contains significant areas of Banksia woodland (approx. 15% of the bushland) that:
  - are habitat for the state and federally listed rare flora species *Macarthuria keigheryi;*
  - is most likely floristic community type 20a and contains one of five known populations of *Consopermum* aff. *undulatum* (BJK 2800) which is apparently as rare as *Consopermum undulatum* which is listed at the state and federal levels[1];
  - are habitat for significant vertebrate fauna including the state listed Priority fauna species Quenda and the Crowned Snake (*Notechis coronatus*);
  - are habitat for significant invertebrate fauna including species of *Laestrygones* in the family Toxopidae never previously recorded from the Swan Coastal Plain; and
  - contains areas of *Banksia* woodland intermediate between the *Banksia* woodland of the Pinjarra Plain/Foothills and the Bassendean Dunes.
- Contains areas of wetland, which are recognised nationally, predominantly mapped (approx. 85% of the bushland) by the state as conservation category and recognised as requiring retention.
- Contains vertebrate and invertebrate species that are considered regionally significant including several unnamed invertebrate species as well as the rare huntsman spider (*Zachria flavicoma*).

[1] Two floristic community types are most likely to occur in the area, types 20a and 23a as well as transitions between these two types. Floristic community type 20a is a threatened ecological community. The area of 20a coincides with the location of *Consopermum* aff. *undulatum* (BJK 2800). 15/09/03

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1) A/CEO to note
2) DEM

22 January 2004

noted -

Urban Bushland Council WA Inc

Mr Derek Carew-Hopkins
A/Chief Executive Officer
Department of Environmental Protection
PO Box K822
PERTH WA 6842

DEPARTMENT OF ENVIRONMENTAL PROTECTION
RECORDS SECTION
27 JAN 2004
FILE NO
NAME
FILE NO CEO 84/04
NAME

RESOURCE MANAGEMENT
30 JAN 2004
DATE RECEIVED

Dear Mr Carew-Hopkins

Information on Perth Airport

The Urban Bushland Council has received new information regarding plankton in wetlands at Perth Airport.

The report was prepared by Joan Powling, Consulting Freshwater Biologist using samples collected by Kevin McLean, representative of the Friends of Perth Airport.

Copy of the report is attached for your information.

Regards,

Renata Zelinova
Project Officer

File 185

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SCANNED

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Examination of Net Plankton at the Perth Airport Wetlands

Collected by Kevin McLean
22nd August, 2nd November and 11th November 2003

Net plankton samples were collected from two to three sites on the wetlands at Perth International Airport on three occasions in the latter half of 2003. The last sample was collected immediately prior to the wetland drying up in November.

The plankton net was 23cm in diameter with a mesh size of 35 microns. It was swept through the water several times, from the shore, and the collected contents were split in order to preserve one half in Lugols Iodine. Both samples were sent to Melbourne and examined using a Wild Inverted Microscope.

Results

The first sample, in August, was dominated by zooplankton (microscopic planktonic animals) and organic detrital material, the latter probably as a result of heavy rain prior to sampling. The water was a dark peaty colour and the only algae observed were some diatoms (algal cells made of silica) and two flagellate algae (capable of independent movement). The most abundant types of zooplankton were two types of calanoid copepods and two cladocerans (water fleas), the latter including a species of *Daphnia*. Fragments of freshwater sponge colonies were also present.

The second and third samples, collected ten weeks later, contained a more diverse collection of zooplankton and included several types of rotifers, protozoans, *Hydra*, nematodes and chironomid (non-biting midge, bloodworm) larvae in addition to the sponges above. In addition to these mostly microscopic animals there were many ostracods (shell shrimps), corixids and notonectids (aquatic bugs) and beetle larvae.

The algae had also become more diverse but this may have been due to a more concentrated sampling effort. Diatoms were again the dominant algae but there was also a green filamentous alga with masses of epiphytic diatoms attached along its length. Flagellates were again present and of particular interest were several green cells known as desmids, one of which was a rare species of the genus *Micrasterias*.

Discussion

This account of the biota of this wetland is only a snapshot of its condition in one season in one particular year. Comparisons can not be made here of its condition relative to any other year or set of conditions. However, the presence of so many zooplankton and the diversity of aquatic animals indicates the water was in a good state of health with respect to dissolved oxygen status. Algae are very good indicators of water quality and those present in these few samples show that it is not in any way eutrophic, that is showing the effects of a high load of nutrients. Desmids in particular indicate a water of low pH, low salinity and low nutrient concentrations.

The discovery of the *Micrasterias* was of particular interest as it is a species not yet described from the eastern states. It was however observed in samples collected in September 1995 from the Brixton Street wetlands also on the Swan Coastal Plain. Notably Perth Airport wetlands and the Brixton Street wetlands belong to the same consanguineous suite.

One of the epiphytic diatoms found on the green filamentous algae, a species of *Eunotia*, was also a rare type, not previously seen in samples from other parts of Australia but described in overseas literature as a species of "upland waters".

Recommendations

Samples such as these which might seem trivial and not part of an organised routine monitoring programme, are contributing to the store of knowledge necessary for the process of making decisions which will affect the environment of wetlands such as these. If algae have not been collected in the past, then this is new knowledge and over the years it can be built upon and serve as a monitoring tool.

It is recommended that if monitoring is to take place, algae should be included along with the invertebrates and zooplankton. Diatoms in particular, are very useful indicator organisms if identified properly. Monthly samples, collected over the inundation period, would suffice. Samples collected immediately after the wetlands begin to fill would be of particular interest as these would show which species were able to survive periods of desiccation in the sediments. This applies to the aquatic animals also, many of which have desiccation resistant stages.

Joan Powling
14th December 2003

List of Organisms from Perth Airport Wetlands, August to November 2003

ALGAE:
Phylum Cyanophyta (Cyanobacteria or Blue-green algae)
cf. *Aphanothece* sp.

Phylum Bacillariophyta (Diatoms)
Acnanthes sp.
Eunotia species (2)
Eunotia cf. *naegelii* (epiphytic on *Oedogonium*)
Gomphonema sp.
Pinnularia sp.
Navicula sp.
Nitzschia sp.
Synedra ulna
unidentified diatoms

Phylum Heterokontophyta
Class Cryptophyceae (bi-flagellates)
Mallomonas sp.
Synura sp.

Phylum Dinophyta (dinoflagellates)
unidentified dinoflagellate (small)

Phylum Euglenophyta (uniflagellates)
Euglena sp.
Phacus sp.
Trachelomonas hispida
Tracheomonas volvocina
Tracheomonas species
unidentified green flagellate

Phylum Chlorophyta (green algae)
Scenedesmus species (2)
Ankistrodesmus sp.
Eudorina sp. (colony)
Oedogonium sp. (filamentous)
Closterium species (4)
Cosmarium sp.
Euastrum species (2)
Micrasterias cf. *tropica*

Classification of Plants: (same as for terrestrial plants)
Phylum: suffix "phyta" (also referred to as a Division)
Class: suffix "phyceae"
Order: suffix "ales"
Family: suffix "aceae"
Genus: in italics
species: in italics

ZOOPLANKTON:
Phylum Protozoa (single-celled animals)
Class Rhizopoda
Arcella sp.
Difflugia sp.
Euglypha sp.

Class Rotifera (rotifers)
Polyarthra sp.
Conochilus sp.
Asplanchna sp.
Lecane sp.

Class Crustacea

Cladocera (water fleas)
Daphnia carinata
unidentified cladoceran

Ostracoda (seed shrimps)
unidentified ostracods

Copepoda
calanoids (2 types, 1 large, 1 small)

OTHER ANIMALS
Phylum Porifera
freshwater sponge spicules

Phylum Cnidaria
Hydra sp.

Class Nematoda
nematodes (roundworms)

Class Insecta (insects)

Hemiptera (water bugs)
corixids (water-boatmen)
notonectids (backswimmers)

Diptera (two-winged flies)
chironomid larvae (bloodworms)

tranen
revegetation systems

Precinct 5 Rehabilitation
Westralia Airports Corporation

Vegetation Monitoring Report

July 2005

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1 INTRODUCTION

The Perth Airport is located approximately 10 km east of Perth and covers an area of 2,105 ha over 3 municipalities: City of Belmont, City of Swan, and the Shire of Kalamunda. The airport land is bounded by Tonkin Highway, Great Eastern Highway, Kalamunda Road, and Abernethy Road.

Figure 2 in Appendix 1 shows the airport is divided into 7 precincts, each with its own independent management objectives. The southern part of Precinct 2C was cleared for development in 2003 and the opportunity arose to utilise high quality topsoil and bush for the rehabilitation of unauthorised access tracks and the construction of a wetland in Precinct 5 (conservation zone).

Tranen Revegetation Systems were commissioned in May 2005 to continue the vegetation monitoring program in Precinct 5 for initial works that were undertaken in November 2003. The monitoring of these works are to continue for 5 years as committed to in the Precinct 5 Rehabilitation Plan (ENV Australia, 2003) approved by the Department of Transport and Regional Services, and the Department of Environment and Heritage.

The aim of the monitoring is to catalogue progress within the rehabilitation areas and to determine whether remedial actions are required. The program involves monitoring 11 permanently established transects in Precinct 5 by:

- Counting the total number of native seedlings;
- Identifying all species (both native and introduced) contained within;
- Determining the percentage cover of native and introduced species;
- Observing factors that may be impeding or promoting plant establishment; and
- Maintaining a photographic log for visual comparison.

The monitoring is to be conducted in spring and autumn each year for the five year period. This report details the findings from assessments conducted in December 2004 by ENV Australia, and June 2005 by Tranen Revegetation Systems.

2 BACKGROUND

The southern section of Precinct 2C has been developed as a business park. The development is outlined in the approved Master Plan and in the Major Development Plan (MDP), (The Planning Group, 2003). The MDP provides a detailed description of the environmental values of Precinct 2C South, the impacts associated with the development, and how these impacts are to be managed or mitigated.

As 8 of the 44 hectares within Precinct 2C South were classed as in 'good condition' (Mattiske, 2003) it was decided that this resource should not be wasted and that it would be used to rehabilitate sections of the conservation zone Precinct 5.

The general approach to the rehabilitation was to collect carefully selected soil and vegetation material from the cleared section of Precinct 2C South and use it to rehabilitate unauthorised access tracks and a constructed wetland in Precinct 5. The best quality vegetation and topsoil from Precinct 2C South was selected for use in the same vegetation community type in Precinct 5.

The activities undertaken during the clearing of Precinct 2C South and the rehabilitation of Precinct 5 involved:

- Bandicoot capture and relocation;
- Seed collection;
- Preparation and levelling of tracks;
- Relocation of soil surrounding a dead *Macarthuria keigheryi* plant (declared rare);
- Clearing and stockpiling of trees for use as brush and barricades;
- Clearing and stockpiling of other vegetative matter. A portion was mulched for later use and the remainder used for brushing;
- Windrowing of top 30 mm of topsoil (soil seed bank) from Precinct 2C South and relocation;
- Spreading of stockpiled mulch on remaining topsoil. Topsoil and mulch then windrowed to a depth of 150 mm to ensure thorough mixing. Mixture relocated to same vegetation system in Precinct 5;
- Spreading the soil seed bank over the topsoiled tracks and then deep ripping with a delta winged tine;
- Brushing and placement of large logs at the entry points to prevent further unauthorised access;
- Nomination to two tracks to self regenerate. The track in the Melaleuca vegetation community was also ripped and barricaded with logs, however the track in the Pericalymma community was not; and
- Conversion of a degraded open section to the north of the rehabilitation tracks into a constructed wetland.

Follow up weed control was undertaken in May 2005. This involved the spraying of grass specific herbicide in the constructed wetland to prepare for additional rehabilitation works by the Conservation Volunteers of Australia (CVA). Tubestock were planted and tree-guarded around the wetland area in June 2005.

3 MONITORING METHODOLOGY

11 monitoring transects have been established in five different vegetation systems. There is one control transect for each location and one rehabilitation transect for each area except for the constructed wetland which has two transects and one control. The vegetation systems are:

1. Corymbia calophylla / Banksia attenuata (CcBa);
2. Pericalymma ellipticum (Pe);
3. Melaleuca preissiana / Pericalymma ellipticum (MpPe);
4. Banksia attenuata / Banksia menziesii (BaBm); and
5. Wetland.

Appendix 1 contains drawings showing the general position of the rehabilitation zones and the monitoring transects.

The monitoring began in December 2004 and was conducted by ENV Australia. Tranen Revegetation Systems were then commissioned to continue the monitoring program in June 2005, making a few modifications to the methodology.

3.1 Transect Layout

The transects were established in December 2003 shortly after the rehabilitation works were completed. The rehabilitation transects were established along the middle of the tracks, and the control plots nearby within a minimally disturbed section of the same type of existing bushland. Each transect is marked by six stakes spaced at 10m intervals (see Figure 1 below).

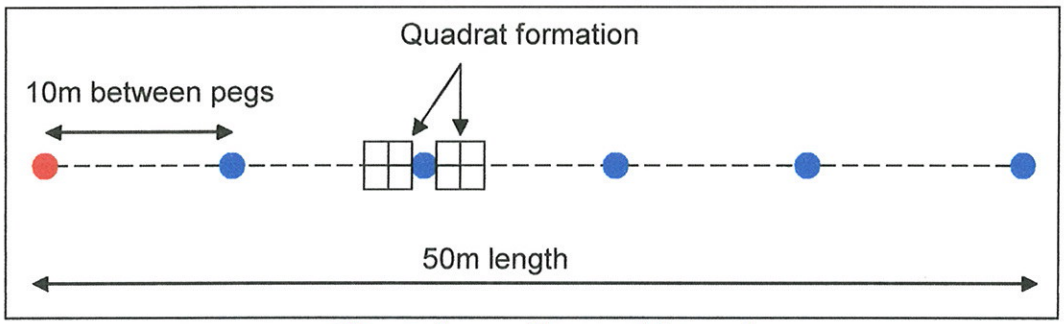


Figure 1 Transect Layout

The first marker is the location from which the photo is taken, and the remaining five stakes are where the two 2 m x 2 m quadrats are placed. The co-ordinates for the start and end point of each transect were determined using GPS and the details can be found in Appendix 2. For some tracks the transects may not be in a straight line as they have been placed on changes of direction in the track. The transects do however still span for 50m.

In the constructed wetland the transects were located so that they began at the waters edge and proceeded up slope. The wetland control transect was located in Runway Swamp located some distance away near the end of Runway 21R.

3.2 Methodology

The monitoring program was established by ENV Australia for the first assessment in December 2004 and involves the recording of the following information for each quadrat:

- Transect and quadrat number;
- Species present;
- Number of alive and dead plants;
- Percentage cover of alive and dead plants;
- General observations of the site e.g. thick ground litter, rubbish, etc; and
- Photographic record.

The percentage cover was determined for each structural layer by assessing the amount of shade cast by each of the five main layers: grasses, herbs, sedges, shrubs, and trees. Native and introduced species were recorded separately.

For the tracks that were left to self-regenerate the only recordings made were a subjective assessment regarding the state of each site and a photographic record. No quantitative data was collected.

4 RESULTS

The information summarised in this section (further details and comparisons can be found in Appendix 3) is from both the December 2004 monitoring assessment conducted by ENV Australia, and the June 2005 monitoring by Tranen Revegetation Systems. No raw data was made available to Tranen from the December 2004 assessment, therefore the results presented for the 2004 assessment have been derived from the following source:

- Vegetation Rehabilitation Monitoring Report Precinct 5 (ENV Australia, 2004)

4.1 Flora

A total of 171 taxa have been recorded to date during the two assessments. Table 1 below contains a summary to date. A complete list of species can be found in Appendix 5.

Table 1 Total Number of Species Identified During Assessments

Species	Dec 04	Jun 05	Total To Date
Native	107	96	135
Introduced	26	24	36
Total	**133**	**120**	**171**

4.1.1 Declared Rare and Priority Species

No Endangered or Vulnerable species pursuant to s178 of the Environmental Protection and Biodiversity Act, 1999 were located during either monitoring assessment.

No plant taxa gazetted for the area as Declared Rare of Priority Flora pursuant to subsection 1 of Section 23F of the Wildlife Conservation Act, 1950 (Western Australian Herbarium, 2005) were located during either monitoring assessment.

4.1.2 Introduced Species

During the course of the two assessments 36 introduced species have been recorded in total. One of the species identified (* Moraea flaccida – One-Leaf Cape Tulip) is listed as a Declared Plant pursuant to Part IV, Section 37 of the Agriculture and Related Resources Protection Act, 1976 (Department of Agriculture, 2005). For this particular location it has been given a P1 classification which under the Act prohibits movement of plants or their seeds within the State. This also prohibits the movement of contaminated machinery and produce including livestock and fodder.

The declared plant was found in small populations in the control transects of two vegetation communities: *Corymbia calophylla* / *Banksia attenuata* and, *Banksia attenuata* / *Banksia menziesii*. No specimens were observed in the rehabilitation transects for these communities.

4.2 Species Richness

Table 2 below is a summary of the number of species found within each of the monitoring transects for the two assessments. The details of the species found in each transect can be found in Appendix 2.

Table 2 Number of Species Identified By Transect

Transect	Dec 04		Jun 05		Combined Total	
	Native	Introduced	Native	Introduced	Native	Introduced
CcBa (C)	34	11	38	7	40	12
CcBa (R)	30	6	25	9	34	8
Pe (C)	17	3	16	1	19	3
Pe (R)	20	13	18	4	21	13
MpPe (C)	11	2	15	1	16	2
MpPe (R)	17	8	15	10	20	10
BaBm (C)	35	4	36	5	38	6
BaBm (R)	21	6	20	7	24	7
Wetland (C)	11	9	16	5	17	10
Wetland A (R)	29	8	24	9	33	12
Wetland B (R)	14	10	7	10	15	14
Total	**107**	**26**	**96**	**24**	**132**	**34**

Although there has been a reduction between assessments in the number of species recorded in some transects and overall, there has been a significant proportion of new species identified. 28 new native and 10 new introduced species were recorded even though 11 less native and 2 less weed species were observed.

4.3 Native Plant Density

A count of the number of individual native plants was made during the June 2005 assessment and can be found in Table 3. No data is available from the December 2004 assessment for comparison.

Table 3 Native Stem Counts and Density

Transect Location	Stem Count	Density (Stems / m^2)
CcBa (C)	1,065	26.6
CcBa (R)	275	6.9
Pe (C)	1,332	33.3
Pe (R)	1,255	31.4
MpPe (C)	677	16.9
MpPe (R)	374	9.4
BaBm (C)	898	22.5
BaBm (R)	175	4.4
Wetland (C)	1,054	26.4
Wetland A (R)	591	14.8
Wetland B (R)	53	1.3

4.4 Structural Layers and Surface Cover

Tables 4 to 8 below show the average composition of the five main structural layers (grasses, herbs, sedges, shrubs, and trees) by percentage ground cover for each of the five vegetation systems. In each table the control plot (marked with a C) is shown in red, followed by the December 2004 assessment and the June 2005 assessment for comparison.

The figures represent the amount of shade cast by the structural layers for each quadrat.

Table 4 CcBa Structural Layer Composition

Layer Type	Native / Weed	CcBa (C)	CcBa (R)	CcBa (R)
Date		Jun-05	Dec-04	Jun-05
% Grass	Native	0%	1%	0%
% Grass	Weed	1%	5%	1%
% Herb	Native	33%	1%	1%
% Herb	Weed	4%	2%	2%
% Sedge	Native	8%	0%	0%
% Sedge	Weed	0%	0%	0%
% Shrub	Native	20%	7%	0%
% Shrub	Weed	0%	0%	0%
% Tree	Native	24%	3%	0%
% Tree	Weed	0%	0%	0%
TOTAL	**Native**	**86%**	**12%**	**1%**
TOTAL	**Weed**	**6%**	**7%**	**2%**

Table 5 Pe Structural Layer Composition

Layer Type	Native / Weed	Pe (C)	Pe (R)	Pe (R)
Date		Jun-05	Dec-04	Jun-05
% Grass	Native	0%	2%	0%
% Grass	Weed	0%	3%	0%
% Herb	Native	3%	1%	0%
% Herb	Weed	0%	3%	1%
% Sedge	Native	26%	1%	1%
% Sedge	Weed	0%	0%	0%
% Shrub	Native	47%	7%	2%
% Shrub	Weed	0%	0%	0%
% Tree	Native	0%	0%	0%
% Tree	Weed	0%	0%	0%
TOTAL	**Native**	**76%**	**10%**	**3%**
TOTAL	**Weed**	**0%**	**5%**	**1%**

Table 6 MpPe Structural Layer Composition

Layer Type	Native / Weed	MpPe (C)	MpPe (R)	MpPe (R)
Date		Jun-05	Dec-04	Jun-05
% Grass	Native	0%	1%	0%
% Grass	Weed	0%	3%	4%
% Herb	Native	2%	1%	1%
% Herb	Weed	0%	1%	3%
% Sedge	Native	24%	0%	0%
% Sedge	Weed	0%	0%	0%
% Shrub	Native	27%	2%	0%
% Shrub	Weed	0%	0%	0%
% Tree	Native	7%	0%	0%
% Tree	Weed	0%	0%	0%
TOTAL	**Native**	**61%**	**4%**	**1%**
TOTAL	**Weed**	**0%**	**4%**	**7%**

Table 7 BaBm Structural Layer Composition

Layer Type	Native / Weed	BaBm (C)	BaBm (R)	BaBm (R)
Date		Jun-05	Dec-04	Jun-05
% Grass	Native	4%	0%	0%
% Grass	Weed	0%	2%	3%
% Herb	Native	17%	1%	0%
% Herb	Weed	0%	1%	5%
% Sedge	Native	6%	0%	0%
% Sedge	Weed	0%	0%	0%
% Shrub	Native	28%	2%	0%
% Shrub	Weed	0%	0%	0%
% Tree	Native	7%	0%	0%
% Tree	Weed	0%	0%	0%
TOTAL	**Native**	**62%**	**3%**	**1%**
TOTAL	**Weed**	**0%**	**3%**	**8%**

Table 8 BaBm Structural Layer Composition

Layer Type	Native / Weed	Wet (C)	Wet A (R)	Wet A (R)	Wet B (R)	Wet B (R)
Date		Jun-05	Dec-04	Jun-05	Dec-04	Jun-05
% Grass	Native	0%	0%	0%	0%	0%
% Grass	Weed	1%	2%	1%	5%	0%
% Herb	Native	2%	1%	0%	2%	0%
% Herb	Weed	2%	1%	2%	2%	1%
% Sedge	Native	21%	1%	0%	1%	0%
% Sedge	Weed	0%	2%	0%	8%	0%
% Shrub	Native	15%	7%	4%	2%	0%
% Shrub	Weed	0%	0%	0%	0%	0%
% Tree	Native	4%	0%	0%	0%	0%
% Tree	Weed	0%	0%	0%	0%	0%
TOTAL	**Native**	**42%**	**9%**	**5%**	**5%**	**0%**
TOTAL	**Weed**	**3%**	**4%**	**3%**	**15%**	**1%**

4.5 Self-Regenerating Tracks

The first track, located within a Banksia littoralis / Melaleuca rhaphiophylla vegetation community has shown little natural recruitment. Native seedlings were observed but only in small clusters within low lying depressions. The majority of the track is infested with annual weeds. There are also significant infestations amongst the adjoining undisturbed bushland.

The track through the Pericalymma heath has good native recruitment with reasonable species richness and plant numbers, and the growth rates are greater than in some of the transects. Weed levels are minimal and do not appear to be having any negative effects.

5 DISCUSSION

5.1 General

The species richness across the site is increasing, with 28 new native species being recorded. It is possible that the actual number of species may be higher than recorded due to the difficulty in the identification of young germinants, and different growth cycles amongst species. Several species could only be identified to genus or family level.

The use of topsoil at this stage has proven to be successful with respects to species richness. A direct seeding or seedling planting approach would not have provided the number of species that have been recorded to date, due to some of the species being difficult to harvest for seed, or to propagate.

Most seedlings are at early stages of development averaging 100 mm in height. This is normal for the start of autumn, with most growth occurring during spring. A significant proportion (up to 60%) of the foliage cover recorded in December 2004 has been lost across all sites, but this was expected due to the extended dry summer experienced in 2004/05.

Weed levels across the site are moderate. If the annual weeds are left uncontrolled at this stage then they will begin to dominate and the rehabilitation effort will suffer. At this stage the annual grasses, flat-weeds, and the small population of declared weeds are the potential concerns.

The brush and log placement has worked well for all of the rehabilitation tracks within Precinct 5, as no traffic impacts have been noted so far. The exception is for the constructed wetland, which has been heavily impacted by unauthorised vehicle access. It has been difficult to control the traffic in this area as it is large and new accesses are constantly being created.

As the plants that were recorded have survived a dry summer, most are expected to survive through to the next assessment. This will be the most critical assessment, as it will indicate whether remedial works need to be scheduled for 2006.

Some remedial works were conducted in the constructed wetland in May and June 2005 (weed spraying and planting of tubestock). Until unauthorised vehicle access is controlled (some damage has already been observed to new plantings), there is no point wasting resources in the area. Once a solution to the problem is found then remedial action can be initiated.

5.2 *Corymbia calophylla / Banksia attenuata*

This rehabilitation area is progressing very well with an average of 7 plants/m^2 and 25 native species represented. There are good levels of tree germination, however only a small number of sedges were found in the monitoring plots.

Native ground cover is only 1% at this stage, indicating that most of the seedlings observed may have only recently germinated. Fortunately weed levels are also low and currently provide little competition for the existing natives.

Figure 2 CcBa Control and Rehabilitation Transect Photos

* *Moraea flaccida* (One-Leaf Cape Tulip) was recorded in the control transect in small numbers.

5.3 *Pericalymma ellipticum*

Figure 3 Pe Control and Rehabilitation Transect Photos

The Pericalymma rehabilitation track has shown the greatest number of germinants with an average of 31.4 plants / m^2. This is very close to the 33.3 plants/m^2 recorded in the control transect. There were also two more native species in the rehabilitation transect than in the control.

Native ground cover is 3% which, given the high number of seedlings, indicates that they are not very developed, which is to be expected at this stage. Weed cover is less so the effects of competition at this stage are minimal.

5.4 *Melaleuca preissiana / Pericalymma ellipticum*

This rehabilitation track has high levels of brush material (average 42% ground cover) which is keeping the traffic off, but may be inhibiting plant growth as well.

Notwithstanding this the number of seedlings is good with an average of 9.4 plants/m^2. The majority of these seedlings are found in the bare sections devoid of brush and in these patches the density is approaching that of the control.

Figure 4 MpPe Control and Rehabilitation Transect Photos

Native cover is low at 1%, especially when compared with the 7% cover of the mostly annual introduced species.

5.5 *Banksia attenuata / Banksia menziesii*

Figure 5 BaBm Control and Rehabilitation Transect Photos

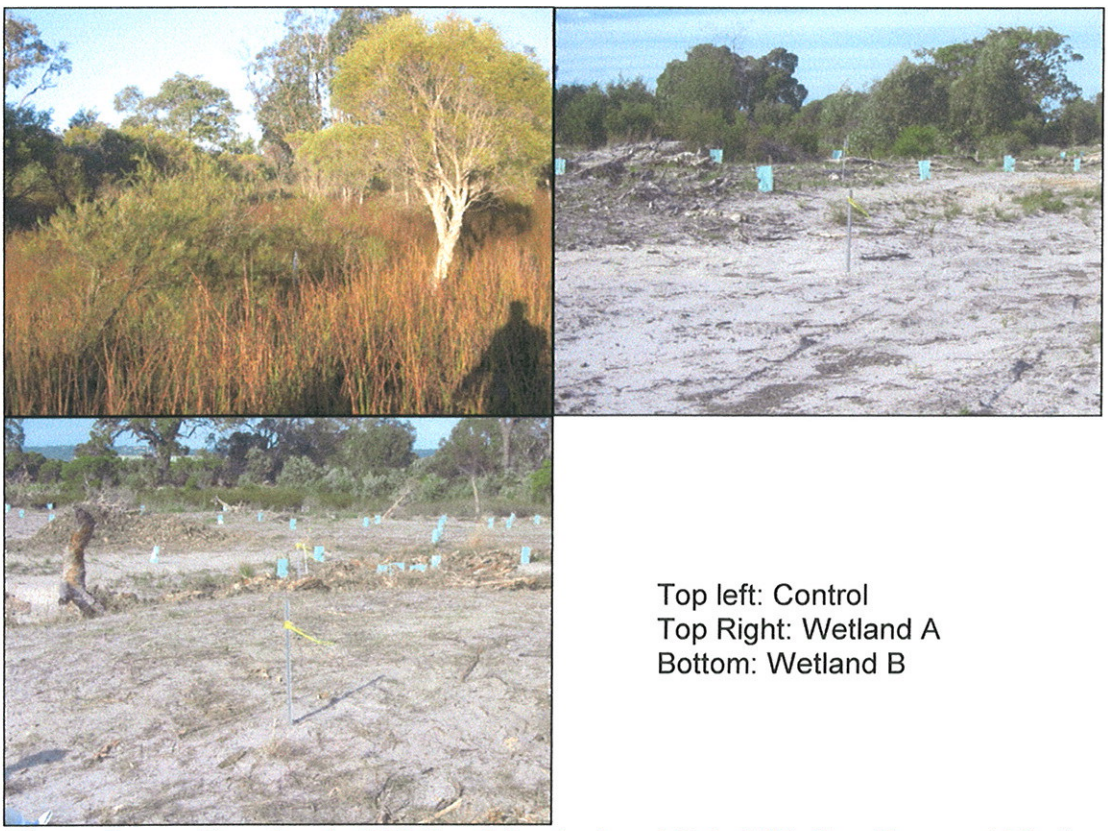
Of the tracks the BaBm rehabilitation area has the lowest density of native germinants, with 4.4 seedlings/m^2. This may seem low in comparison, but if this level can be maintained then the track will progress towards recovery.

The track recorded 20 species within the transect, which is more than half that observed in the control. This is a reasonable number for this stage of development.

The control plot is somewhat degraded with an open understorey and tree canopy. Many of the surrounding Banksias are dead, so it is possible that dieback has infected this area.

Weed coverage levels are relatively high in the rehabilitation transect, compared with the cover levels of natives. The declared weed, One-leaf Cape Tulip (**Moraea flaccida*) was observed in the control transect.

5.6 Constructed Wetland



Top left: Control
Top Right: Wetland A
Bottom: Wetland B

Figure 6 Constructed Wetland Control and Rehabilitation Transect Photos

The constructed wetland has been damaged by motorbike and 4WD vehicle access, especially in the lower sections. Wetland A shows promise in the upland section as this has not been damaged and most of the 591 natives were recorded in 6 quadrats. The density in the upland section is approaching that of the control. Wetland B in comparison has only 53 native plants, with most concentrated in two quadrats that were protected from vehicular traffic.

Native cover averages 5% in Wetland A, which is the highest of all the recordings during this assessment, and is spread over 6 of the 10 quadrats. Weed cover is also low. Ground cover averages 0% in Wetland B for both natives and weeds demonstrating the impact the unauthorised traffic has had.

6 CONCLUSIONS

For this stage of development the rehabilitation of most sites are progressing towards a successful outcome. Most sites show a healthy number of native seedlings establishing, especially considering the dry conditions experienced up to the time of assessment.

It is expected that a significant proportion of the established plants will still be present (or more if there is further germination) at the next spring assessment. The only locations where success is unlikely without assistance is in the constructed wetland and in the self-regenerating Banksia littoralis / Melaleuca rhaphiophylla track.

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Appendix 1 Transect Location Maps

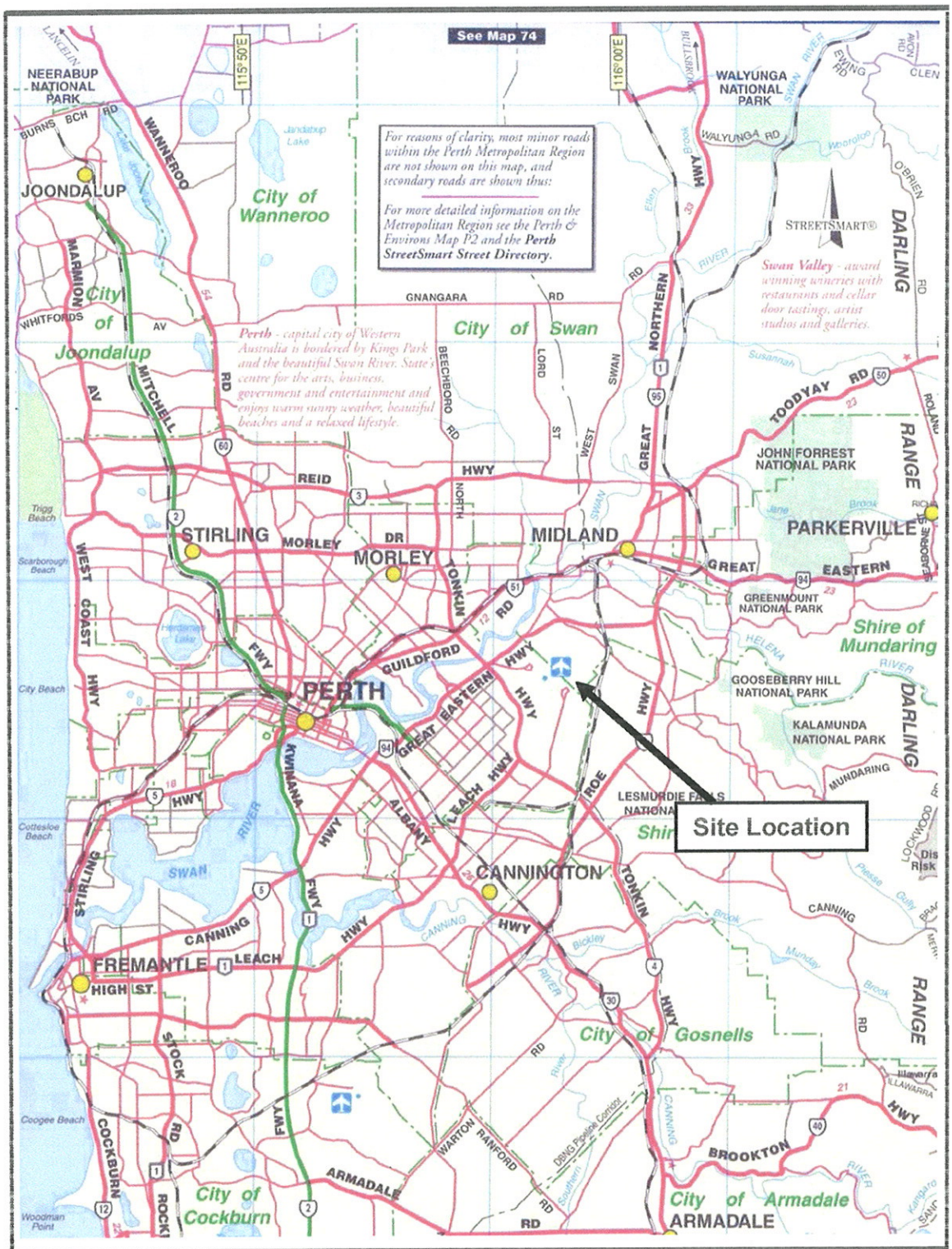


FIGURE 1 - Site Location		
CLIENT: Westralia Airports Corporation		
DRAWN BY: LS	CHECKED BY: NW	JOB NUMBER: 04.128
DATE: 19/1/2005	REPORT ISSUE: Final	SCALE: NTS

env Australia

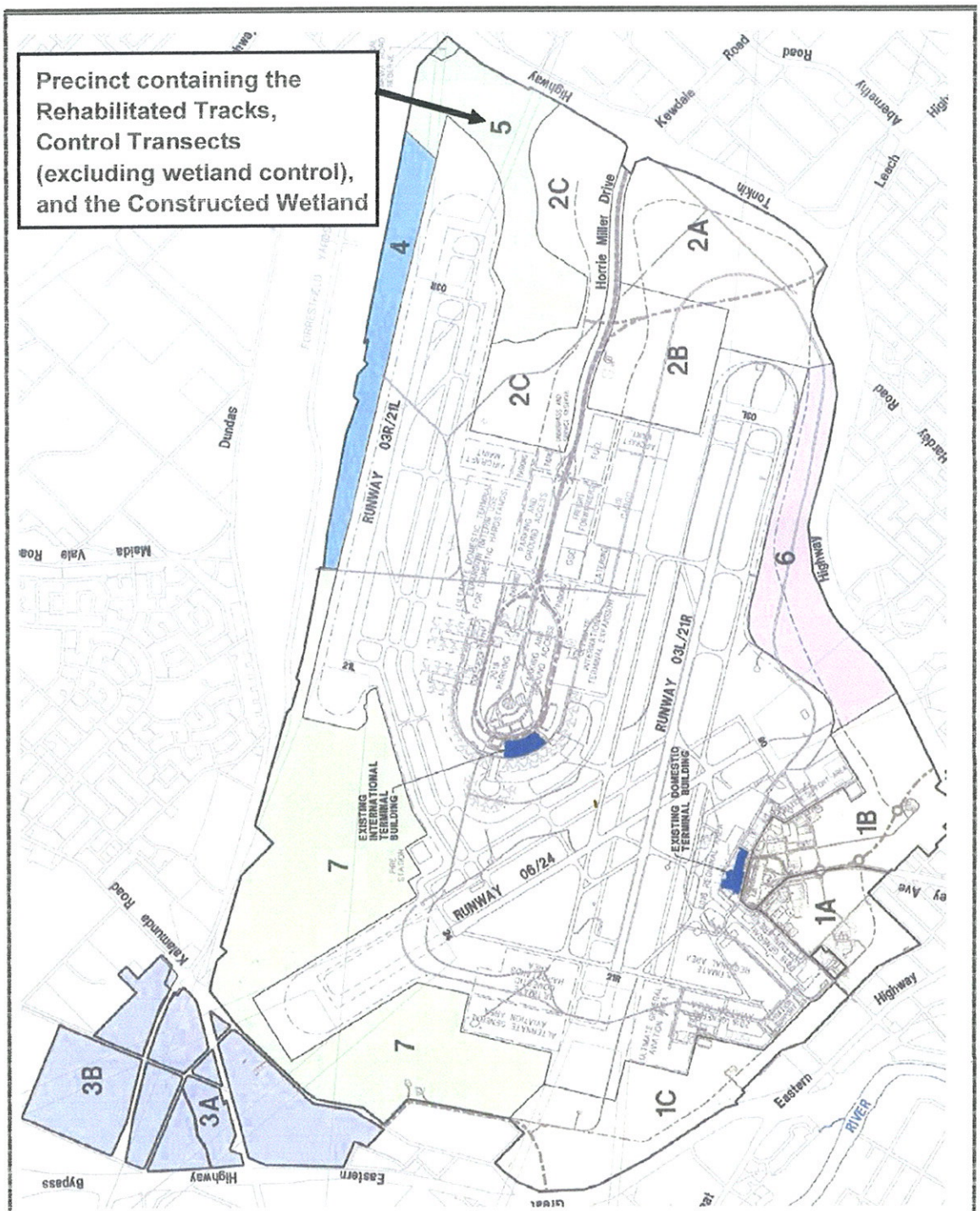
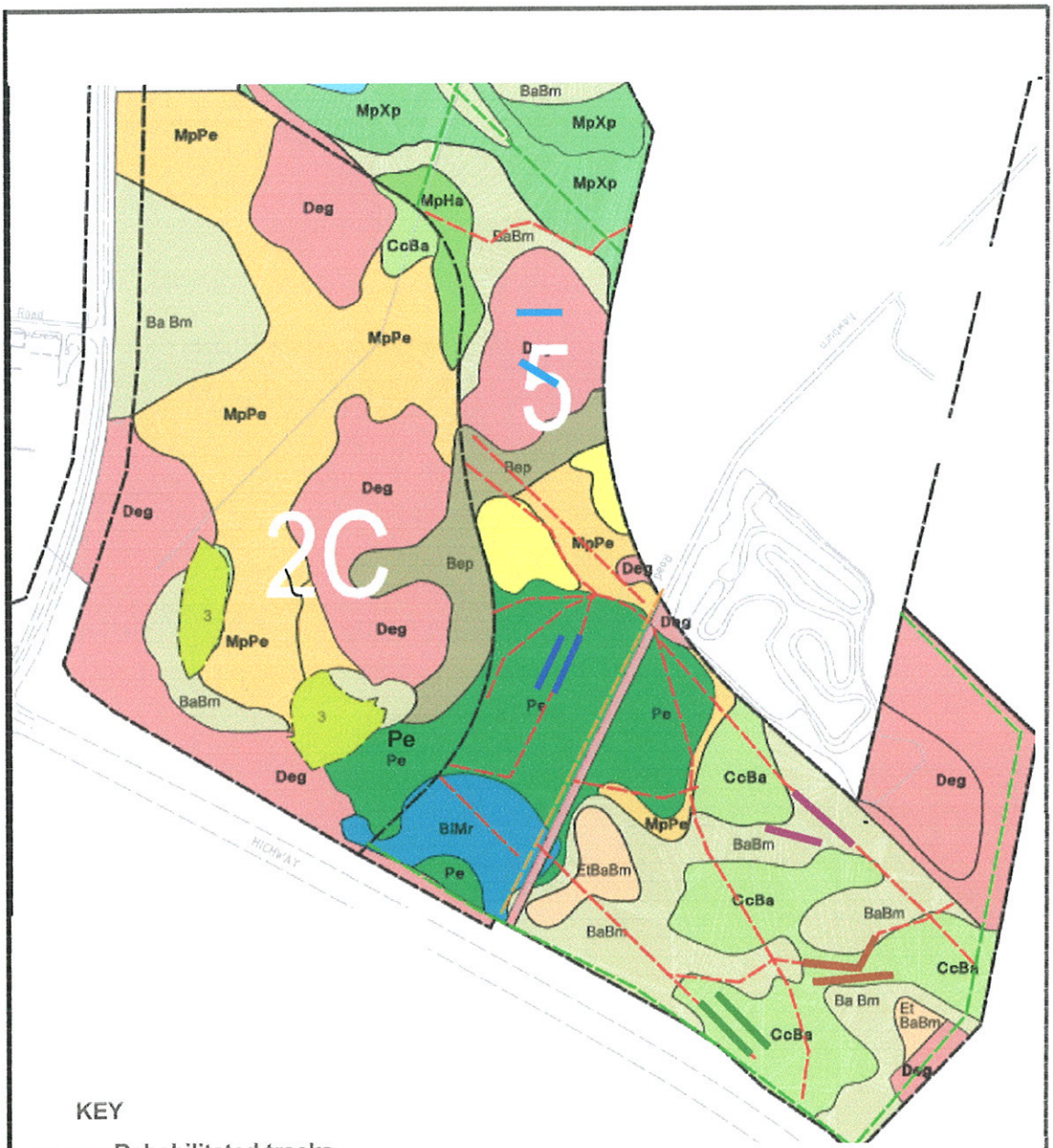


FIGURE 2 – Perth Airport Precincts		
CLIENT: Westralia Airports Corporation		
DRAWN BY: NW	CHECKED BY: KL	JOB NUMBER: 04.128
DATE:10/1/2005	REPORT ISSUE: FINAL	SCALE: NTS

env Australia



KEY

- Rehabilitated tracks
- Rehab and control transects
- Rehabilitation monitoring transects for constructed wetland

FIGURE 3: Location of rehabilitation and control transects

CLIENT: Westralia Airports Corporation

DRAWN BY: NW	CHECKED BY: KL	JOB NUMBER: 04.128
DATE: 10/1/05	REPORT ISSUE: Final	Insert generated by GJC @ WAC

env Australia

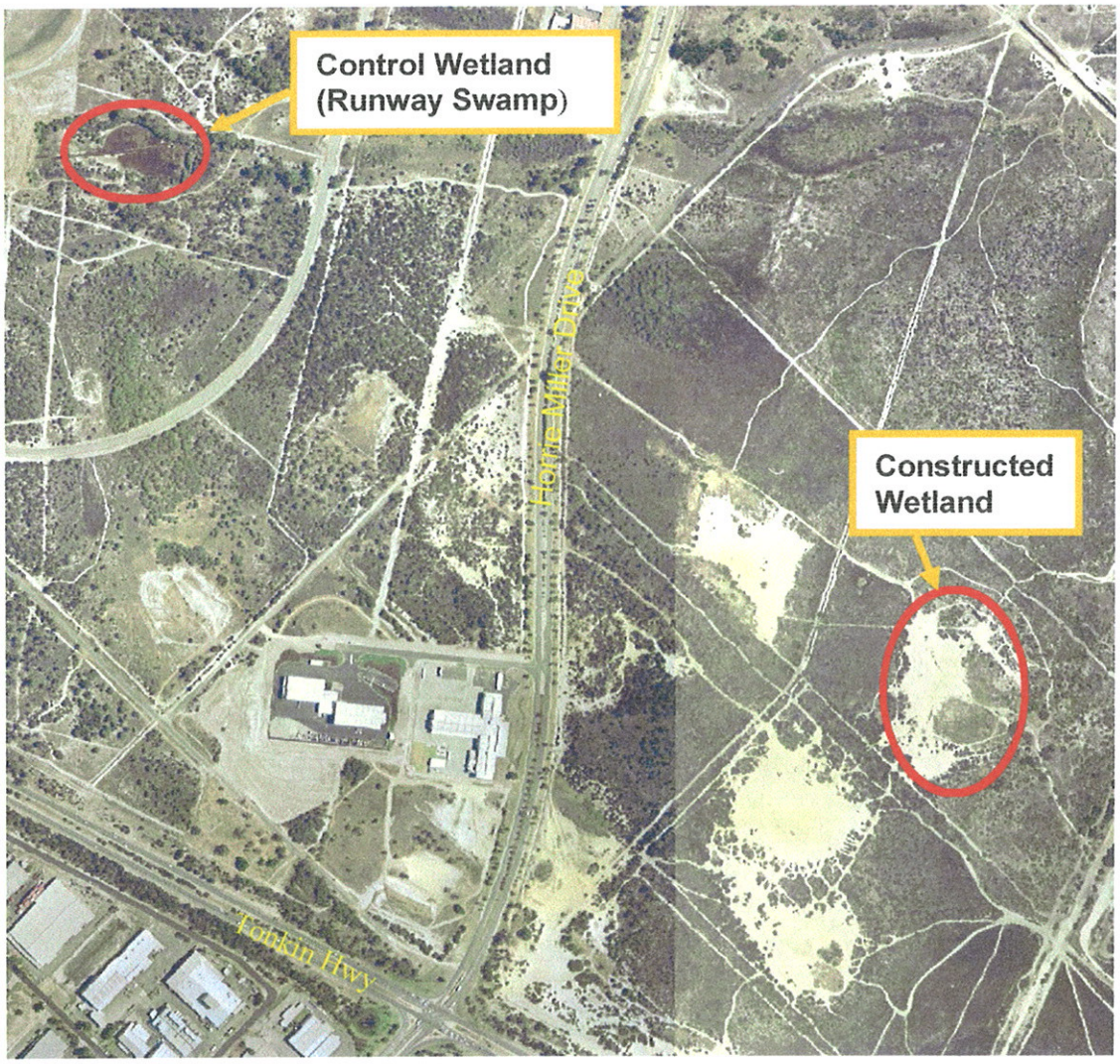


FIGURE 4 – Location of Control and Constructed Wetlands		
CLIENT: Westralia Airports Corporation		
DRAWN BY: NW	CHECKED BY: SB	JOB NUMBER: 04.128
DATE:10/1/05	REPORT ISSUE: Final	SCALE: NTS

env Australia

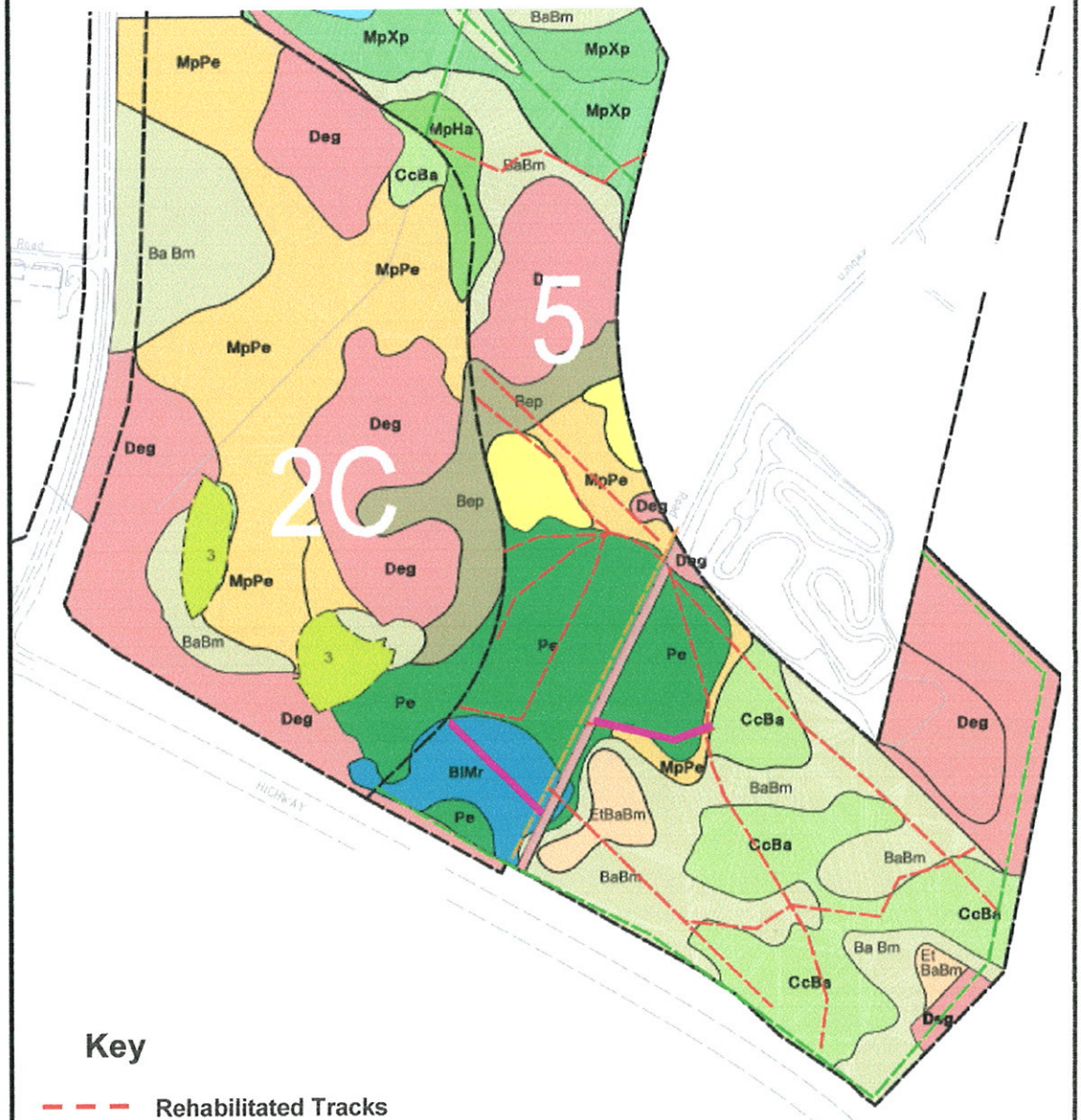


FIGURE 5: Location of tracks that were nominated to regenerate themselves

CLIENT: Westralia Airports Corporation

DRAWN BY: NW	CHECKED BY: KL	JOB NUMBER: 04.128
DATE: 10/1/05	REPORT ISSUE: Final	Insert generated by GJC @ WAC

env Australia

Appendix 2 Transect Location and Orientation Details

Transect Location and Orientation Details

Transect	Flagging Colour	Direction from Start	Start Easting *	Start Northing	Finish Easting *	Finish Northing
CcBa (R)	Orange / Yellow	NW	403354 E	6461471 N	403325 E	4641500 N
CcBa (C)	Orange / Yellow	S	403394 E	6461535 N	403387 E	6461573 N
MpPe (R)	Orange / Yellow	E	403443 E	6461576 N	403499 E	6461573 N
MpPe (C)	Orange / Yellow	SE	403470 E	6461566 N	403513 E	6461552 N
BaBm (R)	Orange / Yellow	NW	403508 E	6461734 N	403479 E	6461772 N
BaBm (C)	Orange / Yellow	NW	403446 E	6461749 N	403425 E	6461790 N
Pe (R)	Orange / Yellow	NE	403045 E	6461868 N	403071 E	6461913 N
Pe (C)	Orange / Pink	NE	403116 E	6462054 N	403094 E	6462017 N
Wetland (C)	Orange / Yellow	SE	401829 E	6463201 N	401785 E	6463185 N
Wetland A (R)	Orange / Yellow	SE	403056 E	6462477 N	403082 E	6462450 N
Wetland B (R)	Orange / Yellow	SE	403050 E	6462400 N	403079 E	6462383 N

- Note: All co-ordinates for Area 50 (GDA94)

Appendix 3 Transect Summaries

tranen revegetation systems

Precinct 5 Monitoring
Individual Summary

Location: CcBa (Control)

Species	Score	Observed	
* Avena sp.	8	Y	
* Briza maxima	12	Y	
* Ehrharta calycina	27	Y	
* Gladiolus caryophyllaceus	61	Y	
* Hypochaeris glabra	36	Y	
* Moraea flaccida	11	Y	
* Ursinsia anthemoides	19	Y	
? Gonocarpus sp.		Y	
Acacia applanata		Y	
Acacia extensa		Y	
Acacia huegeliii		Y	
Acacia pulchella	28	Y	
Alexgeorga nitens	54	Y	
Boronia ramosa subsp anethifolia		Y	
Bossiaea eriocarpa	6	Y	
Bossiaea ornata		Y	
Burchardia umbellata		Y	
Conostylis juncea		Y	
Corymbia calophylla		Y	
Dampiera linearis	4	Y	
Dasypogon bromelifolius	36	Y	
Desmocladus fasciculatus		Y	
Drosera sp	4	Y	
Gompholobium tomentosum	4	Y	
Hibbertia hypericoides	2	Y	
Hovea trisperma	1	Y	
Hypocalymma angustifolium	4	Y	
Hypocalymma sp.	2	Y	
Hypolaena exculsa	7	Y	
Jacksonia floribunda	23	Y	
Laxmannia ramosa	3	Y	
Lechenaultia sp	3	Y	
Leucopogon ? Sp. Murdoch (M. Hislop 1037)	3	Y	
Leucopogon conostephoides	1	Y	
Lomandra nigricans	1	Y	
Lyginia barbata / imberbis	35	Y	
Patersonia occidentalis		Y	
Philotheca spicata	23	Y	
Phlebocarya ciliata	32	Y	
Pterostylis sanguinea		Y	
Scholtzia involucrata	1	Y	
Thysanotus manglesianus		Y	
Thysanotus multiflorus	2	Y	
Tricoryne elatior	4	Y	
Xanthorrhoea preissii	18	Y	
Dead Matter %		8%	
Total Natives		1065	26.6
Native Cover %		78%	
Weed Cover %		6%	

Main Natives	1	Alexgeorgea nitens
	2	Dasypogon bromelifolius
	3	Lyginia barbata / imberbis
Main Weeds	1	Gladiolus carylophyllaceus
	2	Flatweeds (Hypochaeris et al)
	3	Ursinia anthemesiodes
Site Description	Good ground cover with few weeds.	

tranen revegetation systems

Precinct 5 Monitoring Individual Summary

Location: CcBa (Rehab)

Species	Score	Observed	
* Arctotheca calendula	7	Y	
* Romulea rosea	14	Y	
* Briza maxima	22	Y	
* Ehrharta calycina	51	Y	
* Erodium botrys		Y	
* Gladiolus caryophyllaceus	33	Y	
* Hypochaeris glabra	83	Y	
* Sonchus oleraceus		Y	
* Ursinsia anthemoides	17	Y	
? Gonocarpus sp.	4	Y	
Adenanthos cygnorum	14	Y	
Allocasuarina humilis		Y	
Banksia attenuata	5	Y	
Banksia menziesii	31	Y	
Bossiaea eriocarpa	3	Y	
Conostylis juncea		Y	
Conostylis sp.	3	Y	
Corymbia calophylla	6	Y	
Dasypogon bromelifolius	10	Y	
Eremaea pauciflora	1	Y	
Gompholobium tomentosum	9	Y	
Hibbertia hypericoides	2	Y	
Hypocalymma sp.	1	Y	
Jacksonia floribunda	4	Y	
Kennedia prostrata	53	Y	
Laxmannia squarrosa	51	Y	
Lyginia barbata / imberbis		Y	
MYRTACEAE sp.		Y	
Patersonia occidentalis	1	Y	
Pericalymma ellipticum	1	Y	
Photo Sample 1	2	Y	
Scholtzia involucrata	3	Y	
Stirlingia latifolia	1	Y	
Verticordia densiflora var densiflora	2	Y	
Total Natives		275	6.9
Native Cover %		1%	
Weed Cover %		2%	

Main Natives	1	Kennedia prostrata
	2	Laxmannia squarrosa
	3	Banksia menziesii
Main Weeds	1	Flatweeds (Hypochaeris et al)
	2	Erharta calycina
	3	Gladiolus caryophyllaceus
Site Description	Relatively even coverage and distribution. Flatweeds young but eveywhere.	

tranen revegetation systems

Precinct 5 Monitoring Individual Summary

Location: Pe (Control)

Species	Score	Observed	
* Ursinsia anthemoides	9	Y	
? Philotheca spicata		Y	
Calothamnus lateralis		Y	
Cytogodinium leptocarpoides	76	Y	
Dampiera linearis		Y	
Dasypogon bromelifolius	4	Y	
Euchilopis linearis	8	Y	
Hypolaena exculsa		Y	
Laxmannia ramosa	4	Y	
Laxmannia squarrosa	2	Y	
Lyginia barbata / imberbis		Y	
Melaleuca seriata	23	Y	
Pericalymma ellipticum	114	Y	
Phlebocarya ciliata	6	Y	
Stirlingia latifolia	1	Y	
Unidentiable Native		Y	
Verticordia densiflora var densiflora	2	Y	
Total Natives		1332	33.3
Native Cover %		76%	
Weed Cover %		0%	
Main Natives	1	Pericalymma ellipticum	
	2	Cytogodinium leptocarpoides	
	3	Melaleuca seriata	
Main Weeds	1	Ursinia anthemesioides	
	2		
	3		
Site Description	Very few weeds emerging.		

tranen revegetation systems

Precinct 5 Monitoring
Individual Summary

Location: Pe (Rehab)

Species	Score	Observed	
* Ehrharta calycina	57	Y	
* Hypochaeris glabra	51	Y	
* Pelargonium sp	3	Y	
* POACEAE sp	1	Y	
* Ursinsia anthemoides	13	Y	
Adenanthos cygnorum	5	Y	
Calothamnus lateralis	2	Y	
Dasypogon bromelifolius	6	Y	
Desmocladus flexuosus		Y	
Euchilopis linearis	14	Y	
Hypolaena exculsa	11	Y	
Laxmannia ramosa	2	Y	
Laxmannia squarrosa		Y	
Lepidosperma longitudinale	6	Y	
Lyginia barbata / imberbis	3	Y	
Melaleuca lateritia	1	Y	
Melaleuca rhaphiophylla	3	Y	
Patersonia occidentalis	1	Y	
Pericalymma ellipticum	94	Y	
Phlebocarya ciliata	25	Y	
Sample G (Unidentifiable)	1	Y	
Verticordia densiflora var densiflora	52	Y	
Total Natives		1255	31.4
Native Cover %		3%	
Weed Cover %		1%	

Main Natives	1	Pericalymma ellipticum
	2	Verticordia densiflora var densiflora
	3	Phlebocarya ciliata
Main Weeds	1	Erharta calycina
	2	Flatweeds (Hypochaeris et al)
	3	Ursinia anthmesioides
Site Description	Excellent germination levels evenly distributed across site. Currently similar number of seedlings as there are plants in control plot.	

tranen revegetation systems

Precinct 5 Monitoring
Individual Summary

Location: MpPe (Control)

Species	Score	Observed	
* Hypochaeris glabra	38	Y	
Astartea affinis (ms)	39	Y	
Caladenia sp.	1	Y	
Calothamnus lateralis	7	Y	
Cassytha sp.	4	Y	
Eutaxia virgata		Y	
Goodenia ? pulchella	3	Y	
Lepidosperma longitudinale	5	Y	
Meeboldina cana	85	Y	
Melaleuca lateritia	26	Y	
Melaleuca rhaphiophylla	6	Y	
Melaleuca seriata	6	Y	
Melaleuca teretifolia	4	Y	
Pericalymma ellipticum	20	Y	
Villarsia albiflora	10	Y	
Wahlenbergia preissii	9	Y	
Total Natives		677	16.9
Native Cover %		60%	
Weed Cover %		0%	
Main Natives	1	Meeboldina cana	
	2	Astartea affinis	
	3	Melaleuca lateritia	
Main Weeds	1	Flatweeds (Hypocaheris et al)	
	2		
	3		
Site Description	Less dense and fewer seedlings than Pe Control		

tranen revegetation systems

Precinct 5 Monitoring
Individual Summary

Location: MpPe (Rehab)

Species	Score	Observed	
* Anagallis arvensis		Y	
* Avena sp.	5	Y	
* Briza maxima		Y	
* Ehrharta calycina	61	Y	
* Eragrostis curvula	2	Y	
* Gladiolus caryophyllaceus	12	Y	
* Hypochaeris glabra	71	Y	
* Ursinsia anthemoides	4	Y	
* Vulpia sp.	31	Y	
? Kunzea recurva		Y	
Bossiaea eriocarpa	1	Y	
Cassytha sp.	2	Y	
Centella asiatica		Y	
Dasypogon bromelifolius		Y	
Gompholobium tomentosum		Y	
Hypocalymma sp.		Y	
Jacksonia furcellata	1	Y	
Kennedia prostrata	7	Y	
Laxmannia squarrosa	38	Y	
Meeboldina roycei		Y	
Melaleuca preissiana	11	Y	
Patersonia occidentalis	45	Y	
Pericalymma ellipticum	51	Y	
Verticordia densiflora var densiflora	18	Y	
Dead Matter %		42%	
Total Natives		374	9.4
Native Cover %		1%	
Weed Cover %		7%	

Main Natives	1	Pericalymma ellipticum
	2	Patersonia occidentalis
	3	Laxmannia squarrosa
Main Weeds	1	Flatweed (Hypochaeris et al)
	2	Erharta calycina
	3	Vulpia sp
Site Description	High levels of brush on track may be inhibiting germination and plant development, although keeping traffic off. Majority of seedlings in barer patches so density currently close to control plot.	

tranen revegetation systems

Precinct 5 Monitoring Individual Summary

Location: BaBm (Control)

Species	Score	Observed	
* Gladiolus caryophyllaceus	44	Y	
* Hypochaeris glabra	4	Y	
* Moraea flaccida	81	Y	
* Solanum nigrum	3	Y	
* Ursinsia anthemoides	3	Y	
? Gonocarpus sp.		Y	
? Liliaceae sp.		Y	
Acacia pulchella		Y	
Alexgeorga nitens	58	Y	
Amphipogon turbinatus	19	Y	
Banksia menziesii	5	Y	
Bossiaea eriocarpa	5	Y	
Burchardia umbellata		Y	
Calytrix fraseri	4	Y	
Cassytha sp.	2	Y	
Conostephium pendulum	2	Y	
Conostylis juncea	1	Y	
Dampiera linearis	3	Y	
Dasypogon bromelifolius	6	Y	
Desmocladus flexuosus		Y	
Eremaea pauciflora	21	Y	
Gastrolobium capitatum	1	Y	
Gompholobium tomentosum		Y	
Hibbertia hypericoides	4	Y	
Hibbertia racemosa		Y	
Jacksonia floribunda	12	Y	
Laxmannia ramosa	7	Y	
Laxmannia squarrosa		Y	
Lepidosperma squamatum		Y	
Leucopogon conostephoides	11	Y	
Lomandra hermaphrodita		Y	
Lyginia barbata / imberbis	32	Y	
Melaleuca seriata	20	Y	
Patersonia occidentalis	9	Y	
Petrophile linearis		Y	
Philotheca spicata	3	Y	
Phlebocarya ciliata		Y	
Scholtzia involucrata	17	Y	
Stylidium repens		Y	
Tricoryne elatior		Y	
Xanthorrhoea preissii	3	Y	
Dead Matter %		23%	
Total Natives		898	22.5
Native Cover %		43%	
Weed Cover %		0%	

Main Natives	1	Alexgeorgea nitens
	2	Lyginia barbata / imberbis
	3	Eremaea pauciflora
Main Weeds	1	Moraea flaccida (declared)
	2	Gladiolus caryophyllaceus
	3	Flatweed (Hypochaeris et al)
Site Description		

tranen revegetation systems

Precinct 5 Monitoring Individual Summary

Location: BaBm (Rehab)

Species	Score	Observed	
* Avena sp.	1	Y	
* Ehrharta calycina	48	Y	
* Gladiolus caryophyllaceus	8	Y	
* Hypochaeris glabra	89	Y	
* Ursinsia anthemoides	29	Y	
* Vulpia sp.	30	Y	
* Watsonia meriana var bulbillifera	6	Y	
? Gonocarpus sp.	10	Y	
Adenanthos cygnorum	4	Y	
Alexgeorga nitens	7	Y	
Banksia menziesii	17	Y	
Bossiaea eriocarpa	2	Y	
Bossiaea ornata	1	Y	
Cassytha sp.	1	Y	
Dampiera linearis	5	Y	
Dasypogon bromelifolius	12	Y	
Drosera sp	2	Y	
Eremaea pauciflora	1	Y	
Gompholobium tomentosum	14	Y	
Jacksonia floribunda	4	Y	
Laxmannia ramosa	4	Y	
Laxmannia squarrosa	5	Y	
Pericalymma ellipticum		Y	
Philotheca spicata	16	Y	
Podotheca angustifolia	38	Y	
Quinetia urvellii	3	Y	
Stirlingia latifolia	3	Y	
Dead Matter %		37%	
Total Natives		175	4.4
Native Cover %		1%	
Weed Cover %		8%	

Main Natives	1	Podotheca angustoflia
	2	Banksia menziesii
	3	Philotheca spicata
Main Weeds	1	Flatweed (Hypochaeris et al)
	2	Erharta calycina
	3	Vulpia sp
Site Description	Significant weed cover in parts considering all young germinants. Low native cover with respect to other sites but still averages 4 seedlings / m2. Brush cover may be restricting germination.	

tranen revegetation systems

Precinct 5 Monitoring
Individual Summary

Location: Wetland Control

Species	Score	Observed	
* Cyndon dactylon	20	Y	
* Eragrostis curvula	13	Y	
* Gladiolus caryophyllaceus	24	Y	
* Hypochaeris glabra	45	Y	
* Ursinsia anthemoides	45	Y	
Astartea affinis (ms)		Y	
Baumea articulata	27	Y	
Cassytha sp.	8	Y	
Centella asiatica	12	Y	
Eucalyptus rudis		Y	
Eutaxia virgata		Y	
Goodenia ? Pulchella	13	Y	
Hypocalymma angustifolium	36	Y	
Jacksonia furcellata	2	Y	
Meeboldina cana	99	Y	
Melaleuca lateritia	13	Y	
Melaleuca rhaphiophylla	3	Y	
Melaleuca teretifolia		Y	
Pterostylis sanguinea	3	Y	
Schoenus subfascicularis	5	Y	
Wahlenbergia preissii	14	Y	
Total Natives		1054	26.4
Native Cover %		38%	
Weed Cover %		3%	
Main Natives	1	Meeboldina cana	
	2	Hypocalymma angustifolium	
	3	Baumea articulata	
Main Weeds	1	Flatweed (Hypochaeris et al)	
	2	Ursinia anthemoides	
	3	Gladiolus caryophyllaceus	
Site Description			

tranen revegetation systems

Precinct 5 Monitoring Individual Summary

Location: Wetland A

Species	Score	Observed	
* Ehrharta calycina	44	Y	
* Gladiolus caryophyllaceus	2	Y	
* Hypochaeris glabra	60	Y	
* Isolepis marginata	6	Y	
* Lupinus consentinii		Y	
* Oxalis sp.		Y	
* Unidentified Dicotyledon		Y	
* Unidentified Monocotyledon		Y	
* Ursinsia anthemoides	3	Y	
? Kunzea recurva		Y	
Acacia pulchella	4	Y	
Adenanthos cygnorum	4	Y	
Astartea sp.		Y	
Calytrix fraseri		Y	
Conostylis sp.	3	Y	
Dasypogon bromelifolius	8	Y	
Desmocladus flexuosus		Y	
Drosera sp		Y	
Eucalyptus rudis		Y	
Euchilopis linearis	13	Y	
Gompholobium tomentosum	46	Y	
Hypocalymma angustifolium	23	Y	
Hypolaena exculsa	7	Y	
Jacksonia floribunda	2	Y	
Jacksonia furcellata	9	Y	
Kennedia prostrata	5	Y	
Kunzea ericifolia	6	Y	
Laxmannia squarrosa		Y	
Patersonia occidentalis		Y	
Pericalymma ellipticum		Y	
POACEAE sp	2	Y	
Sample B		Y	
Stylidium sp.		Y	
Total Natives		591	14.8
Native Cover %		5%	
Weed Cover %		3%	

Main Natives	1	Gompholobium tomentosum
	2	Hypocalymma angustifolium
	3	Euchilopsis linearis
Main Weeds	1	Flatweeds (Hypochaeris et al)
	2	Erharta calycina
	3	Isolepis marginata
Site Description	Bottom section damaged by vehicle traffic - monitoring stakes missing. Upland section quite dense averaging 24 seedlings/m2.	

tranen revegetation systems

Precinct 5 Monitoring
Individual Summary

Location: Wetland B

Species	Score	Observed	
* Anagallis arvensis	4	Y	
* Arctotheca calendula	15	Y	
* Ehrharta calycina	58	Y	
* Gladiolus caryophyllaceus	6	Y	
* Hypochaeris glabra	30	Y	
* Isolepis marginata	7	Y	
* Lupinus consentinii	21	Y	
* Oxalis glabra	3	Y	
* Oxalis sp.	5	Y	
* Unidentified Dicotyledon	2	Y	
Adenanthos cygnorum	6	Y	
Desmocladus flexuosus	2	Y	
Gompholobium tomentosum	1	Y	
Hypocalymma angustifolium	13	Y	
Hypolaena exculsa	6	Y	
Jacksonia furcellata	4	Y	
Melaleuca preissiana	17	Y	
Total Natives		53	1.3
Native Cover %		0%	
Weed Cover %		1%	
Main Natives	1	Melaleuca preissiana	
	2	Hypocalymma angustifolium	
	3	Adenanthos cygnorum	
Main Weeds	1	Erharta calycina	
	2	Flatweeds (Hypochaeris et al)	
	3	Lupinus consentinii	
Site Description	Most of area damaged by motorbikes. Lowest monitoring stake missing.		

Appendix 4 List of Species Identified By Transect

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Precinct 5 Monitoring
Species Diversity Summary

Species	CcBa C	CcBa R	Pe C	Pe R	MpPe C	MpPe R	BaBm C	BaBm R	Wetland C	Wetland A	Wetland B	Summary Jun 05	Summary Dec 04
Taxa Identified Jun 05													
? Acacia alata													Y
Acacia applanata	Y											Y	
Acacia extensa	Y											Y	Y
Acacia huegeliii	Y											Y	Y
Acacia pulchella	Y						Y			Y		Y	Y
Acacia sp.													Y
Adenanthos cygnorum		Y		Y				Y		Y	Y	Y	Y
* Aira caryophyllea													Y
Alexgeorga nitens	Y						Y	Y				Y	Y
Allocasuarina fraseriana													Y
Allocasuarina humilis		Y										Y	
Amphipogon turbinatus							Y					Y	Y
* Anagallis arvensis var arvensis													Y
* Anagallis arvensis var caerulea													Y
* Anagallis arvensis						Y					Y	Y	
* Arctotheca calendula		Y									Y	Y	Y
Astartea affinis (ms)					Y				Y			Y	Y
Astartea sp.										Y		Y	Y
* Avena barbata	Y					Y		Y				Y	Y
Banksia attenuata		Y										Y	Y
Banksia menziesii		Y					Y	Y				Y	Y
Baumea articulata									Y			Y	Y
Boronia ramosa subsp anethifolia	Y											Y	
Boronia sp.													Y
Bossiaea eriocarpa	Y	Y				Y	Y	Y				Y	Y
Bossiaea ornata	Y							Y				Y	Y
* Briza maxima	Y	Y				Y						Y	Y
* Briza minor													Y
Burchardia umbellata	Y						Y					Y	Y
Caladenia sp.					Y							Y	
Calothamnus lateralis			Y	Y	Y							Y	Y
Calytrix fraseri							Y			Y		Y	Y
Cassytha sp.					Y	Y	Y	Y	Y			Y	Y
* Centaurium erythraea													Y
Centella asiatica						Y						Y	
Centella asiatica									Y			Y	
Centrolepis aristata													Y
* Cicendia filiformis													Y
Conostephium minus													Y
Conostephium pendulum							Y					Y	Y
Conostylis juncea	Y	Y					Y					Y	Y
Conostylis sp.		Y								Y		Y	Y
Corymbia calophylla	Y	Y										Y	Y
CRASSULACEAE sp.													Y
* Cyndon dactylon									Y			Y	Y
Cytogodinium leptocarpoides			Y									Y	Y
Dampiera linearis	Y		Y				Y	Y				Y	Y
Dasypogon bromelifolius	Y	Y	Y	Y		Y	Y	Y		Y		Y	Y

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Precinct 5 Monitoring
Species Diversity Summary

Species	CcBa C	CcBa R	Pe C	Pe R	MpPe C	MpPe R	BaBm C	BaBm R	Wetland C	Wetland A	Wetland B	Summary Jun 05	Summary Dec 04
Daviesia sp													Y
Desmocladus fasciculartus	Y											Y	Y
Desmocladus flexuosus				Y			Y			Y	Y	Y	Y
Desmocladus sp													Y
Drosera sp	Y							Y		Y		Y	Y
* Ehrharta calycina	Y	Y		Y		Y		Y		Y	Y	Y	Y
* Eragrostis curvula						Y			Y			Y	
Eremaea pauciflora		Y					Y	Y				Y	Y
* Erodium botrys		Y										Y	
Eucalyptus marginata													Y
Eucalyptus rudis									Y	Y		Y	Y
Eucalyptus sp.													Y
Euchilopis linearis			Y	Y						Y		Y	Y
Eutaxia virgata					Y				Y			Y	Y
Gastrolobium capitatum							Y					Y	
* Gladiolus caryophyllaceus	Y	Y				Y	Y	Y	Y	Y	Y	Y	Y
Gompholobium sp.													Y
Gompholobium tomentosum	Y	Y				Y	Y	Y		Y	Y	Y	Y
Gonocarpus sp.?	Y	Y					Y	Y				Y	
Goodenia ? pulchella					Y				Y			Y	
Hibbertia hypericoides	Y	Y					Y					Y	Y
Hibbertia racemosa							Y					Y	Y
Hibbertia stellaris													Y
Hovea trisperma	Y											Y	Y
* Hydrocotyle bonariensis													Y
Hypocalymma angustifolium	Y								Y	Y	Y	Y	Y
Hypocalymma sp.	Y	Y				Y						Y	Y
* Hypochaeris glabra / Flatweed	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Hypolaena exculsa	Y		Y	Y						Y	Y	Y	Y
* Introduced Species 1													Y
* Introduced Species 2													Y
* Isolepis marginata										Y	Y	Y	Y
Jacksonia floribunda	Y	Y					Y	Y		Y		Y	Y
Jacksonia furcellata						Y			Y	Y	Y	Y	Y
Jacksonia sp													Y
Jacksonia sternbergiana													Y
* Juncus articulatus													Y
Kennedia coccinea													Y
Kennedia prostrata		Y				Y				Y		Y	Y
Kunzea ericifolia										Y		Y	
? Kunzea recurva						Y				Y		Y	
Lagenophora huegellii													Y
Laxmannia ramosa	Y		Y	Y			Y	Y				Y	Y
Laxmannie sp.													Y
Laxmannia squarrosa		Y	Y	Y		Y	Y	Y		Y		Y	Y
Lechenaultia biloba	Y											Y	Y
Lechenaultia ? biloba													Y
Lechenaultia expansa													Y
? Lechenaultia sp.													Y
Lepidosperma longitudinale				Y	Y							Y	Y

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Precinct 5 Monitoring
Species Diversity Summary

Species	CcBa C	CcBa R	Pe C	Pe R	MpPe C	MpPe R	BaBm C	BaBm R	Wetland C	Wetland A	Wetland B	Summary Jun 05	Summary Dec 04
Lepidosperma sp													Y
Lepidosperma squamatum							Y					Y	Y
Lepidosperma tenue													Y
Leucopogon ? Sp. Murdoch (M. Hislop 1037)	Y											Y	
Leucopogon conostephoides	Y						Y					Y	Y
Leucopogon sp													Y
Levenhookia preissii													Y
? Liliaceae sp.							Y					Y	
Lobelia tenuior													Y
Lomandra hermaphrodita							Y					Y	Y
Lomandra nigricans	Y											Y	
Lomandra sp													Y
* Lotus subbiflorus													Y
* Lupinus consentinii										Y	Y	Y	
Lyginia barbata / imberbis	Y	Y	Y	Y			Y					Y	Y
Meeboldina cana					Y				Y			Y	
Meeboldina roycei						Y						Y	Y
Melaleuca lateritia				Y	Y				Y			Y	Y
Melaleuca preissiana						Y					Y	Y	
Melaleuca rhaphiophylla				Y	Y				Y			Y	Y
Melaleuca seriata			Y		Y		Y					Y	Y
Melaleuca sp													Y
Melaleuca teretifolia					Y				Y			Y	Y
* Moraea flaccida	Y						Y					Y	
MYRTACEAE sp.		Y										Y	
* Oxalis glabra											Y	Y	
* Oxalis sp.										Y	Y	Y	
Patersonia occidentalis	Y	Y		Y		Y	Y			Y		Y	Y
? Patersonia sp													Y
* Pelargonium sp				Y								Y	Y
Pericalymma ellipticum		Y	Y	Y	Y	Y		Y		Y		Y	Y
Petrophile linearis							Y					Y	Y
Philotheca spicata	Y						Y	Y				Y	Y
? Philotheca spicata			Y									Y	
Phlebocarya ciliata	Y		Y	Y			Y					Y	Y
Photo Sample 1		Y										Y	
? Phyllanthus sp													Y
POACEAE sp				Y						Y		Y	Y
Podotheca angustifolia								Y				Y	
PROTEACEAE sp													Y
Pterostylis sanguinea	Y								Y			Y	
Quinetia urvellii								Y				Y	
RESTIONACEAE sp													Y
* Romulea rosea													Y
? Sample B (Unidentifiable)										Y		Y	
? Sample G (Unidentifiable)				Y								Y	
Schoenus subfascicularis									Y			Y	
Scholtzia involucrata	Y	Y					Y					Y	Y
Siloxerus humifusus													Y
* Solanum nigrum							Y					Y	

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Precinct 5 Monitoring
Species Diversity Summary

Species	CcBa C	CcBa R	Pe C	Pe R	MpPe C	MpPe R	BaBm C	BaBm R	Wetland C	Wetland A	Wetland B	Summary Jun 05	Summary Dec 04
* Sonchus oleraceus		Y										Y	Y
Stirlingia latifolia		Y	Y					Y				Y	Y
Stylidium brunonianum													Y
Stylidium dichotomum													Y
Stylidium piliferum													Y
Stylidium repens							Y					Y	Y
Stylidium sp.										Y		Y	
? Tetratheca hirsuta													Y
Thysanotus manglesianus	Y											Y	Y
Thysanotus multiflorus	Y											Y	Y
Trachymene pilosa													Y
Tricoryne sp	Y						Y					Y	Y
* Trifolium sp													Y
Unidentiable Native			Y									Y	
* Unidentified Dicotyledon										Y	Y	Y	
* Unidentified Monocotyledon										Y		Y	
* Ursinsia anthemoides	Y	Y	Y	Y		Y	Y	Y	Y	Y		Y	Y
* Vellereophyton dealbatum													Y
Verticordia densiflora var densiflora		Y	Y	Y		Y						Y	Y
Verticordia sp													Y
Villarsia albiflora					Y							Y	
* Vulpia sp.						Y		Y				Y	
Wahlenbergia preissii					Y				Y			Y	
* Watsonia meriana var bulbillifera								Y				Y	Y
Xanthorrhoea preissii	Y						Y					Y	Y
Total Species	**45**	**33**	**17**	**22**	**16**	**24**	**41**	**27**	**21**	**33**	**17**	**120**	**133**
Native Species	**35**	**27**	**17**	**21**	**13**	**19**	**34**	**21**	**19**	**30**	**15**	**95**	**105**
Introduced Species	**10**	**6**	**0**	**1**	**3**	**5**	**7**	**6**	**2**	**3**	**2**	**25**	**28**

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Poison Gully Branch Drain Rehabilitation
Westralia Airports Corporation

Vegetation Monitoring Report

June 2005

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1 INTRODUCTION

Tranen Revegetation Systems were commissioned in April 2005 to monitor the revegetation of the Poison Gully Drain rehabilitation works. The aim of the assessment is to determine the level of success of the rehabilitation works and to provide information for future planning.

This assessment is a continuation of and relies upon the monitoring program established by ENV Australia in spring 2004 (ENV Australia, 2004).

1.1 Background

In April 2003 works associated with the maintenance of the Poison Gully Drain resulted in an impact upon 0.8 hectares of bushland on the eastern side of the drain. The incident involved the storage of approximately 1,200 m^3 of soil on an area of vegetation outside of the designated drainage reserve.

A remediation plan was developed in consultation with officers from the Department of Transport and Regional Services (DOTARS) and the Department of Environment and Heritage. Remediation of the area was completed in April 2004 and involved:

- Removal of the excess soil using a bobcat until the natural soil or vegetation was exposed (August 2003);
- Spraying the entire area for weeds with Glyphosate (February 2004); and
- Dividing the affected area into sections that had similar vegetation communities and degree of regrowth. Methods of treatment were then established for each of these sections (see table below).

Table 1 Initial Treatment Classifications

Condition	Action	Applicable Section(s)
Successful native regrowth, no or low number of weeds.	No action, leave as is. Spraying for weeds not needed at this stage.	C, D, E
Successful native regrowth, large number of weeds.	Spot spraying.	A
No or low number of native regrowth, dominant number of weeds.	Spray all weeds, cover with mulch then deep rip. Direct seeding using seed stored in the provenance seed bank.	B, F, G, H

Sections that required direct seeding were classified according to the surrounding vegetation systems, of which three were identified. All were seeded with a selection of species and quantities suitable to the areas. These sections were prepared by spraying, mulching and ripping to ensure the best conditions for success of the direct seeding operation.

The airport security perimeter fence dissects the drain and on the eastern side there are two small sections that were also affected by the soil placement. As they are

relatively small direct seeding was not considered necessary, however after the overburden was removed they were mulched and ripped.

1.2 Site Maintenance

Shortly after the autumn 2005 assessment the entire site was blanket sprayed with Targa ®, a grass specific herbicide. More mature specimens of * *Eragrostis curvula* do not always respond to grass specific herbicides such as Targa ® and Fusilade ®, and therefore Glyphosate was also applied by spot spraying. The other non-grass species were also targeted in this application, but only if they were located far enough away from the native seedlings that the risk of damage through spray drift was minimal.

Additional revegetation activities took place in June 2005 on a 12 m strip between the access road following the drain, and the 2004 revegetation areas. The site was ripped in May, allowed to settle for one month, sprayed with broad spectrum herbicide, lightly scarified, and then direct seeded.

Hand removal of weeds has been conducted on two separate occasions since the 2004 installation works, by the Conservation Volunteers of Australia. The first targeted all species, and the second targeted only bulb species such as **Watsonia* and *Gladiolus.

2 MONITORING METHODOLOGY

The Remediation Plan for Poison Gully requires that the following are monitored until spring 2009:

- Regrowth of native species;
- Numbers of weeds;
- Areas that have not responded to remediation.

2.1 Spring 2004 Assessment Methodology

The methodology for the spring 2004 monitoring assessment by ENV Australia involved a general assessment of the site:

- Identifying the native species that have grown in the remediated areas;
- Determining the native species that have grown from the direct seeding mix;
- Determining the native species that have regrown naturally;
- Identifying the areas that have not responded to the remediation works;
- Identifying the weed species in the remediated areas;
- Determining any further work that may be required; and
- Compiling a photographic record of the sections (no fixed reference points).

2.2 Autumn 2005 Assessment Methodology

The protocol established for the spring 2004 assessment was expanded upon with the following additional criteria measured and activities conducted in the autumn 2005 assessment (conducted 12 May 2005):

- Four randomly located permanent monitoring quadrats (measuring 5 m x 5 m) were established in the main rehabilitation areas to represent the different conditions on site, with each quadrat broken down into 1 m x 1 m increments for assessment;
- Stem counts of each native species within quadrats;
- Determination of average native plant heights and observations on plant health and development;
- Estimation of weed cover with identification of the most dominant and potentially threatening species; and
- Photographic representation of the site from a permanently established point for each plot.

Table 2 below provides details of the location of the sections in which the plots were located. The locations are also indicated on the maps in Appendix 2.

Table 2 Monitoring Plot Locations and Description

Plot	Location	Description	Sections Represented
1	H	Under canopy	G, H
2	F	Midway through section	E, F
3	B	Western end of section in middle	B
4	B	Centre of section close to existing vegetation	B, C, D

3 RESULTS

The information presented in this report is a summary of the recordings from both the spring 2004 and autumn 2005 monitoring assessments. Appendix 3 contains the details of the monitoring recordings.

3.1 Section A

This section was not originally direct seeded due to good natural regrowth. The only remediation involved chemical control of the weeds.

No quantitative assessments were carried out in this section as there is already considerable species representation and plant density. The site was observed for weeds, and indicated a significant weed presence.

3.2 Section B

Section B was sprayed for weeds, mulched, ripped, and direct seeded. Two monitoring plots were set up, in this the largest of the sections; one to determine what is occurring in the centre of the corridor (Plot 3), and the other located close to existing vegetation to determine if natural recruitment is occurring (Plot 4).

Although weed levels are high in this section, the levels of natives are also high. Plot 3 contained 146 native plants (5.4 plants/m^2), and Plot 4 contained 84 (3.3 plants/m^2). A total of 17 native species and 10 weed species were recorded in or near the monitoring plots. Twenty-five native species have been recorded to date within the entire section, with nine new species noted since spring 2004.

Figure 1 Monitoring Plot 3 (May 2005)

The predominant weed in this section is **Eragrostis curvula* (Lovegrass). Also present in significant numbers were **Dittrichia graveolens* (Stinkwort), **Erharta calycina,* and flat-weeds (i.e. **Hypochaeris glabra*, **Arctotheca calendula*, etc.). The spring 2004 monitoring indicated **Aira caryophyllea* at relatively high levels. This

species was not detected in 2005, most likely as it is an annual species that emerges during the cooler winter period. A total of 13 introduced species have been observed in Section B during the two assessments.

Figure 2 Monitoring Plot 4 (May 2005)

3.3 Sections C, D, E

These sections did not need any remediation (including weed spraying) and were left alone to self-sustain.

Weeds levels are low in these sections and native regrowth is moderate, mostly arising by natural recruitment from the surrounding established vegetation. Some bare patches exist in the middle of these sections.

Ten native species have been recorded in Section C, 12 in Section D, and 11 in Section E. The same five introduced species have been recorded in all three sections.

3.4 Section F

Section F was sprayed for weeds, mulched, ripped, and direct seeded. Monitoring Plot 2 was established within this section.

This section showed a similar response to Section B in spring 2004, however at present the native plant density is much lower at around 1 plant/m2 (see Plot 2). The species richness is the highest of all the areas with 12 native species found in or around the plots, and 22 native species identified across the section to date.

Weed cover in this section is relatively high compared to surrounding areas, with some individuals of Lovegrass (**Eragrostis curvula*) and Veldt Grass (**Erharta calycina*) well established. Six introduced species were observed within Plot 2 during this assessment, and 12 introduced species have been identified here to date.

Figure 3 Monitoring Plot 2 (May 2005)

3.5 Sections G and H

Sections G and H were both sprayed for weeds, mulched, ripped, and direct seeded. Both sections are located next to each other and are presently in similar condition. Monitoring Plot 1 was positioned in section H.

A total of 89 natives (3.5 plants/m^2) from 10 species were identified in Plot 1 during the assessment with 2 more species noted immediately outside the plot. A total of 19 native species have been observed to date in sections G and H. Approximately one quarter of the plants within the plot are established plants that were not originally affected by the drain maintenance activities.

Only one introduced species was found in Plot 1, in very low numbers, and in early stages of development. Four introduced species have been identified in Sections G and H to date.

Figure 4 Monitoring Plot 1 (May 2005)

3.6 Areas Outside of the Security Fence

This section has a Eucalyptus overstorey with little underneath except for a few introduced species. Gladiolus caryophyllaceus was the main weed observed, but was only at early stages of development and in moderate numbers.

3.7 12m Strip

The 12 m strip adjacent to the remediation section was not rehabilitated in 2004. It was left undisturbed to determine whether it would regenerate naturally except for a small portion, which was ripped to determine whether this would stimulate germination of seed stored in the underlying layers.

This section has had little native response, except for a small section adjacent to the western end of Section F where some trees and understorey were not impacted greatly by the excess soil placement. *Pericalymma ellipticum*, *Verticordia densiflora var. densiflora*, *Astartea fascicularis*, and *Lepidosperma pubisquameum* were all found to have emerged / germinated within a 10 m radius of the trees. Weeds were hand pulled from this small stand of naturally recruited natives and the section delineated so that weed spraying and earthworks would not be conducted in this section.

Several introduced species (mostly * *Dittrichia graveolens*) were also found amongst the natives.

The preparation of this area for seeding was planned for shortly after the monitoring assessment. Seed was sourced from suitable species stored in the provenance seed bank.

4 DISCUSSION

4.1 Species Richness

Species richness is acceptable for this stage of development. During the spring 2004 assessment 38 species were identified within the entire rehabilitation corridor. In autumn 2005 26 species were identified within the monitoring plots or the close vicinity. Of these 26 species 8 have emerged since the 2004 assessment. Therefore 46 species have been identified over the last year.

Although some species may have perished over the dry summer, it is likely that they are still present and were not encountered whilst traversing the site during this latest assessment. Secondary germination is expected from the original seedbank, as well as from other seed that may enter the site.

4.2 Plant Density

The plant density is reasonable in most areas for a direct seeding operation of this type. Plot 2 (representative of Section F) shows a significantly lower density when compared with the other three plots, but is acceptable for this time of year. At this stage remedial works are not required in this section as secondary germination may occur. The spring 2005 assessment may determine if remedial works are required.

4.3 Plant Development

Native seedlings that have germinated from seed ranged in height from 50 mm to 200 mm depending on the species. This is promising given the recent dry summer. Previously established plants that have re-emerged (ie *Xanthorrhoea sp*) are more developed than seed germinants due to existing root structures and some are up to 0.5 m tall.

Seedling heights will be one of the key indicators of plant development in future assessments.

4.4 Introduced Species

11 introduced species were recorded in the monitoring plots during the autumn assessment. The main species that have the potential to cause problems at this point are **Eragrostis curvula*, **Dittrichia graveolens*, flat-weeds (e.g. **Hypochaeris glabra*, **Arctotheca calendula*, etc – difficult to positively identify at this stage), and **Gladiolus caryophyllaceus*.

Other species that were identified as threats during the spring 2004 assessment are the grass species **Avena barbata*, **Erharta calycina*, and **Aira caryophyllea* (not typically invasive, but was found in large numbers at the time).

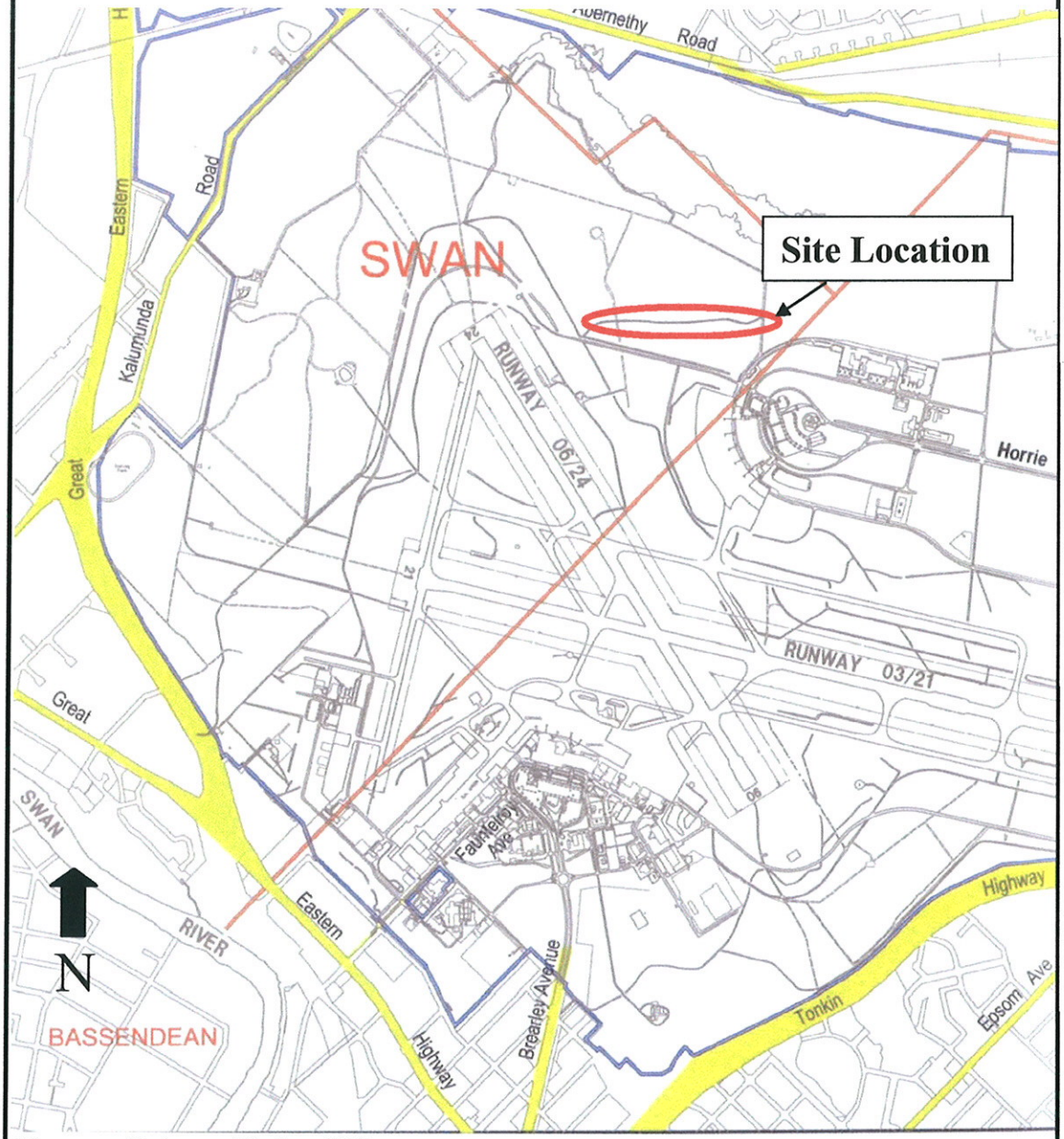
5 CONCLUSIONS

The current richness and density of native species, if sustained, are sufficient for the revegetation to be successful. These levels should be sustained if weed levels are minimised and there are no significant negative impacts such as predation or adverse weather conditions.

6 REFERENCES

1. Remediation Plan for Poison Gully Drain, WAC, May 2004
2. Monitoring of Remediation Works of Poison Gully Drain, ENV Australia, 2004

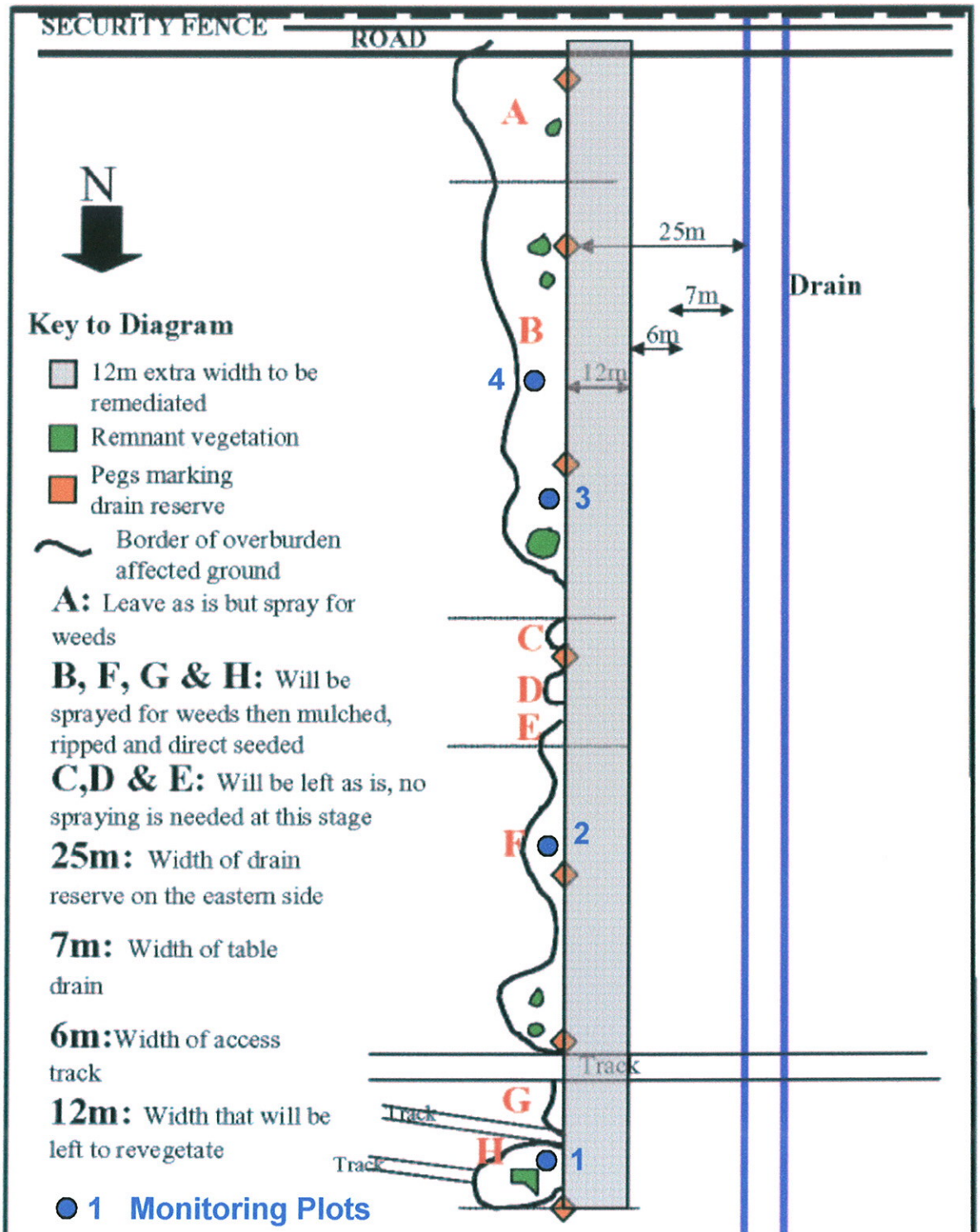
Appendix 1 Site Location



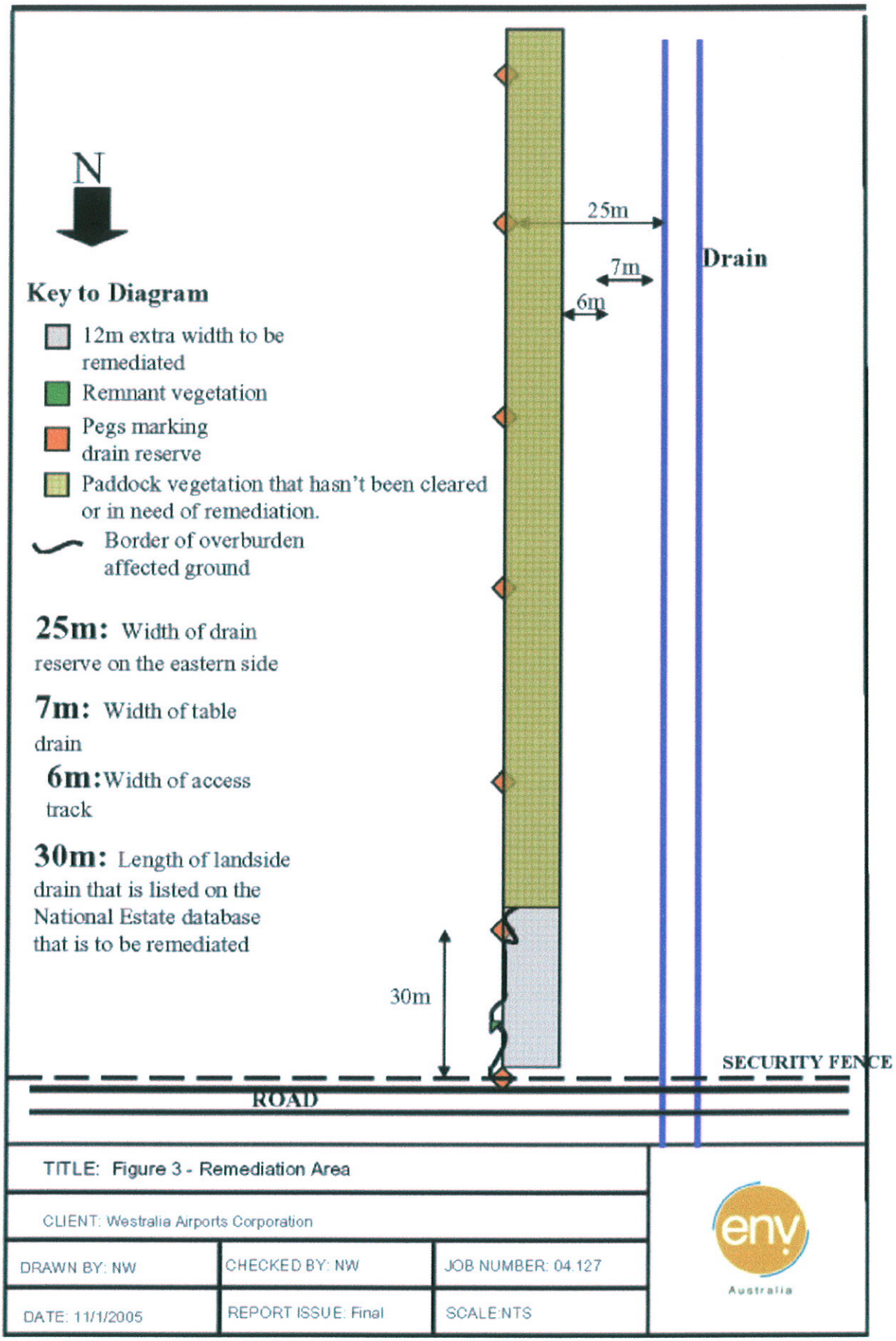
Map source: Environment Strategy, 2004

Figure 1 - Site Location		
CLIENT: Westralia Airports Corporation		
DRAWN BY: NW	CHECKED BY: NW	JOB NUMBER: 04.127
DATE:11/1/2005	REPORT ISSUE: Final	SCALE: NTS

env Australia



TITLE: Figure 2 - Remediation Area		
CLIENT: Westralia Airports Corporation		
DRAWN BY: NW	CHECKED BY: NW	JOB NUMBER: 04.127
DATE: 11/1/2005	REPORT ISSUE: Final	SCALE:NTS


N
Key to Diagram
12m extra width to be remediated
Remnant vegetation
Pegs marking drain reserve
Paddock vegetation that hasn't been cleared or in need of remediation.
Border of overburden affected ground
25m: Width of drain reserve on the eastern side
7m: Width of table drain
6m: Width of access track
30m: Length of landside drain that is listed on the National Estate database that is to be remediated
25m
7m
6m
Drain
30m
SECURITY FENCE
ROAD
TITLE: Figure 3 - Remediation Area
CLIENT: Westralia Airports Corporation
DRAWN BY: NW
CHECKED BY: NW
JOB NUMBER: 04.127
DATE: 11/1/2005
REPORT ISSUE: Final
SCALE:NTS
env Australia

Appendix 3 Detailed Monitoring Records

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Poison Gully
Native Monitoring Summary

Taxa	PLOT 1	PLOT 2	PLOT 3	PLOT 4	TOTAL
Acacia saligna					
Adenanthos cygnorum	1	2			3
Alexgeorgia nitens					
Allocasuarina humilis	45				45
Astartea scoparia					
Banksia attenuata					
Banksia telmatiaea		3	1	2	6
Bolboschoenus caldwellii					
Bossiaea eriocarpa					
Burchardia umbellata					
Conostylis aculeata		1	1		2
Conostylis juncea					
Conostylis sp.	6				6
Coymbia calophylla					
Cyathochaeta avenacea					
Cyperus sp.				1	1
Dampiera alata					
Dasypogon bromelifolius					
Desmocladus flexuosus	2		1		3
Dryandra lindleyana					
Dryandra nivea					
Desmocladus fasciculatus					
Gompholobium marginatum					
Haemodorum laxum					
Haemodorum sp.					
Hakea prostrata	1				1
Hakea varia					
Hardenbergia comptoniana					
Jacksonia furcellata	1				1
Jacksonia sternbergiana			4	2	6
Kennedia prostrata					
Lepidosperma pubisquameum		2			2
Lomandra sp.					
Lyginia imberbis			3		3
Mesomolaena tetragona					
Patersonia occidentalis				1	1
Pericalymma ellipticum var floridum		8	17	29	54
Petrophile linearis					
Schoenus curvifolius					
Siloxerus humifusus	8				8
Stirlingia latifolia					
Verticordia densiflora var densiflora		6	109	49	164
Waitzia suaveolens					
Xanthorrhoea brunonis	9				9
Xanthorrhoea preissii	15				15
? Acacia stenoptera	1				1
TOTAL STEM COUNT:	89	22	136	84	331
AVERAGE DENSITY (Plants/m2)	3.6	0.9	5.4	3.4	3.3
NUMBER OF NATIVE SPECIES IN PLOTS	10	6	7	6	19
NUMBER OF SPECIES IN OR AROUND PLOT	12	12	8	8	26
NUMBER OF NATIVE SPECIES NOV 04					38
NUMBER OF NATIVE SPECIES TO DATE	19	22	21	21	46

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Poison Gully
Weed Monitoring Summary

Taxa	PLOT 1	PLOT 2	PLOT 3	PLOT 4	TOTAL
* Aira caryophyllea				Y	Y
* Anagallis arvensis			Y		Y
* Arctotheca calendula		Y		Y	Y
* Avena barbata					
* Briza maxima					
* Briza minor					
* Conyza sp.		Y			Y
* Cynodon dactylon		Y		Y	Y
* Dittrichia graveolens		Y	Y	Y	Y
* Eragrostis curvula	Y	Y	Y	Y	Y
* Erharta calycina					
* Gladiolus caryophyllaceus			Y		Y
* Hypochaeris glabra / Flatweeds		Y	Y	Y	Y
* Lupinus consentinii				Y	Y
* Poaceae sp.					
* Trifolium sp.					
* Ursinia anthemoides					
* Weed A				Y	Y
% WEED COVER IN PLOT	**0%**	**8%**	**10%**	**7%**	
NUMBER OF WEED SPECIES IN/AROUND PLOT	**1**	**6**	**5**	**8**	**11**
NUMBER OF WEED SPECIES NOV 04					**11**
NUMBER OF WEED SPECIES TO DATE	**3**	**12**	**10**	**13**	**18**

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Poison Gully
Native Monitoring Sheets

Date Monitored: 12/05/2005
Monitored By: Tranen (DG)

Plot Number: 1
Location Description Section H

Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	TOTAL	OBSERVED	Spring 04
Acacia saligna																												
Adenanthos cygnorum													1													1	Y	Y
Alexgeorgia nitens																												
Allocasuarina humilis	4			7	1	5	1				1	4		1	5		2	3		2	1		3	1	4	45	Y	Y
Astartea scoparia																												
Banksia attenuata																												
Banksia telmatiaea																												
Bolboschoenus caldwellii																												
Bossiaea eriocarpa																												Y
Burchardia umbellata																												
Conostylis aculeata																												
Conostylis juncea																												
Conostylis sp.					1	1																	2	1	1	6	Y	
Coymbia calophylla																												
Cyathochaeta avenacea																												
Cyperus sp.																												
Dampiera alata																												
Dasypogon bromelifolius																												
Desmocladus fasciculatus																					1		1			2	Y	Y
Dryandra lindleyana																												Y
Dryandra nivea																											Y	
Eucalyptus sp.																												Y
Gompholobium marginatum																												Y
Haemodorum laxum																												
Haemodorum sp.																												Y
Hakea prostrata																				1						1	Y	
Hakea varia																												Y
Hardenbergia comptoniana																												
Jacksonia furcellata																				1						1	Y	
Jacksonia sternbergiana																											Y	Y
Kennedia prostrata																												
Lepidosperma pubisquameum																												
Lomandra sp.																												
Lyginia imberbis																												
Mesomolaena tetragona																												
Patersonia occidentalis																												
Pericalymma ellipticum var floridum																												
Petrophile linearis																												
Schoenus curvifolius																												
Siloxerus humifusus																		1	1	5		1				8	Y	
Stirlingia latifolia																												
Verticordia densiflora var densiflora																												
Waitzia suaveolens																												Y
Xanthorrhoea brunonis																	2			3	3		1			9	Y	Y
Xanthorrhoea preissii						1					1									8	4	1				15	Y	
? Acacia stenoptera																			1							1	Y	
TOTAL:	4			7	2	7	1				2	4	1	1	5		4	4	2	20	9	2	7	2	5	89	12	

Comments: Grass trees established - have re-emerged from underneath spoil and mulch. Looks bare from a distance but a close inspection reveals otherwise. Most of the new seedlings located within the rip lines.

NOTE: Species in red included in seed mixes. Species in black have emerged / germinated naturally.

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Poison Gully
Weed Monitoring Sheets

Date Monitored: 12/05/2005
Monitored By: Tranen (DG)

Plot Number: 1
Location Description Section H

Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	TOTAL	Spring 04
* Aira caryophyllea																											
* Anagallis arvensis																											
* Arctotheca calendula																											
* Avena barbata																											
* Briza maxima																											
* Briza minor																											
* Conyza sp.																											
* Cynodon dactylon																											
* Dittrichia graveolens																											
* Eragrostis curvula													Y		Y		Y									3	
* Erharta calycina																											Y
* Gladiolus caryophyllaceus																											
* Hypochaeris glabra / Flatweeds																											Y
* Lupinus consentinii																											
* Poaceae sp.																											
* Trifolium sp.																											
* Ursinia anthemoides																											
* Weed A																											
PERCENTAGE COVER	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	4%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
TOTAL SPECIES													1		1		1									1	

Comments:

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Poison Gully
Native Monitoring Sheets

Date Monitored: 12/05/2005
Monitored By: Tranen (DG)

Plot Number: 2
Location Description Section F

Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	TOTAL	OBSERVED	Spring 04
Acacia saligna																											Y	
Adenanthos cygnorum									1								1									2	Y	Y
Alexgeorgia nitens																												
Allocasuarina humilis																												
Astartea scoparia																												Y
Banksia attenuata																											Y	
Banksia telmatiaea	1								1									1								3	Y	Y
Bolboschoenus caldwellii																												Y
Bossiaea eriocarpa																												
Burchardia umbellata																												
Conostylis aculeata									1																	1	Y	
Conostylis juncea																												
Conostylis sp.																												Y
Coymbia calophylla																											Y	
Cyathochaeta avenacea																												Y
Cyperus sp.																												
Dampiera alata																												
Dasypogon bromelifolius																												
Desmocladus fasciculatus																											Y	
Dryandra lindleyana																												Y
Dryandra nivea																												
Eucalyptus sp.																												Y
Gompholobium marginatum																												
Haemodorum laxum																												
Haemodorum sp.																												
Hakea prostrata																												
Hakea varia																											Y	Y
Hardenbergia comptoniana																												
Jacksonia furcellata																											Y	Y
Jacksonia sternbergiana																												
Kennedia prostrata																												Y
Lepidosperma pubisquameum			2																							2	Y	Y
Lomandra sp.																												
Lyginia imberbis																												
Mesomolaena tetragona																												
Patersonia occidentalis																												
Pericalymma ellipticum var floridum		2	2										1							1				1	1	8	Y	Y
Petrophile linearis																												
Schoenus curvifolius																												
Siloxerus humifusus																												Y
Stirlingia latifolia																												Y
Verticordia densiflora var densiflora										1	1	1	1	1		1										6	Y	Y
Waitzia suaveolens																												
Xanthorrhoea brunonis																												
Xanthorrhoea preissii																												Y
TOTAL:	1	2	4						3	1	1	1	2	1		1	1	1		1				1	1	22	12	17

Comments:

NOTE: Species in red included in seed mixes. Species in black have emerged / germinated naturally.

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Poison Gully
Weed Monitoring Sheets

Date Monitored: 12/05/2005
Monitored By: Tranen (DG)

Plot Number: 2
Location Description Section F

Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	TOTAL	Spring 04
* Aira caryophyllea																											Y
* Anagallis arvensis																											Y
* Arctotheca calendula															Y	Y		Y	Y							4	Y
* Avena barbata																											
* Briza maxima																											
* Briza minor																											Y
* Conyza sp.																		Y								1	
* Cynodon dactylon											Y	Y	Y			Y		Y	Y							6	
* Dittrichia graveolens					Y		Y														Y	Y			Y	5	
* Eragrostis curvula	Y	Y	Y	Y	Y			Y			Y				Y	Y	Y				Y	Y	Y	Y	Y	15	
* Erharta calycina																											Y
* Gladiolus caryophyllaceus																											Y
* Hypochaeris glabra / Flatweeds	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y			Y	Y		Y		Y	19	
* Lupinus consentinii																											
* Poaceae sp.																											
* Trifolium sp.																											
* Ursinia anthemoides																											Y
* Weed A																											
PERCENTAGE COVER	5%	2%	5%	10%	10%	2%	1%	7%	5%	1%	5%	15%	2%	2%	10%	10%	30%	5%	20%	1%	20%	15%	2%	5%	5%	8%	
TOTAL SPECIES	2	2	2	2	3	1	2	2			3	2	2	1	3	4	2	3	2	1	3	2	2	1	3	6	

Comments: Lovegrass (Eragrostis) established. Flat weeds just emerging so difficult to identify.

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Poison Gully
Native Monitoring Sheets

Date Monitored: 12/05/2005
Monitored By: Tranen (DG)

Plot Number: 3
Location Description Section B

Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	TOTAL	OBSERVED	Spring 04
Acacia saligna																												Y
Adenanthos cygnorum																												
Alexgeorgia nitens																												
Allocasuarina humilis																												
Astartea scoparia																												Y
Banksia attenuata																												
Banksia telmatiaea										1																1	Y	Y
Bolboschoenus caldwellii																												Y
Bossiaea eriocarpa																												
Burchardia umbellata																												
Conostylis aculeata																				1						1	Y	
Conostylis juncea																												
Conostylis sp.																												Y
Coymbia calophylla																												
Cyathochaeta avenacea																												Y
Cyperus sp.																												
Dampiera alata																												
Dasypogon bromelifolius																												
Desmocladus fasciculatus																				1						1	Y	
Dryandra lindleyana																												Y
Dryandra nivea																												
Eucalyptus sp.																												Y
Gompholobium marginatum																												
Haemodorum laxum																												
Haemodorum sp.																												
Hakea prostrata																												
Hakea varia																												Y
Hardenbergia comptoniana																											Y	
Jacksonia furcellata																												Y
Jacksonia sternbergiana					2											1									1	4	Y	
Kennedia prostrata																												Y
Lepidosperma pubisquameum																												Y
Lomandra sp.																												
Lyginia imberbis														1	1							1				3	Y	
Mesomolaena tetragona																												
Patersonia occidentalis																												
Pericalymma ellipticum var floridum	2		1	1				1		1	1	2		2					1	1			1	2	1	17	Y	Y
Petrophile linearis																												
Schoenus curvifolius																												
Siloxerus humifusus																												Y
Stirlingia latifolia																												Y
Verticordia densiflora var densiflora	5	5	6	2	4	2	3		7	9	6	3	2	6	1		3	6	5	5	9	6	10	2	2	109	Y	Y
Waitzia suaveolens																												
Xanthorrhoea brunonis																												
Xanthorrhoea preissii																												
TOTAL:	7	5	7	3	6	2	3	1	7	11	7	5	2	9	2	1	3	6	6	8	9	7	11	4	4	136	8	16

Comments: Rabbit droppings within plot. Consitent weed cover across plot but good native distribution too.

NOTE: Species in red included in seed mixes. Species in black have emerged / germinated naturally.

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Poison Gully
Weed Monitoring Sheets

Date Monitored: 12/05/2005
Monitored By: Tranen (DG)

Plot Number: 3
Location Description Section B

Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	TOTAL	Spring 04
* Aira caryophyllea																											Y
* Anagallis arvensis			Y			Y	Y						Y													4	Y
* Arctotheca calendula																											Y
* Avena barbata																											
* Briza maxima																											
* Briza minor																											Y
* Conyza sp.																											
* Cynodon dactylon																											
* Dittrichia graveolens					Y				Y	Y	Y	Y		Y	Y	Y				Y	Y					10	
* Eragrostis curvula	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	25	Y
* Erharta calycina																											Y
* Gladiolus caryophyllaceus							Y																			1	Y
* Hypochaeris glabra / Flatweeds		Y	Y	Y	Y	Y	Y		Y				Y	Y	Y		Y		Y					Y	Y	14	
* Lupinus consentinii																											
* Poaceae sp.																											
* Trifolium sp.																											
* Ursinia anthemoides																											Y
* Weed A																											
PERCENTAGE COVER	10%	10%	5%	5%	5%	10%	10%	15%	10%	20%	5%	10%	10%	5%	15%	10%	15%	5%	10%	10%	5%	5%	5%	10%	20%	10%	
TOTAL SPECIES	1	2	3	2	3	3	4	1	3	2	2	2	3	3	3	2	2	1	2	2	2	1	1	2	2	5	

Comments:

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Poison Gully
Native Monitoring Sheets

Date Monitored: 12/05/2005
Monitored By: Tranen (DG)

Plot Number: 4
Location Description Section A

Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	TOTAL	OBSERVED	Spring 04
Acacia saligna																											Y	
Adenanthos cygnorum																												Y
Alexgeorgia nitens																												
Allocasuarina humilis																												Y
Astartea scoparia																												
Banksia attenuata																										2	Y	Y
Banksia telmatiaea	1								1																			Y
Bolboschoenus caldwellii																												
Bossiaea eriocarpa																												
Burchardia umbellata																												
Conostylis aculeata																												
Conostylis juncea																												Y
Conostylis sp.																											Y	
Coymbia calophylla																												Y
Cyathochaeta avenacea															1											1	Y	
Cyperus sp.																												
Dampiera alata																												
Dasypogon bromelifolius																												
Desmocladus fasciculatus																												Y
Dryandra lindleyana																												
Dryandra nivea																												Y
Eucalyptus sp.																												
Gompholobium marginatum																												
Haemodorum laxum																												
Haemodorum sp.																												
Hakea prostrata																												Y
Hakea varia																												
Hardenbergia comptoniana																												Y
Jacksonia furcellata																		1								2	Y	
Jacksonia sternbergiana		1																										Y
Kennedia prostrata																												Y
Lepidosperma pubisquameum																												
Lomandra sp.																												
Lyginia imberbis																												
Mesomolaena tetragona																										1	Y	
Patersonia occidentalis		1																										
Pericalymma ellipticum var floridum				2		2	1			2	1	4			1		4	1		3	1	6			1	29	Y	Y
Petrophile linearis																												
Schoenus curvifolius																												Y
Siloxerus humifusus																												Y
Stirlingia latifolia																												
Verticordia densiflora var densiflora	2			2			1		2	3	1	3	3	5	7	4	1	6	3	5					1	49	Y	Y
Waitzia suaveolens																												
Xanthorrhoea brunonis																												
Xanthorrhoea preissii																												
TOTAL:	3	2		4		2	2		3	5	2	7	3	6	8	8	2	7	6	6	6				2	84	8	16

Comments:

NOTE: Species in red included in seed mixes. Species in black have emerged / germinated naturally.

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Poison Gully
Weed Monitoring Sheets

Date Monitored: 12/05/2005
Monitored By: Tranen (DG)

Plot Number: 4
Location Description Section A

Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	TOTAL	Spring 04
* Aira caryophyllea																			Y			Y				2	Y
* Anagallis arvensis																											Y
* Arctotheca calendula											Y					Y										2	Y
* Avena barbata																											
* Briza maxima																											
* Briza minor																											Y
* Conyza sp.																											
* Cynodon dactylon											Y									Y						2	
* Dittrichia graveolens	Y																									1	
* Eragrostis curvula	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	24	Y
* Erharta calycina																											Y
* Gladiolus caryophyllaceus																											Y
* Hypochaeris glabra / Flatweeds	Y			Y	Y	Y	Y		Y	Y		Y		Y	Y	Y		Y	Y	Y		Y	Y	Y	Y	18	
* Lupinus consentinii			Y																							1	
* Poaceae sp.																											
* Trifolium sp.																											Y
* Ursinia anthemoides																											
* Weed A	Y		Y	Y	Y		Y		Y			Y		Y	Y	Y		Y		Y		Y	Y	Y	Y	16	
PERCENTAGE COVER	10%	5%	5%	5%	5%	5%	5%	5%	5%	10%	20%	10%	5%	5%	1%	2%	2%	20%	10%	20%	5%	5%	5%	5%	2%	7%	
TOTAL SPECIES	4	1	3	3	3	2	3	1	3	2	3	3	1	3	2	4	1	3	3	4	1	4	3	3	3	8	

Comments:

FLORA AND VEGETATION OF GUILDFORD CEMETERY

DRAFT

Prepared for:
Ministry for Planning
Albert Facey House
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PERTH.

Prepared by:
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August 2001

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A: List of Taxa Recorded from Guildford Cemetery
B: Total Taxa Recorded for the Different Vegetation Units
C: Quadrat Data
D Figures
Figure 1. Vegetation Units
Figure 2. Vegetation Condition
Figure 3. Significant Plant Taxa
Figure 4. Threatened Ecological Communities
Figure 5. Protection Value

1 INTRODUCTION

1.1 General Introduction

The Ministry for Planning commissioned Bennett Environmental Consulting Pty Ltd to prepare a report on the flora and vegetation of the remnant vegetation at Guildford Cemetery. Guildford Cemetery is included within Perth Airport and Adjacent Bushland in the Bush Forever Site 386 (Government of Western Australia, 2000).

Planning for the cemetery requires the development of additional areas of the site for burials and memorials. The undeveloped areas are bushland. This requires that a survey of these bushland areas be undertaken.

1.2 Location

Guildford Cemetery is located to the north east of the Perth Metropolitan Region, about 20km from Perth centre. It is transected by Kalamunda Road, and bounded by Great Eastern Highway Bypass near where it joins Kalamunda Road on the north and by the Perth Airport on the south. Noise created by the Perth airport has an influence on an acceptable noise level to conduct a funeral. Peter Cala and Associates (1988) suggest that due to the noise that the southern edge should be bunded and planted to screen and reduce the noise intensity.

1.3 Land Tenure

Guildford Cemetery is a "C" Class Crown Reserve, number 21697, identified as Swan Location 12001 and zoned Public Purpose in the Metropolitan Region Scheme It is a 24 ha. reserve for the purpose of a cemetery and is vested with the Metropolitan Cemeteries Board. The interdenominational cemetery was established in 1890 and was maintained by the local community, most recently the Shire of Swan, until 1989 when the Metropolitan Cemeteries Board took over the cemetery responsibility. The original Guildford Cemetery was situated in James Street, Guildford, but the graves at the current cemetery date back to 1892.

1.4 Objectives of the Current Survey

There are several objectives for the current survey. These include:

- vegetation communities and their associated flora;
- presence of any threatened ecological communities;
- regional assessment of the area;
- linkage to other bushland areas;
- any relevance to the Commonwealth Biodiversity Legislation;
- vegetation community viability;
- assessment of protection values and
- vegetation management issues.

The above information was to be obtained by undertaking a vegetation and flora survey of the area in June – July with a second survey to be undertaken during the spring. The second survey should record plants flowering especially orchid species, many of which were observed in leaf during the first survey.
Each of the above topics will be discussed in the report.

2 PHYSICAL ENVIRONMENT

2.1 Climate

The area has a dry Mediterranean climate with an average rainfall of ± 850mm per year, with about 80% occurring between May and August. The winters are mild with a mean maximum temperature of 16.2°C and a mean minimum of 10.2°C. The summers are warm to hot with a mean maximum temperature of 31°C and a mean minimum of 18.6°C (Bureau of Meteorology, 2001).

2.2 Geology

Guildford Cemetery occurs within two different geological units, both part of the Swan Coastal Plain. One is the Guildford unit within the Pinjarra Plain, the other is the Southern River unit within the Bassendean Dunes. The Guildford unit occurs in the west of the cemetery and the Southern River, the interzone between the Pinjarra Plain and the Bassendean Dunes, to the east.

The wetlands at Guildford Cemetery are included in the Mungala Suite (Semeniuk, 1987). Geomorphically they are the transition between the Bassendean Dunes and Pinjarra Plain. The underlying stratigraphy is a complex of sands, clays, calcrete and laterite. Wetlands lie along the depressions at the distributary ends of the creeks or adjacent to the intermittent disconnected drainage channels.

2.3 Soils

The alluvial terrain, along the eastern fringe of the Coastal Plain, comprises material of different ages. The older layers, characterised by duplex soils, are mapped as the Guildford unit. The Guildford soil association consists of quartz sand that ranges from very fine grained to medium grained, but contains a very small amount of coarser material. Some zones of quartz free clays are encountered, and where surface weathering has occurred, the clay content has been reduced giving rise to clayey sand. The sediments are usually mottled in shades of brown, orange, yellow and grey, and are variously lateritised and oxidised at the surface. (Biggs and Wilde, 1980).

The Southern River unit occurs where sand appears to have been blown over the alluvial soil. The swamps as a result have a clay base.

2.4 Landforms

The Guildford unit consists of lenticular interbeds and mixtures of sand, clay and conglomerate that are locally calcareous. Most of the unit is of fluvial origin but it also includes estuarine and shallow-marine intercalations, especially near the base (Biggs and Wilde, 1980). The fluviatile deposits occur on a flat plain consisting of medium textured yellow duplex soils. The Southern River unit is sandy or swamps with clay bases.

2.5 Flora and Vegetation

Guildford Cemetery intersects two Vegetation Complexes – Guildford on the western half of the site and Southern River on the eastern half. It is one of the few remaining remnants of the intergrade between Bassendean Central and South and Southern River Vegetation Complexes. The Guildford Cemetery remnant contains a mixture of wetlands and uplands in excellent to good condition that is typical of the interface of the

Bassendean Dunes and Pinjarra Plain (Environmental Protection Authority, 1999) the zone between these two areas being mapped as the Southern River Vegetation Complex by Heddle *et al* (1980).

Heddle *et al.* (1980) states that the Guildford Vegetation Complex is dominated by a mixture of an open forest, in sections a tall open forest of *Corymbia calophylla* (marri) – *Eucalyptus wandoo* (wandoo) and *E. marginata* (jarrah) and woodland of wandoo. There are minor components including the fringing vegetation along streams eg woodland of *E. rudis – Melaleuca rhaphiophylla.* Most of this area has been subject to logging and clearing since European settlement. The Southern River Complex consists of an open-woodland of marri-jarrah-banksia on the elevated areas and a fringing vegetation of *E.rudis – M. rhaphiophylla* along the streams.

Structural formations include: *C.calophylla, E. wandoo, E. marginata* Open Forest; *C. calophylla, E. marginata, Banksia* spp. Open Forest; *E.rudis, M. rhaphiophylla* Woodland and *C. calophylla* Woodland.

In Bush Forever (Government of Western Australia, 2000), Guildford Cemetery and Perth Airport are included in the same Site No. 386, that is they are part of the same ecosystem. Perth Airport includes the following vegetation complexes, Bassendean Complex – Central and South and Southern River Complex and the Guildford Complex. The Floristic Community Types (Gibson *et. al,* 1994) included for Bush Forever Site 386 are:

Supergroup2: Seasonal Wetlands

- *Melaleuca preissiana* damplands (Floristic Community Type 4);
- Mixed shrub damplands (Floristic Community Type 5);
- Herb-rich saline shrublands in clay pans (Floristic Community Type 7);
- Wet forests and woodlands (Floristic Community Type 11);
- *Melaleuca teretifolia* and/or *Astartea* affin. *fascicularis* shrublands (Floristic Community Type 12); and
- Forests and woodlands of deep seasonal wetlands (Floristic Community Type 15).

Supergroup 3: Uplands centered on Bassendean Dunes and Danaragan Plateau

- *Banksia attenuata* woodlands over species rich dense shrublands (Floristic Community Type 20a);
- Eastern *Banksia attenuata* and/or *Eucalyptus marginata* woodlands (most northern occurrence) (Floristic Community Type 20b); and
- Central *Banksia attenuata – B. menziesii* woodlands (Floristic Community Type 23a).

The Environmental Protection Authority (1999) lists two threatened ecological communities, Floristic Community Types 20a and 20b as being present at the cemetery in addition to the wetland vegetation. Van Der Moezel (2000) identified three Floristic Community Types in the Guildford Cemetery. These are:

- *Melaleuca preissiana* damplands (Floristic Community Type 4);
- Mixed shrub damplands (Floristic Community Type 5); and
- Central *Banksia attenuata – B. menziesii* woodlands (Floristic Community Type 23a).

In Gibson *et. al* (1994) Floristic Community Type 20a was found on sandy soils at the base of the scarp at Forrestfield covering the land units Southern River and Karakatta.

Structurally it is either, *Banksia attenuata* woodlands or *Eucalyptus marginata – B. attenuata* woodlands. Sites with this community type were differentiated from the other subgroups in Floristic Community Type 20 by the occurrence of *Mesomelaena pseudostygia, Alexgeorgea nitens, Daviesia nudiflora, Synaphea spinulosa, Hibbertia racemosa* and *Stylidium calcaratum*. Floristic Community Type 20b was found on sands at the base of the scarp covering the land units Guildford or Forrestfield. Most sites were *Eucalyptus marginata – Banksia attenuata* woodlands but *Banksia* woodlands and heaths were also recorded. Species that differentiated this group included *Mesomelaena pseudostygia, Hakea stenocarpa, Conostylis setosa* and *Johnsonia* affin. *pubescens* as well as the absence of species indicative of Floristic Community Type 20a.

Floristic Community Type 23a (Gibson *et al*, 1994) is restricted to the Bassendean system. It is characterised by the presence of *Banksia ilicifolia, Kunzea ericifolia, Jacksonia furcellata, Leptomeria cunninghamii, Adenanthos obovatus, Melaleuca preissiana, Schoenus rodwayanus, Hypocalymma angustifolium, Pericalymma ellipticum, Thysanotus multiflorus* and *Baumea vaginalis*.

3 SURVEY METHODOLOGY

The whole cemetery site, as defined in the information provided by the Ministry for Planning, was surveyed on foot to assess the different vegetation units present. In each vegetation unit a permanent, 10m x 10m ($100m^2$) quadrat was placed in a N,S,E,W orientation selecting the quadrat site for the best vegetation condition. A star picket was placed at the NW corner and metal droppers placed at the remaining three corners. A metal tag with the quadrat number was attached to the star picket. A GPS reading was made and a photograph taken at the NW corner.
In addition to the placement of the permanent quadrat the whole of the vegetation unit was traversed on foot to record additional taxa for the unit not represented in the quadrat. By recording these opportunistic species the total species list for each vegetation unit was increased considerably.

3.1 Vegetation

The vegetation of the area was defined for the whole unit, not just for the quadrat. The quadrat was placed in a characteristic section of the community but often it was not possible to include all tree species within the 10m x 10m quadrat. Where tree taxa occurred outside of the quadrat these taxa were recorded separately and built into the vegetation classification. The descriptions were prepared using the vegetation layers as listed in Table 1.
Changes in vegetation structure at Guildford include variation in the;

tree layer, eg. Banksia spp, Jarrah and Marri,
shrub layer, eg. Proteaceae, Myrtaceae and Papilionaceae species, and
understorey layer, eg. sedges, herbs, grasses

Table 1. Vegetation layers. Adapted from: Bush Forever (Government of Western Australia, 2000)

Life Form/ Height Class	Canopy Cover			
	100-70%	70-30%	30-10%	10-2%
Trees over 30m	Tall Closed Forest	Tall Open Forest	Tall Woodland	Tall Open Woodland
Trees 10-30m	Closed Forest	Open Forest	Woodland	Open Woodland
Trees under 10m	Low Closed Forest	Low Open Forest	Low Woodland	Low Open Woodland
Tree mallee/Mallee	Closed Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
Shrub mallee	Closed Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
Shrubs over 2m	Closed Tall Scrub	Tall Open Scrub	Tall Shrubland	Tall Open Shrubland
Shrubs 1-2m	Closed Heath	Open Heath	Shrubland	Open Shrubland
Shrubs under 1m	Closed Low Heath	Open Low Heath	Low Shrubland	Low Open Shrubland
Grasses	Closed Grassland	Grassland	Open Grassland	Very Open Grassland
Herbs	Closed Herbland	Herbland	Open Herbland	Very Open Herbland

3.2 Taxa Present

For each quadrat all taxa were recorded, together, where applicable, with their flower colour, average height, percentage cover and if the taxa were rare or endangered. Time

was spent locating additional species within the same vegetation unit but outside of the quadrat. Where the same vegetation unit occurred in different areas these were also searched to increase the taxa for the unit. Taxa were recorded in the field, but where the identity was unknown or uncertain these were collected and pressed, then later identified using keys and by comparison with the specimens housed at the Western Australian Herbarium. Current nomenclature was checked using FloraBase (Western Australian Herbarium, 2001a) and MAX (Western Australian Herbarium, 2001b).

3.3 Vegetation Condition

The vegetation condition of each quadrat and the vegetation community as a whole was recorded using the 6-scale condition rating as appeared in Bush Forever Vol 2, p. 48 (Government of Western Australia, 2000).

Table 2: Condition rating scale from Bush Forever (Government of Western Australia, 2000)

Rating	Description	Explanation
1	Pristine	Pristine or nearly so, no obvious signs of disturbance.
2	Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
3	Very Good	Vegetation structure altered, obvious signs of disturbance.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it.
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.
6	Completely degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.

If the description as given in Table 2 is used, it gives the impression that the bushland is in better condition than it really is. The classification after Trudgen (1991) gives a better indication of the true bushland condition. Categories 4 and above would be better described using the Trudgen method rather than Bush Forever. As an example category 4, where the bushland is significantly altered, often with many weeds, would be better termed "Poor" rather than "Good".

Table 3: Comparison between the Condition descriptions in Bush Forever and Trudgen (1991)

Description Bush Forever	Description Trudgen (1991)
Pristine	Excellent
Excellent	Very Good
Very Good	Good
Good	Poor
Degraded	Very Poor
Completely degraded	Completely Degraded

3.4 Rare and Priority Flora

Known Rare and Priority Flora for the Perth Airport and Adjacent Bushland are listed in Bush Forever, together with any other significant taxa. Where possible Priority taxa were included in the 10m x 10m quadrats.

Table 4. Rare and Priority Flora listed for Perth Airport and Adjacent Bushland in Bush Forever (Government of Western Australia 2000)

Significant Flora	Comments
Conospermum undulatum	Rare
Macarthuria keighery	Rare
Eucalyptus marginata subsp. *elegantella*	Priority 1 taxon
Tripterococcus paniculatus (ms)	Priority 1 taxon
Myriophyllum echinatum	Priority 3 taxon
Stylidum longitubum	Prioirty 3 taxon
Haemodorum loratum	Priority 3 taxon
Conostephium minus	Priority 4 taxon
Villarsia submersa	Priority 4 taxon
Verticordia lindleyi var. *lindleyi*	Piroirty 4 taxon

Table 5. Code and description of Rare and Priority Flora categories

Code	Code Declared Rare and Priority Flora Categories
R	DRF (Declared Rare Flora) -Extant Taxa. Taxa, which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection.
X	DRF (Declared Rare Flora) -Presumed Extinct Taxa. Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently.
1	Priority One -Poorly Known Taxa. Taxa, which are known from one or a few (generally <5) populations, which are under threat.
2	Priority Two -Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat.
3	Priority Three -Poorly Known Taxa. Taxa which are known from several populations, at least some of which are not believed to be under immediate threat.
4	Priority Four -Rare Taxa. Taxa which are considered to have been adequately surveyed and which whilst being rare, are not currently threatened by any identifiable factors.

3.5 GPS Measurements

At the north west corner of each quadrat the GPS reading was recorded in UTM and latitude and longitude. In addition a photograph taken from this same corner, recorded the quadrat. These measurements will be used to locate the quadrats in the maps produced from the survey.

Where rare or priority flora were located outside the quadrat a GPS readingwas recorded for these taxa.

3.6 Soil Assessment

A simple soil assessment was undertaken at each quadrat. This recorded the colour of the soil and its structure. Where rocks were observed these were also recorded.

3.7 Topography

The Ministry for Planning provided maps with contours for the area prior to undertaking the field work. Field notes also included the position of the quadrat and vegetation unit in relation to the topography.

4 RESULTS

Field work was undertaken on 2nd and 5th July 2001. A walk through the cemetery was undertaken to determine the vegetation variation present prior to placing the quadrats. A comparison was made with the vegetation map of Van Der Moezel (2000). All quadrats were placed as far away from tracks as was possible for two reasons. The first was to ensure that pegs would not be visible to the public using the many tracks and secondly to avoid the highly degraded verges along the track perimeters. Additional opportunistic taxa were recorded by walking the vegetation units, firstly that surrounding the quadrat, and then other areas with the same unit.
The active cemetery site was not surveyed as it has been cleared and several exotic trees have been planted in this area, including *Pinus radiata* and *P. pinaster*.

4.1 Vegetation and Flora

4.1.1 Quadrats

Twelve permanent 10m x 10m quadrats were established in the bushland. These mainly correlated with the vegetation mapping of Van Der Moezel (2000).
The positions of the permanent quadrats are given in Table 6 and marked on Map 1.

Table 6: GPS position of quadrats at Guildford Cemetery

Quadrat Number	UTM Easting	UTM Northing	Latitude	Longitude
G1	50 403401	646 8036	S 31°55'10.1"	E 115°58'41.7"
G2	50 403415	646 7961	S 31°55'12.5"	E 115°58'42.1"
G3	50 403420	646 7915	S 31°55'14.0"	E 115°58'42.3"
G4	50 403515	646 7928	S 31°55'13.7"	E 115°58'45.9"
G5	50 403553	646 7967	S 31°55'12.4"	E 115°58'47.4"
G6	50 403581	646 7971	S 31°55'12.3"	E 115°58'48.5"
G7	50 403731	646 7821	S 31°55'17.2"	E 115°58'54.2"
G8	50 403666	646 7850	S 31°55'16.2"	E 115°58'51.7"
G9	50 403539	646 7841	S 31°55'16.5"	E 115°58'46.8"
G10	50 403680	646 7970	S 31°55'12.3"	E 115°58'52.3"
G11	50 403442	646 8069	S 31°55'09.1"	E 115°58'43.2"
G12	50 403163	646 7985	S 31°55'11.7"	E 115°58'32.6"

4.1.2 Vegetation

Many of the annual plants were still too small to positively identify. These will be checked during the spring survey. A total of 12 different vegetation units were identified at Guildford Cemetery. These are identified in Map 1 and the taxa present lsited in Appendix B. The different vegetation units are described below followed by the abbreviation used on the vegetation map.

4.1.2.1 Seasonal Wetlands

Floristic Community Type 4: Melaleuca preissiana damplands

- **Open Woodland of *Melaleuca preissiana* over Open Low Heath of *Pericalymma ellipticum* var. *ellipticum* and *Verticordia densiflora* over Very Open Sedgeland/Herbland** on sandy clay. (Quadrat G6) **(MpPeVd)**
  Dominant trees: Eucalyptus todtiana, Melaleuca preissiana Cover 8%
  Dominant shrubs: *Euchilopsis linearis, Melaleuca seriata, Pericalymma ellipticum* var. *ellipticum, Verticordia densiflora* Cover 70%
  Dominant sedges/herbs: *Hypolaena exsulca, Lyginia barbata, Phlebocarya ciliata* Cover 8%

This vegetation unit occurred on the eastern edge of the wetland vegetation where it abuts the sandier soil of the *Eucalyptus todtiana, Banksia attenuata, B. menziesii* Woodland, hence there are several taxa of that community included in this quadrat.

- **Low Woodland of *Melaleuca preissiana* over Closed Heath of *Pericalymma ellipticum* var. *ellipticum, Euchilopsis linearis* and *Verticordia densiflora* over Sedgeland/Herbland of *Hypolaena exsulca* and *Lyginia barbata*** on clayey sand. (Quadrat G11) **(MpPeEl)**
  Dominant trees: Acacia saligna, Banksia littoralis, Melaleuca preissiana Cover 12%
  Dominant shrubs: *Adenanthos cygnorum* subsp. *cygnorum, Euchilopsis linearis, Melaleuca seriata, Pericalymma ellipticum* var. *ellipticum, Verticordia densiflora*
  Dominant sedges/herbs: **Ehrharta calycina, Hypolaena exsulca, Lyginia barbata*

This vegetation unit occurred to the east of the current entrance to the southern section of the cemetery and adjacent to Kalamunda Road. The major disturbance is a firebreak between this vegetation unit and Kalamunda Road.

Floristic Community Type 5: Mixed Shrub Damplands

The following three vegetation units are all examples of Floristic Community Type 5 but the area of their occurrence was distinct and therefore separated for mapping.

- **Tall Open Scrub of *Melaleuca lateritia* over Open Low Heath of *Calothamnus lateralis* and *Pericalymma ellipticum* var. *ellipticum* over Sedgeland dominated by *Meeboldina roycei*** on clayey sand. (Quadrat G4) **(MlCl)**
  Dominant tall shrubs: *Melaleuca lateritia* Cover 40%
  Dominant shrubs: *Calothamnus lateralis, Hakea varia, Pericalymma ellipticum* var. *ellipticum, Verticordia densiflora* Cover 50%
  Dominant sedges: *Meeboldina roycei* Cover 40%

- **Open Heath of *Hakea varia* over Closed Low Heath of *Pericalymma ellipticum* var. *ellipticum* and *Verticordia densiflora* over Very Open Sedgeland** on clayey sand. (Quadrat G5) **(HvPe)**
  Dominant tall shrubs: Hakea varia Cover 35%
  Dominant shrubs: *Melaleuca seriata, Pericalymma ellipticum* var. *ellipticum, Verticordia densiflora* Cover 90%
  Dominant sedges: *Lyginia barbata* Cover 5%

- **Closed Low Heath of *Pericalymma ellipticum* var. *ellipticum, Verticordia densiflora* over Very Open Herbland** on clayey sand. (Quadrat G1) **(PeVd)**
  Dominant shrubs: *Hakea sulcata, Melaleuca seriata, Pericalymma ellipticum* var. *ellipticum, Verticordia densiflora* Cover 98%
  Dominant herbs: *Cassytha racemosa* Cover 20%
  Dominant sedges: *Hypolaena exsulca, Lyginia barbata* Cover 12%

This was the dominant wetland vegetation at Guildford Cemetery. The other two units occurred as smaller areas within this large unit.

- **Closed Tall Shrub of *Jacksonia sternbergiana* over Closed Low Heath of *Melaleuca seriata, Pericalymma ellipticum* var. *ellipticum* and *Verticordia densiflora* over Sedgeland/Herbland** on sandy clay. (Quadrat G9) **(Js)**
  Dominant tall shrubs: *Jacksonia sternbergiana* (Cover 80%)
  Dominant shrubs: *Melaleuca seriata, Pericalymma ellipticum* var. *ellipticum, Verticordia densiflora* (Cover 95%)
  Dominant sedges/herbs: *Dasypogon bromeliifolius, Lyginia barbata, Mesomelaena tetragona, Phlebocarya ciliata* (Cover 60%)

This was only a small area on the southern boundary.

4.1.2.2 Uplands

Floristic Community Type 3c: Corymbia calophylla – Xanthorrhoea preissii woodlands and shrublands

- **Closed Forest of *Corymbia calophylla* over Open Low Heath of *Xanthorrhoea preissii* over an open Sedgeland of *Mesomelaena tetragona*** on sandy clay. (Quadrat G3) **(CcXp)**
  Dominant trees: *Corymbia calophylla* (Cover 75%)
  Dominant shrubs: *Acacia sessilis, Hibbertia racemosa, Petrophile linearis, Xanthorrhoea brunonis* subsp. *brunonis, X. preissii* (Cover 55%)
  Dominant sedges/herbs: *Alexgeorgea nitens, Dasypogon bromeliifolius, Mesomelaena tetragona, Tricoryne elatior* (Cover50%)

This vegetation unit occurred on a slight rise immediately above the wetland and occurred adjacent to the following vegetation unit.

- **Low Woodland of *Corymbia calophylla* and *Allocasuarina fraseriana* over Shrubland of *Xanthorrhoea preissii* and *Stirlingia latifolia* over Sedgeland of *Alexgeorgea nitens*** on sandy clay. (Quadrat G2) **(CcAf)**
  Dominant trees: *Allocasuarina fraseriana, Corymbia calophylla* (Cover 25%)
  Dominant shrubs: *Acacia sessilis, Petrophile linearis, Stirlingia latifolia, Xanthorrhoea preissii* (Cover 20%)
  Dominant sedges/herbs: *Alexgeorgea nitens, Dasypogon bromeliifolius, Desmocladus flexuosus, Patersonia occidentalis, Trachymene pilosa* (Cover 45%)

Floristic Community Type 20a: Banksia attenuata woodlands over species rich dense shrublands

This was the dominant upland vegetation type within the Guildford Cemetery but consisted of a few distinct component units as mapped in Map 1 and described below.

- **Open Forest of *Allocasuarina fraseriana* over Low Shrubland of *Hibbertia hypericoides* over Sedgeland of *Alexgeorgea nitens* and *Desmocladus fasciculatus* and *D. flexuosus*** on sand. (Quadrat G8) **(AfHh)**
  Dominant trees: *Allocasuarina fraseriana, Banksia attenuata, B. menziesii B. grandis* (Cover 37%)
  Dominant shrubs: *Daviesia decurrens, Jacksonia floribunda, Hibbertia hypericoides, Petrophile linearis* (Cover 40%)
  Dominant sedges/herbs: *Alexgeorgea nitens, Conostylis setigerus, Desmocladus fasciculatus, D. flexuosus, Phlebocarya ciliata* (Cover 75%)

- **Low Woodland of *Eucalyptus marginata* var. *elegantella* over Low Shrubland of several taxa over Open Sedgeland of *Chordifex sinuosus*** on loam. (Quadrat G7)
  Dominant trees: *Eucalyptus marginata* var. *elegantella* (Cover 15%) **(Em)**
  Dominant shrubs: *Acacia pulchella var. glaberrima, Baeckea camphorosmae, Bossiaea eriocarpa, Jacksonia floribunda. Leucopogon conostephioides* (Cover 30%)
  Dominant sedges: *Alexgeorgea nitens, Chordifex sinuosus, Drosera erythrorhiza, Patersonia occidentalis* (Cover 30%)

- **Low Woodland of *Eucalyptus todtiana, Banksia attenuata, B. menziesii* over a Shrubland of mixed taxa over a Sedgland** on sand. (Quadrat 10). **(EtBaBm)**
  Dominant trees: *Eucalyptus marginata* var. *elegantella, E. todtiana, Banksia menziesii* (Cover 25%)
  Dominant tall shrubs: *Allocasuarina humilis, Jacksonia floribunda, Stirlingia latifolia* (Cover 30%)
  Dominant shrubs: *Allocasuarina humilis, Bossiaea eriocarpa, Calytrix flavescens, Conostephium preissii, Daviesia triflora, Hibbertia hypericoides* (Cover 35%)
  Dominant sedges: *Alexgeorgea nitens, Desmocladus flexuosus, Lyginia barbata, Phlebocarya ciliata* (Cover 20%)

- **Woodland of *Eucalyptus marginata* var. *elegantella, Banksia attenuata, B. menziesii* over Open Low Heath of *Hibbertia hypericoides* and *Bossiaea eriocarpa* over Sedgeland** on sand. (Quadrat G12) **(EmBaBm)**
  Dominant trees: *Allocasuarina fraseriana, Banksia attenuata, B. menziesii, Eucalyptus marginata* var. *elegantella* (Cover 25%)
  Dominant shrubs: *Acacia sessilis, Bossiaea eriocarpa, Conostephium pendulum, Hibbertia hyopericoides, Petrophile linearis, Stirlingia latifolia* (Cover 55%)
  Dominant sedges/Herbs: *Dasypogon bromeliifolius, Mesomelaena pseudostygia* Cover 30%)

4.1.3 Vegetation Condition

Each of the quadrats was placed in an area where the vegetation was in the best available condition. The overall condition of the Guildford Cemetery bushland is indicated in Map 2. Generally the bushland was in very good to excellent condition. The areas of degradation were confined to the edge of tracks through the bushland and to the perimeter around the current section of the cemetery.

Table 7. Vegetation condition of each quadrat

Quadrat Number	Vegetation Condition
G1	1
G2	1
G3	1
G4	2
G5	1
G6	1
G7	2-3
G8	1-2
G9	4
G10	1-2
G11	1
G12	2-3

The vegetation condition of the whole area is mapped on Map 2. The edge of Kalamunda road and the tracks through the bushland were typically degraded to some degree by weed invasion. Along the eastern boundary several degraded areas were recorded due to a combination of rubbish dumping and weed invasion (Map 2). Only the active part of the cemetery has exotic trees planted, none of which have invaded the bushland.
The dominant weeds recorded from the cemetery will be discussed in detail in Section 4.5.

4.1.4 Flora

A total of 295 taxa have been recorded for the Perth Airport and Adjacent Bushland (Bush Forever, 2000). During the current survey a total of 149 taxa in 94 genera and 34 families (Appendix A) was recorded. The dominant families are listed in Table 8.

Table 8. Dominant Plant families recorded from Guildford Cemetery

Vascular Plant Family	Number of Genera	Number of Native Taxa	Number of Weed Taxa	Total Number Taxa
Myrtaceae	11	16	0	16
Proteaceae	8	15	0	15
Papilionaceae	8	14	0	14
Poaceae	7	4	5	9
Haemodoraceae	4	9	0	9
Cyperaceae	4	8	0	8
TOTAL	**42**	**66**	**5**	**71**

These six vascular plant families represent 17.5% of the total families recorded, 71% of the total genera and 48% of the taxa.

Woodland of *Eucalyptus marginata* var. *elegantella, Banksia attenuata, B. menziesii* recorded the most taxa, 66, of all the vegetation units and Open Heath of *Hakea varia* over Closed Low Heath of *Pericalymma ellipticum* var. *ellipticum* and *Verticordia densiflora* the lowest with only 14 taxa. Low Woodland of *Eucalyptus marginata* var. *elegantella* over Low Shrubland and Low Woodland of *Corymbia calophylla* and *Allocasuarina fraseriana* over Shrubland of *Xanthorrhoea preissii* and *Stirlingia latifolia* recorded 52 and 54 taxa respectively.

The wetland vegetation units recorded an average of 32.5 taxa, Floristic Community Type 3a, 48 taxa and Floristic Community Type 20a, 51.3 taxa.

4.1.5 Rare and Priority Taxa

Table 9. Significant Flora recorded for Perth Airport and Adjacent Bushland in Bush Forever (Government of Western Australia 2000)

Taxon	Significance Code	Community Unit	Quadrat Number
Conospermum undulatum	Rare		
Macarthuria keighery	Rare		
Tripterococcus paniculatus	Priority 1		
Eucalyptus marginata subsp. *elegantella*	Priority 2	Em, EmBaBm	G7, G12
Myriophyllum echinatum	Priority 3		
Stylidium longitubum	Priority 3		
Haemodorum loratum	Priority 3		
Conostephium minus	Priority 4		
Villarsia submersa	Priority 4		
Verticordia lindleyi subsp. *lindleyi*	Priority 4		
Platysace juncea	p		
Byblis lindleyana	d,p,r,E		
Conospermum triplinervium	s,p (hybrid with *C. undulatum*)		
Levenhookia preissii	p,s		
Cheilanthes austrotenuifolia	uncommon on plain		
Verticordia nitens	s		
Villarsia violifolia	p,s		

Geographical variation
d = populations disjunct from their known geographical range
r = populations at the northern or southern limit of their known geographical range
s = significant populations
p = considered to be poorly reserved
E = taxa endemic to the Swan Coastal Plain

During the first survey, only one significant taxon, *Eucalyptus marginata* subsp. *elegantella* was recorded from the Guildford Cemetery (Map 3). It is the only subspecies of jarrah recorded from the site and was recorded from all the higher, sandy sites within the cemetery. The distribution of this taxon is illustrated in Map 3. Environmental Protection Authority (1999) recorded two additional taxa, *Tripterococcus paniculatus* and *Stylidium longitubum*, as being present in the Guildford Cemetery.

4.1.6 Weed Taxa

A total of 14 weed taxa, representing 9% of the total taxa were recorded from the Guildford Cemetery bushland. The dominant weed families were Poaceae with 5 taxa, Oxalidaceae and Asteraceae with 3 taxa each.
Pinus radiata and *P. pinaster* have been planted on the northern side of the cemetery but this section of the cemetery is no longer adjacent to bushland. These taxa are on the CALM list as having a moderate rating and as being invasive, but no invasion of the bushland was noted. Other exotic taxa are planted in the cemetery, often in formal beds or as avenues through the cemetery but none are near bushland. There is always the risk of planted exotics spreading into the bushland, so in future local native trees and shrubs should be planted. In the newly developed cemetery area to the north of Kalamunda Road, many of the natural trees have been retained.
The 15 weeds have all been determined as weeds by Department of Conservation and Land Management (1999) and the Western Australian Herbarium (2001a,b) and their rating is given below in Table 10. The rating allocated to each weed by CALM is based on three criteria:

- **Invasiveness** – ability to invade natural bushland in good to excellent condition or ability to invade waterways.
- **Distribution** – wide current or potential distribution including consideration of known history of wide spread distribution elsewhere in the world.
- **Environmental impacts** – Ability to change the structure, composition and function of ecosystems. In particular an ability to form a monoculture in a vegetation community.

Ratings indicate the following.

- **High** indicates this weed is prioritised for control and/or research ie prioritising funding to it.
- **Moderate** indicates control or research effort should be directed to it if funds are available, however it should be monitored (possibly a reasonably high level of monitoring).
- **Mild** indicates monitoring of the weed and control where appropriate.
- **Low** indicates that this species would require a low level of monitoring.

Table 10. List of Weed Taxa recorded from Guildford Cemetery (Appendix A)

Scientific Name	Common Name	CALM Rating		
		Rating	Invasiveness	Impacts
**Ehrharta calycina*	Perennial veldt grass	High	✓	✓
**Eragrostis curvula*	African lovegrass	High	✓	✓
**Watsonia bulbillifera*	Watsonia	High	✓	✓
**Aira caryophyllea*	Silver hair grass	Moderate	✓	
**Anagallis arvensis* var. *arvensis*	Pimpernel	Moderate	✓	
**Ehrharta longiflora*	Annual veldt grass	Moderate	✓	
**Briza maxima*	Blowfly grass	Moderate	✓	
**Gladiolus caryophyllaceus*	Wild gladiolus	Moderate	✓	
**Hypochaeris glabra*	Flatweed	Moderate	✓	X
**Solanum nigrum*	Nightshade	Moderate	✓	
**Sonchus oleraceus*	Common sowthistle	Moderate	✓	
**Ursinea anthemoides*	Ursinea	Moderate	✓	
**Oxalis glabra*		Mild		
**Oxalis pes-caprae*	Soursob	Mild		
**Oxalis purpurea*	Four o'clock	Low		

✓= weed is invasive and/or will impact on the bushland.

The distribution of the weeds within the different vegetation units is given in Appendix B. Three of the weed taxa are rated as High on both invasiveness and impact, indicating that these are the weeds that should be targeted as a priority for removal. There were only a few plants of *Watsonia bulbillifera* observed at the edge of the wetland. These should be targetted for immediate removal before they have the chance to spread. *Asparagus asparagoides*, Bridal creeper, a common weed through metropolitan Perth was not recorded during the survey. It is expected that during the spring survey this taxon may be recorded.

Hypochaeris glabra was recorded from 10 vegetation units, *Gladiolus caryophyllaceus* and *Ursinia anthemoides* from 8 vegetation units; *Briza maxima* and *Ehrharta calycina* from 4 vegetation units.

4.2 Threatened Ecological Communities

The Guildford Cemetery remnant contains a mixture of wetlands and uplands in excellent to good condition that is typical of the interface between the Bassendean Dunes and the Pinjarra Plain, the zone between these two areas being mapped as the Southern River Vegetation Complex by Heddle *et al* (1980). The Guildford Cemetery bushland remnant is one of the few areas representing the intergrade of these two complexes in the Perth Metropolitan Area.

The Environmental Protection Authority (1999) listed two threatened environmental communities (Floristic Community Types 20a and 20b) as present at the Guildford Cemetery. In addition this bushland is one of the few remaining representatives of the intergrade between Bassendean Central and South and Southern River Vegetation Complexes. During this current survey Floristic Community Type 20a was identified, in addition Floristic Community Type 3c, considered by English (2001) as Critically

Endangered was also identified. Floristic Community Type 3c was located beside the wetland.

Although the Floristic Vegetation Communities 4 and 5 associated with the wetlands are not listed as endangered, it is unusual to find these communities in such excellent condition. The vegetated wetland is surrounded by regionally significant upland vegetation, as described in Bush Forever for Site 386 (Government of Western Australia, 2000).

The two vegetation complexes in which these floristic communities occur, Guildford and Southern River are listed in Perth's Bushplan (Government of Western Australia, 1998) as having 6% and 17% respectively remaining uncleared of the original vegetation within the Perth Metropolitan Area. With the implementation of Bush Forever (Government of Western Australia, 2000) it is intended that a minimum of 10% of the remainder of any vegetation complex is protected in the Perth Metropolitan area. As such any vegetation of these complexes that remains outside of secure reserves may be considered for some protection status.

The Waters and Rivers Commission has recommended that the wetland within Guildford Cemetery be included in the 'Conservation' management category. It is well vegetated with very little weed invasion and is a significant wetland, as it is estimated that only 16% of the damplands between Moore River and Mandurah remain vegetated.

Within Perth Airport two vegetation units, Forrestfield Bushland and Munday Swamp Bushland, are listed on the Australian Heritage Commission, Register of the National Estate database. Neither occur in or immediately adjacent to the Guildford Cemetery but the wetlands at the cemetery are considered to be a suitable site for Swamp Tortoise release (Environmental Protection Authority, 1999). However as Guildford Cemetery is included within the Bush Forever Site 386 the remnant bushland at Guildford Cemetery is significant for conservation and protection of these listed areas.

The threatened ecological communities are illustrated in Map 4.

4.3 Regional Assessment

The two, wetland Floristic Community Types 4 and 5 recorded at Guildford Cemetery are considered well reserved and of low risk. By being well reserved it indicates these communities are known from two or more A-class National Parks or Nature Reserves.

The upland vegetation included a Threatened Ecological Community, Floristic Community Type 3c. It is estimated there is approximately 41ha of the Floristic Community Type remaining on seven widely separated remnants. Of this 41ha, 4ha occur on land vested in the Commonwealth Government, 27ha vested in Shire Councils, 10ha in unvested reserves or vacant crown land and about 0.3ha in a Nature Reserve.

Floristic Community Type 20a is listed as an Endangered Ecological Community (English, 2001). Gibson *et al* (1994) list this Floristic Community Type as unreserved indicating that it is not known to occur in any A class National Park or Nature Reserve.

The wetlands at Guildford Cemetery are regarded as regionally significant and of an outstanding 'conservation category' seasonally waterlogged basin, Wetland 2034IISE No 66 (Hill *et al*, 1996). This wetland is part of System 6 area, M52 and is in the top 11% of this wetland type and natural grouping. The wetland vegetation organisation and cover is maculiform, ie it reflects the highest levels of wetland habitat interspersion and diversity.

All these Floristic Community Types occur within the larger bushland area of Perth Airport but Guildford Cemetery and Perth Airport bushland are considered one Bush Forever site (Government of Western Australia, 2000).
Floristic Community Type 20a is recorded from other Bush Forever Sites, in particular Bushmead Bushland at Swan (Site 213) and Hawkvale Bushland at High Wycombe (Site 122). These do not link with Guildford Cemetery but are within 10km of the cemetery. Although development of the Hawkvale Bushland was approved, and has occurred, an area of excellent vegetation has been retained for conservation. Floristic Community Type 3a is also recorded from the Talbot Road Bushland (Site 306) and from the Bushmead Bushland, but at the latter location it is degraded.
The two Bush Forever sites closest to the Guildford Cemetery are South Guildford Bushland (Site 311) and Swan River Backwater, South Guildford (Site 491). Site 311 has not had extensive sampling but includes representatives of the Floristic Community Types, Supergroups 1 (Foothills/Pinjarra Plains), 2 (Seasonal Wetlands) and 3 (Uplands centered on Bassendean Dunes and Dandaragan Plain). Both Supergroups 2 and 3 were recorded at the cemetery but the wetlands are *Eucalyptus rudis* over *Banksia ilicifolia*, and were not found at the cemetery. Site 491, on the Swan River at South Guildford has vegetation totally different to that at the Guildford Cemetery.
The above confirms that the bushland of Perth Airport as a whole, that is including Guildford Cemetery, is unique and predominantly in very good to excellent condition.

4.4 Linkage to Other Bushland Areas

The main linkage is to Perth Airport. The cemetery is beside the area intended by the airport for conservation so the wetlands, in particular, form an integral part of the airport wetland complex. There is no adjacent bushland but Guildford Cemetery is considered as part of Greenways 26, 99, 109 and 110 (Tingay, Alan and Associates, 1988). In Map 7, in Bush Forever (Government of Western Australia, 2000) Guildford Cemetery is included in an existing or potential bushland/wetland linkage.
The closest Bush Forever site is No 311 although there is no vegetated linkage. This site includes a Conservation zone wetland, and vegetation associated with the Guildford and Southern River Complexes but no detailed vegetation survey has been undertaken. This site is also part of Greenways 110 and part of the same existing or potential bushland/wetland linkage as Guildford Cemetery.

4.5 Commonwealth Biodiversity Legislation

None of the taxa in the Guildford Cemetery bushland are listed by Environment Australia.
Floristic Vegetation Type 3c is listed as a Threatened Ecological Community by Environment Australia (EPBC Act) under the Environment Protection and Biodiversity Conservation Act 1999 (Environment Australia, 2001). Prior to the establishment of the EPBC Act threatened species and ecological communities were listed under the Endangered Species Protection Act 1992. Taxa or Communities listed under the original act will retain their classification although endangered, vulnerable and extinct have now been added under the 1999 Act to the original endangered under the 1992 Act. As both

these Floristic Community Types were listed in Schedule 2 of the Endangered Species Protection Act they are classified as "Endangered".

In this schedule the listing is as below:

- ***Corymbia calophylla – Xanthorrhoea preissii* Woodlands and Shrublands of the Swan Coastal Plain.** It is characterised by woodlands with common taxa including *Corymbia calophylla, Xanthorrhoea preissii* and *Dryandra nivea* with *Eucalyptus wandoo* as an occasional dominant. It occurs on the driest soils and on sites with lowest rainfall compared to the other three *Corymbia calophylla* communities that occur on the heavy soils of the eastern Swan Coastal Plain. Introduced species include *Briza maxima* and *Romulea rosea* but weed levels in most are quite low. The mean richness for the plots surveyed is 48 taxa per $100m^2$. The remaining seven patches are threatened by clearing, weed invasion, hydrological changes due to clearing and draining and too frequent fires. Originally this community would have extended from Bullsbrook to Waterloo but has been reduced by at least 97%.

Only ecological communities classified by English (2001) as 'critically endangered' are listed under the EPBC Act as 'endangered'.

If development of Floristic Vegetation Type 3c is to continue, a referral will need to be made to Environment Australia. Depending upon this outcome a Commonwealth environmental impact assessment and approval will be required if it is determined there will be a significant impact on the vegetation community viability of this Threatened Ecological Community.

4.6 Vegetation Community Viability

Guildford Cemetery has graves dating back to 1892. The southern side of the cemetery is the oldest and is the only area where intact bushland remains. The northern section of the cemetery has been cleared of the native vegetation, except for a few trees. This cemetery has been used for decades and yet most of the remnant vegetation is in excellent condition so the vegetation has already existed with development for a over century. Provided no additional development of the wetland areas occurs and a sufficient buffer is maintained around the perimeter of the wetlands there is no reason why this vegetation at Guildford Cemetery should not continue to be viable.

4.6.1 Important Vegetation Communities

The cemetery is part of the same ecosystem as Perth Airport, System 6 Area M52 which is listed on the Register of the National Estate by the Australian Heritage Commission (Australian Heritage Commission, 2001). The cemetery includes a small area of Floristic Vegetation Type 3c, listed as a Threatened Ecological Community by Environment Australia under the Environment Protection and Biodiversity Conservation Act 1999 (Environment Australia, 2001). The dominant Floristic Vegetation Type 20a is listed as endangered (English, 2001) of which there are few, small, isolated occurrences, many of which are under threat.

The wetland is regarded by the Waters and Rivers Commission as regionally significant and of an outstanding 'conservation category' seasonally waterlogged basin, Wetland 2034IISE No 66 (Hill *et al*, 1996). This is in the top 11% of this wetland type and natural grouping. The wetland vegetation organisation and cover is maculiform, ie it reflects the

highest levels of wetland habitat interspersion and diversity. The Floristic Vegetation Types 4 and 5 are not listed as endangered (English, 2001).

4.6.2 Size of Communities

The wetland is of a reasonable size, approximately half of the total remaining vegetation at the cemetery and is a part of the total wetland that continues into Perth Airport.
Floristic Vegetation Type 3c, listed as a Threatened Ecological Community by Environment Australia is extremely small and would be under threat of complete removal if the surrounding vegetation was not maintained.
The upland vegetation Floristic Community Type 20a surrounds the wetland area on the east and west. The two areas are therefore separated, about 500m long and 100m wide and could readily be under threat from disturbance.

4.6.3 Condition of Communities

The condition of the cemetery bushland is very good to excellent with only small areas of degraded vegetation with 9% only of the total taxa recorded being weeds. This is a very low percentage of weeds present in an area, so overall the condition of the Guildford Cemetery is excellent. This is indicated in Map 2. Dense weeds are restricted to a few areas only.

4.6.4 Threatening Processes

One of the major threatening processes within the Guildford Cemetery is from people dumping rubbish and driving along the firebreaks and vehicle sized treacks. Cars, old fuel drums, household rubbish, beds and other camping bits and pieces were observed during the survey. Opportunistically passing the cemetery a 4-wheel drive vehicle was seen driving down one of the tracks, presumably to dump rubbish. Fencing is essential, with locked gates placed across the vehicle entrances to bushland. In a couple of areas, away from the tracks, there were old camp sites.
There is a dog refuge close to the airport. From prints on the tracks several of the dogs appear to be walked along the southern firebreak and two major tracks transecting the bushland from north to south. They do not create additional tracks. One person observed walking the firebreak had the dog on a lead. Very few people were observed walking the tracks through the bushland so proliferation of tracks by walkers etc does not appear to be a problem.
Dieback did not appear to be present although there was one area at 50403330N and 6467885E where several *Stirlingia latifolia, Allocasuarina fraseriana* and *Banksia menziesii* were recorded dead and dying. This area stretched for about 20m to the N, W and E of this point. In the Low Woodland of *Eucalyptus marginata* var. *elegantella* beside Kalamunda Road some dead jarrah and Banksia trees are dead but this may be due to other factors. An analysis by a dieback qualified technician should confirm or deny the presence of dieback.
Fires appear to have been prevalent through the bushland although it has not degraded the bushland greatly. The *Banksia attenuata, B. menziesii – Eucalyptus marginata subsp. elegantella – E. todtiana* woodlands appear to have suffered the most, with the trees markedly stunted and the diversity reduced compared to other similar sites. Wildfires are

impossible to contain and Guildford Cemetery has the disadvantage of being on a major road and beside another large bushland area at the airport.
A problem with the bushland immediately beside the grave area is the dumping of dead flowers, branches off trees, plastic flowers etc. Staff from the cemetery have dumped branches cut off the pines, mulch and other materials in this area. This is of concern as if seeds remain in the cones or the discarded flowers, they can fall out, possibly germinate and could eventually become weeds in the bushland. All tree clippings etc should be disposed of off site. Sand disposal did not appear to be the same problem as at the other cemeteries as this is replaced after the burial.
Water draw down by the excessive use of the ground water for irrigation etc would affect the wetland condition. By conserving the vegetation this should not be a concern.

4.7 Assessment of Protection Values

The factors for determining the protection values within Guildford Cemetery are:

- presence of restricted vegetation units;
- bushland condition – it is important to protect the better quality vegetation as determined by the field work;
- maintain the variation in the vegetation as determined during the field work;
- wetland communities and their condition; and
- ensuring a vegetated buffer is maintained between the bushland and the cemetery.

All of Guildford Cemetery is regarded as having the highest protection value but as this project required the assessment of the area it was broken up into the following three categories. Some areas of the cemetery bushland are of higher protection value than other areas but it must be understood that this does not mean that they are not of importance, only of slightly lesser importance. These are described in Table 11 and illustrated in Map 5.

Table 11. Assessment of Protection Values for Vegetation at Guildford Cemetery

SCALE	DESCRIPTION
1	Includes Threatened Ecological Community by Environment Australia (EPBC Act) and/or CALM (English, 2001) and/or Waters and Rivers Authority; Presence of Rare or Priority Flora; vegetation in Excellent to Pristine Condition.
2	Scale 1 but where vegetation is Good to Very Good; may include Significant Taxa.
3	Area degraded but can with effort be restored to a good or better condition. The vegetation community may be common but it is important as a buffer to Protection Value 1 and 2 areas.
4	Includes areas that are not necessary as a buffer and that are in Poor condition.
5	Developed. Vegetation severely altered.

The protection values for Guildford Cemetery are illustrated in Map 5.

4.7.1 Protection Value 1

The major protection values within Guildford Cemetery apply to the extensive and varied wetlands in excellent to very good condition. These wetlands are regarded as regionally significant and of an outstanding 'conservation category' seasonally waterlogged basin,

Wetland 2034IISE No 66 (Hill *et al*, 1996) and are in the top 11% of the maculiform wetland type and natural grouping. The variation in the different vegetation units recorded from this wetland is unusual for such a small area. The Australian Heritage Commission considers this wetland as part of the vegetation units at Perth Airport. Gibson *et al* (1994) include the wetlands as Floristic Community Types 4 and 5, both of which are well reserved and of low risk. Although the vegetation of the wetland is not listed as an Endangered Vegetation Community it is unusual to find wetland vegetation in such good condition. All these Floristic Community Types occur within the larger bushland area of Perth Airport but Guildford Cemetery and Perth Airport bushland are considered one Bush Forever site. In addition this wetland acts as an important connection with the vegetation to be conserved at Perth Airport.
A small area of Floristic Vegetation Type 3c, listed as a Threatened Ecological Community by Environment Australia was recorded from the Guildford Cemetery. This is not recorded from Perth Airport (Government of Western Australia, 2000) but has been recorded from Bushmead Bushland (Bush Forever Site 213) and Talbot Road Reserve (Bush Forever Site 306).

4.7.2 Protection Value 2

The main vegetation bordering the wetland is the Low Woodland of *Eucalyptus todtiana* over a Shrubland of mixed taxa over a Sedgland to the east and Woodland of *Eucalyptus marginata* var. *elegantella, Banksia attenuata, B. menziesii* over Open Low Heath of *Hibbertia hypericoides* and *Bossiaea eriocarpa* over Sedgeland to the west of the wetland. Both these vegetation units are included in the endangered Floristic Vegetation Type 20a. The current southern area of the cemetery is contained within what would originally have been the Woodland of *Eucalyptus marginata* var. *elegantella, Banksia attenuata, B. menziesii* over Open Low Heath of *Hibbertia hypericoides* and *Bossiaea eriocarpa* over Sedgeland. This vegetation unit was typically more degraded than the other units however it must be maintained to provide an important buffer for the wetland vegetation and for continuity with the Perth Airport bushland.

4.7.3 Protection Value 3

Generally the condition of Guildford Cemetery bushland is in good or better condition. There are a few degraded sections but the large section on Kalamunda Road acts as a very important buffer to the wetland and as such must not be developed. This is an area that with time and effort can be quickly restored to its near original condition.

4.7.4 Protection Value 4

The smaller section adjoining Perth Airport on Kalamunda Road is severely degraded but predominantly with *Ehrharta calycina, a weed which is readily controlled with a selective herbicide. Again if time is spent in this area it should be possible to restore it to a much better condition.

4.7.5 Protection Value 5

Current and historical sections of the cemetery.

No additional development should take place within Guildford Cemetery. Recently an area on the south side of the road was cleared for graves, which should provide a sufficient area for burials for several years. If an additional area is required for expansion of the cemetery a new site should be sought. This site should be removed from wetland areas and be degraded. This will ensure the high quality of the current bushland at Guildford Cemetery is assured.

4.8 Vegetation Management Issues

4.8.1 General Issues

- Only use the currently cleared areas for additional burials.
- Organise the removal of trimmed branches and other waste from the cemetery.
- Continue the monitoring of the bushland for dieback.
- Ensure that no further exotic plants are planted in the areas adjacent to the bushland. Exotic plants include all plants not naturally occurring within that particular vegetation unit.

4.8.2 Short Term Issues

- Close unnecessary tracks through the bushland. This can be achieved by the placement of bollards across the closed tracks where they meet the developed area. Most of the tracks are relatively wide, certainly of car width. Tracks necessary for cemetery maintenance and fire control should be maintained.
- Treat the edges of the closed tracks for weeds, using acceptable techniques and preferably undertaken by someone who has sympathy for the vegetation. Remove *Watsonia bulbillifera* plants from the edge of the wetland.
- Rehabilitate the closed tracks with seed collected from the cemetery and Perth Airport bushland, using taxa appropriate to the area.
- Fence the cemetery along Kalamunda Road to the airport access road, blocking access to the southern and eastern boundaries where a lot of dumping has occurred. Where access is required for Cemetery Board vehicles these gates must be locked.
- Develop a fire management plan and ensure that all staff are trained in the required techniques.
- Develop a dieback management plan and ensure all staff understand the importance of the plan and its management.

4.8.3 Medium Term Issues

- Monitor the success of track rehabilitation and plant additional seedlings where and if required to improve the rehabilitation condition.
- Remove rubbish from the bushland.
- Combine management of the wetland and other bushland with the management plan for Perth Airport. If this does occur, then some access through or under the cyclone fence between the two bushland should be

made. This will allow animals to pass between the wetland areas. At present the fence must be a barrier to most animals.

4.8.4 Long Term Issues

- Continue monitoring for spread of dieback. If dieback areas are identified ensure immediate treatment.
- Prepare information on the uniqueness of the vegetation to be distributed to adjacent residences and visitors to the bushland.

5 DISCUSSION

The bushland at the Guildford Cemetery is extremely diverse as indicated by the twelve communities described. The wetland with six vegetation units described for such a small area is unusual and these occur within two Floristic Community Types 4 and 5 (Gibson *et al.*, 1994). The boundaries between the vegetation units were distinct, with the Closed Low Heath of *Pericalymma ellipticum* var. *ellipticum* and *Verticordia densiflora* being the most common unit. However, as a whole, the wetland covers nearly one third of the total remnant bushland at Guildford Cemetery, a size that is viable and should be able to survive the threats listed above. The main threat to the wetland will be water draw down eg. if any further housing/manufacture etc development occurs near the cemetery. Further extension of the cemetery within the higher ground vegetation units will reduce the current vegetated buffer surrounding the wetland area. This could, and most possibly would, be a potential threat to the wetland survival as it would allow weed invasion and possibly open up the area to more people pressure with the development of additional tracks through the wetland.

The bushland is generally in excellent condition with only the current cemetery and other small areas degraded. As a large area of the remnant bushland is wetland and listed as an outstanding 'conservation category' seasonally waterlogged basin no development should occur within this area. This wetland is part of System 6 area, M52 and is in the top 11% of this wetland type and natural grouping and reflects the highest levels of wetland habitat interspersion and diversity. In submissions to the Environmental Protection Authority (1999) the Waters and Rivers Commission advised that the conservation category dampland is well vegetated with only minor levels of weed invasion. It is estimated that only 16% of damplands between the Moore River and Mandurah remain vegetated (Hill et al, 1996). Some other people submitting information to the Environmental Protection Authority (1999) believe the area would meet the general criteria for listing on the Ramsar Convention in that it "supports an appreciable assemblage of rare, vulnerable or endangered species" and "is of special value as the habitat of plants or animals at a critical stage of their biological cycle". The wetlands must not be filled in as 80% of the wetlands on the coastal plain have already been lost (Environmental Protection Authority, 1999).

Floristic Community Type 3c and Floristic Community Type 20a are listed as Critically Endangered and Endangered respectively by English (2001). Floristic Vegetation Type 3c is also listed as a Threatened Ecological Community by Environment Australia, thus requiring permission be sought from Environment Australia before any development of this community can occur. Both these communities are represented elsewhere as stated above but Floristic Community Type 20a also occurs at Perth Airport. *Banksia ilicifolia* was not common at the Guildford Cemetery only being recorded on the edge of the wetland in the Banksia woodland communities.

There must be no barrier between the wetlands in the Guildford Cemetery and the other contiguous wetland in Perth Airport. This will necessitate providing some access through or under the present cyclone fence between the cemetery and airport. The wetlands of the area are being considered for the release of theWestern Swamp Tortoise (*Pseudemydura umbrina*), Australia's most endangered vertebrate species (Kuchling and Burbidge, 1996). This area and Ellen Brook and Twin Swamp Nature Reserves are currently being

considered for the long-term conservation and reintroduciton of the species, but the latter two appear to be too small for the long term survival of the species.
There is evidence of many rabbits in the cemetery bushland, although the vegetation does not appear to be suffering. An attempt should be made to cull their numbers.
The Critically Endangered Guildford Springtail (*Australotomurus* sp. (SAM#122621)) is known only from the Guildford Cemetery. The Department of Conservation and Land Management recommends that no native vegetation within the cemetery be cleared as there is little information about the Guildford Springtail and their interim recovery plan has not yet commenced.
Remnant native vegetation in the Perth Metropolitan area should be retained (Environmental Protection Authority, 1999) especially with such diverse vegetation units, because it is irreplaceable, has outstanding biodiversity, heritage, recreational and scintific value to current and future generations, and contributes to the moderating climate and air quality in Perth. The high ground vegetation provides a good buffer zone for the wetland ensuring the long term viability of the wetlands. Guildford Cemetery is included in Area M52 in System 6
The Waters and Rivers Commission also commented on the excessive abstraction of water for irrigation purposes and the affect it could have on the wetland and that cemeteries are known to pose a risk to groundwater quality (Environmental Protection Authority, 1999).
The main use of the bushland area by the public appears to be using the tracks for 4-wheel driving and dumping of rubbish. Most of the tracks traverse the sandy higher ground and do not pass through the wetland. The firebreak on Kalamunda Road is the main track traversing the wetland.
The large track originally put in when a proposed alternative route through the cemetery was cleared in 1997, must be closed and rehabilitated. Already there are plants commencing to grow but this should be supplemented with seeding and plantings of taxa relevant to the particular vegetation unit and with seed or cuttings collected from the cemetery bushland or with permission from the adjacent airport land. It is essential that the correct taxa are planted and that the genotype of the area be maintained.
Dieback should be monitored through the bushland. Dieback was not apparent when the vegetation survey was undertaken, although one small area, where several plants were recorded dead was noted.

6 RECOMMENDATIONS

The following recommendations for the protection of the Guildford Cemetery bushland and future development for burials are:

- no further development of the bushland for burials, only use the ground currently cleared on the north and south side of Kalamunda road;
- seek an alternative site for the cemetery as Peter Cala (1998) stated that the aircraft noise from Perth Airport was not conducive for funerals;
- consider the possiblity of land acquisition on the north side of Kalamunda Road, including the pistol club, pet food manufacturer, animal refuge and the West Aviat Golf Club;
- when enhancing the natural vegetation nodes in the lawned areas plant only taxa of the appropriate vegetation unit;
- reduce the number of tracks through the bushland, particularly the large one constructed in 1997;
- remove all rubbish from the bushland and fence the area to ensure there is no further dumping of rubbish by people;
- develop a fire management plan;
- remove all tree clippings etc off the cemetery for disposal and develop a plan for future rubbish removal.

Continued monitoring on a regular basis must occur;

- of the permanent quadrats established during this and previous surveys and
- for the presence of new dieback occurrences by professional dieback qualified personnel.

Action plans should be developed for;

- fire prevention and management, in conjunction with the local Fire Brigade and CALM,
- weed control techniques and methods in conjunction with a professional practitioner to ensure the correct spray and/or techniques are applied,
- rehabilitation methods, including ground preparation, seeding and planting techniques,
- seed collection and storage as well as
- monitoring and accepted treatment methods for dieback.

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APPENDIX A

LIST OF TAXA RECORDED FROM GUILDFORD CEMETERY

FAMILY	TAXON	COMMON NAME
ZAMIACEAE	*Macrozamia riedlei*	Zamia
POACEAE	**Aira caryophyllea*	Silvery hairgrass
	Amphipogon turbinatus	
	Austrodanthonia sp.	
	**Briza maxima*	Blowfly grass
	Cyathochaeta avenacea	
	**Ehrharta calycina*	Perennial veldt grass
	**Ehrharta longiflora*	Annual veldt grass
	**Eragrostis curvula*	African lovegrass
	Neurachne alopecuroidea	Foxtail mulga grass
CYPERACEAE	*Lepidosperma angustatum*	
	Lepidosperma squamatum	
	Mesomelaena pseudostygia	
	Mesomelaena tetragona	Semaphore sedge
	Schoenus brevisetis	
	Schoenus curvifolius	
	Schoenus clandestinus	
	Tetraria octandra	
RESTIONACEAE	*Alexgeorgea nitens*	
	Chordifex sinuosus	
	Desmocladus fasciculatus	
	Desmocladus flexuosus	
	Hypolaena exsulca	
	Lyginia barbata	
	Lyginia imberbis	
	Meeboldina roycei	
CENTROLEPIDIACEAE	*Centrolepis aristata*	
COMMELINACEAE	*Cartonema philydroides*	
DASYPOGONACEAE	*Dasypogon bromeliifolius*	Pineapple bush
	Lomandra ? sp	
	Lomandra hermaphrodita	
	Lomandra nigricans	
	Lomandra preissii	
XANTHORRHOEACEAE	*Xanthorrhoea brunonis* subsp. *brunonis*	
	Xanthorrhoea preissii	Grass tree
ANTHERICACEAE	*Arthropodium preissii*	
	Chamaescilla corymbosa var. *corymbosa*	Blue squill
	Johnsonia pubescens var. *pubescens*	Pipe lily
	Laxmannia ramosa subsp. *ramosa*	Branching lily
	Laxmannia sessiliflora	
	Thysanotus manglesianus	Fringed lily
	Tricoryne elatior	Autumn lily
COLCHICACEAE	*Burchardia umbellata*	Milkmaids
HAEMODORACEAE	*Anigozanthos manglesii* subsp. *manglesii*	Red and green kangaroo paw
	Conostylis ? aurea	
	Conostylis aurea	Golden conostylis
	Conostylis festucacea subsp. *festucacea*	
	Conostylis serrulata	

FAMILY	TAXON	COMMON NAME
HAEMODORACEAE (cont.)	*Conostylis setigera* subsp. *setigera*	Bristly conostylis
	Haemodorum laxum	Blood root
	Haemodorum spicatum	Mardja
	Phlebocarya ciliata	
IRIDACEAE	**Gladiolus caryophyllaceus*	Pink gladiolus
	Patersonia juncea	Rush leaved patersonia
	Patersonia occidentalis	Purple flag
	Watsonia bulbillifera	Watsonia
ORCHIDACEAE	*Caladenia sp.*	
	Pterostylis affin. sanguinea	
	Pterostylis sp.	Greenhood
	Pterostylis vittata	Banded greenhood
	Pyrorchis nigricans	Potato orchid
CASUARINACEAE	*Allocasuarina fraseriana*	Sheoak
	Allocasuarina humilis	Scrub sheoak
PROTEACEAE	*Adenanthos cygnorum* subsp. *cygnorum*	Woolly bush
	Banksia attenuata	Slender banksia
	Banksia grandis	Bull banksia
	Banksia ilicifolia	Holly leaved banksia
	Banksia littoralis	Swamp banksia
	Banksia menziesii	Firewood banksia
	Dryandra lindleyana subsp. *lindleyana*	Couch honeypot
	Hakea prostrata	Harch hakea
	Hakea sulcata	Furrowed hakea
	Hakea varia	Variable leaved hakea
	Persoonia sacculata	Snottygobble
	Petrophile linearis	Pixie mops
	Petrophile seminuda	
	Stirlingia latifolia	Blue boy
	Synaphea spinulosa subsp. *spinulosa*	Pinda
LORANTHACEAE	*Nuytsia floribunda*	Christmas tree
LAURACEAE	*Cassytha flava*	Dodder laurel
	Cassytha racemosa	
DROSERACEAE	*Drosera erythrorhiza*	Red ink sundew
	Drosera menziesii	Pink rainbow
	Drosera pallida	Pale rainbow
	Drosera sp.	Sundew
PITTOSPORACEAE	*Pronaya fraseri* var. *fraseri*	Elegant pronaya
MIMOSACEAE	*Acacia applanata*	
	Acacia pulchella var. *glaberrima*	Prickly moses
	Acacia saligna	Orange wattle
	Acacia sessilis	
PAPILIONACEAE	*Bossiaea eriocarpa*	Common brown pea
	Daviesia decurrens	Prickly bitter pea
	Daviesia incrassata	
	Daviesia triflora	
	Euchilopsis linearis	Swamp pea
	Gompholobium tomentosum	Hairy yellow pea
	Hovea chorizemifolia	Holly leaved hovea

FAMILY	TAXON	COMMON NAME
PAPILIONACEAE (cont.)	*Hovea trisperma* var. *trisperma*	Common hovea
	Jacksonia floribunda	Holly pea
	Jacksonia affin. *furcellata*	
	Jacksonia sp. new	
	Jacksonia sternbergiana	Stinkwood
	Kennedia prostrata	Scarlet runner
	Nemcia capitata	Bacon and eggs
	Papilionaceae	
OXALIDACEAE	**Oxalis glabra*	Finger leaf oxalis
	**Oxalis pes-caprae*	Sowersob
	**Oxalis purpurea*	Four o'clock
RUTACEAE	*Boronia ramosa* subsp. *anethifolia*	
DILLENIACEAE	*Hibbertia huegelii*	
	Hibbertia hypericoides	Yellow buttercups
	Hibbertia racemosa	Stalked guinea flower
	Hibbertia rhadinopoda	
VIOLACEAE	*Hybanthus calycinus*	Wild violet
MYRTACEAE	*Astartea fascicularis*	
	Baeckea camphorosmae	Canphor laurel
	Calothamnus lateralis	
	Calytrix flavescens	Summer starflower
	Calytrix fraseri	Pink summer calytrix
	Corymbia calophylla	Marri
	Eremaea pauciflora var. *pauciflora*	
	Eucalyptus marginata subsp. *elegantella*	Jarrah
	Eucalyptus todtiana	Prickly bark
	Melaleuca lateritia	Robin redbreast bush
	Melaleuca preissiana	Moonah
	Melaleuca seriata	Honeymyrtle
	Pericalymma ellipticum var. *ellipticum*	Swamp teatree
	Scholtzia involucrata	Spiked scholtzia
	Verticordia densiflora	Dense featherflower
	Verticordia drummondii	Drummond's featherflower
APIACEAE	*Trachymene pilosa*	Native parsnip
EPACRIDACEAE	*Astroloma pallidum*	Kick bush
	Conostephium pendulum	Pearl flower
	Leucopogon conostephioides	
	Lysinema ciliatum	Curry flower
PRIMULACEAE	**Anagallis arvensis* var. *arvensis*	Pimpernel
CHLOANTHACEAE	*Pityrodia bartlingii*	Woolly dragon
SOLANACEAE	**Solanum ? nigrum*	Black berry nightshade
GOODENIACEAE	*Dampiera linearis*	Common dampiera
	Lechenaultia floribunda	Free flowering leschenaultia
STYLIDIACEAE	*Stylidium amoenum*	Lovely triggerplant
	Stylidium brunonianum	Pink fountain triggerplant
	Stylidium repens	Matted triggerplant
	Stylidium sp.	Triggerplant
ASTERACEAE	**Hypochaeris ? glabra*	
	**Hypochaeris glabra*	Flatweed

FAMILY	TAXON	COMMON NAME
ASTERACEAE (cont.)	*Olearia paucidentata*	Autumn scrub daisy
	Quinetia urvillei	
	Senecio quadridentatus	Cotton fireweed
	**Sonchus oleraceus*	Sowthistle
	**Ursinia anthemoides*	Ursinia

APPENDIX B

TAXA RECORDED FOR EACH VEGETATION UNIT

Abbreviation	Vegetation Description
MpPeVd	Open Woodland of *Melaleuca preissiana* over Open Low Heath of *Pericalymma ellipticum* var. *ellipticum* and *Verticordia densiflora* over Very Open Sedgeland/Herbland
MpPeEl	Low Woodland of *Melaleuca preissiana* over Closed Heath of *Pericalymma ellipticum* var. *ellipticum* and *Verticordia densiflora* over Sedgeland/Herbland of *Euchilopsis linearis, Hypolaena exsulca* and *Lyginia barbata*
MlCl	Tall Open Scrub of *Melaleuca lateritia* over Open Low Heath of *Calothamnus lateralia* and *Pericalymma ellipticum* var. *ellipticum* over Sedgeland dominated by *Meeboldina roycei*
HvPe	Open Heath of *Hakea varia* over Closed Low Heath of *Pericalymma ellipticum* var. *ellipticum* and *Verticordia densiflora*
PeVd	Closed Low Heath of *Pericalymma ellipticum* var. *ellipticum, Verticordia densiflora* over Very Open Herbland
CcXp	Closed Forest of *Corymbia calophylla* over Open Low Heath of *Xanthorrhoea brunonis* subsp. *brunonis* over an open Sedgeland of *Mesomelaena tetragona*
AfHh	Open Forest of *Allocasuarina fraseriana* over Low Shrubland of *Hibbertia hypericoides* over Sedgeland of *Alexgeorgea nitens* and *Desmocladus fasciculatus* and *D. flexuosus*
EmBaBm	Woodland of *Eucalyptus marginata* var. *elegantella, Banksia attenuata, B. menziesii* over Open Low Heath of *Hibbertia hypericoides* and *Bossiaea eriocarpa* over Sedgeland
CcAf	Low Woodland of *Corymbia calophylla* and *Allocasuarina fraseriana* over Shrubland of *Xanthorrhoea preissii* and *Stirlingia latifolia* over Sedgeland of *Alexgeorgea nitens*
Em	Low Woodland of *Eucalyptus marginata* var. *elegantella* over Low Shrubland of several taxa Open Sedgeland of *Chordifex sinuosus*
EtBaBm	Low Woodland of *Eucalyptus todtiana, Banksia attenuata, B. meziesii* over a Shrubland of mixed taxa over a Sedgland
Js	Closed Tall Shrub of *Jacksonia sternbergiana* over Closed Low Heath of *Melaleuca seriata, Pericalymma ellipticum* var. *ellipticum* and *Verticordia densiflora* over Sedgeland/Herbland

PRESENT IN FLORISTIC VEGETATION TYPE / TAXON	FLORISTIC VEGETATION TYPE												
	4		5				3a		20a				
	MpPeEl	MpPeVd	MlCl	HvPe	PeVd	Js	CcXp	CcAf	AfHh	Em	EtBaBm	EmBaBm	Total
Acacia applanata		1					1	1					3
Acacia pulchella var. *glaberrima*		1						1	1	1		1	5
Acacia saligna	1	1	1	1	1								5
Acacia sessilis							1	1	1		1	1	5
Adenanthos cygnorum subsp. *cygnorum*	1	1			1		1		1	1			6
**Aira caryophyllea*								1					1
Alexgeorgea nitens		1					1	1	1	1	1		6
Allocasuarina fraseriana						1	1	1	1	1	1	1	7
Allocasuarina humilis					1				1	1	1		3
Amphipogon turbinatus								1	1		1		3
**Anagallis arvensis* var. *arvensis*						1		1					2
Anigozanthos manglesii subsp. *manglesii*									1	1		1	3
Arthropodium preissii								1		1		1	3
Astartea fascicularis			1										1
Asteraceae					1								1
Astroloma pallidum							1					1	2
Austrodanthonia sp.							1			1		1	3
Baeckea camphorosmae		1						1		1			3
Banksia attenuata						1			1	1		1	4
Banksia grandis									1				1
Banksia ilicifolia	1											1	2
Banksia littoralis	1				1								2
Banksia menziesii	1							1	1	1	1	1	6
Boronia ramosa subsp. *anethifolia*								1					1
Bossiaea eriocarpa										1	1	1	3
**Briza maxima*			1					1		1		1	4
Burchardia umbellata								1	1	1		1	4
Caladenia sp.			1									1	2
Calothamnus lateralis			1	1									2
Calytrix flavescens											1		1
Calytrix fraseri					1								1
Cartonema philydroides	1												1
Cassytha flava		1	1	1	1	1	1						6
Cassytha racemosa	1				1								2
Centrolepis aristata			1										1
Chamaescilla corymbosa var. *corymbosa*		1											1
Chordifex sinuosus										1			1
Conostephium pendulum									1	1	1	1	4
Conostylis ? aurea											1		1
Conostylis aurea		1		1		1		1	1	1		1	7

PRESENT IN FLORISTIC VEGETATION TYPE /	FLORISTIC VEGETATION TYPE												
	4		5				3a		20a				
TAXON	MpPeEl	MpPeVd	MlCl	HvPe	PeVd	Js	CcXp	CcAf	AfHh	Em	EtBaBm	EmBaBm	Total
Conostylis festucacea subsp. *festucacea*			1										1
Corymbia calophylla						1	1	1		1			4
Cyathochaeta avenacea						1							1
Dampiera linearis										1			1
Dasypogon bromeliifolius	1	1			1	1	1	1	1	1	1	1	10
Daviesia decurrens						1			1				2
Daviesia incrassata				1									1
Daviesia triflora									1	1	1	1	4
Desmocladus fasciculatus									1	1			2
Desmocladus flexuosus		1					1	1	1	1	1	1	7
Drosera erythrorhiza	1				1			1	1	1	1	1	7
Drosera menziesii												1	1
Drosera pallida		1							1	1		1	4
Drosera sp.			1										1
Dryandra lindleyana subsp. lindleyana								1					1
**Ehrharta calycina*	1	1				1				1			4
**Ehrharta longiflora*					1			1					2
**Eragrostis curvula*						1							1
Eremaea pauciflora var. *pauciflora*											1		1
Eucalyptus marginata subsp. *elegantella*	1									1	1	1	4
Eucalyptus todtiana		1							1		1		3
Euchilopsis linearis	1	1			1								3
**Gladiolus caryophyllaceus*	1				1	1		1	1	1	1	1	8
Gompholobium tomentosum	1	1			1	1		1		1		1	7
Haemodorum laxum									1	1		1	3
Haemodorum spicatum					1	1		1					3
Hakea prostrata					1								1
Hakea sulcata			1		1	1							3
Hakea varia			1	1	1	1							4
Hibbertia huegelii							1		1			1	3
Hibbertia hypericoides							1	1	1	1	1	1	6
Hibbertia racemosa							1	1					2
Hibbertia rhadinopoda							1						1
Hovea chorizemifolia												1	1
Hovea trisperma var. *trisperma*		1				1	1	1	1	1	1	1	8
Hybanthus calycinus										1			1
**Hypochaeris glabra*	1	1	1		1	1	1	1	1		1	1	10
Hypolaena exsulca	1	1	1	1	1	1			1				7
Jacksonia floribunda		1			1			1	1	1	1	1	7
Jacksonia sp. new	1												1
Jacksonia sternbergiana					1	1			1				3

PRESENT IN FLORISTIC VEGETATION TYPE /	FLORISTIC VEGETATION TYPE												
	4		5				3a		20a				
TAXON	MpPeEl	MpPeVd	MlCl	HvPe	PeVd	Js	CcXp	CcAf	AfHh	Em	EtBaBm	EmBaBm	Total
Laxmannia ramosa subsp. *ramosa*	1	1			1			1	1		1	1	7
Laxmannia sessiliflora												1	1
Lechenaultia floribunda					1								1
Lepidosperma angustatum												1	1
Lepidosperma squamatum	1		1			1	1	1		1			6
Leucopogon conostephioides										1	1	1	3
Lomandra ? sp								1					1
Lomandra hermaphrodita					1								1
Lomandra nigricans	1							1				1	3
Lomandra preissii		1					1	1		1		1	5
Lyginia barbata		1	1	1	1	1	1	1	1		1	1	10
Lyginia imberbis	1												1
Lysinema ciliatum									1			1	2
Macrozamia riedlei							1			1	1	1	4
Meeboldina roycei			1										1
Melaleuca preissiana	1	1	1	1	1	1							6
Melaleuca lateritia			1										1
Melaleuca seriata	1	1	1	1	1	1							6
Mesomelaena pseudostygia									1	1		1	3
Mesomelaena tetragona		1			1	1	1	1		1			6
Nemcia capitata		1			1		1	1				1	5
Neurachne alopecuroidea												1	1
Nuytsia floribunda	1	1			1		1						4
Olearia paucidentata							1	1					2
**Oxalis glabra*										1			1
**Oxalis pes-caprae*										1			1
**Oxalis purpurea*	1									1			2
Papilionaceae				1	1								2
Patersonia juncea		1					1					1	3
Patersonia occidentalis	1				1		1	1	1	1	1		7
Pericalymma ellipticum var. *ellipticum*	1	1	1	1	1	1							6
Persoonia sacculata								1					1
Petrophile linearis							1	1	1	1	1	1	6
Petrophile seminuda											1		1
Phlebocarya ciliata	1	1			1	1	1		1		1		7
Pityrodia bartlingii												1	1
Pronaya fraseri												1	1
Pterostylis sanguinea	1	1						1					3
Pterostylis sp.					1								1
Pterostylis vittata	1										1	1	3
Pyrorchis nigricans											1		1
Quinetia urvillei			1				1	1					3
Schoenus brevisetis		1							1			1	3

PRESENT IN FLORISTIC	FLORISTIC VEGETATION TYPE												
VEGETATION TYPE /	4		5				3a		20a				
TAXON	MpPeEl	MpPeVd	MlCl	HvPe	PeVd	Js	CcXp	CcAf	AfHh	Em	EtBaBm	EmBaBm	Total
Schoenus clandestinus									1				1
Schoenus curvifolius					1								1
Senecio quadridentatus			1										1
**Solanum ? nigrum*	1												1
**Sonchus oleraceus*	1							1					2
Stirlingia latifolia		1		1	1		1	1	1	1	1	1	9
Stylidium amoenum												1	1
Stylidium brunonianum	1								1	1		1	4
Stylidium repens										1			1
Stylidium sp.	1												1
Synaphea spinulosa subsp. *spinulosa*		1					1	1				1	4
Tetraria octandra										1		1	2
Thysanotus manglesianus		1				1	1	1		1	1	1	7
Tricoryne elatior							1					1	2
**Ursinia anthemoides*	1	1			1	1	1	1		1		1	8
Verticordia densiflora	1	1	1	1	1	1							6
Verticordia drummondii					1								1
**Watsonia bulbillifera*						1						1	2
Xanthorrhoea brunonis subsp. *brunonis*						1	1	1				1	4
Xanthorrhoea preissii		1				1	1	1	1			1	6
Xanthosia huegelii	1	1	1		1			1			1	1	7
Cordate leaf - Apiaceae			1										1
Grand Total	38	42	25	14	44	34	40	54	45	52	37	66	491

APPENDIX C

QUADRAT DATA

FLORA DATA SHEETS

Project: MFP -	**Date:** 2nd July 2001	**Surveyors:** EB &JB
Location: SITE G1 Aerial Photograph:N/A		
DATUM: Site 1 Site 2 Site 3 Site 4 Site 5 Site 6	Easting **50 403401**	Northing **646 8036**
Soil type: Sand ✓ :silt : clay Colour Grey	**Rocks**: (average size) **N/A**	**Outcropping** Type and percentage **N/A**
Litter Bark %; Leaves 5 % Twigs 2 %; Logs %	**Topography:** Br; R; US; MS; LS; **DL**; MIC; MAC **Aspect: Swamp**	**Film No:** **Photo No. 3**
Percentage cover of strata (for quadrat) Trees %; Shrubs >2m %; Shrubs 1-2m 98 %; Shrubs <1m %; Herbs 20 %; Grasses/sedges 12 %; Bare Ground %		
Vegetation Description: **Heath of Pericalymma ellipticum var. ellipticum, Verticordia densiflora with scattered Melaleuca preissiana, Acacia saligna, Jacksonia sternbergiana**		
Condition: **1**		
Rare or Priority Flora:		
Other Notes: Dieback/Age since fire/ Predators/Erosion/Weeds/Tracks/Position in cemetery. Behind green shed at the southern entrance		

Colln No	Species	Fl Colour	Ht (cm)	% Cover	Rare/ 1^{o}
	Adenanthos cygnorum subsp. *cygnorum*		120	<1	
G01-4	*Cassytha flava*		T	<1	
G01-2	*Cassytha racemosa*		T	20	
	Dasypogon bromeliifolius		30	1	
	Ehrharta longiflora		5	<1	
	Gladiolus caryophyllaceus		15	<1	
	Gompholobium tomentosum		40	<1	
G01-3	*Hakea sulcata*		90	3	
	Hypochaeris ? glabra		2	<1	
	Hypolaena exsulca		35	2	
	Kennedia prostrata		5	<1	
G01-5	*Laxmannia ramosa* subsp. *ramosa*		25	1	
	Lechenaultia floribunda		15	1	
	Lyginia barbata		50	10	
G01-1	*Melaleuca seriata*		90	5	
	Pericalymma ellipticum var. *ellipticum*	pink	110	75	
	Phlebocarya ciliata		30	2	
	Quinetia urvillei		5	<1	
	Trachymene pilosa		5	<1	
	Ursinia anthemoides		5	<1	
	Verticordia densiflora		60	15	

Quadrat G1

FLORA DATA SHEETS

Project: MFP -	**Date:** 2nd July 2001	**Surveyors:** EB &JB
Location: **SITE G2** **Aerial Photograph:N/A**		
DATUM: Site 1 Site 2 Site 3 Site 4 Site 5 Site 6	Easting **50 403415**	Northing **646 7961**
Soil type: Sand ✓ :silt : clay Colour Grey	**Rocks**: (average size) **N/A**	**Outcropping** Type and percentage **N/A**
Litter Bark %; Leaves % Twigs %; Logs %	**Topography:** Br; R; US; MS; LS; DL; MIC; MAC **Aspect: Flat**	**Film No:** **Photo No. 4**
Percentage cover of strata (for quadrat) Trees 25 %; Shrubs >2m %; Shrubs 1-2m 20 %; Shrubs <1m %; Herbs 45 %; Grasses %; Bare Ground 5 %		
Vegetation Description: **Corymbia calophylla, Allocasuarina fraseriana Woodland over shrubs and sedges**		
Condition: **1**		
Rare or Priority Flora:		
Other Notes: Dieback/Age since fire/ Predators/Erosion/Weeds/Tracks/Position in cemetery Rise above the wetland. No dieback apparent Burnt about 5 years ago		

Colln No	Species	Fl Colour	Ht (cm)	% Cover	Rare/ 1^{O}
	Acacia sessilis		100	3	
	Aira caryophyllea		3	<1	
	Alexgeorgea nitens		25	40	
	Allocasuarina fraseriana		600	20	
	Anagallis arvensis var. *arvensis*		3	<1	
	Arthropodium ? preissii		5	1	
	Burchardia umbellata		15	<1	
	Corymbia calophylla		600	5	
	Dasypogon bromeliifolius		45	10	
G02-2	*Desmocladus flexuosus*		25	3	
	Drosera erythrorhiza		P	<1	
	Ehrharta longiflora		5	<1	
	Gladiolus caryophyllaceus		15	<1	
	Hibbertia hypericoides		50	<1	
G02-1	*Hibbertia racemosa*		40	<1	
	Hovea trisperma var. *trisperma*		50	<1	
	Hypochaeris ? glabra		2	3	
	Lepidosperma squamatum		45	<1	
	Lomandra ? sp		15	<1	
	Nemcia capitata		45	<1	
	Patersonia occidentalis		25	2	
	Petrophile linearis		30	3	
	Quinetia urvillei		5	3	
	Schoenus curvifolius		40	<1	
	Sonchus oleraceus		2	<1	
	Stirlingia latifolia		110	10	
	Trachymene pilosa		5	3	
	Ursinia anthemoides		5	1	
	Xanthorrhoea brunonis subsp. *brunonis*		90	1	
	Xanthorrhoea preissii		110	5	

Quadrat G2

FLORA DATA SHEETS

Project: MFP -	Date: 2nd July 2001	Surveyors: EB &JB
Location: **SITE G3** **Aerial Photograph:N/A**		
DATUM: Site 1 Site 2 Site 3 Site 4 Site 5 Site 6	Easting **50 403420**	Northing **6467915**
Soil type: Sand ✓ :silt : clay Colour Grey	**Rocks**: (average size) **N/A**	**Outcropping** Type and percentage **N/A**
Litter Bark %; Leaves 10 % Twigs 5 %; Logs %	**Topography:** Br; R; US; MS; LS; DL; MIC; MAC **Aspect: Flat**	**Film No:** **Photo No. 5**
Percentage cover of strata (for quadrat) Trees 75 %; Shrubs >2m %; Shrubs 1-2m %; Shrubs <1m 55 %; Herbs 50 %; Grasses %; Bare Ground %		
Vegetation Description: **Corymbia calophylla over sedges and Xanthorrhoea preissii and X. brunonis**		
Condition: **1**		
Rare or Priority Flora:		
Other Notes: Dieback/Age since fire/ Predators/Erosion/Weeds/Tracks/Position in cemetery. Vegetation consists of small stands beside the wetland		

Colln No	Species	Fl Colour	Ht (cm)	% Cover	Rare/ 1^{O}
	Acacia applanata		35	2	
	Acacia sessilis		50	5	
	Alexgeorgea nitens		15	2	
	Allocasuarina fraseriana		300	<1	
G03-3	*Astroloma pallidum*		5	<1	
	Corymbia calophylla		1200	25	
	Dasypogon bromeliifolius		50	15	
	Desmocladus flexuosus		25	<1	
	Hibbertia huegelii		45	3	
G02-1	*Hibbertia hypericoides*		50	2	
G02-3	*Hibbertia racemosa*		45	2	
G03-1	*Hibbertia rhadinopoda*		15	<1	
	Hovea trisperma var. *trisperma*	purple/cream	45	2	
	Kennedia prostrata		5	<1	
	Lepidosperma squamatum		40	2	
	Lomandra preissii	purple/cream	40	<1	
	Lyginia barbata		40	1	
	Mesomelaena tetragona		80	15	
	Nemcia capitata		70	2	
	Nuytsia floribunda		500	1	
	Patersonia occidentalis		50	<1	
	Petrophile linearis		70	3	
	Phlebocarya ciliata		45	<1	
	Schoenus curvifolius		50	1	
	Scholtzia involucrata		30	1	
	Stirlingia latifolia		50	1	
	Thysanotus manglesianus		t	<1	
	Tricoryne elatior		55	10	
	Xanthorrhoea brunonis subsp. *brunonis*		70	5	
	Xanthorrhoea preissii		90	35	

Quadrat G3

FLORA DATA SHEETS

Project: MFP -	**Date:** 2nd July 2001	**Surveyors:** EB &JB
Location: **SITE G4** **Aerial Photograph:N/A**		
DATUM: Site 1 Site 2 Site 3 Site 4 Site 5 Site 6	Easting **50 403515**	Northing **5467928**
Soil type: Sand 8 :silt 2 : clay Colour Dark grey	**Rocks**: (average size) **N/A**	**Outcropping** Type and percentage **N/A**
Litter Bark %; Leaves 15 % Twigs 10 %; Logs %	**Topography:** Br; R; US; MS; LS; **DL**; MIC; MAC **Aspect: Flat**	**Film No:** **Photo No. 6**
Percentage cover of strata (for quadrat) Trees %; Shrubs >2m 40 %; Shrubs 1-2m %; Shrubs <1m 50 %; Herbs %; Grasses /sedges 40 %; Bare Ground 20 %		
Vegetation Description: **Melaleuca sp. ?rhaphiophylla over sedges and Calothamnus lateralis**		
Condition: **2**		
Rare or Priority Flora:		
Other Notes: Dieback/Age since fire/ Predators/Erosion/Weeds/Tracks/Position in cemetery .Few open areas where people appear to have camped some time previously Several plants covered in Cassytha. Fire about 5 years ago		

Colln No	Species	Fl Colour	Ht (cm)	% Cover	Rare/ 1^{o}
	Briza maxima		15	<1	
	Caladenia sp.		10	<1	
G04-1	*Calothamnus lateralis*		110	35	
G04-5	*Centrolepis aristata*		5	<1	
G04-6	*Conostylis festucacea* subsp. *festucacea*		15	<1	
	Drosera sp.		1	<1	
	Hakea varia		140	<1	
	Hypochaeris ? glabra		5	5	
	Lepidosperma squamatum		40	<1	
G04-2	*Meeboldina roycei*		120	40	
	Melaleuca lateritia		300	40	
G04-7	*Pericalymma ellipticum* var. *ellipticum*		115	5	
	Quinetia urvillei		5	2	
G04-4	*Senecio quadridentatus*		120	5	
	Verticordia densiflora		90	5	
	Trachymene pilosa		2	<1	
G04-3	Cordate leaf, unknown _Apiaceae?		2	<1	

Quadrat G4

FLORA DATA SHEETS

Project: MFP -	**Date:** 10th July 2001	**Surveyors:** EB &JB
Location: SITE G5 Aerial Photograph:N/A		
DATUM: Site 1 Site 2 Site 3 Site 4 Site 5 Site 6	Easting **50 403553**	Northing **64679674**
Soil type: Sand 4 :silt 6 : clay Colour Grey	**Rocks**: (average size) **N/A**	**Outcropping** Type and percentage **N/A**
Litter Bark %; Leaves % Twigs 5 %; Logs %	**Topography:** Br; R; US; MS; LS; DL; MIC; MAC **Aspect: Flat**	**Film No:** **Photo No. 7**
Percentage cover of strata (for quadrat) Trees %; Shrubs >2m %; Shrubs 1-2m 35 %; Shrubs <1m 90 %; Herbs %; Grasses/sedges 12 %; Bare Ground 10 %		
Vegetation Description: **Hakea varia over Verticordia densiflora, Melaleuca seriata, Pericalymma ellipticum var. ellipticum**		
Condition: **1**		
Rare or Priority Flora:		
Other Notes: Dieback/Age since fire/ Predators/Erosion/Weeds/Tracks/Position in cemetery .Burnt within the last 5 years		

Colln No	Species	Fl Colour	Ht (cm)	% Cover	Rare/ 1^{O}
	Cassytha racemosa		T	1	
	Conostylis aurea		10	<1	
	Hakea varia		180	35	
	Lyginia barbata		50	5	
	Melaleuca seriata		70	5	
G05-1	*Papilionaceae*		110	<1	
	Pericalymma ellipticum var. *ellipticum*		70	15	
	Verticordia densiflora		50	70	

Quadrat G5

FLORA DATA SHEETS

Project: MFP -	**Date:** 2nd July 2001	**Surveyors:** EB &JB
Location: SITE G6 Near fence Aerial Photograph:N/A		
DATUM: Site 1 Site 2 Site 3 Site 4 Site 5 Site 6	Easting **50 403581**	Northing **546 7971**
Soil type: Sand 7 :silt 3 : clay Colour Grey	**Rocks**: (average size) **N/A**	**Outcropping** Type and percentage **N/A**
Litter Bark %; Leaves 5 % Twigs %; Logs %	**Topography:** Br; R; US; MS; LS; DL; MIC; MAC **Aspect: Flat**	**Film No:** **Photo No. 8**
Percentage cover of strata (for quadrat) Trees 8 %; Shrubs >2m %; Shrubs 1-2m %; Shrubs <1m 70 %; Herbs %; Grasses/sedges 8 %; Bare Ground 10 %		
Vegetation Description: **Melaleuca preissiana and scattered juvenile Eucalyptus todtiana over shrubs**		
Condition: **1**		
Rare or Priority Flora:		
Other Notes: Dieback/Age since fire/ Predators/Erosion/Weeds/Tracks/Position in cemetery. Burnt within the last 5 years		

Colln No	Species	Fl Colour	Ht (cm)	% Cover	Rare/ 1°
	Adenanthos cygnorum subsp. *cygnorum*		150	1	
	Cassytha racemosa		T	<1	
	Chamaescilla corymbosa var. *corymbosa*		5	<1	
	Conostylis aurea		15	<1	
	Dasypogon bromeliifolius		50	1	
	Eucalyptus todtiana		100	1	
	Euchilopsis linearis		40	3	
	Hypochaeris ? glabra		5	<1	
	Hypolaena exsulca		50	3	
G01-1	*Laxmannia ramosa* subsp. *ramosa*		10	<1	
G06-1	*Lyginia barbata*		60	3	
	Melaleuca preissiana		1400	8	
	Melaleuca seriata		40	3	
	Patersonia juncea		35	<1	
	Pericalymma ellipticum var. *ellipticum*		120	25	
	Phlebocarya ciliata		30	3	
	Stirlingia latifolia		130	5	
	Thysanotus manglesianus		T	<1	
	Trachymene pilosa		5	<1	
	Ursinia anthemoides		5	<1	
	Verticordia densiflora		70	40	

Quadrat G6

FLORA DATA SHEETS

Project: MFP -	Date: 2nd July 2001	Surveyors: EB &JB

Location:
SITE G7 In SE corner
Aerial Photograph:N/A

DATUM:	Easting	Northing
Site 1	**50 403731**	**646 7821**
Site 2		
Site 3		
Site 4		
Site 5		
Site 6		

Soil type:	**Rocks**: (average size)	**Outcropping**
Sand 9 :silt 1 : clay Colour Grey	**N/A**	Type and percentage **N/A**
Litter Bark %; Leaves 20 % Twigs %; Logs %	**Topography:** Br; R; US; MS; LS; DL; MIC; MAC **Aspect: Flat**	**Film No:** **Photo No. 9**

Percentage cover of strata (for quadrat)
Trees 15 %; Shrubs >2m %; Shrubs 1-2m %; Shrubs <1m 30 %;
Herbs %; Grasses/sedge 30 %; Bare Ground 15 %

Vegetation Description:
Eucalyptus marginata Woodland

Condition:
2-3

Rare or Priority Flora:

Other Notes: Dieback/Age since fire/ Predators/Erosion/Weeds/Tracks/Position in cemetery .Rubbish scattered in area
Burnt within the last 3 years

Colln No	Species	Fl Colour	Ht (cm)	% Cover	Rare/ 1^{O}
	Acacia pulchella var. *glaberrima*		145	5	
	Adenanthos cygnorum subsp. *cygnorum*		120	1	
	Alexgeorgea nitens		5	8	
	Arthropodium ? preissii		5	<1	
	Baeckea camphorosmae		45	8	
	Banksia attenuata		50	1	
	Banksia menziesii		120	<1	
	Bossiaea eriocarpa		35	4	
	Burchardia umbellata		15	<1	
G07-3	*Chordifex sinuosus*		25	15	
	Conostephium pendulum		45	1	
G07-1	*Conostylis serrulata*		15	<1	
	Dasypogon bromeliifolius		45	1	
	Daviesia triflora		50	2	
	Drosera erythrorhiza		5	5	
	Drosera pallida		T	<1	
	Ehrharta calycina		40	<1	
	Eucalyptus marginata subsp. *elegantella*		1000	15	
	Gladiolus caryophyllaceus		10	<1	
	Gompholobium tomentosum		50	3	
G07-4	*Haemodorum laxum*		30	<1	
	Hibbertia hypericoides		50	1	
	Hybanthus calycinus		45	1	
	Jacksonia floribunda		110	2	
	Lepidosperma squamatum		45	1	
G07-2	*Leucopogon conostephioides*		35	2	
	Lomandra preissii		55	<1	
	Mesomelaena pseudostygia		45	1	
	Mesomelaena tetragona		60	<1	
	Patersonia occidentalis		50	2	
	Petrophile linearis		50	1	
	Stylidium brunonianum		5	<1	
	Stylidium repens		15	<1	
	Tetraria octandra		40	<1	
	Ursinia anthemoides		5	1	

Quadrat G7

FLORA DATA SHEETS

Project: MFP -	**Date:** 2ndJuly 2001	**Surveyors:** EB &JB
Location: SITE G8 Aerial Photograph:N/A		
DATUM: Site 1 Site 2 Site 3 Site 4 Site 5 Site 6	Easting **50 403666**	Northing **6467850**
Soil type: Sand ✓ :silt : clay Colour Grey	**Rocks**: (average size) **N/A**	**Outcropping** Type and percentage **N/A**
Litter Bark %; Leaves 80 % Twigs 5 %; Logs %	**Topography:** Br; R; US; MS; LS; DL; MIC; MAC **Aspect: Slighlty lower than Banksia**	**Film No:** **Photo No. 10**
Percentage cover of strata (for quadrat) Trees 37 %; Shrubs >2m %; Shrubs 1-2m %; Shrubs <1m 40 %; Herbs %; Grasses/sedges 75 %; Bare Ground 5 %		
Vegetation Description: **Allocasuarina fraseriana with scattered Banksia spp.**		
Condition: **1-2**		
Rare or Priority Flora:		
Other Notes: Dieback/Age since fire/ Predators/Erosion/Weeds/Tracks/Position in cemetery. Burnt within the last 3 years		

Colln No	Species	Fl Colour	Ht (cm)	% Cover	Rare/ 1^{o}
	Acacia sessilis		35	<1	
	Alexgeorgea nitens		20	30	
	Allocasuarina fraseriana		1200	35	
	Amphipogon turbinatus		40	1	
	Anigozanthos manglesii subsp. *manglesii*		10	<1	
	Banksia attenuata		110	1	
	Banksia grandis		1200	5	
	Banksia menziesii		120	1	
	Burchardia umbellata		15	<1	
	Conostephium pendulum		50	1	
	Conostylis aurea		25	<1	
	Conostylis setigera subsp. *setigera*		15	3	
G08-1	*Daviesia decurrens*	orange-red	50	8	
	Daviesia triflora		40	1	
	Desmocladus fasciculatus		20	30	
	Desmocladus flexuosus		30	15	
	Drosera erythrorhiza		2	<1	
	Drosera pallida		T	<1	
	Gladiolus caryophyllaceus		15	<1	
	Haemodorum laxum		10	<1	
	Hibbertia hypericoides	yellow	45	20	
	Hypochaeris ? glabra		5	2	
	Jacksonia floribunda		110	2	
	Laxmannia ramosa subsp. *ramosa*	white	20	1	
	Lyginia barbata		60	1	
	Mesomelaena pseudostygia		50	1	
	Patersonia occidentalis		40	2	
	Petrophile linearis		50	2	
	Phlebocarya ciliata		30	2	
	Scholtzia involucrata		35	<1	
	Schoenus clandestinus		5	<1	

Quadrat G8

FLORA DATA SHEETS

Project: MFP -	**Date:** 10th July 2001	**Surveyors:** EB &JB
Location: SITE G9 Aerial Photograph:N/A		

DATUM:	Easting	Northing
Site 1	**50 403539**	**6467841**
Site 2		
Site 3		
Site 4		
Site 5		
Site 6		

Soil type:	**Rocks**: (average size)	**Outcropping**
Sand ✓ :silt : clay	**N/A**	Type and percentage **N/A**
Colour Pale grey		
Litter	**Topography:** Br; R; US; MS;	**Film No:**
Bark %; Leaves 10 %	LS; DL; MIC; MAC	
Twigs %; Logs %	**Aspect: Flat**	**Photo No.**

Percentage cover of strata (for quadrat)

Trees %; Shrubs >2m 80 %; Shrubs 1-2m %; Shrubs <1m 95 %;
Herbs %; Grasses/sedges 60 %; Bare Ground 5 %

Vegetation Description:
Jacksonia over shrubs

Condition:
4 weeds relatively abundant

Rare or Priority Flora:

Other Notes: Dieback/Age since fire/ Predators/Erosion/Weeds/Tracks/Position in cemetery
.Near Peg 1920. Small area only but very dense
Near track junction on southern boundary

Colln No	Species	Fl Colour	Ht (cm)	% Cover	Rare/ 1^{O}
	Anagallis arvensis var. *arvensis*		2	<1	
	Cassytha flava		T	<1	
	Conostylis serrulata		30	<1	
	Dasypogon bromeliifolius		50	7	
	Daviesia decurrens		45	1	
	Ehrharta calycina		70	2	
	Eragrostis curvula		110	5	
	Gladiolus caryophyllaceus		20	1	
	Gompholobium tomentosum		70	1	
	Hypochaeris ? glabra		2	3	
	Hypolaena exsulca		50	3	
	Jacksonia sternbergiana		400	80	
	Lepidosperma squamatum		50	2	
	Lyginia barbata		70	30	
	Melaleuca preissiana		1000	3	
	Melaleuca seriata		90	30	
	Mesomelaena tetragona		90	5	
	Pericalymma ellipticum var. *ellipticum*		90	30	
	Phlebocarya ciliata		50	10	
	Verticordia densiflora		100	50	
	Xanthorrhoea brunonis subsp. *brunonis*		70	2	
	Xanthorrhoea preissii		90	5	

Quadrat G9

FLORA DATA SHEETS

Project: **MFP -**	**Date:** **2nd July 2001**	**Surveyors:** **EB &JB**
Location: **SITE G10** **Aerial Photograph:N/A**		
DATUM: Site 1 Site 2 Site 3 Site 4 Site 5 Site 6	Easting **50 403680**	Northing **646 7970**

Soil type: Sand ✓ :silt : clay Colour Grey	**Rocks**: (average size) **N/A**	**Outcropping** Type and percentage **N/A**
Litter Bark %; Leaves 5 % Twigs 15 %; Logs %	**Topography:** Br; R; US; MS; **LS;** DL; MIC; MAC **Aspect: Higher ground**	**Film No:** **Photo No. 11**

Percentage cover of strata (for quadrat)
Trees 25 %; Shrubs >2m %; Shrubs 1-2m 30 %; Shrubs <1m 35 %;
Herbs %; Grasses/sedges 20 %; Bare Ground 10 %

Vegetation Description:
Eucalyptus todtiana, Banksia menziesii, B. attenuata over shrubs

Condition:
1-2

Rare or Priority Flora:

Other Notes: Dieback/Age since fire/ Predators/Erosion/Weeds/Tracks/Position in cemetery.

Colln No	Species	Fl Colour	Ht (cm)	% Cover	Rare/ 1^{o}
	Acacia sessilis		70	1	
	Alexgeorgea nitens		10	30	
	Allocasuarina humilis		170	5	
	Amphipogon turbinatus		40	1	
	Banksia menziesii		170	2	
	Bossiaea eriocarpa		45	2	
	Calytrix flavescens		50	5	
	Conostephium pendulum		20	1	
	Conostylis ? aurea		30	<1	
	Dasypogon bromeliifolius		50	2	
	Daviesia triflora		90	2	
	Desmocladus flexuosus		30	10	
	Drosera erythrorhiza		2	<1	
	Eucalyptus todtiana		1000	15	
	Gladiolus caryophyllaceus		15	<1	
	Hibbertia hypericoides		60	10	
	Hypochaeris ? glabra		5	<1	
	Jacksonia floribunda		150	15	
	Laxmannia ramosa subsp. *ramosa*		15	<1	
	Lyginia barbata		60	5	
	Patersonia occidentalis		40	5	
	Petrophile linearis		30	1	
	Phlebocarya ciliata		30	2	
	Pterostylis vittata		15	<1	
	Stirlingia latifolia		170	10	
	Thysanotus manglesianus		T	<1	

Quadrat G10

FLORA DATA SHEETS

Project: MFP -	**Date:** 5th July 2001	**Surveyors:** EB &JB
Location: SITE G11 Aerial Photograph:N/A		
DATUM: Site 1 Site 2 Site 3 Site 4 Site 5 Site 6	Easting **50 403442**	Northing **646 8069**
Soil type: Sand 4 :silt 6 : clay Colour Grey	**Rocks**: (average size) **N/A**	**Outcropping** Type and percentage **N/A**
Litter Bark %; Leaves 10 % Twigs 15 %; Logs 2 %	**Topography:** Br; R; US; MS; LS; DL; MIC; MAC **Aspect: Flat**	**Film No:** **Photo No. 13**
Percentage cover of strata (for quadrat) Trees 12 %; Shrubs >2m %; Shrubs 1-2m 95 %; Shrubs <1m 20 %; Herbs %; Grasses/sedges 30 %; Bare Ground <5 %		
Vegetation Description: **Melaleuca preissiana Woodland over shrubs**		
Condition: **1 Really excellent few weed, dense vegetation**		
Rare or Priority Flora:		
Other Notes: Dieback/Age since fire/ Predators/Erosion/Weeds/Tracks/Position in cemetery .Burnt a few years ago		

Colln No	Species	Fl Colour	Ht (cm)	% Cover	Rare/ 1^{O}
	Acacia saligna		300	2	
	Adenanthos cygnorum subsp. *cygnorum*		250	2	
	Banksia littoralis		900	5	
	Cassytha racemosa		T	1	
	Ehrharta calycina		70	2	
	Euchilopsis linearis		25	15	
	Gladiolus caryophyllaceus		20	1	
	Hypochaeris ? glabra		5	<1	
	Hypolaena exsulca		55	12	
	Lepidosperma squamatum		35	1	
	Lyginia imberbis		50	15	
	Melaleuca preissiana		500	10	
	Melaleuca seriata		45	8	
	Pericalymma ellipticum var. *ellipticum*		120	50	
	Pterostylis sanguinea		15	<1	
	Pterostylis vittata		10	<1	
	Solanum ? nigrum		4	<1	
	Sonchus oleraceus		5	<1	
	Trachymene pilosa		5	<1	
	Ursinia anthemoides		5	<1	
	Verticordia densiflora		110	45	

Quadrat G11

FLORA DATA SHEETS

Project: MFP -	**Date:** 5th July 2001	**Surveyors:** EB &JB
Location: SITE G12 to south of graves **Aerial Photograph:N/A**		
DATUM: Site 1 Site 2 Site 3 Site 4 Site 5 Site 6	Easting **50 403163**	Northing **646 7985**
Soil type: Sand ✓ :silt : clay Colour Grey	**Rocks**: (average size) **N/A**	**Outcropping** Type and percentage **N/A**
Litter Bark %; Leaves 70 % Twigs 10 %; Logs %	**Topography:** Br; R; US; MS; LS; DL; MIC; MAC **Aspect: Flat**	**Film No:** **Photo No. 14**
Percentage cover of strata (for quadrat) Trees 25 %; Shrubs >2m %; Shrubs 1-2m %; Shrubs <1m 55 %; Herbs %; Grasses/sedges 30 %; Bare Ground %		
Vegetation Description: **Jarrah/Banksia over shrubs and sedges**		
Condition: **2-3**		
Rare or Priority Flora:		
Other Notes: Dieback/Age since fire/ Predators/Erosion/Weeds/Tracks/Position in cemetery.		

Colln No	Species	Fl Colour	Ht (cm)	% Cover	Rare/ 1°
	Acacia sessilis		50	5	
	Allocasuarina fraseriana		600	5	
	Arthropodium ? preissii		5	<1	
	Astroloma pallidum		5	1	
	Banksia attenuata		1100	5	
	Banksia menziesii		950	2	
	Bossiaea eriocarpa		50	25	
	Briza maxima		45	1	
	Burchardia umbellata			<1	
	Caladenia sp.			<1	
	Conostephium pendulum		55	5	
	Conostylis serrulata		30	<1	
	Dasypogon bromeliifolius		45	25	
	Daviesia triflora		50	1	
G12-1	*Desmocladus flexuosus*		50	2	
	Drosera erythrorhiza		2	1	
	Drosera menziesii		7	<1	
	Drosera pallida		1	<1	
	Eucalyptus marginata subsp. *elegantella*		1000	12	
	Gompholobium tomentosum		45	1	
	Haemodorum laxum		35	1	
	Hibbertia huegelii		25	<1	
	Hibbertia hypericoides		50	20	
	Hovea trisperma var. *trisperma*		50	1	
	Hypochaeris ? glabra		2	1	
	Jacksonia floribunda		170	2	
	Kennedia prostrata		7	<1	
G1-5	*Laxmannia ramosa* subsp. *ramosa*		50	1.5	
G12-2	*Lepidosperma angustatum*		45	1	
	Mesomelaena pseudostygia		45	5	
	Nemcia capitata		50	<1	
	Patersonia juncea		45	1	
	Petrophile linearis		45	2	
	Pityrodia bartlingii		25	<1	
	Pronaya fraseri		T	<1	
	Pterostylis vittata		15	<1	
	Stirlingia latifolia		70	5	
	Stylidium amoenum		5	<1	
	Stylidium brunonianum			<1	
	Synaphea spinulosa subsp. *spinulosa*		50	1	
	Tetraria octandra		50	5	
	Thysanotus manglesianus		T	<1	
	Trachymene pilosa		5	<1	
	Xanthorrhoea brunonis subsp. *brunonis*		70	1	

Quadrat G12

APPENDIX D

FIGURES

Figure 1. Vegetation Units
Figure 2. Vegetation Condition
Figure 3. Significant Plant Taxa
Figure 4. Threatened Ecological Communities
Figure 5. Protection Value

Sat 18 Aug

N

0 25 50 75 100m

SCALE 1 : 2 500

LEGEND

- Botanical Survey Area
- Cadastral Boundary
- Vegetation Unit Boundary
- G2 10m x 10m Quadrat

VEGETATION LEGEND

Seasonal Wetlands

MpPeVd — Open Woodland of *Melaleuca preissiana* over Open Low Heath of *Pericalymma ellipticum* and *Verticordia densiflora* over Very Open Sedgeland/Herbland.

MpPeEl — Low Woodland of *Melaleuca preissiana* over Closed Heath of *Pericalymma ellipticum* and *Verticordia densiflora* over Sedgeland/Herbland of *Euchilopsis linearis*, *Hypolaena exsulca* and *Lyginia barbata*.

MlCl — Tall Open Scrub of *Melaleuca lateritia* over Open Low Heath of *Calothamnus lateralis* and *Pericalymma ellipticum* over Sedgeland dominated by *Meeboldina roycei*.

HvPe — Open Heath of *Hakea varia* over Closed Low Heath of *Pericalymma ellipticum* and *Verticordia densiflora*.

PeVd — Closed Low Heath of *Pericalymma ellipticum*, *Verticordia densiflora* over Very Open Herbland.

Js — Closed Tall Shrub of *Jacksonia sternbergiana* over Closed Low Heath of *Melaleuca seriata*, *Pericalymma ellipticum* and *Verticordia densiflora* over Sedgeland/Herbland.

GREAT EASTERN HIGHWAY BYPASS

KALAMUNDA ROAD

Cemetery

Cemetery

EmBaBm

MpPeEl

Gl1

VdPe

Gl

EtBaBm

Em

G12

EmBaBm

EmBaBm

CcAf

G2

HvPe

G5

G6

G10

MpPeVd

AfHh

G4

MlCl

CcXp

G3

VdPe

EtBaBm

VdPe

VdPe

Js

G9

Cc

AfHh

G8

G7

Em

Uplands

CcXp — Closed Forest of *Corymbia calophylla* over Open Low Heath of *Xanthorrhoea preissii* over Open Sedgeland of *Mesomelaena tetragona*.

CcAf — Low Woodland of *Corymbia calophylla* and *Allocasuarina fraseriana* over Shrubland of *Xanthorrhoea preissii* and *Stirlingia latifolia* over Sedgeland of *Alexgeorgea nitens*.

AfHh — Open Forest of *Allocasuarina fraseriana* over Low Shrubland of *Hibbertia hypericoides* over Sedgeland of *Alexgeorgea nitens* and *Desmocladus fascicularis* and *D. flexuosus*.

EmBaBm — Woodland of *Eucalyptus marginata* var. *elegantella*, *Banksia attenuata*, *B. menziesii* over Open Low Heath of *Hibbertia hypericoides* and *Bossiaea eriocarpa* over a Sedgeland.

Em — Low Woodland of *Eucalyptus marginata* var. *elegantella* over Low Shrubland of several taxa over Open Sedgeland of *Chordifex sinuosus* (ms).

EtBaBm — Low Woodland of *Eucalyptus todtiana* over a Shrubland of mixed taxa over Sedgland.

guildford veg.dgn

Ministry for Planning
BOTANICAL SURVEY FOR MIDLAND, GUILDFORD AND PINNAROO CEMETERIES

VEGETATION UNITS - GUILDFORD CEMETERY

FIGURE 1

Date: 09-08-01

Designed: EB

Sat 18 Aug

N

0 25 50 75 100m

SCALE 1 : 2 500

LEGEND

- Botanical Survey Area
- Cadastral Boundary
- Vegetation Condition Boundary

CONDITION LEGEND

1	Pristine	Pristine or nearly so, no obvious signs of disturbance.
2	Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
3	Very Good	Vegetation structure altered, obvious signs of disturbance.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.
6	Completely degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.

GREAT EASTERN HIGHWAY BYPASS

KALAMUNDA ROAD

Cemetery

6

Cemetery

6

4-5

3-4

1-2

4-5

4-5

5

3-4

3-4

1-2

5

4-5

3-4

4-5

3-4

1-2

3-4

4-5

Ministry for Planning
BOTANICAL SURVEY FOR MIDLAND, GUILDFORD AND PINNAROO CEMETERIES

VEGETATION CONDITION GUILDFORD CEMETERY

FIGURE 2

Date: 09-08-01

Designed: EB

guildford cond.dgn

Sat 18 Aug

N

0 25 50 75 100m

SCALE 1 : 2 500

LEGEND

- Botanical Survey Area
- Cadastral Boundary
- Significant Taxa Boundary

SIGNIFICANT PLANT TAXA LEGEND

Eucalyptus marginata subsp. *elegantella*
Priority 2 taxon

GREAT EASTERN HIGHWAY BYPASS

KALAMUNDA

Cemetery

Cemetery

ROAD

Ministry for Planning
BOTANICAL SURVEY FOR MIDLAND, GUILDFORD AND PINNAROO CEMETERIES

SIGNIFICANT PLANT TAXA GUILDFORD CEMETERY

FIGURE 3

Date: 09-08-01

Designed: EB

guildford sig.dgn

Sat 18 Aug

N

0 25 50 75 100m

SCALE 1 : 2 500

LEGEND

- Botanical Survey Area
- Cadastral Boundary
- Theatened Community Boundary

GREAT EASTERN HIGHWAY BYPASS

KALAMUNDA

Cemetery

Floristic Vegetation Type 20a

Cemetery

Floristic Vegetation Type 20a

Regional Significant Wetland

ROAD

Floristic Vegetation Type 20a

Floristic Vegetation Type 3c

Regional Significant Wetland

Regional Significant Wetland

Floristic Vegetation Type 20a

Floristic Vegetation Type 3c

guildford eco.dgn

Ministry for Planning
BOTANICAL SURVEY FOR MIDLAND, GUILDFORD AND PINNAROO CEMETERIES

THREATENED ECOLOGICAL COMMUNITIES GUILDFORD CEMETERY

FIGURE 4

Date: 09-08-01

Designed: EB

Sat 18 Aug

N

0 25 50 75 100m

SCALE 1 : 2 500

LEGEND

- Botanical Survey Area
- Cadastral Boundary
- Protection Value Boundary

PROTECTION VALUES LEGEND

1 Includes Threatened Ecological Community by Environment Australia (EPBC Act) and/or CALM (English, 2001) and/or Waters and Rivers Authority; Presence of Rare or Priority Flora. Vegetation in Excellent to Pristine Condition.

2 Scale 1 but where vegetation is Good to Very Good; May include Significant Taxa.

3 Area degraded but can with effort be restored to a good or better condition. The vegetation community may be common but it is important as a buffer to Protection Value 1 and 2 areas.

4 Includes areas that are not necessary as a buffer and that are in Poor condition.

5 Developed. Vegetation severely altered.

GREAT EASTERN HIGHWAY BYPASS

KALAMUNDA ROAD

Cemetery

Cemetery

ROAD

Ministry for Planning
BOTANICAL SURVEY FOR MIDLAND, GUILDFORD AND PINNAROO CEMETERIES

PROTECTION VALUE - GUILDFORD CEMETERY

FIGURE 5

Date: 09-08-01

Designed: EB

guildford prot.dgn

LEGEND

- Cadastre - DLI 1/03/04
- Highway
- Local Rd - Sealed
- Local Government Authorities - DLI 15/06/03
- Bush Forever - MFP 07/01
- Swan Coastal Plain North 1m Orthomosaic - DLI 03

N

0 250 m

Scale 1:11,814
(Approximate when reproduced at A4)

Geocentric Datum of Australia 1994

Note: the data in this map have not been projected. This may result in geometric distortion or measurement inaccuracies.

Prepared by: PerryS
Prepared for:
Date: Tuesday, 8 June 2004 15:35

Information derived from this map should be confirmed with the data custodian acknowledged by the agency acronym in the legend.

Department of Environment

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INTRA-DEPARTMENTAL REFERRAL
EIA DIVISION, PLANNING ASSESSMENTS BRANCH

To:	Gary Whisson, Ecological Systems Branch
Title of Proposal/Issue:	Tonkin Hwy/Stanton Road Interchange
Briefing Officer and Branch:	Sarah Perry (Planning and Infrastructure Branch)
Date of Request:	8 June 2004
Date Advice Required:	**6 July 2004**

Not Done by BSK

The Proposal

It is proposed to close the current alignment of Brearley Ave as the entrance to the Domestic airport via Great Eastern Hwy and replace it with a new alignment from Tonkin Hwy in the vicinity of the Stanton Road interchange (see attached plan). This will require a diamond interchange and moving the existing Tonkin Highway alignment 40m eastward into the airport land, to a total requirement of 4.8ha of Airport land.

Stage in the process

This re-alignment is a long-term planning proposal and at this stage DPI are wanting to determine if the attached vegetation and fauna assessment is to DoE's satisfaction

Information/advice requested

It would be appreciated if you could please review the attached report and advise if the vegetation and fauna of the study area have been adequately described.

Should you have any queries please do not hesitate to contact me on ext 7050.

Kind regards

Sarah Perry

Sarah Perry

John / Bowen.
Advice please

Main Roads Western Australia

Biological Assessment for Stanton Rd/Tonkin Hwy Interchange

Draft Report - TH4081A

July 1997

Main Roads Western Australia

Biological Assessment for Stanton Rd/Tonkin Hwy Interchange

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Report by: S. Grein

Signed:

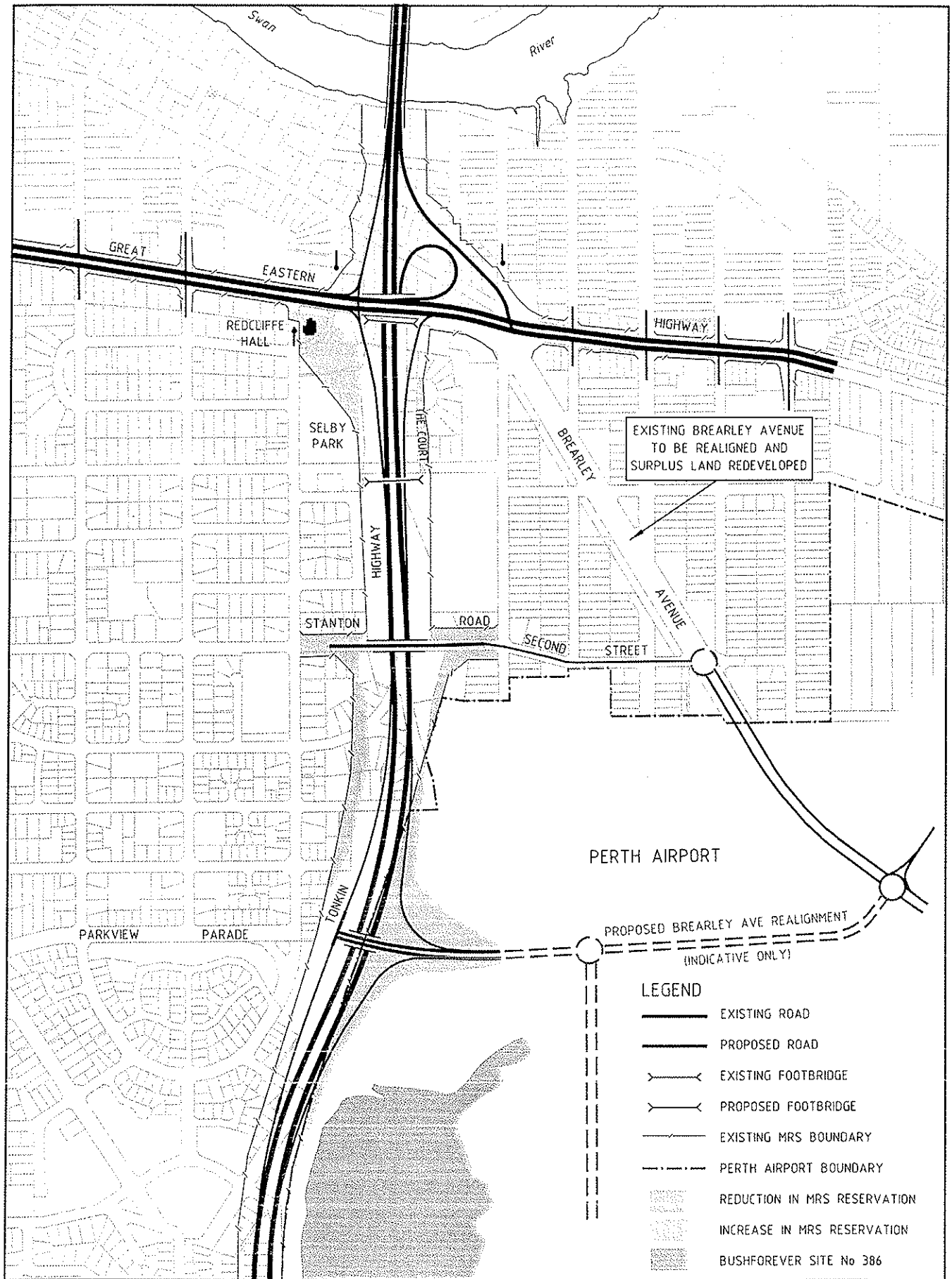
Approved:

Date: 4 July 1997
Distribution:

Draft Report - TH4081A

Halpern Glick Maunsell Pty Ltd
629 Newcastle Street, Leederville WA 6007

Consulting Engineers & Environmental Scientists
Telephone: 9281 6100 Facsimile: 9281 6299



Department for Planning and Infrastructure

GDA

NORTH

SCALE 1:10 000

0 100 200

Metres

TONKIN HIGHWAY

GT EASTERN HWY TO STANTON RD

PROPOSED PLANNING CONCEPT AND RESERVATION CHANGES

INTEGRATED TRANSPORT PLANNING DIRECTORATE
r:dgn_gda94/mstation/stanton/03803050.dgn
23 Apr 2004
SOURCE

ORIGINAL DRAWING SIZE
A4

Biological Assessment for Stanton Rd/Tonkin Hwy Interchange

Contents

1.0 Introduction
- 1.1 Background
- 1.2 Study Objectives
- 1.3 Climate
- 1.4 Physiography and Soils
- 1.5 Regional Vegetation
- 1.6 Previous Studies

2.0 Flora Survey
- 2.1 Methodology
- 2.2 Results
- 2.3 Significant Flora

3.0 Vegetation Survey
- 3.1 Methodology
- 3.2 Vegetation Associations
- 3.3 Description of Vegetation Associations

4.0 Fauna Assessment
- 4.1 Methodology
- 4.2 Results
- 4.2.1 Frogs
- 4.2.2 Tortoises
- 4.2.3 Lizards
- 4.2.4 Snakes
- 4.2.5 Birds
- 4.2.6 Mammals
- 4.2.7 Threatened Fauna

5.0 Conservation Significance

6.0 References

Figures
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- Figure 2 Vegetation Associations of Stanton Rd Interchange Study Area

Plates

Appendices
- A Reptile and Amphibia List for Perth Airport
- B Bird species List for Perth Airport

1.0 Introduction

1.1 Background

Perth Airport is situated approximately 9 km east of the Perth Central Business District. The airport land covers 2,108 hectares and is currently under the control of the Federal Airports Corporation (FAC). The land includes infrastructure such as runways and terminals associated with the provision of airport services and large areas which have been left undeveloped. Much of the undeveloped land has been cleared for agricultural activities prior to acquisition by the FAC, but significant areas of remnant bushland remain.

Development plans for Perth Airport have identified a proposed new access road into the Domestic Terminal from Tonkin Highway in the vicinity of Stanton Road interchange and the closure of the current access from Brearley Avenue off Great Eastern Highway. The proximity of the Great Eastern Highway interchange to the proposed Stanton Road interchange precludes the development of ramps on the northern side of Stanton Road and denies the necessary four-way access to the airport given development of the new airport access road. The study area is shown in Figure 1.

A recent stakeholders meeting agreed that further work defining flora and fauna constraints be undertaken prior to preparation of detailed design plans. The purpose of this report is to provide an assessment of the remaining flora, vegetation and fauna within the Stanton Rd study area (Figure 2). The report, in combination with other inputs and planning priorities will assist Main Roads Western Australia (MRWA) in selecting a suitable design options for the proposed interchange.

1.2 Study Objectives

The aims of this study are to:

- Compile a list of the native plant species occurring within the study area;
- Compile a list of weed species (declared or otherwise) present within the study area;
- Identify any rare and endangered flora taxa;
- Describe and map the vegetation within the study area;
- Assess the significance of the flora and vegetation;
- Compile a list of vertebrate fauna species occurring within the study area; and
- Identify any threatened fauna species.

1.3 Climate

Rainfall and temperature are important climatic features that should be considered when describing the environment of the Perth Airport environment as these largely determine the seasonal rise and fall of the groundwater and the filling and drying out of seasonal wetlands and damplands.

Perth has a Mediterranean climate with hot dry summers and cool wet winters. The annual average rainfall is 890 mm with the majority of the precipitation falling between May and September. From December to March the temperature is typically hot with a mean daily maxima of approximately 29^{o}C. With the end of winter and the onset of hot weather, the evaporation rate rises and the water table and the levels in water in wetlands and damplands falls.

1.4 Physiography and Soils

The study area is located on the Bassendean Dune belt of the Swan Coastal Plain. These dunes occur in a belt approximately 15 km wide westwards from the foot of the Darling Scarp, with alluvial deposits of the narrow Pinjarra Plain typically separating the Scarp, from the dunes. The dunes themselves consist of low hills of quartz sands with seasonal wetlands frequently occurring in low depressions (Wilde and Low, 1978).

Geologically, the study site is covered by sandy soils which are very light grey at the surface and yellow at a depth and consist of fine to medium grained, sub-rounded grains which have been deposited by wind. In general the sandy soil profile extends to about 10 m below the surface where it is replaced by clay which continues for a further 10 m. Another sand layer occurs beneath the clay zone. In the areas of depression there are regions of peaty clay which are dark grey and black with varying amounts of sand content (Gozzard, 1986).

1.5 Regional Vegetation

The vegetation of the study area predominantly belongs to the Southern River Complex (Heddle, *et. al.*, 1978), with a small area in the south-west corner belonging to the Bassendean Complex (Central and South).

The Southern River Complex is comprised of open woodlands of Marri *Corymbia calophylla*, Jarrah *Eucalyptus marginata*, with Banksia species on elevated areas and fringing woodlands of Flooded gum *Eucalyptus rudis* and Swamp Paperbark *Melaleuca rhaphiophylla* bordering wetland areas.

The Bassendean Complex (Central and South) ranges from woodlands of jarrah, She-oak *Allocasuarina fraseriana* and *Banksia* species to low woodlands of *Melaleuca* species and sedgelands on damper areas.

These descriptions of the principal vegetation types are necessarily general. This report provides a more detailed description of the several vegetation associations wihin the study area.

1.6 Previous Studies

There have been four previous studies of the flora and vegetation on land within the boundaries of the Perth Airport. In 1994 Alan Tingay and Associates undertook a flora and vegetation survey of the airport area. Also in 1994, Alan Tingay and Asociates undertook an invertebrate and vertebrate fauna survey of the Perth Airport area. The resultant flora and vegetation report included a series of vegetation association maps and figures which indicated the condition of each association. A species list was produced which incorporated the list provided by Dixon, 1983 was also produced. In 1983, Dixon surveyed the flora and vegetation within the area of the proposed International Terminal Building site and associated facilities. The study resulted in a species list and a vegetation map for much of the western half of the airport land, particularly surrounding the runway. No declared rare or priority species were recorded at the time.

A series of reports was produced in the 1980's to study the effects of the Great Eastern Highway Bypass on the native flora within the road reserve and nearby wetlands (Backshall and Hart, 1986; Mattiske and Associates, 1989). Small areas of the airport land in the north-east section were included in these studies.

2.0 Flora Survey

2.1 Methodology

A detailed floristic survey of the study area was undertaken to establish a floristic breakdown of the vegetation association present by means of a systematic plotless sampling and traversing of the vegetation associations identified from aerial photography. In addition specific searches for Declared Rare and Priority Flora previously recorded from the area was also undertaken.

It should be noted that many species occurring within the study area may not have been recorded at the time this survey was undertaken due to seasonal variation (ie some species grow vegetatively only in spring and summer months) and lack of flowering material. It should also be noted that due to a lack of flowering material a number of specimens could not be identified past the genus level.

Specimens which were difficult to identify in the field were collected, dried, pressed and later identified and verified at the Western Australian Herbarium.

2.2 Results

A total of 109 species of flora from 28 families were recorded from the Stanton Road study area. These species are typical of those found on Bassendean Dune soil types and are detailed in Table 2.1. The most common Families are Myrtaceae (19 species), Papilionaceae (14 species), Proteaceae (12 species) and Cyperaceae (10 species).

As the time at which this survey was undertaken did not correspond with the flowering period for many of the flora species within the study area, several species were either unable to be identified or were identifiable only to the genus level. This is particularly the case for members of the Orchidaceae and Stylidiaceae families.

Table 2.1 Stanton Road Study Area Flora List

Flora Species recorded from Stanton Rd Interchange study area (* denotes introduced species)

Family/*Species*	**Common Name**
Zamiacaeae	
Macrozamia riedlei	Zamia Palm
Pinaceae	
Pinus pinaster	Pine Tree
Poaceae	
**Arcotheca calendula*	Cape Weed
**Briza maxima*	Blowfly Grass
**Cynodon dactylon*	Couch
**Ehrharta calycina*	Veldtgrass
**Lolium rigidum*	Rye Grass
Stipa semibarbata	
Cyperaceae	
Baumea articulata	Jointed Rush
Cyperus difformis	Rice Sedge
Lepidosperma angustaum	

Lepidosperma gladiatum	Coast Sword-sedge
Lepidosperma longitudinale	Pithy Sword-sedge
Lepidosperma tenue	
Mesomelaena gracilliceps	
Mesomelaena pseudostygia	
Mesomelaena tetragona	
Tertaria octandra	
Restionaceae	
Loxocarya flexuosa	
Lyginia barbata	
Restio stenostachyus	
Dasypogonaceae	
Calectasia cyanea	Blue Tinsel Lily
Dasypogon bromellifolius	Pineapple Bush
Lomandra preissii	
Xanthorrhoaceae	
Xanthorrhoea brunonis	
Xanthorrhoea preissii	Grasstree
Anthericaceae	
Johnsonia sp	Rush Lily
Haemodoraceae	
Anigozanthus viridis	Swamp Kangaroo Paw
Conostylis aculeata	Prickly Conostylis
Conostylis setigera	Bristly Cottonhead
Haemodorum paniculatum	Mardja
Typhaceae	
Typha domingensis	Bulrush
Iridaceae	
Patersonia occidentalis	Purple Flags
**Watsonia bulbillifera*	Watsonia
Orchidaceae	
Caladenia flava	Cowslop Orchid
Microtis media	Tall Migonette Orchid
Casuarinaceae	
Allocasuarina fraseriana	
Allocasuarina humilis	She-oak
Proteaceae	Dwark Sheoak
Adenanthos cygnorum	Woolly Bush
Banksia attenuata	Slender Banksia
Banksia grandis	Bull Banksia
Banksia ilicifolia	Holly-leaved Banksia
Banksia menzesii	Firewood Banksia
Dryandra sessilis	Parrot Bush
Hakea lissocarpha	Honey Bush
Hakea prostrata	Harsh Hakea
Petrophile linearis	Pixie Mops
Stirlingia latifolia	Blueboy
Synaphea petioralis	
Synaphea spinulosa	
Loranthaceae	
Nuytsia floribunda	Christmas Tree
Droseraceae	
Drosera erythrorrhiza	Red Ink Sundew
Drosera gigantea	Giant Sundew
Mimosaceae	
Acacia alata	Winged Wattle
Acacia huegelii	
Acacia pulchella	Prickly Moses
Acacia saligna	Orange Wattle

Acacia stenoptera	Belalie
Papilionaceae	
Aotus gracillma	
Bossieae eriocarpa	Common Brown Pea
Bossieae ornata	Broad Leaved Brown Pea
Daviesia decurrens	Prickly Bitterpea
Daviesia divericata	Marno
Daviesia incrassata	
Gompholobium tomentosum	Hairy Yellow Pea
Hardenbergia comptoniana	Native Wisteria
Hovea trisperma	Common Hovea
Jacksonia densiflora	
Jacksonia fucellata	Grey Stinkwood
Jacksonia sternbergiana	Stinkwood
Kennedia coccinea	Coral Vine
Nemcia capitata	
Oxalidaceae	
**Oxalis pes-caprae*	Sour Sop
Rutaceae	
Boronia ramosa	
Eriostemon spicatus	Pepper and Salt
Euphorbiaceae	
Monotaxis grandiflora	Diamond of the Desert
Phyllanthus calycinus	False Boronia
**Tarxacacum oficinale*	Dandelion
Stackhousiaceae	
Tripterococcus brunonsis	Winged Stackhousia
Dilleniaceae	
Hibbertia hypericoides	Yellow Buttercups
Hibbertia racemosa	Stalked Guinea Flower
Hibbertia stellaris	Orange Stars
Myrtaceae	
Agonis flexuosa	Peppermint Tree
Astartea fascicularis	
Baeckea camphorosmae	Camphor Myrtle
Calistemon sp.	
Calothamnus laterilis	
Calytrix fraseri	Pink Summer Calytrix
Corymbia calophylla	Marri
Eucalptus marginata	Jarrah
Eucalyptus rudis	Flooded Gum
Hypocalymma angustifolium	White Myrtle
Kunzea recurva	
Leptospermum erubescens	Roadside Teatree
Leptospermum laevigatum	Coastal Teatree
Melaleuca acerosa	Coastal Honeymyrtle
Melaleuca lateritia	Robin Redbreast Bush
Melaleuca preissiana	Moonah
Pericalymma ellipticum	Swamp Teatree
Regalia ciliata	
Scholtzia involucrata	Spiked Scholtzia
Lamiaceae	
Hemiandra pungens	Snakebush
Epacridaceae	
Conostephium pendulum	Pearl Flower
Conostephium preissii	
Leucopogon conostephiodes	
Lysinema ciliatum	Curry Flower
Styphelia tenuiflora	Common Pinheath

Asclepiadaceae	
* *Gomphocarpus fruticosus*	Narrowleaf Cotton Bush
Goodeniaceae	
Dampiera linearis	Common Dampiera
Asteraceae	
Asteridea sp.	

2.3 Significant Flora

None of the species recorded from the study area are gazetted as Declared Rare or Priority Flora (CALM, 1996a). However one species previously listed as a Priority 2 taxa, *Daviesia physodes* was recorded from several vegetation associations. *Daviesia physodes* (Papilionaceae) is a shrub species up to 1.8m tall. Although previously listed as a Priority 2 species, the Flora of the Perth Region (Marchant *et al.*, 1987) describes the species as widespread and common throughout the Perth Metropolitan area.

3.0 Vegetation Survey

3.1 Methodology

The vegetation of the Stanton Rd Airport Study Area was described using a system devised by Specht and modified by Aplin (1979). This system classifies vegetation on the basis of height and cover of the tallest stratum. To provide a more detailed description of the vegetation, the dominant species are included in the description of the type of vegetation association. For example a Closed Scrub which is dominated by *Hypocalymnma angustifolium* shrubs is described as *Hypocalymma angustifolium* Closed Scrub. In many instances more than one species is dominant within an association.

A vegetation map was prepared from information collected during field surveys and from interpretation of a 1:20,000 aerial photograph (Figure 2). Data was collected by means of a systematic plotless sampling and traversing the vegetation association identified from the aerial photography.

3.2 Vegetation Associations

A total of 21 vegetation associations were identified within the study area as a result of this survey. These associations are based on vegetation formations (eg Woodland, Low Woodland, Heaths and Shrublands) . The classification into groups was performed essentially for mapping purposes.

Extensive traversing of associations identified was required during the course of this study as they would often changed too rapidly or it was too difficult to accurately differentiate where one association ended and another began from the aerial photography. Also, while it was possible to describe different associations based on the dominant species of the tallest strata, it was not always possible to accurately map the associations.

3.3 Description of Vegetation Associations

As with the species of flora present, the vegetation of the study area strongly reflects the underlying Bassendean Dune soil types as well as the proximity of the water table to the soil surface. In generally the drier, well drained areas on higher ground supported *Banksia* Low Open Woodlands and *Eucalyptus* Woodlands, while those areas subject to seasonal inundation and rising groundwater tended to support Heaths, Low Woodlands of *Melaleuca preissiana* and reed communities. A map outlining the vegetation associations within the study area is presented in Figure 2. All associations occurred on grey, quartzite Bassendean Dune soils, unless specified otherwise.

Jarrah *Eucalyptus marginata*/*Banksia* Open Woodland

This association type occurred predominantly on the elevated dry soils in the northern and central regions of the study area. This vegetation type essentially differed from the Closed Jarrah/Banksia Woodland association in its more open canopy, it has a poorer understorey species richness and a higher level of exotic infestation. The dominant species were Firewood Banksia *Banksia menziesii,* Slender Banksia *Banksia attenuata,* with Jarrah *Eucalyptus marginata* co-dominant. The association also includes occasional She-oak *Allocasuarina fraseriana* trees and Marri *Corymbia calophylla* in some areas. The understorey is typically heath to 1 m tall with common species

including Zamia *Macrozamia riedlei*, Yellow Buttercups *Hibbertia hypericoides*, Hairy Yellow Pea *Gompholobium tomentosum*, White Myrtle *Hypocalymma angustifolium*, *Jacksonia densiflora*, and Grey Stinkwood *J. furcellata*. Dense stands of tall Stinkwood *J. sternbergiana* often fringed this association as did Woolly Bush *Adenanthos cygnorum*. This association and the Closed version were the only ones to support the previously Priority 2 listed *Daviesia phsodes*.

The understorey of this vegetation association was particularly weed infested, particularly in areas adjacent to residential housing, and cycle paths at the northern end of the study area near the Stanton Rd overpass. Watsonia *Watsonia bulbillifera* was particularly common weed species in this association and the northern-most section of the study area included several individuals of the Declared weed Narrowleaf Cottonbush *Gomphocarpus fruticosus*.

Jarrah *Eucalyptus marginata/Banksia* Closed Woodland with occasional *Allocasuarina fraseriana*

This association differed from the Jarrah *Eucalyptus marginata/Banksia* Open Woodland association in the density of the of the dominant species and foliage cover of the uppermost strata. Also the level of weed infestation and disturbance was significant lower and the species richness level of the understorey species was notably higher. *Allocasuarina fraseriana* was also a more prominent associated tree species. The understorey was again predominantly heath dominated with dominant species including *Hibbertia hypericoides, Kunzea recurva, Gompholobium tomentosum*, Pixie Mops *Petrophile linearis, Daviesia decurrens, Daviesia triflora*, Common Hovea *Hovea trisperma*, Prickly Moses *Acacia pulchella*, Zamia *Macrozamia riedlei*, Roadside Teatree *Leptospermum erubescens*, Grasstrees *Xanthorrhoea brunosis* and Grasstree *Xanthorrhoea preissii*. The association was often fringed by an *Adenanthos cygnorum/Jacksonia sternbergiana* Tall Shrubland and/or *Adenanthos cygnorum/Jacksonia furcellata* Open Shrubland association.

Apart from the periphery of the association, which were adjacent to firebreaks and access tracks and consequently exposed to edge effects, the level of disturbance and associated weed infestation in the understorey of this association was generally low.

Eucalyptus rudis/Melaleuca preissiana Open Woodland

This predominantly Flooded Gum *Eucalyptus rudis* Open Woodland, with scattered smaller *Melaleuca preissiana* trees in the middle to upper stratum, occurred adjacent to two very similar asscociations, Jarrah *Eucalyptus marginata/* Flooded gum *Eucalyptus rudis/ Melaleuca preissiana* Open Woodland **and** Flooded Gum *Eucalyptus rudis* Open Woodland. The major factor differentiating the three associations was absence or inclusion of *E. marginata* or *M. preissiana* components. Understorey, herb and weed species were essentially identical in all three associations, as was the level of disturbance.

Jarrah *Eucalyptus marginata/* Flooded gum *Eucalyptus rudis/ Melaleuca preissiana* Open Woodland

This very open association occurred on poorly drained soils in a small section of the south-eastern section of the study area. The dominant overstorey species were *Eucalyptus marginata* and *E. rudis* with smaller trees of Moonah *Melaleuca preissiana* and Christmas Tree *Nuytsia floribunda* occurring sporadically throughout the association. The understorey was a low closed heath dominated by *Gompholobium tomentosum, Acacia pulchella, Hypocalymma anustifolium, Melaleuca acerosa*, along with the herbs Purple Flags *Patersonia occidentalis* and Pineapple Bush *Dasypogon bromellifolius*.

Occasional Orange Wattle *Acacia saligna and Jacksonia furcellata* occurred sporadically throughout this association.

The low closed nature of the heath understorey in this association is largely responsible for the exclusion of many of the weed species that occur in the more open understoreys of other association.

Marri *Corymbia calophylla* Woodland over *Hypocalymma angustifolium* Closed-scrub.

The road reserve at the south-eastern end of the study area was composed of this association. The density of the *Hypocalymma angustifolium* Closed Scrub virtually excluded all other native understorey species from the association.

Due to the road reserves closed proximity to Tonkin Highway, the level of disturbance (rubbish) and weed infestation was of a high level.

Flooded Gum *Eucalyptus rudis* Open Woodland

This association accounted for a small area (approximately 0.25 ha) at the south-eastern end of the study area on an area of wet flats, adjacent to an seasonally inundated low heath. Associated understorey species included *Melaleuca preissiana, Acacia saligna, Xanthorrhoea preissii, Gompholobium tomentosum* and occassional *Jacksonia sternbergiana.*

Marri *Corymbia calophylla* Woodland over *Leptospermum laevigatum* and *Adenanthos cygnorum* Open-scrub

This association, occurring on a dry, flat and disturbed landscape, occupied a small area at the south-eastem end of the study area. The several *Corymbia calophylla* trees dominated the upper stratum of the association, while the understorey was dominated by Coastal Teatree *Leptospermum laevigatum* and *Adenanthos cygnorum,* almost to the exclusion of all other understorey species.

Marri *Corymbia calophylla/Melaleuca preissiana* Open Woodland

Eucalyptus calophylla dominated Open Woodlands frequently dominate the south-eastern sections of the study at an elevation below *Banksia* dominated Woodlands but above that of wetland vegetation. This association is a transition between dryland and wetland soils, with *Melaleuca preissiana* trees particularly prominent on the wetter periphery of the association, while *Corymbia calophylla* occupies the drier areas.

The understorey is a low-closed scrub with conspicuous species including *Acacia pulchella, Gompholobium tomentosum, Astartea* sp., *Hypocalymma angustifolium* and *Bossiaea eriocarpa.* The lilioid species *Dasypogon bromeliifolius* and *Conostylis aculeata* occupy the lower stratum. *Jacksonia furcellata* and *J. densiflora* tall shrubs occur intermittently on the fringes of the association. Native Wisteria *Hardenbergia comptoniana* was a prominent creeper species in this association.

Despite the openness of the association, invasive weed s were limited to a few *Watsonia bulbillifera* individuals with some Veldtgrass *Ehrharta calycina* and Couch *Cynadon dactylon.*

Marri *Corymbia calophylla* Woodland

This association differs from other where *Corymbia calophylla* is the dominant component in that there was no other co-dominant species, either in the

upper stratum or in the understorey. *Adenanthos cynorum* was prominent around the fringes, although only a few juvenile specimens occurred with the association itself. Among the understorey species recorded were Common Brown Pea *Bosseae eriocarpa, Daviesia incrassata, Hibbertia hypericoides, Hypocalymma angustifolium, Acacia pulchella, Kunzea recurva*, Common Pinheath *Styphelia tenuiflora, Acacia stenoptera*. Both *Jacksonia furcellata* and *J. densiflora* were conspicuous in the middle stratum throughout the association. Lower strata herb species included *Dasypogon bromellifolius, Patersonia occidentalis, Stackhousia monogyna* and Red Ink Sundew *Drosera erythrorhiza*.

Adenanthos cygnorum/Jacksonia sternbergiana Tall Shrubland

This shrubland association occurs on dry sandy soil in a small section at the north-western end of the study area, surrounding a Jarrah/Banksia Closed Woodland area. *Adenanthos cygnorum* Woolly Bush Shrublands are characteristic of disturbed sandy areas as is Stinkwood *Jacksonia sternbergiana*. The occurrance of *J. sternbergiana*, a common tall shrub in the study area, may indicate a previous Jarrah Woodland area where the trees have been removed. Few understorey species were recorded, with lower strata dominated by introduced weed species including Dandelion *Taraxacum oficinale*, Cape Weed *Arcotheca calendula, Watsonia bulbililfera* and Couch *Cynadon dactylon*.

Adenanthos cygorum/Jacksonia densiflora Open Shrubland

This association is similar to the *Adenanthos cygnorum/Jacksonia sternbergiana* Tall Shrubland association in topography and landform, the primary difference being that *J. sternbergiana* was replaced by *J.densiflora* and the structure of the association is considerably more open. Occurring adjacent to a Jarrah/Banksia association, the *Jacksonia densiflora* component of the association may also indicate a previous Jarrah Woodland association that has been cleared. The aerial photography of the association lends support to this supposition.

Associated lower stratum species recorded included Blueboy *Stirlingia latiflora, Hibbertia hypericoides, Gompholobium tomentosum, Daviesia decurrens, Acacia pulchella* and *Petrophile linearis*. Prominent herb species included *Conostylis aculeata, Anigozanthus viridis, Dasypogon bromellifolius* and Giant Drosera *Drosera gigantea*.

Adenanthos cygnorum/Kunzea recurva Open Scrub

Adenanthos cygnorum and *Kunzea recurva* Open Scrub up to 2 m and with less than 10% cover dominate this association which fringes Jarrah/Banksia associations on sandy soils prone to waterlogging in the middle sections of the study area. The understorey consists of a variety of low shrub layer of species including Roadside Teatree *Leptospermum erubescens, Daviesia incrassata, Daviesia decurrens, Styphelia tenuiflora, and Hypocalymma angustifolium*. Herbaceous species included *Patersonia occidentalis, Loxocarya flexuosa* and the weeds *Watsonia bulbillifera*, Couch *Cynadon dactylon, Erharta calycina* and Rye Grass *Lolium rigidum*.

Adenanthos cygnorum Closed Scrub

This association is comprised of a pure stand of *Adenanthos cygnorum* to 2 m tall on dry sandy soils in the middle sections of the study area. This area may represent regrowth of areas cleared of *Banksia* or *Eucalyptus* trees. Although the association has been relatively disturbed by firebreaks and access tracks, the level of weed invasion is relatively low, with some areas of Wild Oat *Avena fatua* and Veldtgrass *Ehrharta calycina*.

***Adenanthos cygnorum/Kunzea recurva/Jacksonia sternbergiana* Open Scrub**

These three species virtually comprise all species present in this Open Scrub association on moderately wet soils in the centre of the study area. The association is subject to waterlogging and contains a low shrub herb layer of *Patersonia occidentalis, Loxocarya flexuosa, Drosera gigantea, Drosera erythrorhiza* and *Watsonia bulbillifera.*

***Melaleuca preissiana* Low Open Woodland**

Melaleuca preissiana occurs as a Low Open Woodland, 2 to 4 m tall over heath which is seasonally inundated. In these areas the understorey is dominated by species which are inundation tolerant including *Lepidosperma longitudinale, Kunzea recurva, Gompholobium tomentosum* and *Hypocalymma angustifolium.*

***Adenanthos cygnorum/Hypocalymma angustifolium/Pericalymma ellipticum* Low Closed Heath**

A small pocket of seasonally inundated wetland in the central region of the study area is dominated by a Low Closed Heath of *Adenanthos cygnorum, Hypocalymma angustifolium* and Swamp Teatree *Pericalymma ellipticum.* All three co-dominant species were between 1.0m and 1.5m in height will a dense cover. Less prominant shrub species included *Acacia pulchella, Kunzea recurva* and the herbs *Watsonia bulbillifera* and *Anigozanthus viridis.*

***Adenanthos cygnorum/ Nuytsia floribuna//Melaleuca preissiana* High Shrubland**

Occurring predominantly over a seasonally-wet flat, this tall shrub association is dominated *Adenanthos cygnorum, Nuytsia floribunda* and *Melaleuca preissiana* with occassional fringing *Allocasuarina fraseriana, Leptospermum laevigatum,* and *Eucalyptus marginata.* Associated understorey species include *Stirlingia latifolia, Jacksonia densiflora, Gompholobium tomentosum, Kunzea recurva, Leptospermum erubscens, Acacia alata, Acacia pulchella* and *Xanthorrhoea preissii.* Sub-shrub and herb species includes *Dasypogon bromellifolius, Patersonia occidentalis, Conostylis aculeata* and *Drosera gigantea. Lepidosperma longitudinale* and *L. angustatum* were prominent reed species in this association, particularly on the wetter margins.

The north-eastern side of the association had recently been disturbed by earthworks, and was subsequently predisposed to weed infestation. These included *Watsonia bulbillifera, Ehrharta calycina, Lolium rigidum, Arcotheca calendula, Cynadon dactylon* and *Oxalis pes-caprae.* Apart from slightly disturbed areas along the margins of the association, the understorey remained relatively weed and disturbance free.

Bulrush *Typha domingensis* Sedgeland

A major drain run through the majority of the study area. The fringes and open water of this drain have been naturally revegetated with *Typha domingensis.* Other less commonly recorded species on the fringes of the drain included *Calistemon* sp. and *Myriophyllum* sp.***Adenanthos cygnorum/Hypocalymma angustifolium/Jacksonia furcellata* Low Open Heath**

This large association on poorly drained soil, dominates the middle section of the study area. The dominant heath species *Adenanthos cygnorum, Hypocalymma angustifolium* and *Jacksonia furcellata* range from 0.5 to 1.2 m in height. Occasional *Melaleuca preissiana, Allocasuarina fraseriana, Nuytsia*

floribunda and *Leptospermum laevigatum* fringe the association. The presence of *H. angustifolium* indicates that the watertable is close to the surface during winter. Other less commonly occurring heath species include *Gompholobium tomentosum, Kunzea recurva, Leptospermum erubescens, Daviesia incrassata* and *Acacia pulchella*. Sub-shrub and herb species recorded included *Conostylis aculeata, Daypogon bromellifolius, Patersonia occidentalis, Drosera gigantea*, while reed species included *Lepidosperma longitudinale, Lepidosperma tenue, Tertraria octandra* and *Mesomelaena tetragona*

Several weed, native and introduced grass species were prominent, particularly on the edges of the association, where the level of disturbance was highest. The included Blowfly Grass *Briza maxima,* Veldtgrass *Ehrharta calycina,* Cape Weed *Arcotheca calendula,* Soursop *Oxalis pes-caprae,* Couch *Cynodon dactylon* and Rye Grass *Lolium rigidum.*

***Leptospermum laevigatum/Nuytsia floribunda/Melaleuca preissiana* Open Scrub**

This association was prevalent in areas particularly degraded by activities associated with access track and firebreaks. Coastal Teatree *Leptospermum laevigatum* to 4 m was dominant on the fringes of the association, particularly where disturbance was more notable. *L. laevigatum* is an introduced species from the eastern Australia that rapidly colonises sandy disturbed sites. The understorey was comprised of an open heath of *Xanthorrhoea preissii, Kunzea recurva, Melaleuca lateritia* and *Jacksonia densiflora*. Couch *Cynadon dactylon* was the most prominent weed species.

***Hypocalymma angustifolium* Closed Scrub**

This White Myrtle *Hypocalymma angustifolium* Closed Scrub association occurs predominantly along the Tonkin Highway road reserve between Stanton Rd and Klem Ave. Up to 3 m in height and occassional associating with *Adenanthos cygnorum* and *Calothamnus lateralis*, the association acts as a screen, separating Tonkin Hwy from the adjacent Perth Airport bushland.

4.0 Fauna Assessment

4.1 Methodology

In general, vertebrate fauna surveys are undertaken in either spring, summer or autumn, but rarely in winter. This is largely due to the fact that many vertebrate species either hibernate or migrate during the winter months. As this biological survey was undertaken in late June, many of the species one would expect to record during the warmer months were absent from the study area. Therefore, for the purpose of compiling an inventory of vertebrate fauna species for this assessment, it has been necessary to draw on the inventory compiled during a previous fauna survey of the Perth Airport (Alan Tingay and Associates, 1994b) in combination with opportunistic observations during the flora and vegetation phases of the field survey. It should be noted that the study sites chosen during the Tingay fauna survey did not correspond with the area assessed during this particular study of the Stanton Road interchange. However many of the vegetation associations in which fauna species were recorded during the Tingay survey, coincided with those occurring in the Stanton Rd study area.

4.2 Results

A total of 119 species of vertebrates (frogs, reptiles, mammals and birds) have been recorded from surveys undertaken at Perth Airport. Complete lists are provided in Appendices A and B. Many of the frog and fish species previously recorded from wetland areas would be absent from the largely dry Stanton Road study area

4.2.1 Frogs

Eight species of frog have been recorded from the Perth Airport area. This includes 6 species from the Family *Leptodactylidae* which are predominantly ground dwelling and burrowing species and 2 species from the Family *Hydlidae* which are predominantly tree frogs. A full species list is provided in Appendix A.

4.2.2 Tortoises

Two species of tortoise have been reported from wetland areas within the Perth Airport. The Oblong Tortoise *Chelodina oblonga* was reported in drains in the north eastern section of the airport, but it is reasonable to expect, given the similar habitat within the Stanton Road study area, that the species may occur in the drain which winds through large section of the study area.

The Western Swamp Tortoise *Pseudoemydura umbrina*, a Schedule 1 Taxa (CALM, 1996b) has been recorded from the swamps which occur within FAC lands in anecdotal reports (Kuchling and Burbidge, 1996), although it has not been recorded during a recent survey of swamps within the area. However given the area recently supported the species and the difficulty in their detection at low population densities, it seems likely the species still exists in the area and is represented by a few scattered individuals (Kuchling and Burbidge, 1996). Only one swamp within the vicinity of the Stanton Road study area, Five Mile West Swamp 1 was surveyed for this species during the survey undertaken by Kuchling and Burbidge.

4.2.3 Lizards

In total, 16 species of lizard have been recorded from Perth Airport. These include:

- 4 pygopods (Legless Lizards)

- 1 Agamid (Dragon)
- 2 Varanids (Monitors)
- 9 Skinks

The most commonly occurring species were the Bobtail *Tiliqua rugosa Lerista elegans.* Other species captured or observed were less common. *Banksia/Eucalyptus* Woodland supported 12 of the 16 species recorded. However cooler weather at the time surveys were undertaken may have contributed to a less comprehensive list, as fewer individuals of lizards species were active. A full list of species recorded in the Perth Airport bushland is provided in Appendix A.

4.2.4 Snakes

Five species of snake were recorded from the Perth Airport (Alan Tingay and Associates, 1994b). These included :

- 1 species of *Typhlopidae* (Blind Snake)
- 4 species of *Elapid* Snakes (Front fanged land snakes)

The Blind Snake *Rhamphotyphlops,* is a non-venomous topsoil dwelling species found only in Eucalyptus Woodlands within Perth Airport. The Dugite *Pseudonaja affinis* was recorded within *Jacksonia* Shrubland, while the Black-naped Snake *Vermicella bimaculata* a largely nocturnal species was recorded in *Banksia attenuata/Corymbia calophylla* Woodland within Perth Airport. A full list of species recorded in the Perth Airport bushland is provided in Appendix A.

4.1.5 Birds

767.

Seven six species of avifauna have been recorded at Perth Airport and are listed in Appendix B. The number of species that have been recorded in each vegetation association found in the Stanton Road study area is as follows (Alan Yingay an Associates, 1994b) :

- *Melaleuca preissiana* Low Woodland — 21 species
- *Eucalyptus/Banksia* Woodland — 20 species
- *Eucalyptus* Woodland/*Banksia/Allocasuarina fraseriana* Low Woodland/*Adenanthos cygnorum* Shrubland — 20 species
- *Banksia* Woodland — 13 species
- *Eucalyptus* Woodland — 12 species

The avifauna list for Perth Airport includes a number of waterbird species which are seasonal visitors to wetland. Most of these species are found outside the Stanton Rd study area, particularly in Munday Swamp. Several raptor species were also recorded, generally in open grassland or woodland areas. These include the Black Shouldered Kite *Elanus notatus*, the Brown Gohawk *Accipiter fasciatus,* Collared Hawk *A. cirrhocephalus*, Wedge-tail Eagle *Aquila audax,* Little Eagle *Hieraatus morphnoides*, Brown Falcon *Falco berigora* and the Australian Kestral *Falco cenchroides.*

4.2.6 Mammals

Six species of mammal have been recorded from the Perth Airport bushland area Airport (Alan Tingay and Associates, 1994b), including 4 introduced species. These include:

- The Short-beaked Echidna *Tachyglossus aculeatus* has been reported by security staff in *Banksia/Eucalyptus* Woodlands in the vicinity of both the domestic and international terminals. The Echidna is not common in the Perth Metropolitan area.

- The Southern Brown Bandicoot or Quenda *Isoodon fasciventer* (a Schedule 1 Taxa (CALM, 1996b) has been recorded in those areas which have maintained a dense understorey or low shrubs along several sections of Tonkin Highway in the vicinity of the Stanton Rd study area. It has also been trapped during surveys in several types of vegetation including *Eucalyptus* Woodland, *Banksia* Woodland as well as heaths of *Pericalymma ellipticum* Airport (Alan Tingay and Associates, 1994b)..

- The four introduced species included the House Mouse *Mus musculus*, Black Rat *Rattus rattus*, European Fox *Vulpes vulpes* and the Rabbit *oryctolagus cuniculus*. The mouse and rat species were captured regularly during surveys of the Airport by Alan Tingay and Associates, 1994b, while the rabbit was identified from frequent burrows throughout the Stanton Rd study area, and the fox from numerous scats and several carcasses.

4.2.7 Threatened Fauna

A search of CALM's Rare and Threatened fauna database (CALM, 1996b) indicated that 4 species of threatened fauna have been recorded from the study area. Three Schedule 1 Taxa (Fauna which are rare or likely to become extinct) and one Schedule 4 Taxa (Fauna which are otherwise specially protected). These species are as follows:

- Quenda *Isoodon obesulus fasciventer* Schedule 1

- Carnaby's Cockatoo *Calyptorhynchus latirostris*, a summer-autumn visitor to the metropolitan area, where it feeds on understorey species such as *Banksia, Grevillea, Hakea,* and *Acacia*. It was recorded during this survey in *Eucalyptus/Banksia* woodland and previously (Alan Tingay and Associates, 1994b) in *Eucalyptus* woodlands. It does not breed in the study area.

  Schedule 1

- Western Swamp Tortoise *Pseudemydura umbrina* Schedule 1

- Peregrine Falcon *Falco peregrinnus* Schedule 4

None of these species were observed during this survey, although they have been recorded in the past and the vegetation associations described are habitats which are able to support most. It is unlikely that the Five Mile West Swamp 1, just outside the study area, would provide an environment capable of supporting the Schedule 1 Taxa the Western Swamp Tortoise.

5.0 Conservation Significance

The principal planning guide for conservation areas in the Perth Metropolitan area is the System 6 Report, published by the Environmental Protection Authority (EPA). The Perth Airport area is affected by the recommendations included in the System 6 Report. The specific System 6 area that has been affected by the recommendation is Area M52 which includes all the Perth Airport land owned by the Federal Airport Commission (FAC) and subsequently by the Federal Government. The recommendation for Area M52 is that the Commonwealth of Australia should retain as much uncleared land as possible. Management issues considered important for the Area M52 include "*the retention, where possible, of uncleared vegetation; and encouraging, where possible, the growth and regeneration of local indigenous flora*".

The Heritage Council of Western Australia have advised that the study area has not been entered in the Register of Heritage Places, nor is there any Heritage Agreement or Conservation Order affecting it. The Perth Airport has been nominated for classification by the National Trust of Australia (WA). In addition to this, the Australian Heritage Commission placed several areas of the bushland within the Perth Airport area on the interim list of Register of National Estate. Two areas within the Stanton Rd Study Area identified by the Australian heritage Commission as having significance on this basis included:

- Areas of bushland which are considered to support a rich vertebrate fauna, particularly reptiles, and contain populations of the endangered Southern Brown Bandicoot *Isoodon obesulus fusciventor*, which has previously been recorded from several vegetation types in the study area including *Eucalyptus* Woodland, *Banksia* Woodland as well as heaths of *Pericalymma ellipticum* (Alan Tingay and Associates, 1994b).

- Vegetation of the Southern River Complex, which has been cleared or heavily degraded over much of its original area on the Swan Coastal Plain. According to Burbidge and Rolfe (from Australian Heritage Commission, 1992) only 8.6% of the 58,343 ha Southern River Complex remains intact and uncleared. Furthermore of the three System 6 Areas which include this complex, only Whiteman Park can be considered to be securely protected.

The flora and vegetation of the study area also has conservation value given the relatively small area of Bassendean Dune flora protected in reserves in the Perth Metropolitan Region. While most species are not regarded as threatened at present, continuing and increasing development will invariably result in a reduction in diversity of flora, and a subsequent decline in the population of vertebrate and invertebrate fauna sepcies.

6.0 References

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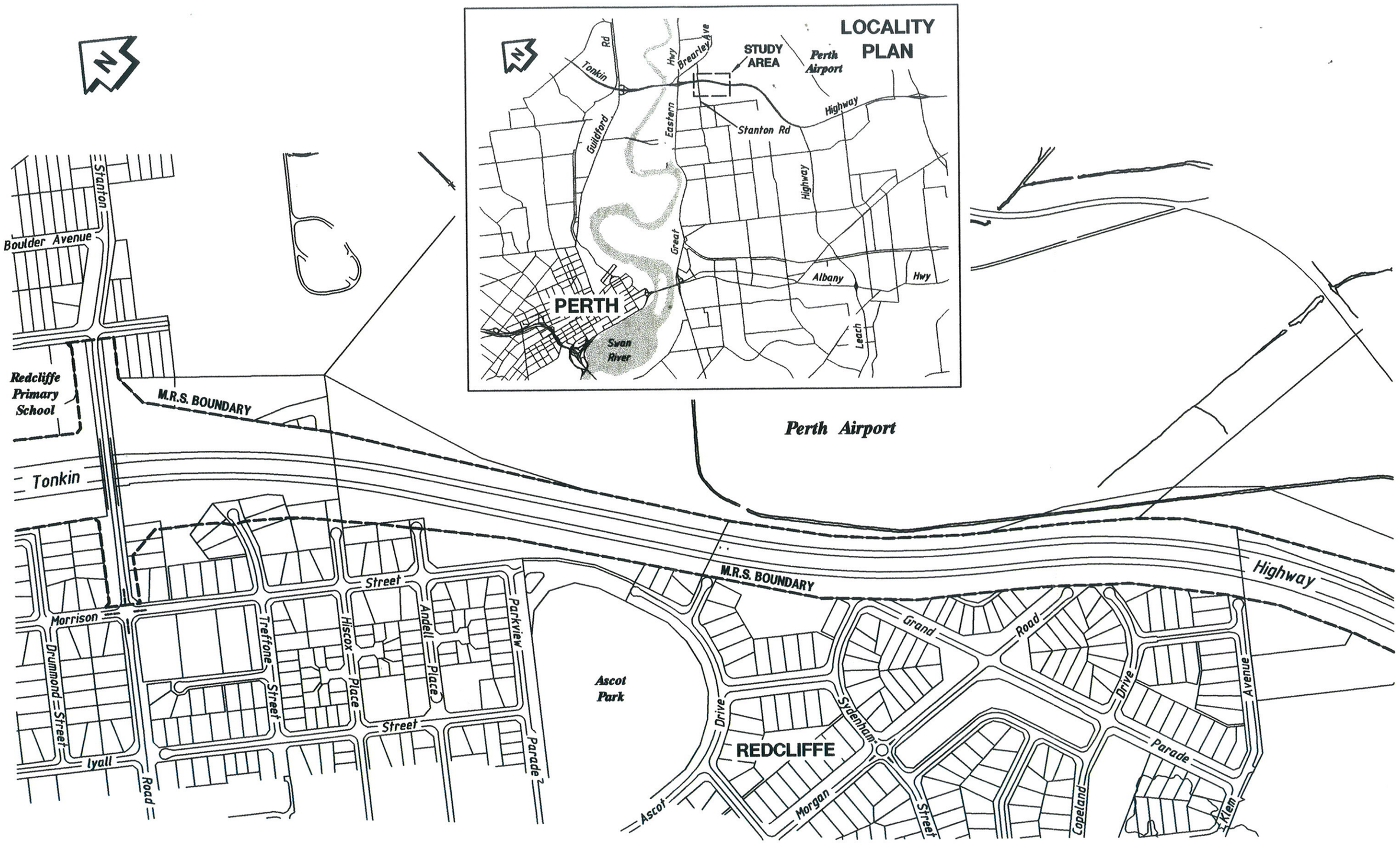

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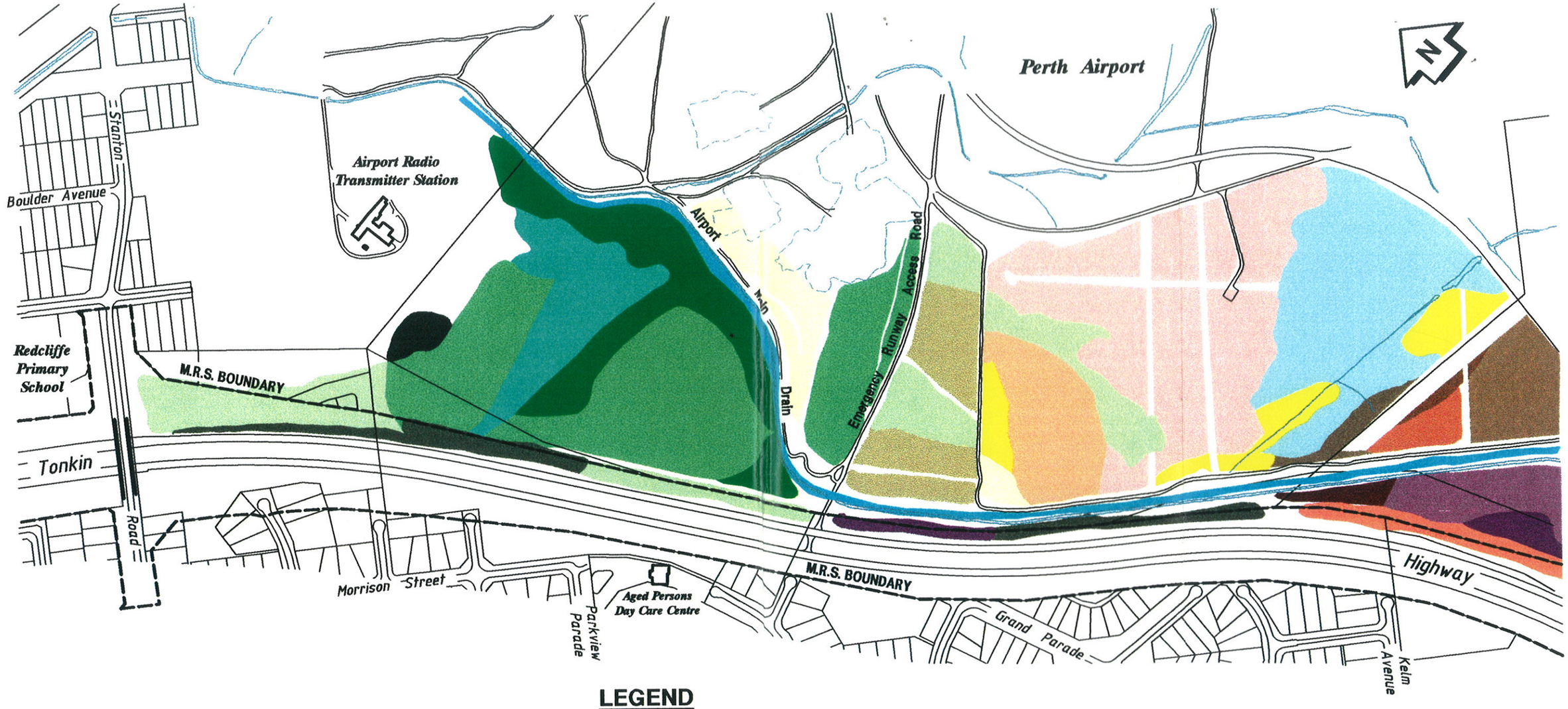
SCALE

0 50 100 150 200 250 300 350

metres

STUDY AREA

FIGURE 1



LEGEND

- *Adenanthos cygnorum/Jacksonia sternbergiana* Tall Shrubland
- *Adenanthos cygnorum/Jacksonia densiflora* Open Shrubland
- *Eucalyptus marginata/Banksia* Open Woodland
- *Hypocalymma angustifolium* Closed Scrub
- *Eucalyptus marginata/Banksia* Closed Woodland with occcassional *Allocasuarina fraseriana*
- *Adenanthos cygnorum/Kunzea recurva* Open Shrub
- *Adenanthos cygnorum* Closed Shrub
- *Adenanthos cygnorum/Kunzea recurva/Jacksonia sternbergiana* Open Shrub
- *Melaleuca preissiana* Low Open Woodland
- *Typha domingensis* Sedgeland
- *Corymbia calophylla* Woodland
- *Adenanthos cygnorum/Hypocalymma angustifolium/Pericalymma ellipticum* Low Closed Heath
- *Adenanthos cygnorum/Jacksonia furcellata/Hypocalymma angustifolium* Low Open Heath
- *Eucalyptus rudis* Open Woodland
- *Leptospermum laevigatum/Nuytsia floribunda/Melaleuca preissiana* Open Shrub
- *Eucalyptus marginata/Eucalyptus rudis/Melaleuca preissiana* Open Woodland
- *Eucalyptus rudis/Melaleuca preissiana* Open Woodland
- *Adenanthos cygnorum/Melaleuca preissiana/Nuytsia floribunda* Shrubland
- *Corymbia calophylla* Woodland over *Hypocalymma angustifolium* Closed Scrub
- *Corymbia calophylla/Melaleuca preissiana* Open Woodland
- *Corymbia calophylla* Woodland over *Leptospermum laevigatum and Adenathos cygnorum* Open Shrub

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SCALE

0 50 100 150 200

metres

VEGETATION ASSOCIATIONS

FIGURE 2

Plate 1 Jarrah *Eucalyptus marginata/Banksia* Open Woodland

Plate 2 Jarrah *Eucalyptus marginata/Banksia* Closed Woodland with occassional *Allocasuarina fraseriana*

Plate 3 *Adenanthos cygnorum/Jacksonia densiflora* Open Shrubland

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Plate 4 *Hypocalymma angustifolium* Closed Scrub

Plate 5 *Adenanthos cygnorum* Closed Scrub, with fringing *Jacksonia sternbergiana*

Plate 6 *Eucalyptus marginata/Banksia* Closed Woodland (background) with *Adenanthos cygnorum/Hypocalymma angustifolium/Pericalymma ellipticum* Low Closed Heath (foreground)

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Appendix A

Reptile and Amphibia Species List from Perth Airport

Reptile and Amphibia Species List for Perth Airport

(Taken from Alan Tingay and Associates, 1994b)

FROGS
LEPTODACTYLIDAE
Heleioporus eyrei (Moaning Frog)
Limnodynastes dorsalis (Banjo Frog)
Myobatrachus gouldii (Turtle Frog)
Pseudophryne guentheri (Guenthers Frog)
Ranidella glauerti
Ranidella insignifera
HYLIDAE
Litoria adelaidensis (Slender Tree Frog)
L. moorei (Bullfrog)
TORTOISE
CHELIDAE
Chelodina oblonga (Oblong Turtle)
SNAKES
TYPHLOPIDAE
Ramphotyphlops australis
ELAPIDAE
Notechis coronatus (Crowned Snake)
Pseudonaja affinis (Dugite)
Rhinoplocephalus gouldii (Gould's Snake)
Vermicella bimaculata (Back-naped Snake)

LIZARDS
PYGOPODIDAE
Delma fraseri
Delma grayii
Lialis burtonis
Pletholax gracilis
AGAMIDAE
Pogona minor
VARANIDAE
Varanus gouldii
Varanus tristis
SCINCIDAE
Bassiana trilineatum
Cryptoblepharus plagiocephalus
Ctenotus fallens
C. impar
C. leseurii
Hemiergis quadrilineata
Lerista elegans
Menetia greyii
Tiliqua rugosa (Bobtail)

Appendix B

Bird Species List from Perth Airport

Bird List for Perth Airport

(Taken from Alan Tingay and Associates, 1994)

PODICIPEDIDAE/GREBES
Tachybaptus novaehollandiae
(Australasian (Black Throated) Grebe)
PELECANIDAE/PELICANS
Pelecanus conspicillatus
(Australian Pelican)
ANHINGIDAE/DARTERS
Anhinga melanogaster
(Darter)
PHALACROCORACIDAE/CORMORAN
Phalacrocorax carbo
(Great Cormorant)
P. sulcirostris
(Little Black Cormorant)
P. melanoleucos
(Little Pied Cormorant)
ARDEIDAE/HERONS
Ardea pacifica
(Pacific Heron)
A. novaehollandiae
(White-faced Heron)
Egretta alba
(Great Egret)
PLATALEIDAE/IBIS AND SPOONBILL
Threskiornis aethiopica
(Sacred Ibis)
T. spinicollis
(Straw-necked Ibis)
Platalea flavipes
(Yellow-billed Spoonbill)
ANATIDAE/DUCKS AND SWANS
Cygnus atratus
(Black Swan)

Tadorna tadornoides
(Australian Shelduck)
Anas superciliosa
(Pacific Black Duck)
Anas rhynchotis
(Australian Shoveler)
A. gibberifrons
(Grey Teal)
Chenonetta jubata
(Maned Duck)
Biziura lobata
(Musk Duck)
ACCIPITRIDAE/KITES AND HAWKS
Elanus notatus
(Black-shouldered Kite)
Accipiter fasciatus
(Brown Goshawk)
A. cirrhocephalus
(Collared Sparrowhawk)
Aquila audax
(Wedge-tailed Eagle)
Hieraaetus morphnoides
(Little Eagle)
FALCONIDAE/FALCONS
Falco berigora
(Brown Falcon)
F. cenchroides
(Nankeen(Australian) Kestrel)
RALLIDAE/CRAKES, RAILS
& GALLINULES
Gallinula tenebrosa
(Dusky Moorhen)
Porphyrio porphyrio
(Purple Swamphen)
Fulica atra
(Eurasian Coot)
CHARADRIIDAE/PLOVERS
Charadius melanops
(Black-fronted Plover)
RECURVIROSTRIDAE/STILTS
Himantopus himantopus
(Black-winged Stilt)

Cladorhynchus leucocephalus
Banded (Pied) Stilt
COLUMBIDAE/PIGEONS AND DOVES
Streptopelia senegalensis
(Laughing Turtle-Dove)
Phaps chalcoptera
(Common Bronzewing)
Ocyphaps lophotes
(Crested Pigeon)
PLATYCERCIDAE/PARROTS
Calyptorhynchus latirostris
(Carnaby's Black-Cockatoo)
Cacatua roseicapilla
(Galah)
Purpureicephalus spurius
(Red-capped Parrot)
Barnardius zonarius
(Ringnecked Parrot/Port Lincoln Ringneck)
Neophema elegans
(Elegant Parrot)
CUCULIDAE/CUCKOO
Cuculus pallidus
(Pallid Cuckoo)
C. pyrrhophanus
(Fan-tailed Cuckoo)
Chrysococcyx lucidus
(Golden (Shining) Bronze Cuckoo)
ALCEDINIDAE/KOOKABURRAS & KINGFISHERS
Dacelo novaeguineae
(Laughing Kookaburra)
Halcyon sancta
(Sacred Kingfisher)
MEROPIDAE/BEE-EATERS
Merops ornatus
(Rainbow Bee-eater)
HIRUNDINIDAE/SWALLOWS AND MARTINS
Hirundo neoxena
(Welcome Swallow)

Cecropis nigricans
(Tree Martin)
C. ariel
(Fairy Martin)
MOTACILLIDAE/PIPIT
Anthus novaeseelandiae
(Richard's Pipit)
CAMPEPHAGIDAE/CUCKOO-SHRIKES & TRILLERS
Coracina novaehollandiae
(Black-faced Cuckoo-Shrike)
Lalage sueurii
(White-winged Triller)
MUSCICAPIDAE/ROBINS AND WHISTLERS
Petroica goodenovii
(Red-capped Robin)
Pachycephala rufiventris
(Rufous Whistler)
Colluricincla harmonica
(Grey Shrike-thrush)
Rhipidura fuliginosa
(Grey Fantail)
R. leucophrys
(Willie Wagtail)
SYLVIIDAE
Acrocephalus australis
(Australian Reed-Warbler)
MALURIDAE/WRENS
Malurus splendens
(Splendid Fairy-wren)
ACANTHIZIDAE
Gerygone fusca
(Western Gerygone (Fly-eater))
Acanthiza pusilla
(Brown (Broad-tailed) Thornbill)
Acanthiza chrysorrhoa
(Yellow-rumped Thornbill)
Daphoenositta chrysoptera
(Varied (Australian) Sitella)

MELIPHAGIDAE/HONEYEATERS
Anthochaera carunculata
(Red Wattlebird)
A. chrysoptera
(Little Wattlebird)
Lichenostomus virescens
(Singing Honeyeater)
Lichmera indistincta
(Brown Honeyeater)
Phylidonyris pyrrhoptera
(New Holland Honeyeater)
Phylidonyris nigra
(White-cheeked Honeyeater)
Phylidonyris melanops
(Tawny-crowned Honeyeater)
Acanthorhynchus superciliosus
(Western Spinebill)
DICAEIDAE
Dicaeum hirundinaceum
(Mistletoebird)
PARDALOTIDAE/PARDALOTES
Pardalotus punctatus
(Spotted Pardalote)
P. striatus
(Striated Pardalote)
ZOSTEROPIDAE:
Zosterops lateralis
(Silvereye)
EPHTHIANURIDAE/CHATS
Ephthianura albifrons
(White-fronted Chat)
GRALLINIDAE/MAGPIE LARK
Grallina cyanoleuca
(Australian Magpie-Lark)
ARTAMIDAE/WOODSWALLOWS
Artamus cinereus
(Black-faced Woodswallow)
Artamus cyanopterus
(Dusky Woodswallow)

CRACTICIDAE/BUTCHER BIRDS
& MAGPIES
Cracticus torquatus
(Grey Butcherbird)
Gymnorhina tibicen
(Australian Magpie)
CORVIDAE/RAVENS
Corvus coronoides
(Australian Raven)

PRECINCT 5
REHABILITATION PLAN
PERTH INTERNATIONAL AIRPORT

On behalf of :
WESTRALIA AIRPORTS CORPORATION

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FIGURE 2 VEGETATION CONDITION

FIGURE 3 LAND MANAGEMENT PLAN - 2003

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1. INTRODUCTION

ENV. Australia (ENV) was commissioned by Westralia Airports Corporation (WAC) to prepare a Rehabilitation Plan for Precinct 5 within the Perth International Airport. Precinct 5 is an area that has been proposed for conservation as described within the approved Master Plan for the Airport (Bechtel Australia, 1999).

The Master Plan describes the proposed uses of land within the boundaries of the airport, including those areas to be developed for non-aeronautical purposes. Approximately 15% of the land within the Perth International Airport is to be retained in its natural state for conservation purposes.

The WAC has committed to managing Precinct 5 to maintain species diversity and remnant bushland wherever possible. Precinct 5 is to be treated with priority regarding rehabilitation and revegetation. It contains Priority 1 areas P1.4, P1.5, and P1.6. A Priority 1 rating is generally assigned to large expanses of vegetation in slightly disturbed condition and wetlands of high conservation attributes.

WAC intends to clear parts of the adjacent 2C Precinct for development as outlined in the approved Master Plan. The WAC seeks to take advantage of this development activity by using the vegetation and soil from the clearing process of 2C in the rehabilitation of Precinct 5. The rehabilitation is also to include the creation of a wetland that will serve as a compensating basin for major rainfall events. This wetland will be created within an highly degraded area of Precinct 5 that sits between areas of relatively high quality vegetation found within Precinct 5. The resulting rehabilitated area will serve as a link between these areas.

This Rehabilitation Plan describes the process of clearing area 2C and rehabilitating Precinct 5. It draws heavily on the environmental work that has been done by the WAC throughout the Perth International Airport by various environmental scientists and botanists both in-house and external to WAC.

2. BACKGROUND

Parts of Area 2C are to be developed as a Business Park. This proposed development is described broadly in the approved Master Plan and in detail in the Major Development Plan for the area prepared by The Planning Group (2003). The Major Development Plan provides a detailed description of the environmental values of area 2C, the potential impacts associated with the development, and how these impacts will be managed or mitigated.

The development of 2C initially involves the clearing and levelling of the area and the installation of trunk services and access roads for the subsequent construction of various developments. Development and thus clearing may be performed on a staged basis.

A number of studies have been performed over the last decade that provides information on the vegetation and flora of Precinct 5 and adjacent areas. This information is very useful in planning the rehabilitation of Precinct 5 and it is contained in the following studies:

Definition of botanical values in Area 2C and parts of Precinct 5 by Eleanor Bennett of Bennett Environmental Consulting in 2002 and 2003.

Definition of botanical values within Precinct 5 by Mattiske Consulting Pty Ltd in 2003.

Botanical surveys performed in the 1990s over the entire Perth airport land holding by Alan Tingay and Associates.

The Environmental Strategy for the Perth International Airport (Bechtel Australia, 1999) which describes the broad environmental strategy for development within its boundaries.

The documents collectively describe the flora and vegetation of the areas within 2C that are to be cleared and that of Precinct 2C. The condition of the vegetation within these two areas has also been described. Figure 1 describes the vegetation units found in Area 2C and Precinct 5. Figure 2 describes the condition of the vegetation in these two areas.

3. APPROACH TO REHABILITATION

The general approach to the rehabilitation is to use carefully collected soil and vegetation material from the part of area 2C to be cleared and use it to rehabilitate those parts of Precinct 5 that require rehabilitation. The best quality vegetation from area 2C will be used to rehabilitate degraded areas with the same vegetation communities types in Precinct 5. The information with regard to vegetation community type and vegetation condition to be used in this process is summated in Figures 1 and 2. Detailed botanical assessments were performed to produce these diagrams.

Initially 20 hectares of the part of area 2C to be developed will be cleared. The part of area 2C to be developed consists of 44 hectares. Only 8 hectares of these 44 hectares are considered to be in "good condition" or better and are considered worthy of use in the rehabilitation process and nearly all of this is within the first 20 hectares to be cleared. A further 2 hectares within the remaining 24 hectares is in good condition and will be used for rehabilitation. The balance of the area which is less than good condition will be cleared and the material stockpiled for use in other areas that are very degraded or are to be landscaped or it will be burnt.

The clearing and rehabilitation work will be implemented by experienced contractors and supervised by appropriately qualified environmental professionals. These people will include specialist contractors, botanists, and environmental management specialists. The WAC proposes to use N. K. Contractors Pty Ltd, a firm very experienced in such work and which performs similar work throughout the Perth Airport. They will operate under the instruction of the botanists that have mapped the vegetation communities and the environmental scientists that have assisted in the planning of the rehabilitation program.

Care and hygiene will be important aspects of the clearing and rehabilitation work. All vehicles and earthwork equipment to be used will be cleaned prior to entry onto the site so that no soil material that may harbour seeds will be brought in. This will also assist in minimising the spread of fungal diseases. The environmental supervisors for the project will inspect the vehicles and machinery to be used in areas of native vegetation. This is in line with current measures operating on the Perth Airport land to address weed and disease management.

Wherever possible the use of material from disturbed areas that contain introduced species and weeds will be avoided to minimize their spread. However where this is unavoidable weed control measures will be undertaken prior to and following works. For example Roundup will be used to treat Love Grass prior to clearing works and Fusillade will be applied after the works to assist with control of Veldt Grass. This treatment is consistent with current weed control methods used in the land management practices currently applied for the Perth Airport.

The process and progress of the rehabilitation program will be assessed on a regular basis so that techniques can be improved over the longer-term program. This review will be undertaken independently.

4. CLEARING OF PART AREA 2C

Areas that have been selected for the provision of material for rehabilitation will be cleared of vegetation first in the manner described below. These areas will be delineated in the field by clear surveyed markings so that all operators know the boundaries of the proposed operations. The clearing operation will be supervised.

4.1 WOODLAND AND HEATH

Initial clearing of the site will involve the lopping and mulching of the larger trees and shrubs, as well as the removal of Balga's (*Xanthorrhoea* species) and any other species which can be feasibly relocated. Any larger trees that can be used for the construction of access barriers will be identified and harvested. Disturbance of low shrubs, sedges and native herbs will be kept to a minimum during this initial phase of the clearing process.

The top 10 cm of the topsoil, including the ground cover vegetation, will be scraped and transported to the area where it will be spread. The material will not be stockpiled and will be taken directly to the rehabilitation area wherever possible in order to maximise the chances of seed and propagules contained in the soil establishing themselves.

Where direct transportation and placement is not possible the following options will be adopted:

- directly place the material into piles within the areas to be treated for latter use. This option will assist in creating local fauna habitat and can be used to block access routes for unauthorised vehicles. The risk associated with this approach is that dead plant material may increase the risk of local fires. However it will decrease the viability of the material.

- create a series of small windrows within the cleared areas and burn the windrows. This method may be employed where the material is considered to contain too much weed material to be of use in rehabilitation.

In areas where larger native trees or shrubs are to be cleared within disturbed sites, the trees and shrubs will be mulched. The mulch will be used in either landscaping operations for the proposed development sites or places on other disturbed sites which are in need of stabilisation.

It is likely that far more material than can be used will be generated from the clearing thus only the best quality material will be utilised in the rehabilitation of Precinct 5.

4.2 WETLAND

Material from the low lying depressions and wetlands within area 2C will be placed in similar areas within Precinct 5. A conventional loader bucket can be used to do the translocation. This technique will assist in the propagation of recalcitrant species and a range of species, for example orchids, will also propagate.

The principle is to excavate a block of vegetation and soil intact to about 40cm in depth with minimal disturbance. This will be done during damp soil conditions to enhance survival. The more surface material relocated the greater the chance of success as the annual herbs and species that are dependent on underground propagules can occur at depth. Direct replacement is preferable, however storage is possible in a prepared area that is not exposed.

A specially designed bucket may be hired depending on availability to minimise block disturbance (bending, compressing) that occurs when using a conventional bucket, as the block has to be tipped out. The modification employs a pushing arm to remove the block, so it is not tipped out but rather placed.

It is proposed to establish wetland vegetation within an area that is proposed as a compensating basin. The preparation of this area is discussed within the following section.

5. PREPARATION OF AREAS TO BE REHABILITATED WITHIN PRECINCT 5

The areas to be rehabilitated within Precinct 5 consist of tracks produced by motor vehicles such as motorbikes, areas where sand has been extracted, and parkland cleared areas that have had some degree of regeneration of native vegetation. It is these areas that will be rehabilitated actively. The tracks in the area are to be rationalised with some to be retained for fire fighting purposes. The proposed track rationalisation is shown in Figure 3.

A gate will be placed on main access points to Precinct 5 and some boundaries will be fenced. Material will be placed to make access to the area difficult for vehicles other than through established tracks that will be controlled with gates.

Material to be used in the rehabilitation will be selected on the basis of the following criteria:

- sourced from sites with similar site conditions in terms of landform, topographical position, soil types, local hydrological conditions and former vegetation types: and
- sourced from sites with similar adjacent vegetation (Banksia woodlands to be relocated within disturbed areas bounded by similar Banksia woodlands, heath communities to be relocated within the disturbed areas bounded by similar communities).

It is expected that the vegetation that is classified as good to very good within 2C as shown in Figure 2 will be used. This vegetation is mostly low woodland of *Banksia* species and closed to open heath of *Pericalimma*.

Wherever feasible, all larger native species and areas of native vegetation will be left intact with areas to be rehabilitated. All aggressive introduced species such as castor oil plants, tagasaste, South African love grass will be either removed by hand or machinery or buried. Selective treatment of introduced species in some of these areas of adjacent native vegetation may be required prior to the earthworks. Such requirements will also be performed following the works, in line with current weed control methods used in the land management practices currently in place for the Perth Airport.

Weed and introduced species will be treated in line with current land management practices adopted in the Perth Airport area which includes recognition of legal requirements related to declared weed species – Agriculture and Related Resources Protection Act 1976.

A grader or similar machine will landscape the proposed rehabilitation areas.

The overburden/topsoil from the areas of native vegetation will be transported and spread over the prepared areas.

Salvaged plants are expected to require storage for a season in preparation for replanting following autumn/winter rains. Appropriate nursery facilities have been prepared for the plants, including artificial watering. Salvaged plants will be stored in suitable bags (200L-500L) for transport and will be prepared for regeneration.

5.1 WETLAND CREATION

An area previously used for sand extraction within Precinct 5 will be rehabilitated as a wetland and will serve as an infiltration basin for stormwater originating from area 2C. This area is the relatively large degraded area within the narrow, central part of Precinct 5 shown in Figure 3.

The wetland will serve hydraulic functions as a stormwater infiltration basin and ecological functions as an area of rehabilitation. The proposed objectives for the wetland are to provide habitat diversity similar to other seasonally damp wetlands in the area and enhance the habitat opportunities for rare flora and fauna known to exist on WAC land.

The wetland serves an important function as a component of the stormwater system. To provide an appropriate level of stormwater protection to the park development the water level within the wetland must not exceed 20m AHD and this is a critical engineering design component for the wetland. The average annual maximum groundwater level for the area where the wetland will be constructed is estimated as 19.3m AHD. The expected variation of groundwater levels in the area of the development is approximately 0.5m.

It is proposed to design the wetland to accommodate some inundation in winter when groundwater levels rise, though for it to be dry in summer. The storage zone of the wetland will be benched to ensure that there are a variety of habitats and to provide a transition to the surrounding existing vegetation (Seasonally Damp Melaleuca Woodland). The specifics of the inundation zones will be designed in coordination to the development of the ecological design. The inclusion of an open water zone is not considered desirable as the presence of water in summer can be problematic due to problems such as nuisance odours and insects.

The storage zone will have a core of wet sedge lands as this vegetation type is most suited to the periodic inundation that will be caused by the stormwater flows and the position of the wetland in the topography. The predominant species *Typha domingensis* can tolerate maximum inundation depths of 0.8m and seasonal flooding ranges of 1 – 1.2m. This is consistent with the hydraulic design of the storage zone. Propagation of *Typha domingensis* is practical by seed and it is proposed to collect seed from WAC land.

The vegetation type seasonally damp heath (Pe) exists in the area 2C and vegetation from this area will be used in the development of the wetland (Figure 1). This vegetation type will surround the core of wet sedge lands in conjunction with seasonally damp woodlands. These vegetation types will provide a transition to the surrounding vegetation. Seasonally damp woodlands (Mr) also exist in the 2C development area, where practical material from this area will be used in the development of the wetland.

6. MONITORING AND ASSESSMENT OF REHABILITATION

Monitoring sites will be established within the treated areas. Quadrat size and number will be determined by the size and number of vegetation communities. Generally, each community requires a minimum of ten quadrats (2m x 2m). If the revegetation area is a mosaic of only two or three communities, each separate occurrence of the community will require ten quadrats, unless occurrences are numerous and small, then some may be omitted. Quadrats are to be identified numerically by location to other quadrats.

Quadrats are to be monitored in April/May and August of each year. Photo monitoring of the revegetation areas is required. This will generate substantial information from the vegetation monitoring and needs to reflect the general conditions of the site outside of the quadrats. Photo monitoring points will be set up at one photograph per ten quadrats (i.e. per community). Photo monitoring points will commence prior to on-ground works as part of the establishment of quadrats so as to provide a photographic record of changes to the site, and will be included every time the quadrat is monitored.

Monitoring data and documentation will include the total number of plants, vegetation structural layer distribution and ratio/density of weed species to native will be recorded for each quadrat. Recommendations will also be made by the revegetation/monitoring contractor on measures to support the rehabilitation works, such as the requirements for supplementary seeding and weed control.

FIGURES

Figure. 1

LEGEND

- **BaBm** — Low Woodland of *Banksia attenuata* and *Banksia menziesii* over a Shrubland of *Xanthorrhoea brunonis* subsp. *brunonis* over a Herbland of *Patersonia occidentalis*.
- **Bep** — Low Woodland of *Banksia attenuata* and *Banksia menziesii* over Open Low Heath of *Eremaea pauciflora* over *Briza maxima* and *Aloegeargia nitens*.
- **CcBa** — Woodland of *Corymbia calophylla* over a Low Open Woodland of *Banksia Attenuata* over a Open Low Heath of mixed species.
- **EtBaBm** — Low Open Forest of *Eucalyptus todtiana*, *Banksia attenuata* and *Banksia menziesii* over an Open Low Heath of *Euchilopsis linearis* and *Hypocalymma angustifilium* over a Herbland of *Patersonia occidentalis*.
- **CcXp** — Open Low Woodland of *Melaleuca preissiana* over an Open Low Heath to Open Low Shrubland of *Pericalymma ellipticum* over *Ehrharta calycina*, *Lepidosperma effusum* and *Patersonia occidentalis*.
- **MpPe** — Woodland of *Corymbia Calophylla* over *Xanthorrhoea preissii* and *Hibbertia subvaginata*.
- **BMr** — Low Closed Forest of *Melaleuca rhaphiophylla* and *Banksia littoralis* over a *Sedgeland/Herbland* of *Schoenus fasciculatis*, *Lepidosperma effusum* and *Hypocheeris glabra*.
- **AtHa** — Mosaic of Closed Heath of *Hakea varia*, *Astartea fascicularis*, *Hypocalymma angustifolium*, *Euchilopsis linearis* and Sedgeland of *Baumea* and *Meeboldina* species.
- **Pe** — Closed to Open Low Heath of *Pericalimma ellipticum* over herbs.
- **Deg** — Mixed Grassland and Herbland of introduced species.

NOTES Base topography supplied by Westralian Airports Corporation.

MICROSTATION FILE : N:\APT DEV\P85 S\VEGETATION P5 2C.DGN	ISS	DRN	AMENDMENTS: 2. GJC Precinct 2C assessment from ENV Australia — APPD: N.K. — DATE: 26.6.2003
DATA SOURCE : MATTISKE CONSULTING PTY LTD, ENV AUSTRALIA BENNETT ENVIRONMENTAL CONSULTING			
ORIGINAL ISSUE DRAWN: GJC APPROVED: N.K. DATE: 18.6.03			

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VEGETATION

South Eastern Corner
East of Horrie Miller Drive

DRAWING No	SCALE	SHEET	SIZE
FS-8387	1:5000	1	A1

PERTH AIRPORT

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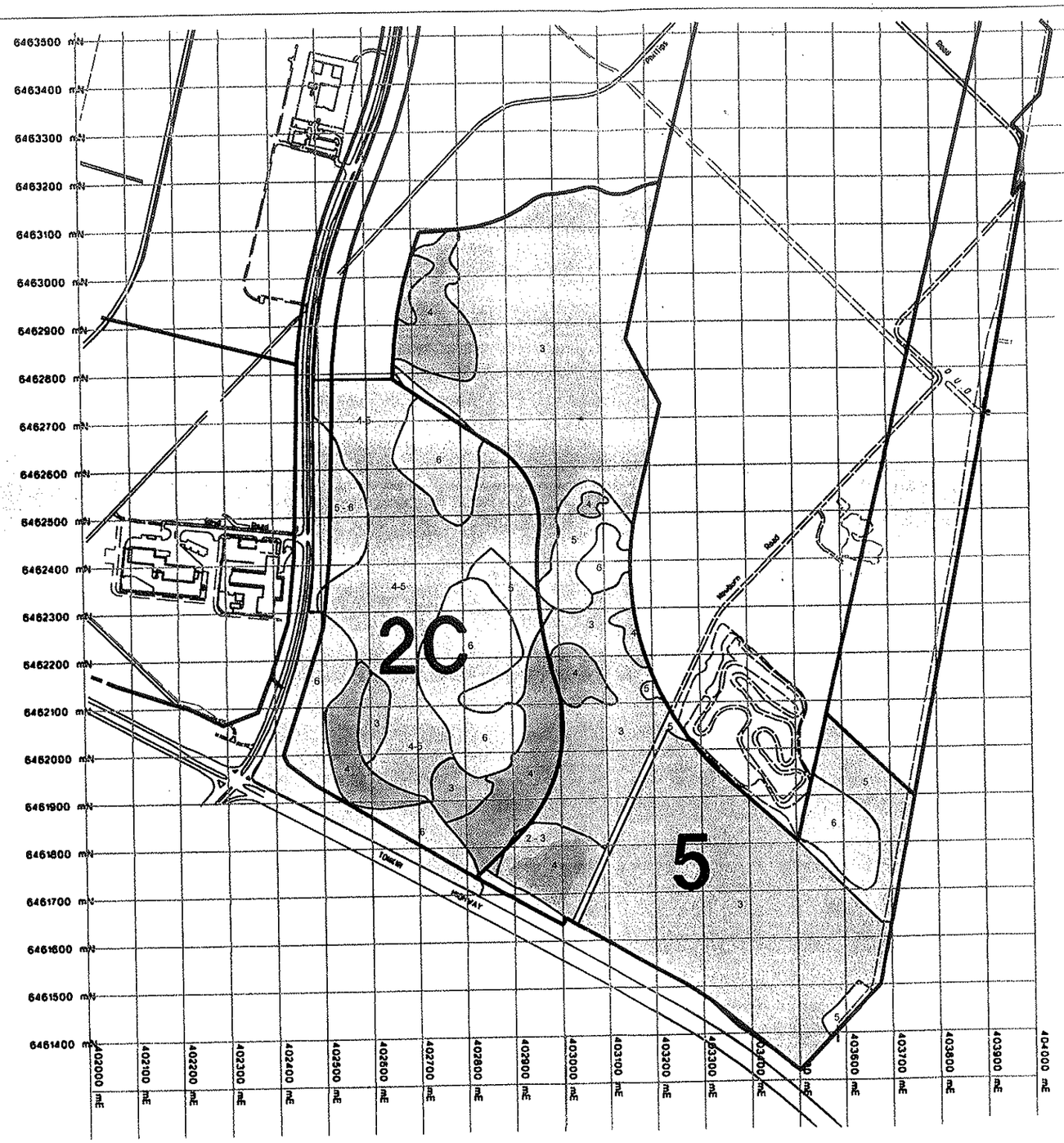
Figure 2



VEGETATION CONDITION LEGEND

1	Pristine	Pristine or nearly so, no obvious signs of disturbance.
2	Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
3	Very Good	Vegetation structure altered, obvious signs of disturbance.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or the ability to regenerate it.
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.
6	Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.

MICROSTATION FILE :
N:\ VEGETATION P5 2C.DGN

DATA SOURCE :
MATTISKE CONSULTING PTY LTD, ENV AUSTRALIA
BENNETT ENVIRONMENTAL CONSULTING

ORIGINAL ISSUE

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ISS	DRN	AMENDMENTS	APPD	DATE
2.	GJC	Precinct 2C assessment from ENV Australia	N.K.	26.5.2003

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VEGETATION CONDITION

South Eastern Corner
East of Horrie Miller Drive

PERTH AIRPORT

DRAWING No.	SCALE	SHEET	SIZE
FS-8387	1:5000	2	A1

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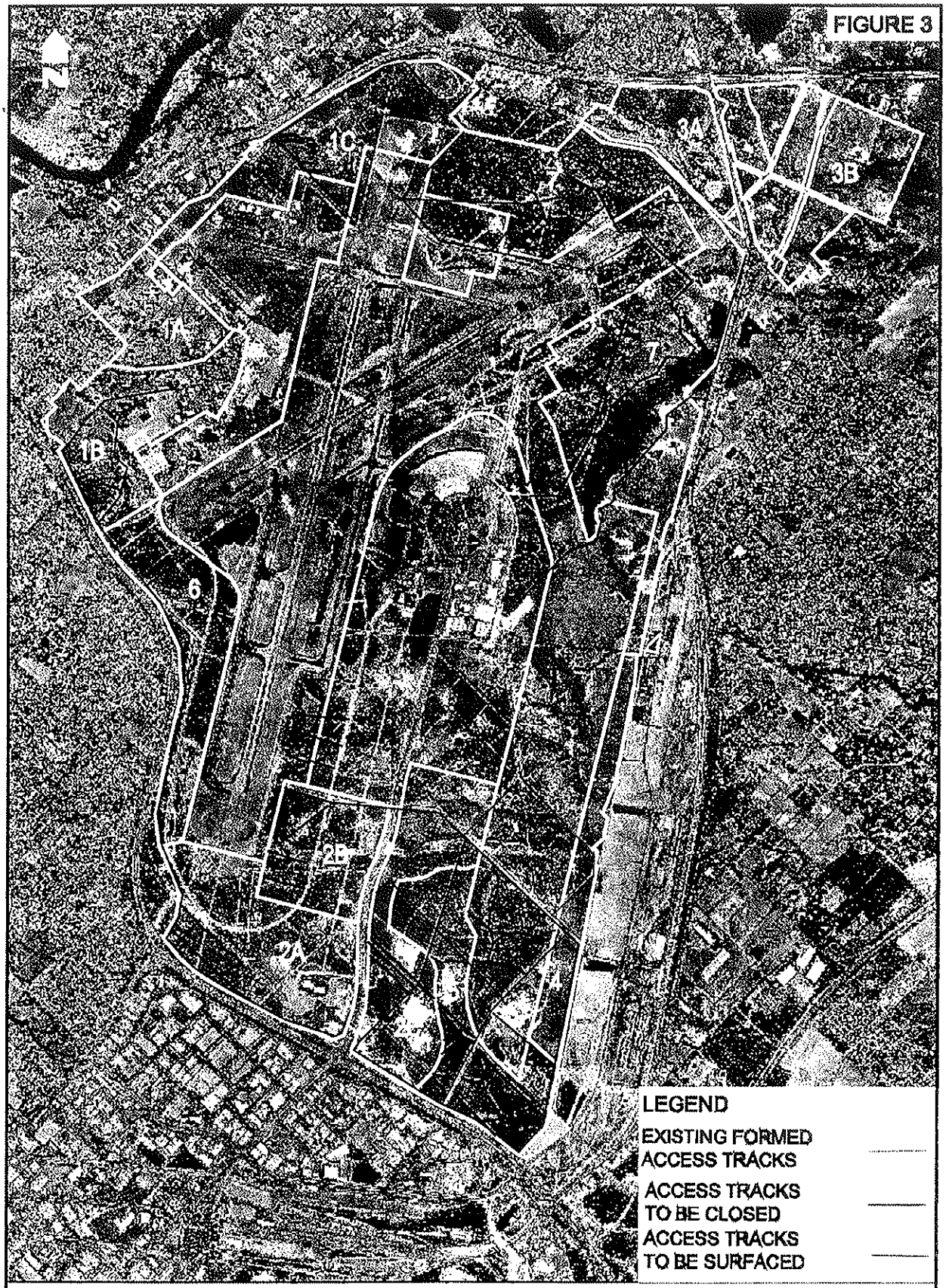
FIGURE 3



LAND MANAGEMENT PLAN - 2003

FIRE ACCESS TRACKS

FS-8337 Sht 3

PERTH AIRPORT

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Vegetation of Perth International Airport Area 2c

Prepared for:
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PERTH 6000

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December 2002

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1 Introduction

Bennett Environmental Consulting Pty Ltd was commissioned by ENV Australia to undertake a vegetation survey of a section of Perth International Airport, the southern section of the area designated 2C. This area includes remnant vegetation bounded by Horrie Miller Drive, Tonkin Highway and Area 5 (See Diagram 1).

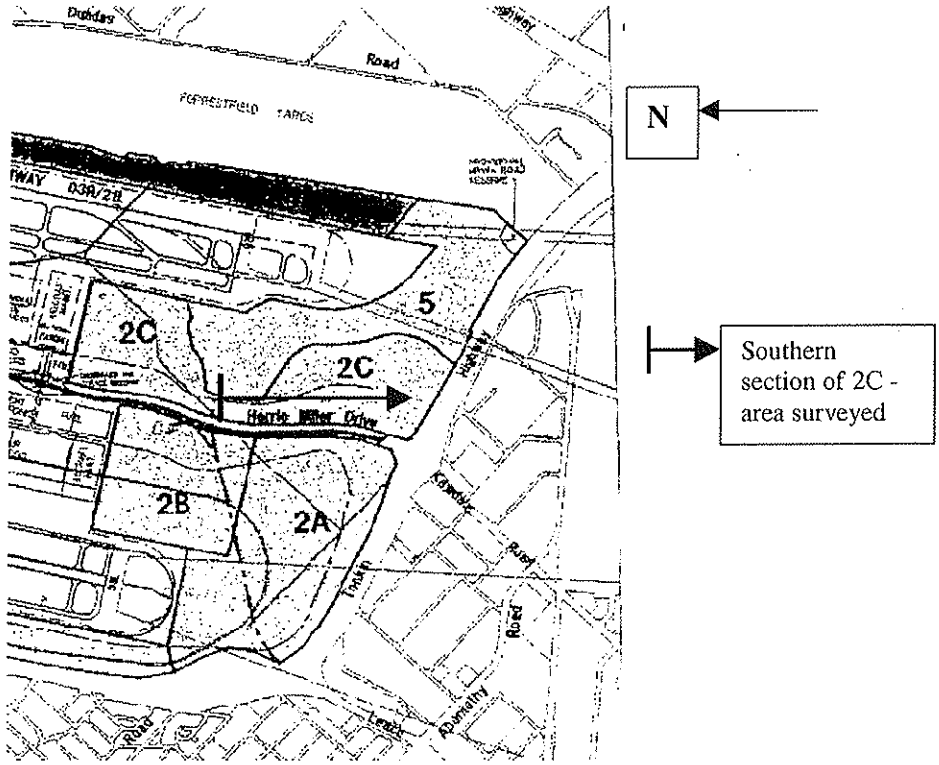

Diagram 1. Survey area, southern section of area 2C

This section of Perth International Airport is included in the Southern River Vegetation Complex within the Bassendean Dunes. This Complex consists of an open-woodland of *Corymbia calophylla* (Marri), *Eucalyptus marginata* (Jarrah) with *Banksia* species on the elevated areas and a fringing woodland of *Eucalyptus rudis* (Flooded gum), *Melaleuca rhaphiophylla* (Paperbark) along the streams (Heddle, 1980). It consists of aeolian deposits of sandplains with low dunes and many intervening swamps; iron and humus podsols, peats and clay (Churchward and McArthur, 1980). Typically the soil is light grey quartz sands.

2 Methods

Field work was undertaken on 19th September 2002, when the remnant bushland was traversed on foot by walking transects. The vegetation communities present were described using the terminology in Table 1, and the species listed. Where species were not recognised in the field these were collected, pressed and later identified using the collections at the Western Australian herbarium.

Table 1. Vegetation layers. Adapted from: Bush Forever (Department of Environmental Protection, 2000)

Life Form/ Height Class	Canopy Cover			
	100-70%	70-30%	30-10%	10-2%
Trees over 30m	Tall Closed Forest	Tall Open Forest	Tall Woodland	Tall Open Woodland
Trees 10-30m	Closed Forest	Open Forest	Woodland	Open Woodland
Trees under 10m	Low Closed Forest	Low Open Forest	Low Woodland	Low Open Woodland
Tree Mallee/Mallee	Closed Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
Shrub Mallee	Closed Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
Shrubs over 2m	Closed Tall Scrub	Tall Open Scrub	Tall Shrubland	Tall Open Shrubland
Shrubs 1-2m	Closed Heath	Open Heath	Shrubland	Open Shrubland
Shrubs under 1m	Closed Low Heath	Open Low Heath	Low Shrubland	Low Open Shrubland
Grasses	Closed Grassland	Grassland	Open Grassland	Very Open Grassland
Herbs	Closed Herbland	Herbland	Open Herbland	Very Open Herbland

The condition of the bushland was recorded using the 1-6 scale in Table 2.

Table 2. Explanation of Vegetation Condition Rating (Government of Western Australia, 2000)

Rating	Description	Explanation
1	Pristine	Pristine or nearly so, no obvious signs of disturbance.
2	Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
3	Very Good	Vegetation structure altered, obvious signs of disturbance.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.
6	Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.

3 Results

Nearly one third of the area surveyed was degraded, with a predominant weed flora. These areas continue to be degraded by trail bikes etc. An arial photograph

of the exact boundaries of the survey area was provided after the draft report had been prepared. It was apparent that areas, additional to that required had been surveyed. These are indicated in the report.

3.1 Vegetation

There were eight vegetation units recorded in the remnant bushland.

1. **Low Woodland of *Banksia attenuata* and *Banksia menziesii* over a Shrubland of *Xanthorrhoea brunonis* subsp. *brunonis* over a Herbland of *Patersonia occidentalis.***

   Dominant trees: *Banksia attenuata, Banksia menziesii, Eucalyptus todtiana, Nuytsia floribunda*

   Dominant shrubs: *Adenanthos cygnorum, Acacia pulchella* var. *pulchella, Eremaea pauciflora, Scholtzia involucrata*

   Dominant herbs/grasses/sedges: *Alexgeorgea nitens, *Ehrharta calycina, Hypolaena exsulca, Patersonia occidentalis, *Ursinia anthemoides*

2. **Low Woodland of *Banksia attenuata* and *Banksia menziesii* over an Open Low Heath of *Eremaea pauciflora* over **Briza maxima* and *Alexgeorgea nitens.***

   Dominant trees: *Banksia attenuata, Banksia menziesii*

   Dominant shrubs: *Bossiaea eriocarpa, Eremaea pauciflora, Jacksonia furcellata, Scholtzia involucrata*

   Dominant herbs/grasses/sedges: *Amphipogon turbinatus, Alexgeorgea nitens, *Gladiolus caryophyllaceus, Stylidium repens, *Ursinia anthemoides*

3. **Woodland of *Corymbia calophylla* over a Low Open Woodland of *Banksia attenuata* over an Open Low Heath of mixed species.**

   Dominant trees: *Banksia attenuata, Banksia menziesii, Corymbia calophylla*

   Dominant shrubs: *Chamaecytisus palmensis, Conostephium pendulum, Hibbertia huegelii, Hypocalymma robustum, Xanthorrhoea preissii*

   Dominant herbs/grasses/sedges: *Alexgeorgea nitens, *Cynodon dactylon, Lyginia barbata, Stylidium calcaratum, Trachymene pilosa*

4. **Low Open Forest of *Eucalyptus todtiana, Banksia attenuata* and *Banksia menziesii* over an Open Low Heath of *Euchilopsis linearis* and**

Hypocalymma angustifolium **over a Herbland of *Patersonia occidentalis*.** (Most of this vegetation unit was outside of Area 2C).

Dominant trees: *Banskia attenuata, Banksia menziesii, Eucalyptus todtiana, Nuytsia floribunda*

Dominant shrubs: *Adenanthos cygnorum, Euchilops linearis, Hypocalymma angustifolium, Xanthorrhoea preissii*

Dominant herbs/grasses/sedges: **Briza maxima, Dasypogon bromeliifolius, *Hypochaeris glabra, Lyginia barbata*

5. **Closed to Open Low Heath of *Pericalymma ellipticum* over herbs.**

   Dominant trees: *Melaleuca preissiana*

   Dominant shrubs: *Astartea* affin. *fascicularis, Calytrix fraseri, Pericalymma ellipticum, Verticordia densiflora*

   Dominant herbs/grasses/sedges: **Ehrharta calycina, *Hypochaeris glabra, Patersonia occidentalis, *Urisnia anthemoides*

6. **Low Open Woodland of *Melaleuca preissiana* over an Open Low Heath to Open Low Shrubland of *Pericalymma ellipticum* over **Ehrharta calycina, Lepidosperma effusum*** **and *Patersonia occidentalis*.**

   Dominant trees: *Melaleuca preissiana*

   Dominant shrubs: *Adenanthos cygnorum, Euchilopsis linearis, Pericalymma ellipticum, Verticordia densiflora*

   Dominant herbs/grasses/sedges: **Ehrharta calycina, Homalosciadium homalocarpum, *Hypochaeris glabra, *Ursinia anthemoides*

7. **Low Closed Forest of *Melaleuca rhaphiophylla*** **and *Banksia littoralis*** **over a Sedgeland/Herbland of *Schoenus fascicularis, Lepidosperma effusum*** **and **Hypochaeris glabra*.** (Outside of Area 2C but included in the original survey.)

   Dominant trees: *Banksia littoralis, Melaleuca rhaphiophylla*

   Dominant shrubs: *Astartea* affin. *fascicularis, Pericalymma elliptica*

   Dominant herbs/grasses/sedges: **Hypochaeris glabra, Lepidosperma effusum, Schoenus fascicularis, *Ursinia anthemoides*

8. **Mixed Grassland and Herbland of introduced species.**

Dominant shrubs: **Chamaecytisus palmensis, *Leptospermum laevigatum*

Dominant herbs: **Arctotheca calendula, *Fumaria capreolata, *Hypochaeris glabra, *Moraea flaccida*

Dominant grasses: **Arundo donax, *Avena barbata, *Cynodon dactylon, *Ehrharta calycina, *Ehrharta longiflora, *Eragrostis curvula*

The species recorded for these communities are listed in Appendix A under the different communities and vascular plant families and mapped in Appendix B.

3.2 Floristic Community Type

Gibson *et al.* (1994) undertook a floristic survey of the Swan Coastal Plain. They surveyed, 509, 10m x 10m quadrats located on 40 different environmental geological units. After undertaking statistical analyses of the data 30 community groups were recognised some of which were further subdivided when distinct subgroups were recognised. Subsequent surveying has resulted in 66 Floristic Community Types being recognised.

The Floristic Community Types recorded during the current survey are inferred from the species present in the vegetation unit and by comparision with the dominant taxa for each Floristic Vegetation Community listed in Gibson *et al.* (1994). The upland vegetation units that include *Banksia attenuata* and *Banksia menziesii* (Vegetation Communities, 1,2,3 and 4) would possibly be representative of the Floristic Community Type 20a. Vegetation Community 5 is Floristic Community Type 5 and Vegetation Community 6 is Floristic Community Type 15.

It is difficult from the information to determine if the dominant Banksia communities recorded are Floristic Community Type 20a or 20b. Referring to the species list in Gibson *et al.* (1994) for these two Floristic Community Types attempting to distinguishing them without statistical analysis is difficult. All quadrats of Floristic Community Type 20a recorded *Alexgeorgea nitens* as present a species not recorded for Floristic Community 20b. *Dasypogon bromeliifolius* was recorded for 100% of Floristic Community Type 20b and 43% of Floristic Community 20a (Gibson *et al.* 1994). All the *Banksia* communities recorded

Alexgeorgea nitens and *Dasypogon bromeliifolius,* which by inference would make those communities Floristic Community Type 20a. Floristic Community Type 20a is found on the sandy soils at the base of the scarp near Forrestfield in the Southern River unit. As mentioned earlier this section of Perth International Airport occurs in the Southern River Vegetation Complex.

Floristic Community Type 20a, "*Banksia attenuata* woodland over species rich dense shrublands", is listed by the Department of Conservation and Land Management as an Endangered Ecological Community. These communities have been adequately surveyed and found to have been subject to a major contraction in area, and/or was originally of limited distribution and is in danger of significant modification throughout its range, or severe modification or destruction over most of its range in the near future. For Floristic Community Type 20a there are few occurrences known, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes (English, 2001).

Floristic Community Type 15, "Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain" is considered a Vulnerable ecological Community by the Department of Conservation and Land Management. These communities have been adequately surveyed and found to be declining, and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured, and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future, if threatening processes continue or begin operating throughout its range. Floristic Community 15 may still be widespread but it is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes (English, 2001).

Floristic Community Type 5 is not listed as a threatened ecological community (English, 2001).

3.3 Vegetation Condition

Nearly one third of the area indicated after the survey had been completed was cleared or disturbed previously and recorded a vegetation condition of 6, completely degraded. The Low Closed Forest of *Melaleuca rhaphiophylla* and

Banksia littoralis outside of Area C but at the south eastern edge of the area surveyed (See Appendix B, Map 1) varied between excellent and good, with only a small portion in excellent condition, however the tree canopy in this vegetation complex was dense. The remainder of the vegetation recorded a vegetation condition of 3-4, good to very good with occasional areas, especially along tracks where the vegetation condition was more degraded and varied between 4 and 5, good to degraded.

The vegetation condition of the site is mapped in Appendix B, Map 2.

3.4 Flora

A total of 161 taxa, 122 genera and 45 vascular plant families were recorded during the survey. The dominant families are: Myrtaceae with 20 taxa (1 introduced); Papilionaceae with 17 taxa (3 introduced); Proteaceae with 14 taxa (1 introduced); Asteraceae with 12 taxa (7 introduced); and Poaceae with 12 taxa (10 introduced). These 5 families represent 11% of the families and 46% of the total number of taxa.

3.5 Weeds

Forty four introduced species of which 3 are considered cultivated and 41 weeds were recorded during the survey. *Chamelaucium uncinatum* (Geraldton wax) is a Western Australian native species which have been planted in several locations and become naturalised. Two species, *Grevillea leucopteris* (Old socks) and *Eucalyptus robusta* (Swamp mahagony) had been planted in the area. All introduced species are listed in Table 3.

The rating allocated to each weed by the Department of Conservation and Land Management (1999) is based on three criteria:

- **Invasiveness** – ability to invade natural bushland in good to excellent condition or ability to invade waterways.
- **Distribution** – wide current or potential distribution including consideration of known history of wide spread distribution elsewhere in the world.
- **Environmental impacts** – Ability to change the structure, composition and function of ecosystems. In particular an ability to form a monoculture in a vegetation community.

Ratings indicate the following.

- **High** indicates this weed is prioritised for control and/or research ie prioritising funding to it.

- **Moderate** indicates control or research effort should be directed to it if funds are available, however it should be monitored (possibly a reasonably high level of monitoring).
- **Mild** indicates monitoring of the weed and control where appropriate.
- **Low** indicates that this species would require a low level of monitoring.

Table 3. Weed taxa recorded during the survey

✓= weed is invasive and/or will impact on the bushland.

Scientific Name	Common Name	CALM Rating		
		Rating	Invasiveness	Impacts
**Ehrharta calycina*	Veld grass	High	✓	✓
**Eragrostis curvula*	African love grass	High	✓	✓
**Euphorbia terracina*	Geraldton carnation weed	High	✓	✓
**Freesia* affin. *leichtlinii*	Freesia	High	✓	✓
**Leptospermum laevigatum*	Victoria tea tree	High	✓	✓
**Lupinus cosentinii*	Sandplain lupin	High	✓	✓
**Moraea flaccida* #P1	One leaf cape tulip	High	✓	✓
**Pelargonium capitatum*	Rose pelargonium	High	✓	✓
**Romulea rosea*	Guildford grass	High	✓	✓
**Aira caryophyllea*	Silvery hair grass	Moderate	✓	
**Anagallis arvensis*	Pimpernel	Moderate	✓	
**Arctotheca calendula*	Cape weed	Moderate	✓	
**Avena barbata*	Barbed oats	Moderate	✓	
**Briza maxima*	Blowfly grass	Moderate	✓	
**Carpobrotus edulis*	Hotentot fig	Moderate	✓	
**Chasmanthe floribunda*	African corn flag	Moderate	✓	
**Cynodon dactylon*	Couch	Moderate	✓	
**Ehrharta longiflora*	Annual veld grass	Moderate	✓	
**Euphorbia peplus*	Petty spurge	Moderate	✓	
**Gladiolus caryophyllaceus*	Wild gladiolus	Moderate	✓	
**Hypochaeris glabra*	Flatweed	Moderate	✓	
**Schinus teberinthifolius*	Japanese peppercorn	Moderate	✓	
**Solanum nigrum*	Black berry nightshade	Moderate	✓	
**Sonchus oleraceus*	Common sowthistle	Moderate	✓	
**Stenotaphrum secundum*	Buffalo grass	Moderate	✓	
**Ursinia anthemoides*	Ursinia	Moderate	✓	
**Vulpia myuros*	Silver grass	Moderate	✓	
**Wahlenbergia capensis*	Cape bluebell	Moderate	✓	
**Chamaecytisus palmensis*	Tagasaste	Mild		
**Dittricha graveolens*	Stinkwort	Mild		
**Fumaria capreolata*	White fumitory	Mild		
**Hedypnois rhagadioloides*	Cretan weed	Mild		
**Oxalis pes-caprae*	Soursob	Mild		
**Raphanus raphanistrum*	Wild radish	Mild		
**Acacia podalyriaefolia*	Silver wattle	Low		
**Agave americanum*	Agave	Low		
**Arundo donax*	Giant weed	Low		
**Conyza bonariensis*	Flaxleaf fleabane	Low		
**Erodium botrys*	Long storksbill	Low		

Scientific Name	Common Name	CALM Rating		
		Rating	Invasiveness	Impacts
**Lotus angustissimus*	Slender birdsfoot trefoil	Low		
**Oxalis purpurea*	Four o'clock	Low		
**Eucalyptus robusta*	Swamp mahogany	Eastern Aust native		
**Chamelaucium uncinatum*	Geraldton wax	Native plant		
**Grevillea leucopteris*	Old socks	Native plant		

#Definition of declaration statuses
There are five levels of declaration possible: P1, P2, P3, P4 and P5. Each of these has different landholder obligations.
P1 - The movement of plants or their seeds is prohibited within the State.
This prohibits the movement of contaminated machinery and produce including livestock and fodder.

Typically where the vegetation was in Good or better condition there was very little weed invasion due to the density of the bushland species. The weed invasion in these areas was mainly along the tracks. The large number of weeds listed is mainly due to the extensive degraded areas with no or very few native plants.

3.6 Rare and Priority Flora

One Declared Rare Flora, *Macarthuria keigheryi* was recorded during the survey. *Conospermum* affin. *undulatum* is a species which appears to be confined to the foothills and resembles *Conospermum undulatum* in the inflorescence but has a narrower, entire not undulate leaf. This species has been observed in similar locations at Kelmscott, Gosnells and Yarloop.

Table 4. Recorded distribution of significant flora in Area 2C

SPECIES	GPS (WSG84)		NUMBER OF PLANTS
	EASTING	NORTHING	
Macarthuria keigheryi	50402633	6462109	1
Conospermum affin. *undulatum*	50402593	6462144	>50
	50402760	6462124	>50

North of the survey area, and close to Horrie Miller Drive, *Conospermum incurvum*, a species common in the northern sandplain was recorded. This species is at the southern end of its known distribution and is therefore regarded as a significant population (Government of Western Australia, 2000).

3.7 Wetlands

The wetland types at Perth International Airport are representative of the Mungala Suite, occurring in the transition between the Bassendean Dunes and Pinjarra Plain.

Lawn (2002) produced a map of the wetlands at Perth International Airport. Within Area 2C most of the Closed to Open Low Heath of *Pericalymma ellipticum* is included as conservation status wetlands. The Low Open Woodland of *Melaleuca preissiana* over an Open Low Heath to Open Low Shrubland of *Pericalymma ellipticum* in the northwest section including the same vegetation community to the south is also listed as a conservation status wetland.

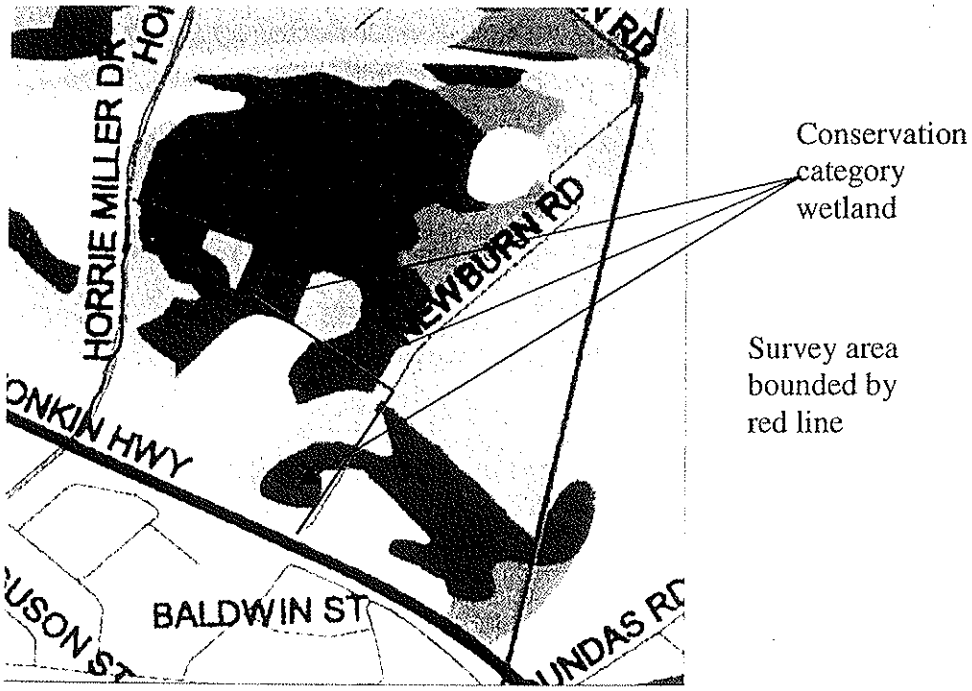

Diagram 2. Map adapted from Lawn (2002)

4 Discussion

Nearly 50% of Area 2C is degraded or completely degraded. In addition several tracks traverse the bushland, often leaving only small pockets of remnant vegetation. Trail bikes and 4-wheel drive vehicles use several of the tracks for recreation.

Nearly all the 41 weeds were recorded from these degraded areas with the remainder of the bushland having only scattered weeds through the vegetation. The majority of weeds in the bushland areas occurred along the track edges, penetrating only a short distance into the bushland where the understorey was dense.

Eight vegetation communities were recorded from this area, one of which consisted of weed taxa. Four of the communities included trees of *Banksia attenuata* and *Banksia menziesii*. These vegetation communities are inferred to be Floristic Community Type 20a, an Endangered Ecological Community (English, 2001). The remaining vegetation community is inferred to be Floristic Community 5, which is not listed as a Threatened Ecological Community (English, 2001). The Department of Conservation and Land Management should be notified if there is to be removal of any part of the Endangered or Vulnerable Ecological Communities.

One Declared Rare Flora, *Macarthuria keigheryi* was recorded from the area. Declared Rare Flora are protected under the Western Australian Wildlife Conservation Act 1950. This Act prohibits the taking of declared rare flora by any person within the state without the consent in writing of the Minister. *Macarthuria keigheryi* is also listed as an Endangered Species by Environment Australia under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (Environment Australia, 2001). None of these plants can be destroyed without Ministerial approval from both the State and Commonwealth authorities.

An undescribed species, *Conospermum* affin. *undulatum*, was recorded from two vegetation communities. This species has been recorded elsewhere in the foothills at Yarloop, Kelmscott and Gosnells.

The vegetation condition of Area 2C varied from Good to Completely Degraded. A map was prepared indicating the condition of the vegetation. Generally where the understorey was dense there was very little weed invasion, where it was more open and on the edges of tracks there were more weeds recorded.

Alan Tingay and Associates (1994) mapped all the bushland at Perth International Airport. The map produced for their report recorded the five following communties:

Ac - *Adenanthos cygnorum* Shrubland; Ba - *Banksia attenuata,* Low Woodland; MpPe - *Melaleuca preissiana* Low Open Woodland over *Pericalymma ellipticum* Closed Heath; Mr - *Melaleuca rhaphiophylla* Low OpenWoodland to Low Closed Forest; and Pe - *Pericalymma ellipticum* Closed Heath.

The *Adenanthos cygnorum* Shrubland was not as apparent during the current survey as much of that area has been degraded. The Ac and Ba communities of Alan Tingay and Associates are equivalent to vegetation units 1,2,3 and 4 of this current survey. MpPe and Pe are directly related to vegetation units 6 and 5 respectively. Alan Tingay and Associates mapped the whole of the airport and the variation noted during this survey may not have been considered to be warranted by them. However the basic vegetation communities between the two surveys are relatively consistent.

Waters and Rivers (Lawn, 2002) list some of the wetland vegetation identified within the survey area as conservation category.

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Appendix A

Species recorded from the southern section of Perth International Airport listed under Vascular Plant Families

LEGEND

ABBREVIATION	EXPLANATION
subsp.	subspecies
var.	variety
*	weed species
sp.	species. (This is used where unidentifiable vegetative material only was present and the correct identification to species was unknown)
affin.	it appears to be closest to but not the species
BaBm	Low Woodland of *Banksia attenuata* and *Banksia menziesii* over a Shrubland of *Xanthorrhoea brunonis* subsp. *brunonis* over a Herbland of *Patersonia occidentalis*
Bep	Low Woodland of *Banksia attenuata* and *Banksia menziesii* over an Open Low Heath of *Eremaea pauciflora* over **Briza maxima* and *Alexgeorgea nitens*
CcBa	Woodland of *Corymbia calophylla* over a Low Open Woodland of *Banksia attenuata* over an Open Low Heath of mixed species
EtBaBm	Low Open Forest of *Eucalyptus todtiana, Banksia attenuata* and *Banksia menziesii* over an Open Low Heath of *Euchilopsis linearis* and *Hypocalymma angustifolium* over a Herbland of *Patersonia occidentalis*
Pe	Closed to Open Low Heath of *Pericalymma ellipticum* over herbs
MpPe	Low Open Woodland of *Melaleuca preissiana* over an Open Low Heath to Open Low Shrubland of *Pericalymma ellipticum* over **Ehrharta calycina, Lepidosperma effusum* and *Patersonia occidentalis*
MrBl	Low Closed Forest of *Melaleuca rhaphiophylla* and *Banksia littoralis* over a Sedgeland/Herbland of *Schoenus fascicularis, Lepidosperma effusum* and **Hypochaeris glabra*
Deg	Mixed Grassland and Herbland of introduced species

FAMILY	TAXON	BaBm	BEp	CcBa	EtBaBm	Pe	MpPe	MrBl	Deg
ZAMIACEAE	*Macrozamia riedlei*			+					
AGAVACEAE	**Agave americanum* var. *americanum*								+
ANTHERICACEAE	*Johnsonia pubescens*			+					
	Laxmannia ramosa var. *ramosa*			+					
	Thysanotus patersonii	+	+		+	+	+		
CENTROLEPIDACEAE	*Centrolepis aristata*					+			
	Centrolepis glabra	+							
COLCHIDACEAE	*Burchardia umbellata*	+	+	+		+	+		
CYPERACEAE	*Isolepis marginatus*	+							
	Lepidosperma effusum					+	+	+	
	Lepidosperma squamatum	+		+					
	Mesomelaena pseudostygia			+					
	Schoenus pedicellatus			+		+			
	Schoenus subfascicularis						+	+	
DASYPOGONACEAE	*Calectasia narragara*			+					
	Dasypogon bromeliifolius	+	+	+	+	+	+		
	Lomandra hermaphrodita			+					
HAEMODORACEAE	*Anigozanthos humilis* subsp. *humilis*		+	+			+		
Cono aurea	*Anigozanthos manglesii* subsp. *manglesii*			+					
	Conostylis aculeata subsp. *aculeata*		+	+		+	+		
	Conostylis serrulata	+	+				+		
	Conostylis setigera subsp. *setigera*			+					
IRIDACEAE	**Chasmanthe floribunda*			+					
	**Freesia alba* x *leichtlinii*						+		
	**Gladiolus caryophyllaceus*	+	+	+	+	+	+		+
	**Moraea flaccida*			+					+
	Patersonia occidentalis	+	+	+	+	+	+	+	
	**Romulea rosea*								+
ORCHIDACEAE	*Caladenia vulgata*			+					
	Diuris sp.	+							
POACEAE	**Aira caryophyllea*	+				+	+		
	Amphipogon turbinatus		+	+					
	**Arundo donax*								+
	**Avena barbata*							+	+
	**Briza maxima*	+	+	+	+				+
	**Cynodon dactylon*							+	+
	**Ehrharta calycina*	+	+			+	+		+
	**Ehrharta longiflora*								+
	**Eragrostis curvula*								+
	Neurachne alopecuroidea			+					
	**Stenotaphrum secundum*							+	
	**Vulpia myuros*							+	+

FAMILY	TAXON	BaBm	BEp	CcBa	EtBaBm	Pe	MpPe	MrBl	Deg
RESTIONACEAE	*Alexgeorgia nitens*	+	+	+	+	+			
	Cytogonidium leptocarpoides	+		+	+				
	Desmocladus flexuosus	+	+	+					
	Hypolaena exsulca	+			+	+	+	+	
	Lyginia imberbis	+	+	+	+	+	+		
	Meeboldina decipiens							+	
XANTHORRHOEACEAE	*Xanthorrhoea brunonis* subsp. *brunonis*	+	+		+				
	Xanthorrhoea preissii	+		+	+	+	+		
AIZOACEAE	**Carpobrotus edulis*	+							
ANACARDIACEAE	**Schinus terebinthifolius*	+							+
APIACEAE	*Homalosciadium homalocarpum*					+	+		
	Trachymene pilosa	+	+	+	+	+	+		
ASTERACEAE	**Arctotheca calendula*					+	+		+
	Brachyscome pusilla		+						
	**Conyza bonariensis*							+	
	**Dittricha graveolens*								+
	**Hedypnois rhagadioloides*						+		+
	**Hypochaeris glabra*			+			+		+
	Lagenifera huegelii			+					
	Millotia tenuifolia	+							
	Podotheca angustifolia		+	+					
	Quinetia urvillea					+	+		
	**Sonchus oleraceus*								+
	**Ursinia anthemoides*	+	+			+	+	+	+
BRASSICACEAE	**Raphanus raphanistrum*						+		+
CAMPANULACEAE	**Wahlenbergia capensis*						+		
CASUARINACEAE	*Allocasuarina humilis*	+		+					
CRASSULACEAE	*Crassula colorata* var. *tuberculata*		+	+					
DILLENIACEAE	*Hibbertia huegelii*	+		+					
	Hibbertia hypericoides			+					
	Hibbertia racemosa	+							
DROSERACEAE	*Drosera erythrorhiza*	+		+					
	Drosera macrantha			+					
	Drosera menziesii	+	+						
	Drosera paleacea			+					
	Drosera stolonifera			+		+	+		
EPACRIDACEAE	*Conostephium pendulum*		+	+					
	Leucopogon conostephioides	+	+		+				
	Lysinema ciliatum		+	+					
EUPHORBIACEAE	**Euphorbia peplus*	+	+	+	+				+
	**Euphorbia terracina*							+	
FUMARIACEAE	**Fumaria capreolata*								+
GERANIACEAE	**Erodium botrys*								+
	**Pelargonium capitatum*							+	
GOODENIACEAE	*Dampiera linearis*	+	+		+	+	+		

FAMILY	TAXON	BaBm	BEp	CcBa	EtBaBm	Pe	MpPe	MrBl	Deg
GOODENIACEAE (cont.)	*Lechenaultia floribunda*					+			
	Scaevola repens	+							
HALORAGACEAE	*Gonocarpus cordiger*		+						
LAURACEAE	*Cassytha racemosa*							+	
LORANTHACEAE	*Nuytsia floribunda*	+		+	+	+			
MIMOSACEAE	**Acacia podalyriifolia*			+					
	Acacia pulchella var. *pulchella*	+	+	+	+	+	+	+	
	Acacia saligna								+
	Acacia sessilis			+					
	Acacia stenoptera	+		+		+	+		
MOLLUGINACEAE	*Macarthuria keigheryi*			+					
MYRTACEAE	*Astartea* affin. *fascicularis*					+	+	+	
	Calytrix fraseri	+		+		+			
	**Chamelaucium uncinatum*	+							+
	Corymbia calophylla			+					
	Eremaea pauciflora	+	+	+					
	Eucalyptus marginata subsp. *elegantella*	+							
	**Eucalyptus robusta*							+	
	Eucalyptus todtiana	+			+				
	Hypocalymma angustifolium				+	+	+	+	
	Hypocalymma robustum	+			+				
	Kunzea glabrescens			+					
	**Leptospermum laevigatum*	+							+
	Melaleuca preissiana			+		+	+	+	
	Melaleuca rhaphiophylla							+	
	Melaleuca seriata	+	+			+	+		
	Melaleuca thymoides			+					
	Pericalymma elliptica	+			+	+	+	+	
	Scholtzia involucrata	+	+	+		+	+		
	Verticordia densiflora	+			+	+			
OXALIDACEAE	**Oxalis pes-caprae*								+
	**Oxalis purpurea*	+							+
PAPILIONACEAE	*Bossiaea eriocarpa*	+	+	+	+				
	**Chamaecytisus palmensis*			+					+
	Daviesia divaricata	+							
	Daviesia incrassata			+		+	+		
	Daviesia physodes				+				
	Daviesia triflora	+	+						
	Euchilopsis linearis	+			+	+	+		
	Eutaxia virgata							+	
	Gompholobium tomentosum		+	+	+	+	+		
	Hovea trisperma	+							
	Jacksonia angulata			+					
	Jacksonia floribunda	+				+			
	Jacksonia furcellata		+			+	+		
	Jacksonia sternbergiana				+				
	Latrobea tenella					+			

FAMILY	TAXON	BaBm	BEp	CcBa	EtBaBm	Pe	MpPe	MrBl	Deg
PAPILIONACEAE (cont.)	**Lotus angustissimus*								+
	**Lupinus cosentinii*								+
PORTULACACEAE	*Calandrinia granulifera*		+			+	+		
PRIMULACEAE	**Anagallis arvensis* var. *caerulea*							+	+
PROTEACEAE	*Adenanthos cygnorum* subsp. *cygnorum*	+	+		+	+	+		
	Banksia attenuata	+	+	+	+				
	Banksia ilicifolia	+							
	Banksia littoralis						+	+	
	Banksia menziesii	+	+	+	+				
	Banksia menziesii (Copper fls)			+					
	Conospermum affin. *undulatum*	+		+					
	Conospermum incurvum		+						
	**Grevillea leucopteris*			+					
	Hakea sulcata					+			
	Hakea varia							+	
	Petrophile linearis	+		+					
	Stirlingia latifolia		+	+		+			
	Synaphea spinulosa		+	+					
RUTACEAE	*Boronia ramosa* subsp. *anethifolia*					+			
	Philotheca spicata		+		+	+	+		
SOLANACEAE	**Solanum nigrum*	+						+	+
STYLIDIACEAE	*Stylidium brunonianum*	+			+				
	Stylidium calcaratum	+	+	+	+	+			
	Stylidium diuroides					+			
	Stylidium repens	+	+						
THYMELAEACEAE	*Pimelea preissii* subsp. *angustifolia*				+				
TREMANDRACEAE	*Platytheca verticillata*		+		+				
VIOLACEAE	*Hybanthus calycinus*			+					

Appendix B

Map 1. Vegetation communities

Map 2. Vegetation condition

Map 3. Vegetation map of Tingay and Associates (1994)

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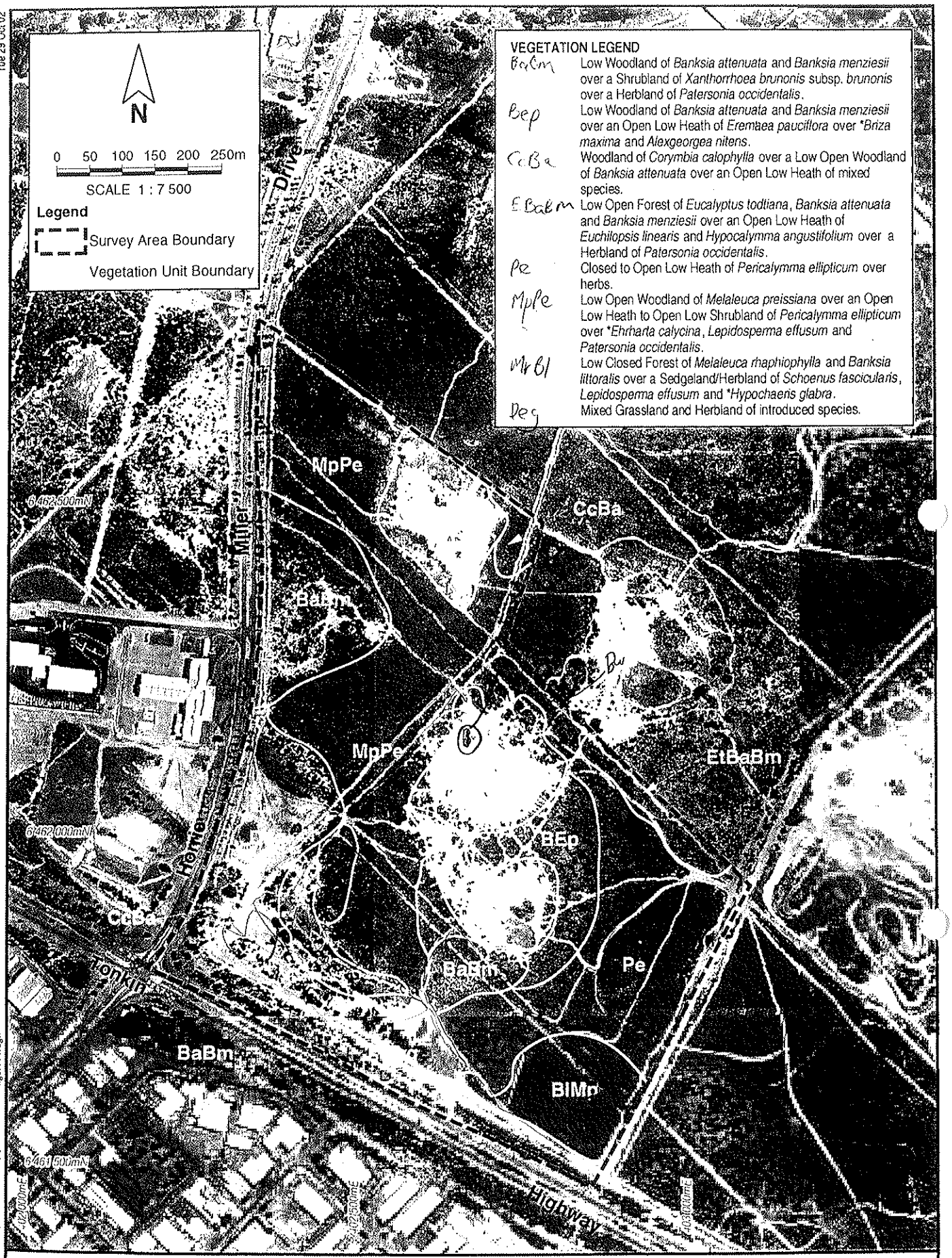


ENV Australia
FLORISTICS OF PERTH INTERNATIONAL AIRPORT
EASTERN SECTION

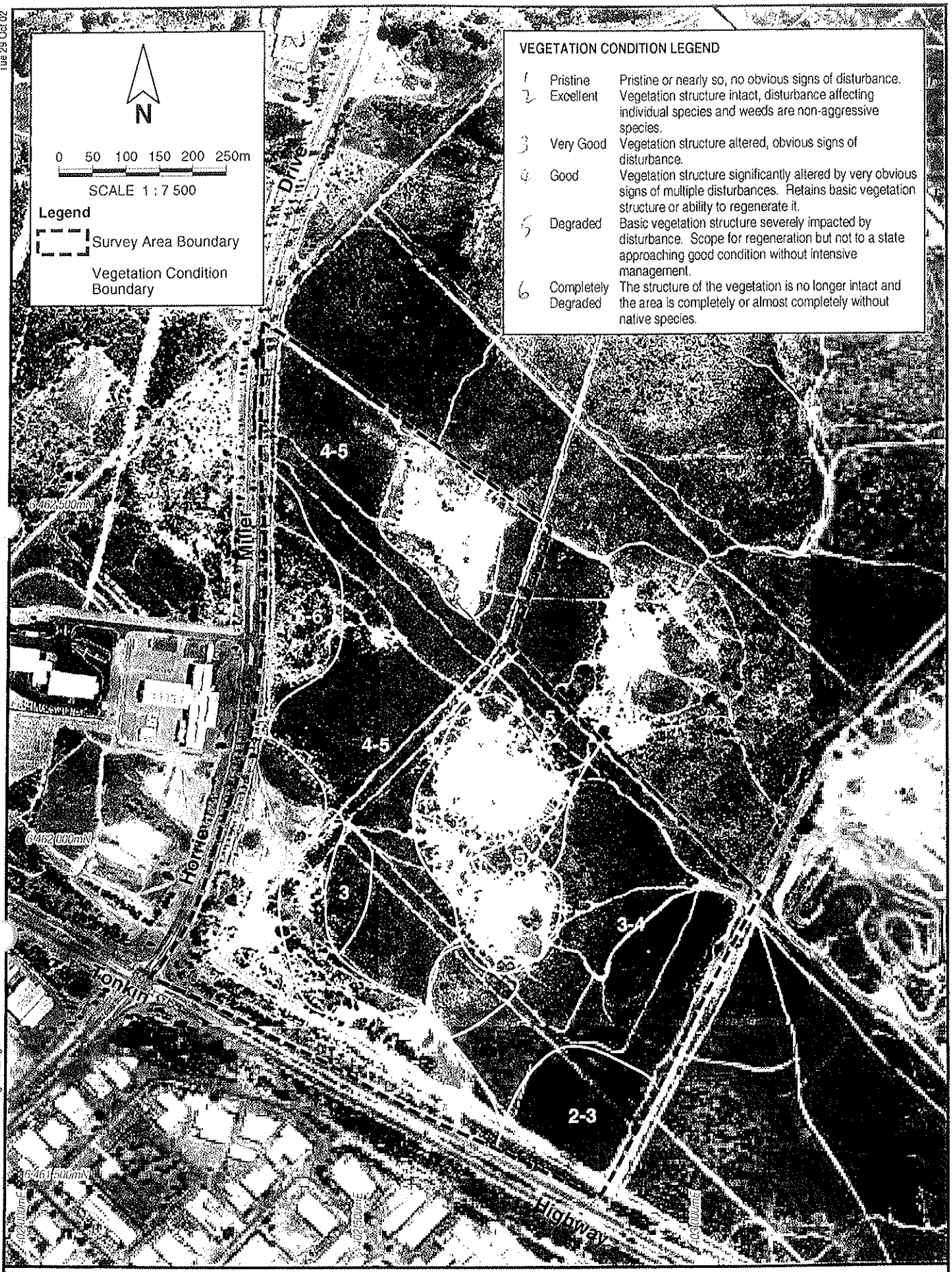
VEGETATION COMMUNITIES

BENNETT ENVIRONMENTAL CONSULTING

Figure 1

Drawn: EB Date: 10/02

PINPOINT CARTOGRAPHICS 0417 904 798 figure01.dgn Tue 29 Oct 02



Tue 29 Oct 02

figure02.dgn

PINPOINT CARTOGRAPHICS 0417 904 798

ENV Australia
FLORISTICS OF PERTH INTERNATIONAL AIRPORT
EASTERN SECTION

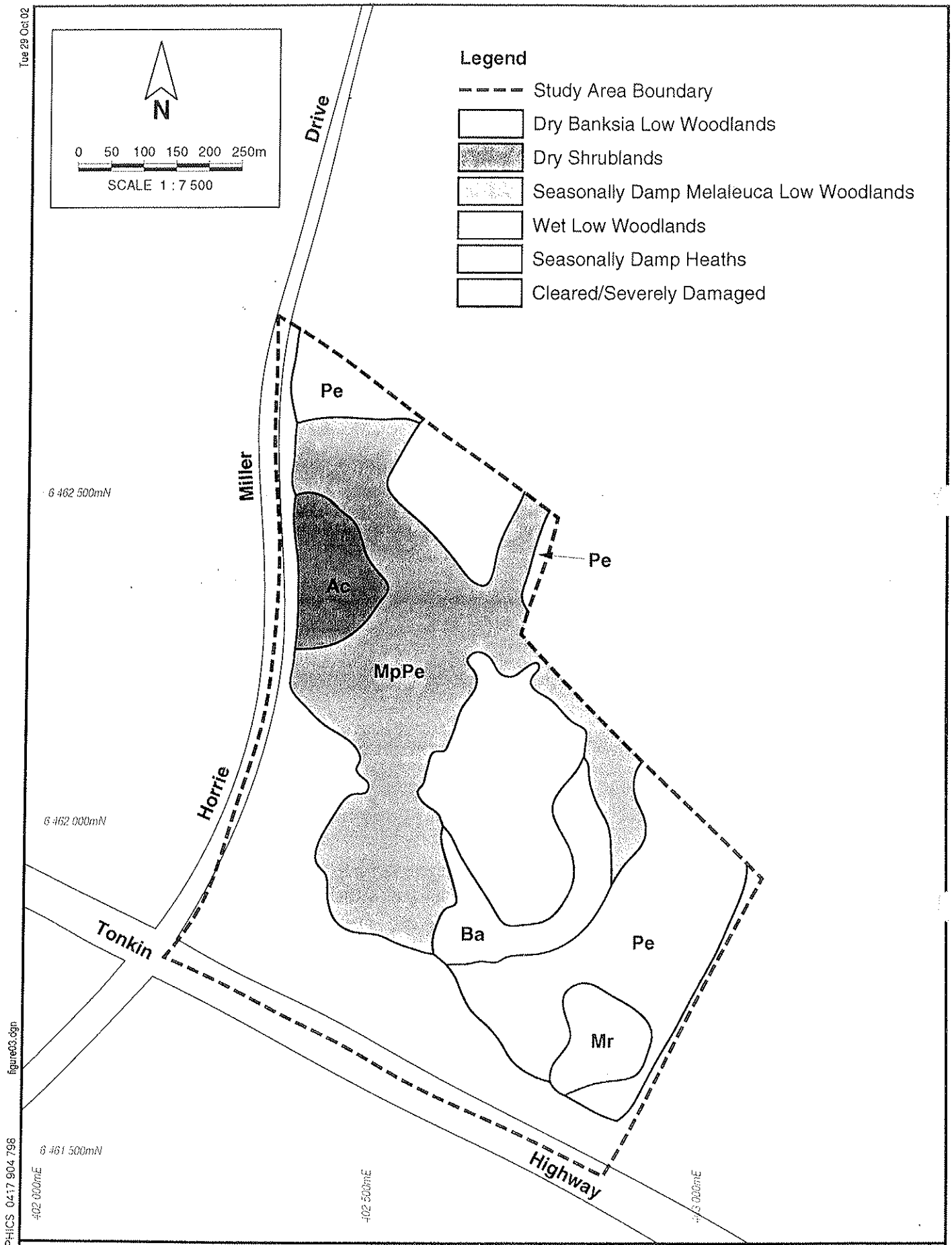
BENNETT ENVIRONMENTAL CONSULTING

VEGETATION CONDITION

Figure 2

Drawn: EB

Date: 10/02



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EASTERN SECTION

BENNETT ENVIRONMENTAL CONSULTING

ALAN TINGAY & ASSOCIATES VEGETATION COMMUNITIES (1994)

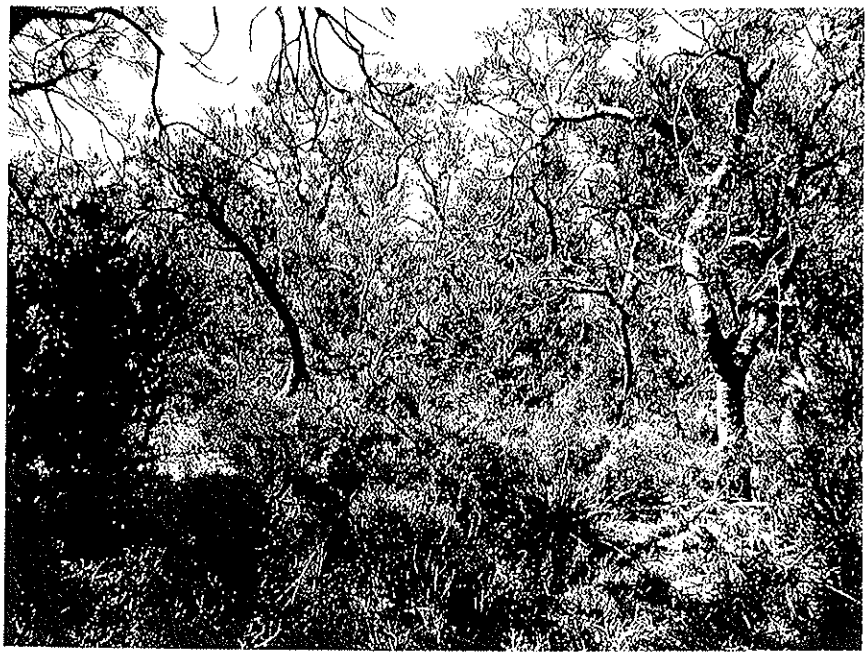
Figure 3

Drawn: EB Date: 10/02

Appendix C

Photographic Record of Vegetation Communities

Low Woodland of *Banksia attenuata* and *Banksia menziesii* over a Shrubland of *Xanthorrhoea brunonis* subsp. *brunonis* over a Herbland of *Patersonia occidentalis.*



Low Woodland of *Banksia attenuata* and *Banksia menziesii* over an Open Low Heath of *Eremaea pauciflora* over **Briza maxima* and *Alexgeorgea nitens.*

Woodland of *Corymbia calophylla* over a Low Open Woodland of *Banksia attenuata* over an Open Low Heath of mixed species.

Low Open Forest of *Eucalyptus todtiana, Banksia attenuata* and *Banksia menziesii* over an Open Low Heath of *Euchilops linearis* and *Hypocalymma angustifolium* over a Herbland of *Patersonia occidentalis.*

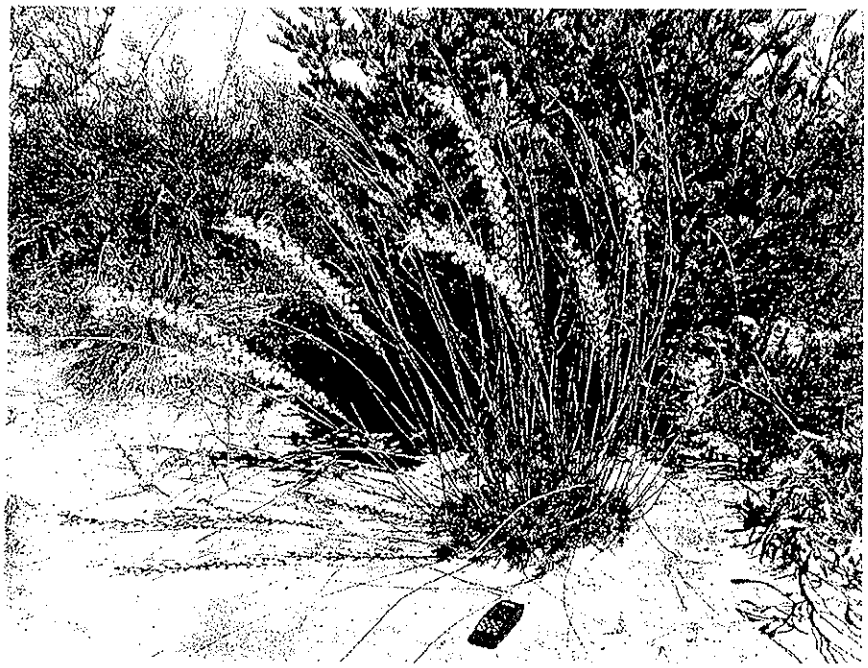
Low Open Forest of *Eucalyptus todtiana, Banksia attenuata* and *Banksia menziesii* over an Open Low Heath of *Euchilops linearis* and *Hypocalymma angustifolium* over a Herbland of *Patersonia occidentalis*.

Low Closed Forest of *Melaleuca rhaphiophylla* and *Banksia littoralis* over a Sedgeland/Herbland of *Schoenus fascicularis, Lepidosperma effusum* and **Hypochaeris glabra*.

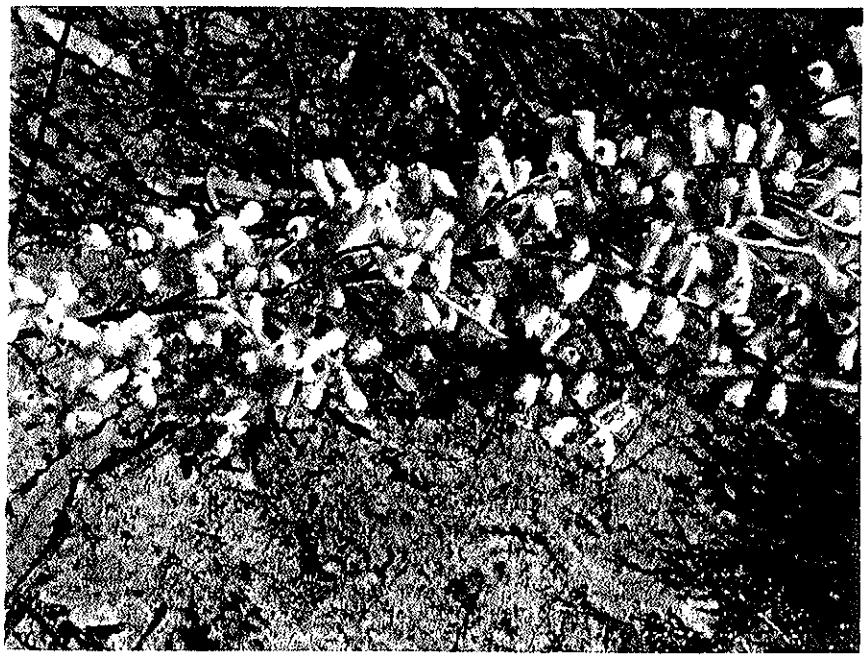
Appendix D

Photographic Record of *Conospermum* species

Mixed Grassland and Herbland of introduced species.



Plant of *Conospermum incurvum.*



Inflorescence of *Conospermum incurvum.*

Plant of *Conospermum* affin. *undulatum.*

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Macarthuria keigheryi

When a vegetation and flora survey was undertaken of Area 2C at Perth International Airport on 19th September 2002, one plant of the Declared Rare Flora *Macarthuria keigheryi* was recorded. Declared Rare Flora are gazetted under the Western Australian Wildlife Conservation Act 1950. This Act prohibits the taking of declared rare flora by any person within the state without the consent in writing of the Minister. *Macarthuria keigheryi* is also listed as an Endangered Species by Environment Australia under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

With the proposed development of some areas in the bushland at the Airport Dr Bennett was requested to locate the plant so that propagation could occur. A search was undertaken on two occasions, 20th and 23rd May 2003. The same GPS point was relocated and the immediate area around searched but the plant was not located. In addition the total area of the vegetation community, Woodland of *Corymbia calophylla* over a Low Open Woodland of *Banksia attenuata* over an Open Low Heath of mixed species, within this section of the Airport was also searched but no plant of this species was located.

Macarthuria keigheryi is an erect or perennial herb, which shoots from an underground rootstock. It has been recorded flowering between September and March. The one located at the site in question was about 15 cm tall with a spread of the same width, but some plants have been recorded up to 40cm x 40cm. Perth has just experienced another hot, dry summer so it likely that the one plant recorded originally may now be dead or dormant. A contractor who has undertaken limited surveying for *Macarthuria keigheryi* has stated that she has never been able to relocate the plants at the type location (D. Papenfus, pers. comm.). The biology of this species is not fully understood and according to the records at the Western Australian Herbarium at each collection location there are a few plants only, often just one located. Larger numbers of plants have been recorded from areas of disturbance eg edges of firebreaks, so it may be a species that is common only after disturbance.

From the searches undertaken it is assumed that the only plant of *Macarthuria keigheryi* located at 50402633E and 6462109N (WGS 84) during a survey in spring 2002 is now dead.

Eleanor Bennett
Director
23rd May 2003

Abernethy Road – Tonkin Highway On-ramp

BFS 386 Biological Information Perth Airport

Full document available on request

Public Environmental Review

Prepared for:

Main Roads Western Australia

Prepared by:

Biota Environmental Sciences Pty Ltd

April 2003