

***Melaleuca huegelii* – *Melaleuca systema***  
**shrublands of limestone ridges**  
**(Swan Coastal Plain Community type 26a - Gibson *et al.* 1994)**

**INTERIM RECOVERY PLAN**

**2004-2009**

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Photograph: Val English

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## **FOREWORD**

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements Nos. 44 and 50.

IRPs outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

CALM is committed to ensuring that Endangered ecological communities are conserved through the preparation and implementation of Recovery Plans or Interim Recovery Plans and by ensuring that conservation action commences as soon as possible after endorsement of that rank by the Minister.

This Interim Recovery Plan will operate from October 2004 to September 2009 but will remain in force until withdrawn or replaced. It is intended that, if the ecological community is still ranked Endangered, this IRP will be reviewed after five years and the need for a full Recovery Plan will be assessed.

This IRP was approved by the Director of Nature Conservation on 4 April 2005. The allocation of staff time and provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting CALM, as well as the need to address other priorities.

Information in this IRP was accurate at October 2004.

## **ACKNOWLEDGMENTS**

The following people provided valuable advice and assistance in the preparation of this Interim Recovery Plan;

|                 |  |
|-----------------|--|
| Neil Gibson     | Senior Research Scientist, CALM's Science Division                 |
| Melissa Hoskins | Project Officer, CALM's WA Threatened Species and Communities Unit |
| Greg Keighery   | Principal Research Scientist, CALM's Science Division              |
| Mike Lyons      | Research Scientist, CALM's Science Division                        |
| Leigh Sage      | Conservation Officer, CALM's Swan Coastal District                 |

## SUMMARY

**Name:** *Melaleuca huegelii* – *M. systema* shrublands of limestone ridges.

**Description:** Species rich thickets, heaths or scrubs dominated by *Melaleuca huegelii*, *M. systema* (previously *M. acerosa*), *Dryandra sessilis* over *Grevillea preissii*, *Acacia lasiocarpa* and *Spyridium globulosum*, occurring on skeletal soil on ridge slopes and ridge tops (community 26a as described by Gibson *et al.* 1994).

**CALM Region:** Swan

**CALM District:** Swan Coastal

**Local Government Authorities:** Wanneroo, Waroona, Gingin

**Recovery Team:** Swan Region Threatened Flora and Communities Recovery Team. Membership: representatives from CALM's Swan Region (Chair), Swan Coastal District, Perth Hills District, Wildlife Branch, WA Threatened Species and Communities Unit (WATSCU) and Science Division; and City of Gosnells, Botanic Garden and Parks Authority (BGPA) and World Wide Fund for Nature (WWF). The Recovery Team will report annually to CALM's Corporate Executive.

**Current status:** Assessed 29 October 1999 as Endangered.

**Habitat requirements:** The broader community type 26 occurs on Spearwood Sands (Tamala Limestone) on large limestone ridges. Two distinct subgroups are related to the degree of soil development on the limestone ridges. Subgroup 26a, the subject of this IRP, occurs on skeletal soil on ridge slopes and ridge tops and is known from massive limestone ridges around Yanchep north of Perth, and south of Perth near Lake Clifton. The other subgroup (26b) is found on the lower slopes or in pockets with deeper soil and is not listed as threatened.

**Critical habitat:** The critical habitat for the limestone ridges community 26a is made up of the limestone ridges on which the plant community occurs.

**Habitat critical to the survival of the community, and important occurrences:** Given that this community is listed as Endangered it is considered that all known habitat of occurrences of the community is habitat critical, and that all occurrences are important.

**Benefits to other species/ecological communities:** Priority flora that have been recorded in some occurrences include *Hibbertia spicata* subsp. *leptotheca* (Priority 3), *Sarcozona bicarinata* (Priority 3) and *Grevillea preissii* (Priority 4). Recovery actions implemented to improve the quality or security of the TEC are likely to also benefit the populations of Priority flora that occur in the community.

**International Obligations:** This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity, ratified by Australia in June 1993, and will assist in implementing Australia's responsibilities under that Convention. However, as the limestone ridges community is not listed under any specific international agreement, the implementation of other international environmental responsibilities is not affected by this plan.

**Role and interests of indigenous people:** According to the Department of Indigenous Affairs Aboriginal Heritage Sites Register there are a number of registered sites known in the vicinity of occurrences of the limestone ridges 26a community. Input and involvement will be sought from any Aboriginal groups that have an active interest in areas of the limestone ridges 26a community, and this is discussed in the recovery actions.

**Social and economic impacts:** The implementation of this recovery plan has the potential to have some social and economic impact as some occurrences are located on private property. Areas on private land that are considered to be 'habitat critical' may be regarded as having potential for uses other than conservation by landholders. Approaches that may minimise this potential impact could include covenants, management agreements or land acquisition. There are also mineral exploration and extraction leases over some areas of land that contain some occurrences of the TEC. Recovery actions refer to continued liaison between stakeholders with regard to these areas.

**Evaluation of the Plans Performance:** CALM, in conjunction with the Swan Region Threatened Flora and Communities Recovery Team, will evaluate the performance of this Interim Recovery Plan. The plan is to be reviewed within five years of the beginning of its implementation. Any changes to management / recovery actions will be documented accordingly.

**IRP Objective(s):** To maintain or improve the overall condition of the plant community in the known locations and reduce the level of threat.

**Criteria for success:**

- An increase in the area of this community under conservation management.
- Maintenance in terms of diversity and basic composition of native species (as described in Gibson *et al.* 1994) as well as biological processes, taking account of natural change of the community over time, as identified through monitoring.
- Improvement in terms of reduction of numbers of exotic species and of other threatening processes as defined in this document, as identified through monitoring.

**Criterion for failure:**

Significant loss of area or further modification of occurrences of the threatened ecological community.

**Recovery Actions:**

|  |   |
|--|---|
| Coordinate recovery actions                      | Implement weed control  |
| Map critical habitat                             | Ensure management strategies are in Management Plan for Yanchep National Park |
| Liaise with land managers                        | Design and conduct research   |
| Minimise further clearing                        | Report on success of management strategies for the community                  |
| Survey new occurrences                           | Review the need for a full Recovery Plan                                      |
| Monitor extent and boundaries                    | Seek to transfer occurrences on public land to Conservation Commission        |
| Disseminate information                          | Fence occurrences on public land  |
| Install markers                                  | Fence occurrences on private land   |
| Design and implement monitoring program          | Assist landowners to access incentives  |
| Develop and implement a Fire Management Strategy | Seek to acquire community on private land                                     |
| Monitor weeds                                    |   |

## 1. BACKGROUND

### 1.1 History, defining characteristics of ecological community, and conservation significance

Limestone rich soils are a common feature of the Swan Coastal Plain and can be divided into two main groups. The first includes limestone soils derived from Aolian deposits near the coast on the Quindalup or Spearwood Sands (usually outcropping as Tamala Limestones). The other occurs east of these bands, as solution deposits between the Spearwood and Bassendean sands, and in the Muchea Limestone soils formed in the Pinjarra Plain (Keighery *et al.* 2003).

The limestone soils of the Swan Coastal Plain contain a wide variety of plant communities that are floristically distinct. One such community ('type 26' as described by Gibson *et al.* 1994) is only found on shallow soils over limestone or massive limestone ridges of Tamala Limestone. There are two distinct subgroups within this community that are related to the degree of soil development. Subgroup 26b is found on the lower slopes or in pockets with deeper soil and is dominated by low shrubs such as *Acacia lasiocarpa*, *Trymalium ledifolium*, *Melaleuca systema*, *Hibbertia hypericoides*, and *Grevillea preissii* with overstorey of *Eucalyptus gomphocephala*, *E. foecunda* and *E. petrensis* on deeper soils. Subgroup 26a occurs on skeletal soil on ridge slopes and tops of ridges, and is dominated by *M. huegelii*, *M. systema* and *M. aff. systema* often over scattered limestone heath species such as *Dryandra sessilis* and *G. preissii* (Keighery *et al.* 2003).

Community 26a is highly restricted and known from massive limestone ridges around Yanchep north of Perth, and south of Perth near Lake Clifton. The community was originally identified in a number of areas during a floristic survey of the southern Swan Coastal Plain in 1994 (Gibson *et al.* 1994). An additional study undertaken in 1997 included installation of quadrats in four additional areas where the ridges were known to occur. These areas were also found to contain the community (Weston and Gibson 1997).

The community is currently known from a total of approximately 164 hectares. Currently, there are approximately 148 hectares of the community found on public lands. Of this, about eight hectares are in CALM Reserves, 26 hectares are in National Parks, 106 hectares are in State Forest (most of which is proposed to be changed to National Park, Nature Reserve or Conservation Park – see Table 1), and about eight hectares are on lands under the care, control and management of other authorities, (mainly Local Government Authorities). Another 16 hectares of the community occur on private land. Areas of threatened ecological communities that occur in State Forest are proposed to be managed for their conservation or recovery as recommended in English and Blyth (1997a). A new policy (CALM 2003) is being developed to help guide management of all threatened ecological communities that occur on lands managed by CALM.

Some occurrences of the community are located within Yanchep National Park. A Management Plan was written for the Park in 1989 and although it does not refer to threatened communities, it does include general management specifications for the vegetation within the park (Smith *et al.* 1989). The IRP for community 26a will be implemented in conjunction with the Yanchep National Park Management Plan.

Most occurrences of community 26a are also included in Perth's Bush Forever, in areas of 'regionally significant bushland to be retained and protected forever' (State of Western Australia 2000). Occurrences that occur within the area covered by Bush Forever, that aren't included in this Plan, mainly occur on private property. The Bush Forever document provides that any proposals likely to affect occurrences of threatened ecological communities will be dealt with through the 'Bush Forever planning process', coordinated between the Department of Environment, Department of Planning and Infrastructure and CALM.

The most significant threat to the community is clearing for mining, housing and road building. Too frequent fire is another major threat to the community. With many of the occurrences surrounded by highly urbanised areas, the frequency of fires, impact of recreational uses and incidence of illegal rubbish dumping are generally increased. These factors can all lead to degradation of plant communities through increasing weed invasion and alteration of structure, species composition or loss of component taxa.

**Table 1.** Extent and location of occurrences

| Occur No. | Location   | Land Tenure                                      | Land Manager | Under Current Mineral Lease | Estimated area   |
|-----------|--|--|--------------|-----------------------------|--|
| 1<br>(66) | State Forest 65 (MYHADR01)                             | State Forest (Proposed National Park)            | CALM         | Y                           | 1.1 ha   |
| 2         | State Forest 65 (MYHADR02)                             | State Forest (Proposed National Park)            | CALM         | Y                           | 1.3 ha   |
| 3         | Yanchep National Park (NP) R9868 (MYYAN01)             | National Park                                    | CALM         |                             | 3.7 ha   |
| 4         | Yanchep NP R9868 (MYYAN02)                             | National Park                                    | CALM         |                             | 5.9 ha   |
| 5         | Yanchep NP R9868 (MYYAN03)                             | National Park                                    | CALM         |                             | 3.4 ha   |
| 6         | Yanchep NP R9868 (MYYAN04) some in Crown Reserve 11928 | National Park, DPI                               | CALM/DP I    |                             | 5.0 ha   |
| 7         | Yanchep NP R9868 (MYYAN05)                             | National Park                                    | CALM         |                             | 0.2 ha   |
| 8         | Yanchep NP R9868 (MYYAN06)                             | National Park                                    | CALM         |                             | 1 ha   |
| 9         | Yanchep NP R9868 (MYYAN07)                             | National Park                                    | CALM         |                             | 0.3 ha   |
| 10        | State Forest 65 (MYYEAL01)                             | State Forest (Proposed National Park)            | CALM         | Y                           | 0.2 ha   |
| 11        | State Forest 65 (MYYEAL02)                             | State Forest (Proposed National Park)            | CALM         | Y                           | 2.2 ha   |
| 12        | State Forest 65 (MYYEAL03)                             | State Forest (Proposed National Park)            | CALM         | Y                           | 2.7 ha   |
| 13        | State Forest 65 (MYYEAL04)                             | State Forest (Proposed National Park)            | CALM         | Y                           | 3.4 ha   |
| 14        | State Forest 65 (MYYEAL05)                             | State Forest (Proposed National Park)            | CALM         | Y                           | 1.9 ha   |
| 15        | State Forest 65 (YAN12, YAN13, YAN15, YAN24)           | State Forest (Proposed National Park)            | CALM         | Y                           | 19.8 ha (an additional ~0.6 ha of original extent completely degraded) |
| 16        | State Forest 65 (MYPARROT01)                           | State Forest (Proposed National Park)            | CALM         | Y                           | 2.9 ha   |
| 17        | State Forest 65 (MYPARROT02)                           | State Forest (Proposed National Park)            | CALM         | Y                           | 4 ha   |
| 18        | Crown Reserve 39412 (MYWAN01)                          | Crown Reserve (quarry)                           | CALM         |                             | 0.9 ha   |
| 19        | Crown Reserve 39412 (MYWAN02)                          | Crown Reserve (quarry)                           | CALM         |                             | 0.6 ha   |
| 20        | State Forest 65 (MYWAN03)                              | State Forest (Proposed Conservation Park)        | CALM         |                             | 1.2 ha   |
| 21        | State Forest 65 (MYWAN04)                              | State Forest (Proposed Conservation Park)        | CALM         |                             | 0.4 ha   |
| 22        | State Forest 65 (MYWABL01)                             | State Forest                                     | CALM         |                             | 0.7 ha   |
| 23        | State Forest 65 (MYWABL10)                             | State Forest                                     | CALM         |                             | 0.1 ha   |
| 24        | State Forest 65 (MYWABL02) And Crown Reserve 11933     | State Forest (Proposed Nature Reserve), DPI land | CALM, DPI    |                             | 4 ha (an additional ~0.2 ha of original extent completely degraded)    |
| 25        | State Forest 65 (MYWABL03)                             | State Forest (Proposed Nature Reserve)           | CALM         |                             | 1.4 ha   |
| 26        | State Forest 65 (MYWABL04)                             | State Forest (Proposed Nature Reserve)           | CALM         |                             | 0.1 ha   |

|    |   |   |                   |   |  |
|----|---|---|-------------------|---|--|
| 27 | State Forest 65 (MYWABL05)                    | State Forest (Proposed Nature Reserve)    | CALM              |   | 0.5 ha   |
| 28 | State Forest 65 (MYWABL06)                    | State Forest (Proposed Nature Reserve)    | CALM              |   | 0.2 ha   |
| 29 | State Forest 65 (MYWABL07)                    | State Forest (Proposed Nature Reserve)    | CALM              |   | 1.6 ha   |
| 30 | State Forest 65 (MYWABL08)                    | State Forest (Proposed Nature Reserve)    | CALM              |   | 0.3 ha   |
| 31 | State Forest 65 (WABL01)                      | State Forest (Proposed Nature Reserve)    | CALM              |   | 10.4 ha  |
| 32 | State Forest 65 (MYWABL11)                    | State Forest (Proposed Nature Reserve)    | CALM              |   | 2.6 ha   |
| 33 | State Forest 65 (MYWABL12)                    | State Forest (Proposed Nature Reserve)    | CALM              |   | 3.7 ha   |
| 34 | Swan Lot 1 (MYWABL13)                         | Private Property                          | Private Landowner | Y | 1.5 ha (an additional ~ 0.5 ha of original extent completely degraded) |
| 35 | State Forest 65 (MYWABL14)                    | State Forest (Proposed Nature Reserve)    | CALM              |   | 2.5 ha   |
| 36 | Swan Lot 12 (MYWABL15)                        | Private Property                          | Private Landowner | Y | 0 ha (original 2.8 ha completely degraded)                             |
| 37 | Swan Lot 12 (MYWABL16)                        | Private Property                          | Private Landowner | Y | 0 ha (original 1.4 ha completely degraded)                             |
| 38 | Swan Lot 12 (MYWABL17)                        | Private Property                          | Private Landowner | Y | 1 ha (condition of northern portion unknown)                           |
| 39 | State Forest 65 (MYWABL18)                    | State Forest (Proposed Nature Reserve)    | CALM              |   | 7.3 ha   |
| 40 | State Forest 65 (MYWABL19)                    | State Forest (Proposed Nature Reserve)    | CALM              |   | 0.8 ha (an additional ~1 ha of original extent completely degraded)    |
| 41 | State Forest 65 (SHE04; SHE05)                | State Forest (Proposed Conservation Park) | CALM              |   | 5.8 ha   |
| 42 | State Forest 65 (MYSHE01)                     | State Forest (Proposed Conservation Park) | CALM              |   | 0.5 ha   |
| 43 | State Forest 65 (MYSHE02)                     | State Forest (Proposed Conservation Park) | CALM              |   | 1.3 ha   |
| 44 | Crown Reserve 39411, Swan Loc 10651 (MYSHE03) | Crown Reserve (quarry)                    | CALM              |   | 1.5 ha   |
| 45 | Crown Reserve 39411, Swan Loc 10651 (MYSHE04) | Crown Reserve (quarry)                    | CALM              |   | 1.4 ha   |
| 46 | Crown Reserve 39411, Swan Loc 10651 (MYSHE05) | Crown Reserve (quarry)                    | CALM              |   | 0.4 ha   |
| 47 | Crown Reserve 39411, Swan Loc 10651 (MYSHE06) | Crown Reserve (quarry)                    | CALM              |   | 0.7 ha   |
| 48 | Crown Reserve 39411, Swan Loc 10651 (MYSHE07) | Crown Reserve (quarry)                    | CALM              |   | 1.4 ha   |
| 49 | Crown Reserve 39411, Swan Loc 10651 (MYSHE08) | Crown Reserve (quarry)                    | CALM              |   | 0.6 ha   |

|    |  |  |                             |  |  |
|----|--|--|-----------------------------|--|--|
| 50 | State Forest 65 (MYSHE09)  | State Forest (Proposed Conservation Park)      | CALM                        |  | 2.8 ha   |
| 51 | Swan Loc 5204; Crown Reserve 11930 (SVH01)   | Unallocated Crown Land; Unvested Crown Reserve | DPI                         |  | 1.4 ha   |
| 52 | Townsite reserve (CLIFT02, CLIFT03)  | Unallocated Crown Land                         | No land manager listed      |  | 3 ha (an additional ~1ha of original extent completely degraded) |
| 53 | Yanchep National Park R9868 (YAN02)  | National Park                                  | CALM                        |  | 5.8 ha   |
| 54 | Neerabup National Park R27575 (NEERABUP01)   | National Park                                  | CALM                        |  | 0.3 ha   |
| 55 | Neerabup National Park R27575 (NEERABUP02)   | National Park                                  | CALM                        |  | 0.2 ha   |
| 56 | Neerabup National Park R27575 (NEERABUP03)   | National Park                                  | CALM                        |  | 0.2 ha   |
| 57 | Neerabup National Park R27575 (NEERABUP04)   | National Park                                  | CALM                        |  | 0.1 ha   |
| 58 | Neerabup National Park R27575 (NEERABUP05)   | National Park                                  | CALM                        |  | 0.1 ha   |
| 59 | Lot 33 Connolly Drive (NEERABUP06)   | Private Property                               | Private land owner          |  | ~0.2 ha extent planned for development                           |
| 60 | Lot 21 Lukin Drive (NEERABUP07)  | Freehold, State                                | Not listed                  |  | 0.4 ha   |
| 61 | Neerabup National Park R27575 (NEERABUP08)   | National Park                                  | CALM                        |  | 0.1 ha   |
| 62 | Lot 52 Old Coast Road (coronation01, coronation02, coronation03, coronation04, coronation05, coronation06) | Private Property                               | Private land owner          |  | 3.6 ha   |
| 63 | Lot 52 Old Coast Road (coronation07)   | Private Property                               | Private land owner          |  | 0.5 ha   |
| 67 | Lot 33 Connolly Dve, Butler (butler01, butler02)   | Private Property (to be Public Open Space)     | Soon to be City of Wanneroo |  | 1.7 ha   |
| 68 | Lot 12 Marmion Ave, Jindalee (jindalee01, jindalee02)  | Private Property                               | Private land owner          |  | Combined area Occ 68 and Occ 69 ~1.4ha (planned for development) |
| 69 | Lot 12 Marmion Ave, Jindalee (jindalee03)  | Private Property                               | Private land owner          |  | Combined area Occ 68 and Occ 69 ~1.4ha (planned for development) |
| 70 | State Forest 16 (SFCLIFT05, SFCLIFT06, SFCLIFT07, SFCLIFT08, SFCLIFT09, SFCLIFT10)                         | State Forest                                   | CALM                        |  | ~10.2 ha   |
| 71 | State Forest 16 (SFCLIFT01, SFCLIFT02, SFCLIFT03, SFCLIFT04)   | State Forest                                   | CALM                        |  | ~8 ha  |
| 72 | Lot 5 Dayrell Road, Nowergup (DAYRELL01, DAYRELL02, DAYRELL03, DAYRELL04)                                  | Private Property                               | Private land owner          |  | 4.6 ha   |



|    |  |                                   |                    |  |   |
|----|--|-----------------------------------|--------------------|--|---|
| 73 | Honeymyrtle Reserve 45006, Butler (Honey01, Honey02, Honey03, Honey04) | Shire Reserve (Public Recreation) | City of Wanneroo   |  | 0.3 ha  |
| 74 | Lot 5 Dayrell Road, Nowergup (DAYRELL05)                               | Private Property                  | Private land owner |  | 0.2 ha  |
| 75 | (ANKETELL01)   | Private Property                  | Alcoa              |  | 1.4 ha (degraded)   |
| 76 | Wattle Ave west, Nowergup  | Shire Reserve                     | City of Wanneroo   |  | ~0.2 ha   |
| 77 | Reserve 25253 One Tree Hill  | Shire Reserve (quarry)            | City of Wanneroo   | Proposed for addition to Neerabup National Park. | ~0.1 ha remains. Unknown additional area of occurrence historically quarried, cleared |
| 78 | Crown Reserve 25253 One Tree Hill                                      | Shire Reserve (quarry)            | City of Wanneroo   |  | ~2 ha   |
| 79 | Carabooda Quarry Crown Reserve 22031                                   | Shire Reserve (quarry)            | City of Wanneroo   |  | <1 ha   |

Note: 1. DPI = Department of Planning and Infrastructure

Note: 2. A portion of the original extent of occurrences 15, 34, 40, 52 and 77, and all of occurrences 36 and 37 have been cleared for limestone mining. Occurrence 24 was partly cleared historically for a fire tower and occurrence 59 was recently planned for residential development. Occurrences 64 and 65 were deemed unlikely to be community 26a following more detailed survey. Occurrences 68 and 69 are planned for residential development.

Note 3: Areas that are considered ‘totally destroyed’ as defined in State of Western Australia (2000) are not included in area data for the community, but areas described as ‘degraded’ or better are included.

## 1.2 Description of Occurrences

Occurrences 1, 2, 10-17, 20-33, 35, 39-43 and 50 are located within State Forest 65 which is currently defined as a multi-use area for uses that include recreation, water catchment protection, timber production on a sustainable yield basis and conservation. Much of the State Forest area is recommended as either National Park, Nature Reserve or Conservation Park in the Forest Management Plan (Conservation Commission of Western Australia 2004). A portion of occurrences 15 and 40 have historically been cleared and mined for limestone. A small portion of Occurrence 24 was cleared historically for a fire tower.

Occurrences 3-5, 7-9 53, and part of Occurrence 6 occur in Yanchep National Park. Occurrence 53 has been slightly modified by weed invasion. Part of Occurrence 6 is located in a Trig Station reserve that is under the care, control and management of DPI.

Occurrences 18 and 19 occur within Crown Reserve 39412. This is a C class 5(g) reserve under the care, control and management of the Conservation Commission. The purpose of the reserve is listed as ‘quarry (limestone)’. Rabbits have impacted this site through increasing the introduction of weeds from propagules and nutrients in their droppings.

Occurrences 34 and 36, 37, 38, 59, 62, 63, 68, 69, 72, 74 and 75 occur on private property. Most of the original area of Occurrence 34 and all of Occurrences 36 and 37 have been cleared for limestone mining, but have regenerated to some extent. Occurrence 59 is to be cleared for the extension of the Freeway. Occurrences 62-63 occur off Old Coast Road on private property. These occurrences appear to have been historically grazed and there is low-level grazing of the area by horses. There are also rabbits present. Limestone extraction is occurring adjacent to these occurrences. Occurrences 68-69 occur on private property at Jindalee. Approval for subdivision has been given and the occurrences are to be cleared for housing and associated infrastructure. Occurrences 72 and 74 occur on private property adjacent to Dayrell Road in Nowergup. This site is proposed for limestone extraction with the application to clear currently with the Environmental Protection Authority. The site is burnt frequently, with three fires occurring in 2003, and this has resulted in a slight increase in weed invasion. Rabbits are also present at the site. Occurrence 75

occurs on land under the care, control and management of Alcoa World Alumina Australia. The area appears to have been heavily grazed historically and the land managers intend to rehabilitate the area by using methods that include replanting and weed control (S. Sandover<sup>1</sup> personal communication).

Occurrences 44-49 are located within Reserve 39411. This is a C class 5(g) reserve under the care, control and management of the Conservation Commission. The listed purpose of this reserve is 'quarry (limestone)'.

Occurrence 51 is located on Unallocated Crown land and Unvested Crown Reserve that includes the Charles Searson Lookout. A small portion of this occurrence was cleared historically for access ways, a fire station and tower.

Occurrence 52 is located on the Clifton Townsite reserve on Unallocated Crown Land with no listed purpose. Approximately a quarter of this occurrence was cleared historically and mined for limestone. Part of the area is also used as an unofficial tip.

Occurrences 54-58 and 61 were all originally located within Neerabup National Park. A portion of the park was excised to allow for development and Occurrence 59 was subsequently cleared. The extension of the Mitchell Freeway has been approved and is likely to result in the clearing of most if not all of the remaining small occurrences. All occurrences are impacted by weeds, high kangaroo numbers and tracks.

Occurrence 60 is located on land under the care, control and management of the State of Western Australia and is immediately south of Neerabup National Park. This occurrence is impacted by weeds, high kangaroo numbers and tracks.

Occurrence 67 occurs on remnant freehold land, most of which is planned as Public Open Space within Butler Estate. The occurrence may have been historically grazed and there is also evidence of impacts of grazing by rabbits and kangaroos. Bridal creeper is encroaching from the edges and may significantly impact the area if not controlled.

Occurrences 70-71 occur within a Class A State Forest Block 16 near Lake Clifton that is under the care, control and management of the Conservation Commission. The condition of the occurrences is varied as it appears the area was grazed historically and there is evidence of rabbits present. Weeds, including bridal creeper, are a major threat, particularly in previously grazed areas.

Occurrence 73 occurs in Honey Myrtle Reserve in Brighton Estate, Butler. The area is under the care, control and management of the City of Wanneroo. The occurrence is highly impacted by recreational users through the creation of illegal tracks, trampling of vegetation and rubbish dumping, as well as frequent fires, weeds and feral animals.

Occurrences 76-79 are all under the care, control and management of the City of Wanneroo. Boundary data are estimated for these areas. Occurrence 76 appears to have been grazed historically, and is now impacted by low to medium level weed invasion. Part of the original extent of Occurrence 77 has been historically quarried, and cleared for Wanneroo Rd. The remaining area of Occurrence 77, and Occurrences 78-79 are in good condition, and are subject to only low level weed invasion.

Data on all known occurrences of threatened ecological communities are held in the threatened ecological communities database at CALM's Wildlife Research Centre, Woodvale.

### **1.3 Biological and ecological characteristics**

Plant taxa that commonly occur in the community are listed at Appendix 1. The mean species richness for 11 plots in the community surveyed by Gibson *et al.* (1994) was 50.2 species in 100 square metres. This is slightly lower than subgroup 26b. An average of eight weed species were also recorded per plot in the Gibson *et al.* (1994) study, which is similar to that found in community type 26b, and is a relatively low level of weed invasion. This floristic information does not include data for many of the occurrences that have been

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<sup>1</sup> Simon Sandover: Senior Environmental Scientist, Alcoa.

entered on the threatened ecological communities database. The community type of many of the occurrences listed in Table 1 has been inferred, from soil and landform characteristics and species present (Occurrences 1, 3-14, 18-29, 32, 33, 38, 42-50 and 54-79), by experienced staff from WATSCU, or Department of Environment (DoE), or environmental consultants.

The following is an extract from Gibson *et al.* (1994) Page 44, that describes the differences between community 26a and other communities located on limestone soils that are closely allied to the type:

“Community type 24 are heaths or heaths with scattered *Eucalyptus gomphocephala* occurring on deeper soils north from Woodmans Point. All but three sites in this community type occur on the Cottesloe unit of the Spearwood system. This community is closely related to community type 25 which encompasses the *E. gomphocephala* - *Agonis flexuosa* woodlands south of Woodmans Point. The former community differs in its virtual lack of species such as *Agonis flexuosa*, *Geranium retrorsum*, *Oxalis perennans*, *Lomandra micrantha* and *Luzula meridionalis*. This change in community type may be related to the drop in rainfall at the northern end of the study area. The southern group was recorded from Karrakatta, Cottesloe and Vasse units. Occasionally dominants other than Tuart were recorded (eg. *E. calophylla* at Paganoni block and *E. decipiens* at Kemerton). In both cases Tuart formed the overstorey nearby.

The heathland sites in community type 24 differ in presence of taxa such as *Dryandra sessilis*, *Calothamnus quadrifidus* and *Schoenus grandiflorus*. This may represent a distinct subgroup within type 24. The southern *E. gomphocephala* - *Agonis flexuosa* woodlands (type 25) are significantly richer than the northern group (52.8 cf. 41.8 species / plot). Weed frequency was very high in both groups (mean values of 14.2 and 12.9).

Community type 26 is restricted to the large limestone ridges north of Perth and those in the Yalgorup area. The two distinct subgroups are related to degree of soil development. On the skeletal soil on ridge slopes and ridge tops heaths dominated by *Melaleuca huegelii*, *M. acerosa*, *M. aff. acerosa* or *Dryandra sessilis* are found (type 26a). On the lower slopes or in pockets where deeper soil is able to develop *Eucalyptus gomphocephala*, *E. foecunda* or *E. petrensis* ms woodlands or mallee develop over a dense heath (type 26b). Occasionally an overstorey was absent.

Type 26b is virtually restricted to the Cottesloe unit. Taxa typical of the limestone heaths are *Trymalium albicans*, *Templetonia retusa*, *Stylidium maritima*, *Wurmbea monantha*, and *Acacia lasiocarpa*. While on the deeper soils *Hibbertia hypericoides*, *Caladenia flava*, *Lagenifera huegelii*, *Sowerbaea laxiflora*, *Schoenus clandestinus* and *Mesomelaena pseudostygia* are common. Species richness is similar in both subgroups (mean 50.2 and 52.7) as was a high mean weed frequency (8.0 and 8.4 species / plot).

Another limestone community was community type 27. This was largely restricted to the Yalgorup area and was either shrubland or mallee heath variously dominated by *Eucalyptus decipiens*, *E. foecunda*, *Melaleuca acerosa* or *Hakea prostrata*. While similar in species composition to type 26 it differs in lacking many of the annual native and weed species and by the occurrence of taxa such as *Acacia truncata*, *Hibbertia spicata* subsp. *leptotheca*, and *Comesperma conferta*. This community has significantly lower species richness than the other two limestone community types (39.0) and significantly lower average number of weeds (less than 1 species / plot). Most sites in this community type fall in the Yoongarillup unit (as do two sites in community type 26b) with an outlier occurring north of Perth on Shire View Hill. The large limestone ridge on which these sites occur appears little different geomorphologically from other large ridge systems north of Perth (Semeniuk 1990) and species composition is more likely to be controlled by light availability.”

It has been noted that Community type 24 would grade into community 26b where the heath element is richer (N. Gibson<sup>2</sup> personal communication).

## 1.5 Geology

Community 26a is associated with ridges of Tamala Limestone. This occurs intermittently on Late Pleistocene ridges (1-2 million years old) that are roughly parallel to the coast on the Swan Coastal Plain. It occurs on the Cottesloe and Karrakatta soil units mainly within the Spearwood system. The Cottesloe soil

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<sup>2</sup> Dr Neil Gibson: Senior Research Scientist, CALM, Woodvale.

unit is described as ‘low hilly landscape with shallow brown sands over limestone’, and Karrakatta soils as ‘undulating landscape with deep yellow sands over limestone’ by Churchward and McArthur (1978). This aeolianite (wind deposited) limestone is mainly composed of shells fossils and quartz sands that formed ancient dune systems. These dunes were then believed to have been leached by percolating ground water and lithified by precipitation as lime cement (Department of Conservation and Environment (DCE) 1980).

Tamala Limestone is a source of road-making material, industrial lime used mainly for cement, builders’ lime and building blocks. The Cottesloe Unit is the main source of limestone for road making and building, and lime for agriculture and industry is mainly sourced from the Quindalup (‘dune and beach ridges composed of calcareous sands’ – Churchward and McArthur 1978) and Cottesloe Soil Units (DCE 1980).

### **1.6 Critical Habitat**

Critical habitat is habitat identified as being critical to the survival of a listed threatened species or listed Threatened Ecological Community. Habitat is defined as the biophysical medium or media occupied (continuously, periodically or occasionally) by an organism or group of organisms or once occupied (continuously, periodically or occasionally) by an organism, or group of organisms, and into which organisms of that kind have the potential to be reintroduced (*Environment Protection and Biodiversity Conservation Act 1999*).

The critical habitat for the limestone ridges 26a community comprises:

- the area of occupancy of known occurrences;
- areas of similar habitat within 200 metres of known occurrences, ie. *Melaleuca huegelii* – *M. systema* (previously *M. acerosa*) shrublands on limestone ridges (these provide potential habitat for natural range extension);
- remnant vegetation that surrounds or links several occurrences (this is to provide habitat for pollinators and to allow them to move between occurrences).

### **1.6 Habitat critical to the survival of the species, and important populations**

Given that this community is listed as endangered it is considered that all known habitat is habitat critical. In addition all occurrences are considered important to the survival of the ecological community. Recovery actions include survey for further occurrences that may lead to the identification of additional habitat critical.

### **1.7 Benefits to other species/ecological communities**

Recovery actions implemented to improve the quality or security of the community are likely to improve the status of any species within the community. Priority flora that also sometimes occur within the occurrences include *Hibbertia spicata* subsp. *leptotheca* (Priority 3), *Sarcozona bicarinata* (Priority 3) and *Grevillea preissii* (Priority 4). Recovery actions implemented to improve the quality or security of the TEC, are likely to also benefit the Priority flora populations.

### **1.8 International Obligations**

This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity, ratified by Australia in June 1993, and will assist in implementing Australia’s responsibilities under that Convention. However, as the 26a limestone ridges community is not listed under any international agreement, the implementation of other international environmental responsibilities is not affected by this plan.

### **1.9 Role and interests of indigenous people**

According to the Department of Indigenous Affairs Aboriginal Heritage Sites Register there are a number of registered sites known from the vicinity of occurrences of the limestone ridges 26a community. In particular, the area of Yanchep and Neerabup National Parks was previously occupied by different groups of the Nyungar people. The areas were occupied and used for hunting, and have associated areas of mythological, ritual and ceremonial significance. In particular, there are namma holes associated with some occurrences of

this community type, as the community occurs on limestone ridges. Yanchep National Park Management Plan objectives are to protect the Aboriginal heritage of the park and encourage greater understanding and appreciation of it. Interpretive programs, including historical walks, and activities involving traditional use of the area, are undertaken in the park (Smith *et al.* 1989). Input and involvement will be sought from any Aboriginal groups that have an active interest in areas of the limestone ridges 26a community, and this is discussed in the recovery actions.

### **1.10 Social and economic impacts**

The implementation of this recovery plan has the potential to have some social and economic impact as some occurrences are located on private property. Areas on private land that are considered to be ‘habitat critical’ may be regarded by landholders or other stakeholders as having potential for uses other than conservation. Approaches that may minimise this potential impact could include covenants, management agreements or land acquisition. There are also mineral exploration and extraction leases over the areas of land that contain some occurrences of the community. Recovery actions refer to continued liaison between stakeholders with regard to these areas.

### **1.11 Evaluation of the Plan’s Performance**

CALM, in conjunction with the Swan Region Threatened Flora and Communities Recovery Team will evaluate the performance of this Interim Recovery Plan. The plan is to be reviewed within five years the beginning of its implementation. Any changes to management / recovery actions will be documented accordingly.

### **1.12 Historical and current threatening processes**

#### **Mining**

Limestone soils have been a focus for mining in the past, and continue to be so. Mineral exploration and extraction leases exist over the area of land in which occurrences 1, 2, 10-17, 34 and 36-38 of the limestone ridges community 26a occurs. A portion of occurrences 15 and 34, and all of the original area of occurrences 36 and 37 have already been cleared for limestone mining. Occurrences 34, 36 and 37 are regenerating to some extent, however. A portion of occurrences 40 and 52 have also been cleared, however, no extraction leases are current for the sites. Occurrences 18, 19, 44 to 49 are located within reserves whose purpose is as a quarry, but this land is now under the care, control and management of the Conservation Commission and is managed for conservation.

#### **Clearing**

In addition to mining, clearing is likely to be associated with developments for road works, housing or industry. A number of occurrences have already been cleared and a number are also proposed to be cleared in the future.

The presence of TECs is considered by the Department of Environment when evaluating the impact of any proposed development. As a result of recent amendments to the *Environmental Protection Act 1986*, any clearing of native vegetation requires a permit, unless done for an exempt purpose. Threatened ecological communities have been defined under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, as environmentally sensitive areas. Provisions in these regulations that allow day-to-day routine vegetation clearing activities without a permit do not therefore apply to clearing within threatened communities. Any clearing proposals in a TEC are to be undertaken under a specific permit.

Clearing as a consequence of the following activities is likely to be particularly significant:

#### **Urban development**

Occurrence 59, 68 and 69 are planned for residential development. A subdivision application has been lodged and approved over Occurrence 67 (State of Western Australia 2003). Large areas of remnant

bushland to the north of Perth, such as Alkimos and Eglinton Estates, are proposed to be developed beyond 2007/2008. The limestone ridges community 26a was recorded as being present within these areas during a survey undertaken in 2002 (ATA Environmental 2002).

### **Amenities development**

Due to the location of this plant community on the tops of ridges, localised clearing for construction of infrastructure is a threat to the limestone ridges 26a community. A small portion of Occurrences 24 and 51 has been cleared historically for building of a fire tower/station. This has resulted in the clearing of vegetation and may exacerbate weed invasion in the area due to ongoing maintenance and use. Trig stations that involve some localised clearing and disturbance are also located on the tops of ridges within Occurrences 6 and 51.

### **Road and track development**

The extension of the Mitchell Freeway through part of Neerabup National Park has been approved and is likely to result in the clearing of occurrences 54 to 58, and 61. Occurrences 51, 54, 59, 60, 61, 73 are also under threat from clearing for tracks. As well as destroying the vegetation and fragmenting remaining remnants, tracks also encourage weed invasion into the adjacent habitat.

### **Weed invasion**

Current weed levels in most occurrences are still quite low. However most of the occurrences of this community are close to or surrounded by urban areas that act as weed sources, and would be vulnerable to weed invasion following any disturbance. Weeds suppress early plant growth by competing for soil moisture, nutrients and light. They also exacerbate grazing pressure and increase the fire hazard due to the easy ignition of high fuel loads, which are produced annually by many weed species. In Occurrences 70 and 71, bridal creeper is present and has the potential for significant impact if not controlled.

### **Grazing and trampling**

Occurrences 62-63, 67 and 70-71 have been historically grazed. There is also evidence that horses and kangaroos are currently impacting Occurrences 62 and 63. Grazing of the community is likely to have caused alterations to the species composition by the selective grazing of edible species, the introduction of weeds and nutrients, and trampling and general disturbance. High numbers of rabbits have also invaded a number of occurrences, selectively grazing more palatable species, and caused damage to vegetation with high densities of warrens.

High kangaroo numbers are also a threat to a number of other occurrences, particularly 54-59, 60, 61 and 67. Kangaroos may impact on the vegetation through grazing, trampling and breaking foliage when moving through the area.

Grazing would also have an impact on the establishment of young plants thereby limiting natural recruitment.

### **Inappropriate fire regimes**

Fires are likely to have a significant effect on the vegetation composition in Mediterranean ecosystems such as those in the south-west of Western Australia (Abbott and Burrows 2003).

Different ecosystems may require particular fire regimes to assist regeneration. There is little data available through which fire regimes that enhance/protect the composition of community 26a can be elucidated so that what actually constitutes an appropriate fire regime will require investigation. It seems likely that fire regimes such as long periods of fire exclusion, sustained frequent burns, and post-fire grazing (eg by rabbits) will be detrimental to the community. A number of the occurrences of this community are close to urban areas, or appear to have been historically viewed as buffers for plantations, and as such have been burnt relatively frequently in recent years. There is evidence of weed invasion and possibly increased numbers of

rabbits as a consequence of historical fire regimes in some areas that have been subject to more frequent burning in recent decades (V. English personal observation).

### **Disturbance due to recreational use / maintenance activities**

A number of occurrences occur in National Parks and State Forest where visitation is high and the impact from recreational users from trampling, rubbish and track creation is increased. Occurrence 52 is also used as an unofficial rubbish tip. Apart from being visually unappealing, rubbish, in particular garden waste, introduces weed seeds into the bushland and increases the fire hazard.

#### **1.13 Guide For Decision-Makers**

Section 1.12 above provides details of current and possible future threats. Proposed developments in the immediate vicinity of limestone ridges community 26a require assessment. No developments should be approved unless the proponent can demonstrate that they will have no significant impact on the limestone ridge community.

#### **1.14 Conservation status**

The limestone ridges community 26a meets the following criteria for Endangered (EN) ecological communities (English and Blyth 1997b):

Biii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.

#### **1.15 Strategies for recovery**

To identify, and influence the management of, the areas in which the community occurs, so maintaining natural biological and non-biological attributes of the sites and the current area covered by the community.

To conduct appropriate research into the ecological characteristics of the community to develop further understanding about the management actions required to maintain or improve its condition.

## **2. RECOVERY OBJECTIVE AND CRITERIA**

**IRP Objective(s):** To maintain or improve the overall condition of the limestone ridges community 26a in the known locations and reduce the level of threat.

### **Criteria for success:**

- An increase in the area of this community under conservation management.
- Maintenance in terms of diversity and basic composition of native species (as described in Gibson *et al.* 1994) as well as biological processes, taking account of natural change of the community over time, as identified through monitoring.
- Improvement in terms of reduction of numbers of exotic species and of other threatening processes as defined in this document, as identified through monitoring.

### **Criterion for failure:**

Significant loss of area or further modification of occurrences of the threatened ecological community.

## **3. RECOVERY ACTIONS**

Note: The responsible authority is frequently listed as the relevant CALM District. This refers largely to initiating and guiding actions. However, in general the relevant CALM District, the Western Australian Threatened Species and Communities Unit (WATSCU) and the Recovery Team share the primary responsibility for securing funds for, and implementing, recovery actions.

### **3.1 Coordinate recovery actions**

The Swan Region Threatened Flora and Communities Recovery Team (SRTFCRT) has been established and consists of representatives from CALM's Swan Region (Chair), Swan Coastal District, Perth Hills District, Wildlife Branch, WATSCU and Science Division; and City of Gosnells, BGPA and World Wide Fund for Nature (WWF). The Recovery Team will continue to coordinate recovery actions for the limestone ridge community and other Declared Rare Flora and Threatened Ecological Communities in their region. They will include information on progress in their annual reports to CALM's Corporate Executive and funding bodies.

**Responsibility:** CALM (Swan Region) through the SRTFCRT  
**Cost:** \$2,100 per year (to run team)  
**Completion date:** Ongoing

### **3.2 Map critical habitat**

It is a requirement of the EPBC Act that spatial data relating to critical habitat be determined. Although critical habitat is described in Section 1, the areas as described have not yet been mapped and that will be done under this action. If any additional occurrences are located, then critical habitat will also be determined and mapped for these locations. If any additional occurrences are located, then critical habitat will also be determined and mapped for these locations ('first stage mapping').

CALM will seek to ensure that proponents of any development that have the potential to impact on this community undertake investigations to compare the conservation significance of occurrences of the community ('second stage mapping'). All occurrences are currently considered as 'critical habitat' for this limestone community but it is possible that some occurrences are so highly degraded as to be considered 'totally destroyed', or that some have been mostly cleared and are now very small in extent and may be no longer considered viable in the long-term.

**Responsibility:** CALM (Swan Coastal District, WATSCU for first stage mapping) through the SRTFCRT Proponents of developments, through CALM (Swan Coastal District) and the SRTFCRT for second stage mapping.  
**Cost:** \$2,000 in first year for first stage mapping. Cost of second stage mapping to be determined.  
**Completion date:** Year 1

### **3.3 Liaise with current land owners, land managers and other relevant groups**

Some of the occurrences of the community are managed by authorities other than CALM, or are privately owned. The involvement of relevant land managers, local landholders, Local Government Agencies, other government departments, holders of mineral extraction leases and industry in the recovery of the community wherever possible and practical is therefore essential to the recovery process. In particular the involvement of the City of Wanneroo and other Local Authorities that contain a number of occurrences, in the recovery of the limestone ridges community 26a will be encouraged. Input and involvement will also be sought from any Aboriginal groups that have an active interest in areas that contain the limestone ridges community 26a.

**Responsibility:** CALM (Swan Coastal District) through the SRTFCRT  
**Cost:** \$2,500 per year for all liaison (not including vehicle costs)  
**Completion date:** Ongoing

### **3.4 Minimise further clearing of the community**

Further clearing or destruction by other means, especially of examples of the community in good condition, will be minimised wherever possible by acquisition, negotiation and planning. Many occurrences occur within sites that are recommended to be reserved for conservation and are included in Bush Forever (State of Western Australia 2000), but reservation has not yet occurred. In particular, this includes Ridges and adjacent bushland, Yanchep/Nowergup (Bush Forever site 381) and Shire View Hill and adjacent bushland, Nowergup/Neerabup (Bush Forever site 293). These Bush Forever sites include Occurrences 1, 2, 10-17, 20-



21, 24-33, 35, 39-43, and 50. The reservation of these areas for conservation would increase the area of this community protected in secure reserves for conservation from the current 26 ha, to 110 ha.

**Responsibility:** CALM (Swan Coastal District) relevant Local Authorities, Department of Planning and Infrastructure through the SRTFCRT  
**Cost:** Costs of all liaison included in 3.4, other costs to be determined  
**Completion date:** Ongoing

### 3.5 Survey newly located occurrences

Areas of the limestone ridges community 26a may occur within areas proposed for development in the future. In addition, there are a suite of occurrences that have been inferred as this community type, and the identity of these will need to be confirmed (in particular Occurrences 54-61, 72, 73 and 74). Plots will need to be installed (as per methods used in Gibson *et al.* 1994) and analysis undertaken to define the community type. Additional occurrences will be entered onto the TEC database, including boundary information, condition and threatening processes.

**Responsibility:** CALM (Swan Coastal District; Science Division) through the SRTFCRT  
**Cost:** \$5,000 per year  
**Completion date:** Ongoing

### 3.6 Monitor the extent and boundaries of occurrences

Occurrences will be monitored every five years. Boundaries can be determined from current aerial photographs and minimal on-site checking. Land manager permission will be sought where occurrences occur on private property.

Accurate GPS mapping of community boundaries has commenced and a Geographic Information System database for TECs has been developed. Extent and boundary information will be added to the threatened ecological communities database as recommended in English and Blyth (1997b), as well as to the District's Geographic Information System database.

**Responsibility:** CALM (Swan Coastal District) through the SRTFCRT  
**Cost:** \$8,000 in the fifth year  
**Completion date:** Ongoing

### 3.7 Disseminate information about the community

To prevent accidental destruction or damage to the community and gain public support for its conservation, information about the community will continue to be provided by staff from CALM to all stakeholders including landholders, and other managers of land that contain the community. This will include information from the threatened ecological community database, and maps indicating the location of the community. Information about private land will only be disseminated if permission is granted by the relevant land manager.

CALM staff will ensure regular liaison with landowners and managers of land that contain the community to ensure threatened ecological community information is up to date.

A large poster that illustrates the significance of TECs, and provides community 26a as one of three examples, has been developed and placed on display at relevant events. The publicity campaign utilising local media and poster displays in prominent areas will be continued, to encourage awareness about this threatened ecological community. An information sheet, which includes a description of the community, its habitat, threats, recovery actions and photos will be produced and distributed.

**Responsibility:** CALM (WATSCU, Swan Coastal District) through the SRTFCRT  
**Cost:** \$2,000 in the first year; \$600 per year thereafter  
**Completion date:** Ongoing

### **3.8 Install markers to indicate the location of occurrences alongside tracks, firebreaks and roads**

To reduce the likelihood of accidental destruction CALM will mark, or encourage the appropriate authorities to mark roadside occurrences of threatened ecological communities, and occurrences located on tracks or firebreaks, with the same pegs as used to mark Declared Rare Flora (DRF). Pegs are already in place alongside some occurrences, as they mark the location of DRF. Where these pegs are located on the boundary of the community there is no need to put additional pegs in place, but additional pegs will be put in where the full extent of the community is not marked. These will be placed about 50 m either side of the boundaries of the community to provide a protective buffer.

**Responsibility:** CALM (Swan Coastal District) through the SRTFCRT  
**Cost:** \$600 in the first year  
**Completion date:** Year 1

### **3.9 Design and implement a program for monitoring flora**

A monitoring program will be established for a representative subset of the limestone ridges 26a community under a variety of management regimes (eg National Park, Shire reserves for recreation and private land). The line intercept method will be used. This consists of installing a transect or number of transects, and/or utilising the permanent plots already in place from the Gibson *et al.* (1994) survey wherever possible. It is likely that the method used will be to record species present at set intervals along the transect so that cover values can be determined for all taxa.

A subset of occurrences will be monitored every five years, or following a disturbance event, such as fire, to provide information on condition. Data collected will then be entered on to a database and then analysed. The results of data analysis will be added to the threatened ecological communities database as recommended in English and Blyth (1997a). This information is essential for determining changes in the community over time and the effects of specific events (eg too frequent fire).

**Responsibility:** CALM (Swan Coastal District) through the SRTFCRT  
**Cost:** \$18,750 in year one (\$3,750 per site x 5 sites); \$12,500 in fifth year to rescore plots  
**Completion date:** Ongoing

### **3.10 Develop and implement a Fire Management Strategy**

There is an urgent need for research into the fire-response of the community (to be completed under Action 3.9 flora monitoring), and to determine the implications of findings for management. This would also include developing a fire history map of the occurrences, which is updated annually. A Fire Management Strategy will include recommendations on fire frequency, intensity, season, and control measures (including the location of fire-breaks). Fire response plans already developed for National Parks will be updated to include the limestone ridges 26a community. These will then be incorporated into the Fire Management Strategy. Close liaison with all stakeholders will be required to develop a Fire Management Strategy.

No new fire breaks will be constructed on occurrences, including during wildfires. A local CALM staff member will be present during wildfires and controlled burns in remnants that contain occurrences of the community, to advise on protecting the conservation values of the community.

**Responsibility:** CALM (Swan Coastal District) through the SRTFCRT; in consultation with all stakeholders  
**Cost:** \$5,500 in first year, \$2,500 per year thereafter  
**Completion date:** Ongoing

### **3.11 Monitor weeds**

Floristic data from Gibson *et al.* (1994) and Weston and Gibson (1997) may help determine weeds that pose the greatest threat to some occurrences as weed species that occur in plots have been recorded. Some

significant weeds in occurrences may not occur in plots, however. Populations of major weeds will be accurately mapped in occurrences of the community where weeds are a significant threat, and appropriate herbicides or other method of weed control determined. Monitoring of weed levels can be included in Action 3.9.

**Responsibility:** CALM (Swan Coastal District) through the SRTFCRT  
**Cost:** \$4,000 every second year to monitor boundaries of weed populations that pose the greatest threat to the community  
**Completion date:** Ongoing

### **3.12 Implement weed control**

The highest priority will be to control weeds, in the early stages of invasion where possible, that pose the greatest threat to the community, eg bridal creeper (*Asparagus asparagoides*). Appropriate methods of weed control are found in Brown and Brooks (2002) and may include hand weeding or localised application of herbicide.

The herb layer is an integral part of this plant community and care will be taken to minimise disturbance of native herbs in any weed control program.

**Responsibility:** CALM (Swan Coastal District) through the SRTFCRT  
**Cost:** \$3,000 per year  
**Completion date:** Ongoing

### **3.13 Ensure strategies for conserving the limestone ridges 26a community are included in the Management Plan for Yanchep National Park**

When the Yanchep National Park Management Plan is updated, strategies for conserving the limestone ridges 26a community will be included.

**Responsibility:** CALM (Swan Coastal District) through the SRTFCRT  
**Cost:** Costs of liaison included in 3.3  
**Completion date:** When Management Plan for the Park is reviewed.

### **3.14 Design and conduct research**

Research will be designed to increase the understanding of characteristics of the community to assist future management decisions. Such research will include:

1. The impact of weeds on the community.
2. The role of disturbance in regeneration of the community.
3. The recovery of the community following recent fires and burns (this will be considered in the Fire Management Strategy).
4. The development of an appropriate monitoring system. Protocols will be developed as part of a future policy on threatened ecological communities based on recommendations in English and Blyth (1997a).
5. Important biological processes in the community, eg pollination biology, germination requirements, longevity and time taken for significant plant taxa in the community to reach maturity.

**Responsibility:** CALM (Swan Coastal District; Science Division) through the SRTFCRT  
**Cost:** Recovery Team to determine costs and likely funds available through other sources and to recommend a research program and sources of funds to CALM  
**Completion date:** Ongoing

### **3.15 Report on success of management strategies for the community**

Reporting on the success of overall strategies to maintain or improve condition of the limestone ridges

community 26a will be done in annual reports prepared by the Recovery Team for CALM's Corporate Executive. A final report will be prepared at the end of five years, and may be included as part of a full Recovery Plan, if required (see 3.16 below).

**Responsibility:** CALM (Swan Coastal District); through the SRTFCRT  
**Cost:** \$2,000 per year  
**Completion date:** Year 5

### **3.16 Review the need for a full Recovery Plan**

At the end of the fourth year of its five-year term this Interim Recovery Plan will be reviewed and the need for further recovery actions, to review this plan, or to develop a full recovery plan, will be assessed. If the community is still ranked as Endangered at that time a full Recovery Plan may be required.

**Responsibility:** CALM (Swan Coastal District and WATSCU) through the SRTFCRT  
**Cost:** \$17,500 in Year 5 (if full Recovery Plan required).  
**Completion date:** Year 5

### **SPECIFIC MANAGEMENT ACTIONS; SECTIONS OF OCCURRENCES 1-33, 35, 38-58, 61, 64, 65, 70, 71 and 73 ON PUBLIC LANDS**

#### **3.17 *Seek to have areas of the community on public land reserved as recommended in the Forest Management Plan***

CALM will continue to seek to have land that contains occurrences 1, 2, 10-17, 20, 21, 24-33, 35, 39-43 and 50 declared as reserves for conservation as recommended in Conservation Commission of WA (2004).

**Responsibility:** CALM (Swan Coastal District; Land Acquisitions Section), Department of Land Information (DOLI) Bush Forever Office at DPI through the SRTFCRT  
**Cost:** Costs of liaison included as part of 3.4  
**Completion date:** Not known

#### **3.18 *Fence occurrences on public lands as necessary***

On the basis of the results of Action 3.5, the requirement for fences will be determined (eg to prevent grazing and trampling by stock). Fences will be erected around areas identified as a high priority through this process. Suitable buffer areas will be included, as required.

**Responsibility:** CALM (Swan Coastal District) through the SRTFCRT, in liaison with relevant landholders  
**Cost:** Costs of liaison included in 3.4; fencing costs to be determined  
**Completion date:** Year 2

### **SPECIFIC MANAGEMENT ACTIONS - OCCURRENCES 34, 36-38, 59, 62, 63, 67-69, 72, 74 and 75 PRIVATE LANDS.**

#### **3.19 *Seek to have occurrences on private land fenced where appropriate***

On the basis of the results of Action 3.5, the requirement for fences will be determined (eg to prevent grazing and trampling by stock). Fences will be erected around areas identified as a high priority through this process. Suitable buffer areas will be included, as required.

**Responsibility:** CALM (Swan Coastal District) through the SRTFCRT, in liaison with landholders  
**Cost:** Costs of liaison included in 3.4; fencing costs to be determined  
**Completion date:** Year 2

**3.20 *Encourage and assist landowners to access available incentives and mechanisms for conserving the limestone ridges 26a community***

Incentives for protection include conservation covenants available through a range of agencies to ensure long term protection of the community. Funds may also be available through programs including the Commonwealth's Natural Heritage Trust, for example the Threatened Species Network grants for small community-based projects, or through the Regional programs as part of a wider project for on-ground recovery work on threatened ecological communities in an NRM Region.

**Responsibility:** CALM (Swan Coastal District) through the SRTFCRT, in liaison with landholders  
**Cost:** Costs of liaison included in 3.4  
**Completion date:** Ongoing

**3.21 *Seek to acquire occurrences for the conservation estate if the community is not being successfully managed for conservation, or if they become available***

If management for conservation seems unlikely to result from actions in this IRP, or if areas that contain occurrences of the community become available, CALM will seek funds and negotiate to acquire occurrences and adequate buffer areas. Such areas will then be declared Class A reserves for the purpose of 'Conservation of Flora and Fauna' under the care, control and management of the Conservation Commission.

The highest priorities for areas for acquisition are the largest areas in good condition on private land, where land managers may not wish to manage the areas for conservation. Occurrences that may have high priority for acquisition include occurrences 62, 72 and 74. There was also a recent development proposal for the land that contains occurrences 72 and 74.

Other areas that have a high priority for addition to the conservation estate include Occurrences 51 and 52 – 'Shire View Hill' and the Lake Clifton Townsite reserve respectively. Status as Unallocated Crown Land offers no security for the high conservation values associated with the site. The sites are presumably managed by the respective Local Government Authorities (City of Wanneroo and the Shire of Waroona).

Occurrences 34, 36, 37 and 38 occur on private land and have been degraded historically by grazing or mining. CALM will liaise with the land managers to seek to improve the security of the occurrences through mechanisms such as Conservation Covenants that are available through a range of agencies.

Occurrences 44-49 are in a Crown Reserve with the purpose of 'quarry', but are under the care, control and management of the Conservation Commission. Most of the area of the limestone ridges community in this reserve have been cleared and mined, but there are still small pockets of the community in the reserve. CALM will seek to ensure that these remaining pockets of the community are managed for conservation.

**Responsibility:** CALM (Swan Coastal District; WATSCU, Land Acquisitions Section) through the SRTFCRT, in liaison with landholders  
**Cost:** Market price of land at time of purchase  
**Completion date:** Ongoing

**Table 3: Summary of recovery actions**

| <b>Recovery Action</b>   | <b>Occurrences</b>                              | <b>Responsibility</b>  | <b>Completion date</b>        |
|--|---|--|-------------------------------|
| Coordinate recovery actions  | All   | CALM (Swan Region)   | Ongoing                       |
| Map critical habitat   | All   | CALM (Swan Coastal District, WATSCU)                               | Year 1                        |
| Liaise with land managers  | All   | CALM (Swan Coastal District)                                       | Ongoing                       |
| Minimise further clearing  | All   | CALM (Swan Coastal District)                                       | Ongoing                       |
| Survey new occurrences   | All   | CALM (Blackwood District, Science Division)                        | Ongoing                       |
| Monitor extent and boundaries  | All   | CALM (Swan Coastal District)                                       | Ongoing                       |
| Disseminate information  | All   | CALM (WATSCU, Swan Coastal District)                               | Ongoing                       |
| Install markers  | All   | CALM (Swan Coastal District)                                       | Year 1                        |
| Design and implement monitoring program                                    | 5 sites   | CALM (Swan Coastal District)                                       | Ongoing                       |
| Develop and implement a Fire Management Strategy                           | All   | CALM (Swan Coastal District) in consultation with all stakeholders | Ongoing                       |
| Monitor weeds  | All   | CALM (Swan Coastal District)                                       | Ongoing                       |
| Implement weed control   | All   | CALM (Swan Coastal District)                                       | Ongoing                       |
| Include management strategies in Management Plan for Yanchep National Park | 3-9, 53-58, 61                                  | CALM (Swan Coastal District)                                       | When plan reviewed            |
| Design and conduct research  | All   | CALM (Swan Coastal District; Science Division)                     | Ongoing                       |
| Report on success of management strategies for the community               | All   | CALM (Swan Coastal District)                                       | Year 5                        |
| Review the need for a full Recovery Plan                                   | All   | CALM (Swan Coastal District and WATSCU)                            | Year 5 (if required)          |
| Seek to reserve areas on public land as per Forest Management Plan         | 1, 2, 10-17, 20, 21, 24-33, 35, 38-43 and 50    | (Swan Coastal District; Land Acquisitions Section), DOLI           | Indefinite                    |
| Fence occurrences on public land   | To be determined                                | CALM (Swan Coastal District), land managers                        | Year 2                        |
| Fence occurrences on private land  | To be determined                                | CALM (Swan Coastal District), landholders                          | Year 2                        |
| Assist landowners to access incentives                                     | 34, 36-38, 59, 60, 62, 63, 67-69, 72, 74 and 75 | CALM (Swan Coastal District), landholders                          | Ongoing                       |
| Seek to acquire community on private land                                  | To be determined                                | CALM (Swan Coastal District; WATSCU, Land Acquisitions Section)    | When required or as available |

**Table 4: Summary of costs for each recovery action**

| <b>Recovery Action</b>   | <b>Year 1</b>    | <b>Year 2</b> | <b>Year 3</b> | <b>Year 4</b> | <b>Year 5</b> |
|--|------------------|---------------|---------------|---------------|---------------|
| Coordinate recovery actions  | \$2,100          | \$2,100       | \$2,100       | \$2,100       | \$2,100       |
| Map critical habitat   | \$2,000          |               |               |               |               |
| Liaise with land managers  | \$2,500          | \$2,500       | \$2,500       | \$2,500       | \$2,500       |
| Minimise further clearing  |                  |               |               |               |               |
| Survey new occurrences   | \$5,000          | \$5,000       | \$5,000       | \$5,000       | \$5,000       |
| Monitor extent and boundaries  |                  |               |               |               | \$8,000       |
| Disseminate information  | \$2,000          | \$600         | \$600         | \$600         | \$600         |
| Install markers  | \$600            |               |               |               |               |
| Design and implement monitoring program                                    | \$18,750         |               |               |               | \$12,500      |
| Develop and implement a Fire Management Strategy                           | \$5,500          | \$2,500       | \$2,500       | \$2,500       | \$2,500       |
| Monitor weeds  | \$4,000          |               | \$4,000       |               | \$4,000       |
| Implement weed control   | \$3,000          | \$3,000       | \$3,000       | \$3,000       | \$3,000       |
| Include management strategies in Management Plan for Yanchep National Park |                  |               |               |               |               |
| Design and conduct research  | To be determined |               |               |               |               |
| Report on success of management strategies for the community               | \$2,000          | \$2,000       | \$2,000       | \$2,000       | \$2,000       |
| Review the need for a full Recovery Plan                                   |                  |               |               |               | \$17,500      |
| Seek to reserve areas on public land as per Forest Management Plan         | To be determined |               |               |               |               |
| Fence occurrences on public land   | To be determined |               |               |               |               |
| Fence occurrences on private land  | To be determined |               |               |               |               |
| Assist landowners to access incentives                                     |                  |               |               |               |               |
| Seek to acquire community on private land                                  | Market price     |               |               |               |               |

**Summary of costs over five years**

|               |                  |
|---------------|------------------|
| <b>Year 1</b> | <b>\$47,450</b>  |
| <b>Year 2</b> | <b>\$17,700</b>  |
| <b>Year 3</b> | <b>\$21,700</b>  |
| <b>Year 4</b> | <b>\$17,700</b>  |
| <b>Year 5</b> | <b>\$59,700</b>  |
| <b>Total</b>  | <b>\$164,250</b> |

**4. TERM OF PLAN**

This Interim Recovery Plan will operate from October 2004 to September 2009 but will remain in force until withdrawn or replaced. After five years, the need to review this IRP or to replace it with a full Recovery Plan will be determined.

**5. REFERENCES**

- Abbott, I. and Burrows, N. (eds) (2003). *Fire in ecosystems of south-west Western Australia: impacts and management*. Bachhuys Publishers, Leiden, Netherlands.
- ATA Environmental (2002) *Alkimos Eglinton Environmental Review*. ATA Environmental, Perth.
- Brown, K. and Brooks, K. (2002) *Bushland weeds; a practical guide to their management*. Environmental Weeds Action Network (Inc), Western Australia.
- CALM (1992) Policy Statement No. 44 *Wildlife Management Programs*. Perth, Western Australia.
- CALM (1994) Policy Statement No. 50 *Setting Priorities for the Conservation of Western Australia's Threatened Flora and Fauna*. Perth, Western Australia.

- CALM (2003) Draft Policy Statement number 9. Conserving Threatened Species and Ecological Communities. Perth, Western Australia.
- Churchward H.M and McArthur, W.M. (1978) Darling System Landform and Soils. Department of Conservation and Environment. Perth, Western Australia.
- Conservation Commission of Western Australia (2004). *Forest Management Plan 2004-2013*. Government of Western Australia. Perth, Western Australia.
- Department of Conservation and Environment (1980). Atlas of Natural Resources Darling System Western Australia. Perth.
- English, V. and Blyth, J. (1997a) *Identifying and Conserving Threatened Ecological Communities in the South West Botanical Province*. Project N702, Final Report to Environment Australia. Department of Conservation and Land Management. Perth, Western Australia.
- English, V. and Blyth, J. (1997b) Development and application of procedures to identify and conserve threatened ecological communities in the South-west Botanical Province of Western Australia. *Pacific Conservation Biology* 5, 124-138.
- Gibson, N., Keighery, B., Keighery, G., Burbidge, A and Lyons, M. (1994) *A floristic survey of the Southern Swan Coastal Plain*. Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.).
- Keighery, G., Gibson, N., Muir, B. and Keighery, B. (2003) Common and rare limestone communities of the Swan Coastal Plain. *Summary Proceedings, Threatened Ecological Communities Symposium*. Department of Conservation and Land Management, Perth.
- Semeniuk, V. (1990) The geomorphology and soils of the Yoongarillup Plain in the Mandurah – Bunbury coastal zone, south-western Australia: a critical appraisal. *Journal of the Royal Society of Western Australia*. 73: 1-7.
- Smith, V., Briggs, A., Hales, T. Herford, I. and Orr, K. (1989) *Yanchep National Park Management Plan 1989 – 1999*. Management Plan No 14, Department of Conservation and Land Management.
- State of Western Australia (2000) *Bush Forever*. Western Australian Planning Commission, Perth.
- State of Western Australia (2003) *Metropolitan Development Program. Urban Land Release Plan 2003/2004 to 2007/2008*. Western Australian Planning Commission, Perth.
- Weston, A.S. and Gibson, N. (1997) *Report on the limestone vegetation of Wabbling Hill area, Reserves 39411 and 39412, and the Ridges extension to Yanchep National Park*. Department of Conservation and Land Management, Perth.



## APPENDIX 1

**Typical (occurs in >75% plots in that community) and common (occurs in 50-75% of plots in that community) of taxa found in plots (from Gibson *et al.*, 1994)**

|   | <b>Taxon</b>  |
|---|---|
|   | <i>Acacia lasiocarpa</i>                              |
| * | <i>Aira caryophyllea</i>                              |
| * | <i>Anagallis arvensis</i>                             |
|   | <i>Crassula colorata</i>                              |
|   | <i>Danthonia occidentalis</i>                         |
|   | <i>Daucus glochidiatus</i>                            |
| * | <i>Dischisma arenarium</i>                            |
|   | <i>Dryandra nivea</i>                                 |
|   | <i>Dryandra sessilis</i>                              |
|   | <i>Eriochilus dilatatus</i>                           |
|   | <i>Gompholobium tomentosum</i>                        |
|   | <i>Grevillea thelemanniana</i> subsp. <i>preissii</i> |
|   | <i>Hardenbergia comptoniana</i>                       |
| * | <i>Heliophila pusilla</i>                             |
|   | <i>Hydrocotyle hispidula</i>                          |
| * | <i>Hypochaeris glabra</i>                             |
|   | <i>Leucopogon parviflorus</i>                         |
|   | <i>Loxocarya flexuosa</i>                             |
|   | <i>Melaleuca acerosa</i>                              |
|   | <i>Melaleuca huegelii</i>                             |
|   | <i>Millotia tenuifolia</i>                            |
|   | <i>Mitrasacme paradoxa</i>                            |
|   | <i>Opercularia vaginata</i>                           |
|   | <i>Parietaria debilis</i>                             |
|   | <i>Pterostylis</i> aff. <i>nana</i>                   |
| * | <i>Sonchus oleraceus</i>                              |
|   | <i>Stipa compressa</i>                                |
|   | <i>Stipa flavescens</i>                               |
|   | <i>Stylidium maritimum</i> Ms                         |
|   | <i>Templetonia retusa</i>                             |
|   | <i>Thysanotus manglesianus/patersonii</i> complex     |
|   | <i>Trachymene pilosa</i>                              |
|   | <i>Trymalium albicans</i>                             |
| * | <i>Vulpia myuros</i>                                  |
|   | <i>Wurmbea monantha</i>                               |

\* Introduced