Department of
Environment and
Conservation (NSW)

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Approved Recovery Plan

Persoonia nutans R.Br. (Nodding Geebung) Recovery Plan

January 2006

Australian Government

Department of
Environment and
Conservation (NSW)

The NPWS is part of the Department of Environment and Conservation

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Persoonia nutans Recovery Plan

Executive summary

This document constitutes the National and NSW State Recovery Plan for the shrub *Persoonia nutans* (Proteaceae), and as such considers the conservation requirements of the species across its known range. It identifies the future actions to be taken to ensure the short and long-term viability of *P. nutans* in nature and the parties who will carry out these actions.

Persoonia nutans is listed as endangered in the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and as endangered in the Schedules of the NSW *Threatened Species Conservation Act 1995*. The species is a NSW endemic restricted to the Cumberland Plain, western Sydney, between Richmond in the north and Macquarie Fields in the south. The species has a disjunct distribution, with the majority of individuals (99%) restricted to a small area in the north of the species range, with isolated small populations occurring in the south.

The species is an obligate seeder and therefore in the event of a fire all existing *P. nutans* plants are killed and regeneration is dependent upon recruitment from a soil stored seed bank. *Persoonia nutans* populations are likely to be dynamic throughout the landscape, particularly in the north of the species range, and fluctuations in space and time of above ground individuals will be a natural occurrence. Given these fluctuations in time and space, the number of individuals and populations is difficult to estimate. Current information suggests there are 27 populations of *P. nutans* supporting greater than 5500 individuals in total. Only seven of these populations occur within conservation reserves, with the majority of populations occurring on private property and unoccupied crown land.

The main threats to the survival of *P. nutans* are habitat loss and fragmentation (due to clearing for mining, and rural/residential development) and inappropriate fire regimes, particularly frequent fire. The species is also threatened by habitat degradation due to disturbance associated with unrestricted access to *P. nutans* habitat. The overall objective of this recovery plan is to ensure the continued and long-term survival of *P. nutans* in the wild by promoting the *in situ* conservation of the species across its natural range. Specific recovery objectives include:

- minimise the loss and fragmentation of *P. nutans* habitat;
- identify and minimise the operation of threats at sites where *P. nutans* occurs;
- implement a survey and monitoring program that will provide information on the extent and viability of *P. nutans*;
- provide public authorities with information that assists in conserving the species;
- raise awareness of the species and involve the community in the recovery program; and
- promote research questions that will assist future management decisions.

It is intended that the recovery plan will be implemented over a five year period. The total cost to implement the plan is $40,600 over five years, although this does not include site management costs as these costs are yet to be determined.

Lisa Corbyn
Director General
Department of Environment and Conservation

Bob Debus MP
Minister for the Environment

Acknowledgments

This recovery plan is based on a previous Conservation Research Statement and Recovery Plan for *Persoonia nutans* (NSW National Parks and Wildlife Service 1996). The original plan was prepared by Geoff Robertson, Maria Matthes and Martin Smith.

The Department of Environment and Conservation (DEC) wishes to acknowledge the following for their contributions to the development of this recovery plan:

- For providing information during preparation of this revised Recovery Plan; Diana Picone (Bankstown City Council); Peter Cuneo and Tracey Armstrong (Botanic Gardens and Domain Trust); Danny Wotherspoon (Blue Mountain Wilderness Services Pty Ltd); Emma Stevenson and Ken Donaldson (Campbelltown City Council); Jonathan Sanders and Sue Wesson (Department of Environment and Conservation), Lee De Gail (Department of Lands), Stephen Barry (Department of Mineral Resources); Teresa James (Environmental Consultant); Rebecca Ward (Liverpool City Council); Rhiannan Pace (Penrith City Council); Laurie Caffarella (Regional Illegal Dumping (RID) Squad; and Paul Rymer (University of Wollongong).

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- The Australian Government Department of the Environment and Water Resources (previously Environment and Heritage) Natural Heritage Trust Program for the provision of funding to prepare this recovery plan and also the previous Conservation Research Statement and Recovery Plan.

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1 Introduction

Persoonia nutans (Proteaceae) is an erect to spreading shrub with yellow flowers and reddish stems and branches. The species is a NSW endemic, restricted to the Cumberland Plain in western Sydney, between Richmond in the north and Macquarie Fields in the south. The main threats to the survival of *P. nutans* are habitat loss and fragmentation (due to clearing for mining, and rural/residential development) and inappropriate fire regimes, particularly frequent fire. The species is also threatened by habitat degradation due to disturbance associated with unrestricted access to *P. nutans* habitat.

This document constitutes the formal NSW and National Recovery Plan for *P. nutans* and as such considers the requirements of the species across its known range. The recovery plan outlines the current status of the species, identifies threats to persistence, details past and current management initiatives, details the recovery program for the species over the next five years, and identifies the parties responsible for implementing recovery actions.

2 Legislative context

2.1 Conservation status

Persoonia nutans is listed as endangered under the *Threatened Species Conservation Act 1995* (*TSC Act 1995*). The species is also listed as endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act 1999*). In addition, approximately half of the known *P. nutans* populations occur within habitat listed as endangered ecological communities in Schedule 1, Part 3 of the *TSC Act 1995* (Section 5.2).

A review of the current conservation status of *P. nutans* found that the species is appropriately listed as endangered (Appendix 1). *Persoonia nutans* meets the requirements for endangered given that it possesses a restricted extent of occurrence; that the majority (>90%) of known individuals are restricted to only two populations; and that continuing declines are expected.

The consequences of listing a species under the *TSC Act 1995* are outlined throughout the remainder of Section 2. Briefly, among the consequences of listing are the following:

- a recovery plan must be prepared for the species;
- consideration must be given to the species when assessing the impacts of developments and activities, with the aim of minimising adverse impacts; and
- other actions which are likely to result in the harming or picking of that species or damage its habitat must be licensed.

2.2 Recovery plan preparation

The *TSC Act 1995* provides a legislative framework to protect and encourage the recovery of threatened species, endangered populations and endangered ecological communities in NSW. Under this legislation the Director General of the Department of Environment and Conservation (DEC) has a responsibility to prepare recovery plans for all species, populations and ecological communities listed as endangered or vulnerable on the *TSC Act 1995* schedules. Similarly, the *EPBC Act 1999* requires that the Commonwealth Minister for the Environment ensures that there is approved conservation advice in place for each nationally-listed species and community. The Commonwealth Minister may also require the preparation of a recovery plan for nationally listed species and communities or adopt plans prepared by others including those developed by State agencies. Both Acts include specific requirements for the matters to be addressed by recovery plans and the administrative process for preparing recovery plans.

This recovery plan has been prepared to satisfy the requirements of both the *TSC Act 1995* and the *EPBC Act 1999* and therefore will be the only recovery plan for the species. It is the intention of the Director General of the DEC to forward this recovery plan to the Commonwealth Minister for the Environment for adoption.

2.3 Recovery plan implementation

The *TSC Act 1995* requires that a public authority must take any appropriate measures available to implement actions included in a recovery plan for which they have agreed to be responsible. Public authorities and councils identified as responsible for the implementation of recovery plan actions are required by the *TSC Act 1995* to report on measures taken to implement those actions. In addition, the Act specifies that public authorities must not make decisions that are inconsistent with the provisions of the plan.

The public authorities responsible for actions in this plan are: the Department of Environment and Conservation (DEC), Department of Planning (DoP), Department of Lands (DOL), Department of Corrective Services, and the councils of Campbelltown, Liverpool, Bankstown, Blacktown, Hawkesbury, and Penrith. Consequently, the actions outlined for each of these public authorities must be implemented as described in the plan and public authorities that manage land that supports *P. nutans* must manage the site in accordance with this

plan. Relevant land management issues include fire management and habitat management.

The *EPBC Act 1999* specifies that a Commonwealth agency must not take any action that contravenes a recovery plan and states that the Commonwealth must implement a recovery plan on those areas that apply to Commonwealth lands. A population of *Persoonia nutans* has been recorded on Commonwealth land at Holsworthy Military Area, Holsworthy.

2.4 Relationship to other legislation

Persoonia nutans is known to occur on both private and public lands within the council areas of Campbelltown, Liverpool, Bankstown, Blacktown, Hawkesbury, and Penrith. The lands on which *P. nutans* occurs include those that are owned or managed by: Campbelltown City Council, Department of Corrective Services, Department of Environment and Conservation, Commonwealth Department of Defence, Department of Lands, and private landowners.

Relevant NSW and Commonwealth legislation includes:`

- *Threatened Species Conservation Act 1995*;
- *Threatened Species Conservation Amendment Act 2002;*
- *National Parks and Wildlife Act 1974;*
- *Environmental Planning and Assessment Act 1979;*
- *Local Government Act 1993;*
- *Rural Fires Act 1997;*
- *Native Vegetation Conservation Act 1997;*
- *Native Vegetation Act 2003;*
- *Protection of the Environment (Operations) Act 1998*
- *Noxious Weeds Act 1993*
- Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999;*
- *Crown Lands Act, 1989;* and
- *Aboriginal Land Rights Act 1983*

2.5 Environmental assessment

2.5.1 State environmental assessment

The New South Wales *Environmental Planning and Assessment Act 1979* (*EP&A Act 1979*) requires that consent and determining authorities, and the Director General of the DEC as a concurrence authority, consider relevant recovery plans when exercising a decision-making function under Parts 4 and 5 of the Act. Decision-makers must consider known and potential habitat, biological and ecological factors and the regional significance of individual populations.

The following public authorities have a decision making function in relation to *P. nutans* and must consider the conservation strategy outlined in this plan and attached EIA guidelines (Appendix 3) when considering any activity which may affect *P. nutans*:

- The Department of Planning (DoP) as a consent authority, and in the making of Environmental Planning Instruments under the *EP&A Act 1979*;
- The Department of Environment and Conservation (DEC) as a land manager, licensing authority and in a concurrence role under the *EP&A Act 1979*;
- Campbelltown, Liverpool, Bankstown, Blacktown, Hawkesbury, and Penrith councils as land managers and/or consent and determining authorities, and in the making of Environmental Planning Instruments under the *EP&A Act 1979*; and
- The Rural Fire Service (RFS) when issuing Bush Fire Hazard Reduction Certificates.

The Minister for Planning is the consent authority for State significant development under Part 3A of the EP&A Act 1979. In this capacity he takes advice from the Department of Planning, who in turn seek advice from the Department of Environment and Conservation (NSW).

Additional public authorities may have responsibilities if the species is located in other areas in the future.

Any activity not requiring development consent under the *EP&A Act 1979*, and which is likely to affect *P. nutans*, requires a Section 91 licence under the provisions of the *TSC Act 1995* or a Section 132C licence under the *NP&W Act 1974*. The type of licence required will depend upon the activity proposed. If the activity is for scientific, conservation or educational purposes, a Section 132C licence is required. For example, any rehabilitation works, including weed control, in the habitat of *P. nutans* will require a Section 132C licence if no other approvals are required under the *EP&A Act 1979*.

2.5.2 Commonwealth environmental assessment

The *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999)* regulates actions that may result in a significant impact on nationally listed threatened species and ecological communities. It is an offence to undertake any such actions in areas under State or Territory jurisdiction, as well as on Commonwealth-owned areas, without obtaining prior approval from the Commonwealth Minister for the Environment. As *P. nutans* is listed under the *EPBC Act 1999*, any person proposing to undertake actions likely to have a significant impact on this species should

refer the action to the Commonwealth Minister for the Environment for consideration (in addition to the state consent or determining authority). That Minister will then decide whether the action requires *EPBC Act 1999* approval.

Administrative guidelines, to assist proponents in determining whether their action is likely to have a significant impact, are available from the Australian Government Department of the Environment and Water Resources (DEW; previously Environment and Heritage).

In cases where the action does not require *EPBC Act 1999* approval, but will result in the death or injury to *P. nutans* in a Commonwealth area, a permit will be required from the Commonwealth Minister for the Environment, under the *EPBC Act 1999*.

The Commonwealth Minister for the Environment can also delegate the role of assessment and approval to other Commonwealth Ministers under a Ministerial Declaration and to the States and Territories under bilateral agreements. The development of a bilateral agreement between NSW and the Commonwealth is not complete at the date of this publication, but when in place will avoid the need for duplication of environmental assessment.

Further information concerning the operation of the *EPBC Act 1999* environmental assessment requirements can be obtained from DEW.

2.6 Key threatening processes

The *EPBC Act 1999* and the *TSC Act 1995* provide for the identification and listing of key threatening processes (KTP). A KTP is a process that threatens, or has the capability to threaten, the survival or evolutionary development of species, populations or endangered ecological communities.

2.6.1 New South Wales

Five key threatening processes listed under the *TSC Act 1995* (as of April 2004) are likely to, or potentially, threaten *P. nutans*. *'Clearing of native vegetation'*, has reduced the habitat of *P. nutans* (Sections 4.2 and 8.2.1). *'High frequency fire resulting in the disruption of life cycle process in plants and animals and loss of vegetation structure and composition'*, is highly likely to threaten the persistence of *P. nutans* populations (Sections 6 & 8.2.2). '*Competition from feral honeybees Apis mellifera L.*' may also threaten *P. nutans* given that feral honeybees may reduce seed set in species of *Persoonia* due to inefficient transfer of pollen (Bernhardt and Weston 1996). '*Infection of native plants by Phytopthora cinnamomi'* and '*Anthropogenic climate change'* may also affect *P. nutans*. "*Competition and grazing by the feral European rabbit*" and "*Invasion of native plant communities by exotic perennial grasses*" are KTPs known to affect *P. nutans* at Simmos Beach Reserve.

In addition to these listed KTPs, a range of other processes are generally recognised as threatening the survival of *P. nutans* (Section 8.2).

2.6.2 Commonwealth

Three KTPs currently listed under the *EPBC Act 1999* (as of April 2004) are likely to, or potentially, threaten *P. nutans*. These KTPs are similar to *TSC Act 1995* listed KTPs and include; dieback caused by the root-rot fungus (*Phytophthora cinnamomi*), land clearance, and loss of climatic habitat caused by anthropogenic emissions of greenhouse gases.

2.7 Critical habitat

The *TSC Act 1995* makes provision for the identification and declaration of critical habitat for species, populations and ecological communities listed as endangered. Once declared, it becomes an offence to damage critical habitat (unless the action is specifically exempted by the *TSC Act 1995*) and a species impact statement is mandatory for all developments and activities proposed within critical habitat, unless the impact is deemed trivial or negligible by the Director General of the DEC.

To date, critical habitat has not been declared for *P. nutans* under the *TSC Act 1995*. However, this recovery plan identifies the habitat features and locations (Sections 4, 5 and Appendix 2) that would contain habitat that is critical to the survival of the species, as required by the *EPBC Act 1999*. It is not currently considered a high priority to nominate critical habitat for *P. nutans*, as no demonstrable conservation outcome would accompany its identification and declaration. Action 1.3 of this Recovery Plan provides a mechanism for reconsidering the need for critical habitat nomination during the final year of implementation of the Plan.

3 Taxonomy & description

The genus *Persoonia* belongs to the family Proteaceae. The genus is endemic to Australia, contains c. 100 species and is represented in all states of Australia, with 49 species recorded from NSW (Weston 2002). Eight *Persoonia* taxa are listed as threatened nationally under the *EPBC Act 1999* and nine are listed as threatened in the schedules of the NSW *TSC Act 1995*.

The following description of *Persoonia nutans* R. Br. (syn: *P. nutans* R. Br. Subsp. A in Jacobs and Prickard 1981) is from Weston (2002): Erect to spreading shrub, young branchlets sparsely to

moderately hairy. Leaves linear, 1-3 cm long, 1-1.8 mm wide, usually flat, with recurved margins, sparsely hairy when immature, and glabrescent when mature, smooth. Inflorescences usually growing on into a leafy shoot; flowers mostly subtended by leaves; pedicels 7-12 mm long, recurved, glabrous. Tepals 8.5-11 mm long, caudate, glabrous. Ovary glabrous.

Persoonia nutans sometimes grows with *P. laurina* and *P. hirsuta* but no hybrids are known (Weston and Johnson 1991).

4 Distribution, abundance & land tenure

4.1 Current distribution

Persoonia nutans is a NSW endemic, restricted to the Cumberland Plain in western Sydney, between Richmond in the north and Macquarie Fields in the south (Figure 1). The species has a disjunct distribution, with the majority of populations (& 99% of individuals) occurring in the north of the species range in the Agnes Banks, Londonderry, Castlereagh, Berkshire Park and Windsor Downs areas. This disjunct distribution is presumably influenced by soil type given that the species is confined to aeolian and alluvial sediments (Section 5.1). In the north, these deposits are extensive, whereas in the south these deposits are limited and the species is less abundant.

The species' core distribution occurs within the Penrith, and to a lesser extent, Hawkesbury, Local Government Areas (LGA), with isolated and relatively small populations also occurring in the Liverpool, Campbelltown, Bankstown and Blacktown LGAs.

There is likely to be numerous additional sites supporting *P. nutans* that have not yet been recorded given:

(i) the availability of potential habitat (Figures 2 and 3). In particular, near Holsworthy in the south, and in the Shanes Park area in the north, where outcrops of suitable soil supporting suitable vegetation exist;
(ii) that there has been very little targeted survey for the species; and that
(iii) the species may not be detected during targeted survey at a particular site even if it is present (in the soil-stored seed bank) given that *P. nutans* is an obligate seeder (Section 6) and the number of above ground individuals will fluctuate in space and time.

The species current known distribution equates to a linear range of approximately 45km across the species entire range and only 14km excluding the southern relatively small and disjunct populations (these southern populations account for <1% of total individuals). The species possesses an *extent of occurrence*[1] of approximately 38km^2. Given that very little is known of the area of known populations, the species' *area of occupancy*[2] (AOO) is unknown. The estimated area of potential habitat (i.e. suitable vegetation community and suitable soil type) is currently 5300 ha in the north of the species range and 573 ha in the south of the species range (Figures 2 and 3). These values considerably overestimate the AOO of *P. nutans* given that the species will not occupy all these areas at a particular point in time and some of this potential habitat may not be suitable habitat (e.g. may be subject to high fire frequency).

Population specific locational information is provided in Appendix 2 and additional information on population size is provided in Section 4.3. References to site numbers throughout this plan correspond to Appendix 2. Given concerns that the publication of exact location details for populations of *P. nutans* may compromise conservation, a complete Appendix 2 will not to be released to the public (detailed location descriptions and grid refs are excluded). Public authorities, land managers, or others with genuine reasons for requiring the data, may request the entire Appendix 2 by contacting the Threatened Species Unit (contact details provided on inside front cover).

4.2 Historical distribution

Persoonia nutans was probably never widespread across the Cumberland Plain as it is confined to aeolian and alluvial sediments. In the north, where the species appears to be locally abundant, these deposits are extensive, whereas in the south, where the species occurs only as relatively small and isolated populations, these deposits are limited (Figure 1). It is therefore likely that the species' extent of occurrence was historically similar to its current extent, although there may have been some losses to the north-east (south of Windsor) and north-west (north of Agnes Banks Nature Reserve) due to residential development and mining respectively.

Within the species current known range there would have been losses as considerable habitat has been cleared for mining, agriculture and rural-residential development (Section 8.2.1). For example, Agnes Banks Woodland and Castlereagh Scribbly Gum Woodland, the vegetation

[1] *Extent of occurrence* is the 'area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of a taxon…' (as defined by IUCN (2000)). 'This measure may exclude discontinuities or disjunctions within the overall distributions of a taxa' and in the case of *P. nutans* the central unoccupied area of the species distribution has been excluded.
[2] *Area of occupancy* is defined as the area within its 'extent of occurrence' which is actually occupied by a taxon (IUCN 2000).

communities that support the majority of *P. nutans* (Section 5.2), have been reduced to only 15.9% and 52.7% respectively of their pre-European settlement extent (NSW NPWS 2002a). In particular, the mining of large areas that previously supported Agnes Banks Woodland would have resulted in the loss of considerable numbers of *P. nutans*. For example, an unknown number of *P. nutans* plants were destroyed when site P10c was sand mined in the 1990s. The top-soil was removed prior to mining, stockpiled and returned to the site after completion of the mining. Subsequently, 1000's (potentially as great as 12,000) *P. nutans* seedlings germinated from the returned top-soil (D. Wotherspoon pers. com. 2004). However, the majority of these individuals will be lost to an approved residential subdivision in the near future.

The local extinction of at least one population has been recorded: L4, which was lost to industrial development (Appendix 2). There are also a number of other sites that are potentially extinct, including L2 which may have been lost to road widening; Pd2 which may have been lost to clearing for residential development; and P10c, if not cleared already, as discussed above, will soon be cleared for residential development.

4.3 Population structure & size

In the north of the species range, *Persoonia nutans* does not typically appear in discrete populations, but rather, occurs as scattered individuals throughout suitable habitat. Survey within the north of the species range is likely to reveal additional occurrences. It is therefore difficult to place precise limits on the boundaries of known populations. However, based on available information, there are 27 known extant populations[3] of *P.nutans* (Appendix 2).

Current known estimates of population size were obtained largely from survey work undertaken in 1996 (NSW NPWS 1996). Given that *P. nutans* is a fire sensitive obligate seeder (Section 6), the species will exhibit considerable fluctuations in the number of mature individuals over time, depending upon time since fire. Consequently, estimates of above ground abundance should be viewed with caution and may be a poor indicator of the potential abundance of *P. nutans* at a site.

Available information suggests that the total number of mature *P. nutans* individuals across all 25 known populations is greater that 5500. Population size varies from only a few individuals to thousands of plants, although the majority of populations support a low number of plants (Table 1). 84% of all populations support less than 50 individuals, with only two populations (P8, P10) supporting >500 plants. The majority of individuals occur in the north of the species range, with less than 1% of individuals occurring within the southern part of the species range.

Table 1: Size class distribution for the 27 known extant populations of *Persoonia nutans*

Size class[#]	Number of populations*	% of total no. of popns
≤ 10	17	63
11 ≤ 50	6	22
51 ≤ 200	1	4
201 ≤ 500	1	4
≥501	2	7

[#]number of mature individuals

*using lowest (pessimistic) estimate of population size

4.4 Land tenure & zoning

4.4.1 Land tenure

Over half the known populations of *P. nutans* (18/27) occur on freehold land (Table 2). However, given that the majority of populations on freehold land are relatively small and/or haven't been subject to targeted survey, freehold populations support only 2% of known individuals. The majority of known individuals occur within conservation reserves (70%) (nature reserves & regional parklands managed by the DEC) and crown land (28%). The remaining 1% of individuals occur on a range of tenures as outlined in Table 2.

The conservation reserves that support *P. nutans* occur within the north of the species range and include Agnes Banks Nature Reserve (NR), Windsor Downs NR, Castlereagh NR and the proposed Regional Parklands within the ADI site (Figure 1). The Crown Lands that support *P. nutans* are collectively known as the Castlereagh-Londonderry Crown Lands. Much of these crown lands are currently subject to an aboriginal lands claim under the NSW *Aboriginal Land Rights Act 1983*.

4.4.2 Zoning

The zoning of areas supporting *P. nutans* is described in Table 3. The majority of populations occur in areas with a rural zoning (13/25), however given that these populations are typically small and/or haven't been subject to targeted survey, these populations account for only 29% of known individuals. The majority of individuals (70% and 5/27 populations) occur within Nature Reserves managed by the DEC. The remaining zonings account for <1% of known individuals.

[3] Populations are recognised in this recovery plan as 'geographically or otherwise distinct groups between which there is little demographic or genetic exchange (typically one successful migrant individual)' (IUCN 2000). Given the absence of information on gene flow in *P. nutans*, populations have been delineated using the 'rule of thumb' provided by Keith et al. (1997) of geographic discontinuity of more than 1 km. Groups of plants not separated by >1km are referred to as sites within this plan.

Additional site-specific detail on zoning and tenure is provided in Appendix 2.

4.4.3 Adequacy of representation in conservation reserves

Despite the majority of known individuals occurring within formal conservation reserves (nature reserves and regional parklands managed by the DEC) (see Section 4.4.1), *Persoonia nutans* is inadequately represented in conservation reserves, particularly within the south of the species range. Only 17.8% of potential habitat (see Figures 2 & 3) and only seven of the 27 known populations (part or all of populations P1, P2, P3, P10, H2, BL1 and BL2), occur within conservation reserves. None of the southern populations occur within a formal conservation reserve, although, one of the southern populations (C1) is relatively protected within Simmos Beach Recreation Reserve (managed by Campbelltown City Council).

Table 2: Tenure and land managers for the 27 known extant populations of *Persoonia nutans*

Tenure*	Landmanager	Number of populations	Estimate of % of total number of individuals
Freehold[#]	Freehold	18	2
Conservation Reserve	Department of Environment and Conservation (NSW)	7	70
Crown	Department of Lands	5	28
Community land	Campbelltown City Council	1	<1
Commonwealth	Department of Defence	1	<1
Road verge	Unknown	2	<1

*where a population occupies two different tenures it has been recorded as two separate populations.

[#] Estimates for the number of individuals on freehold land do not include the 1000s of plants at P10c that will be, or have been already, cleared for residential development.

Table 3: Land-use zoning for the 27 known extant populations of *Persoonia nutans*

Zoning	Number of populations	Estimate of % of total number of individuals
Rural	13	29
Nature Reserve (DEC estate)	5	70
Special Uses (subject to rezoning proposal)	1	<1
Recreation/ Public open space	3	<1
Environmental protection-Rural and Residential	3	<1
Regional Parklands (DEC estate)	2	<1
Industrial	2	<1
Road reserve/utility	2	<1

*where a population occupies two different land-use zonings it has been recorded as two separate populations.

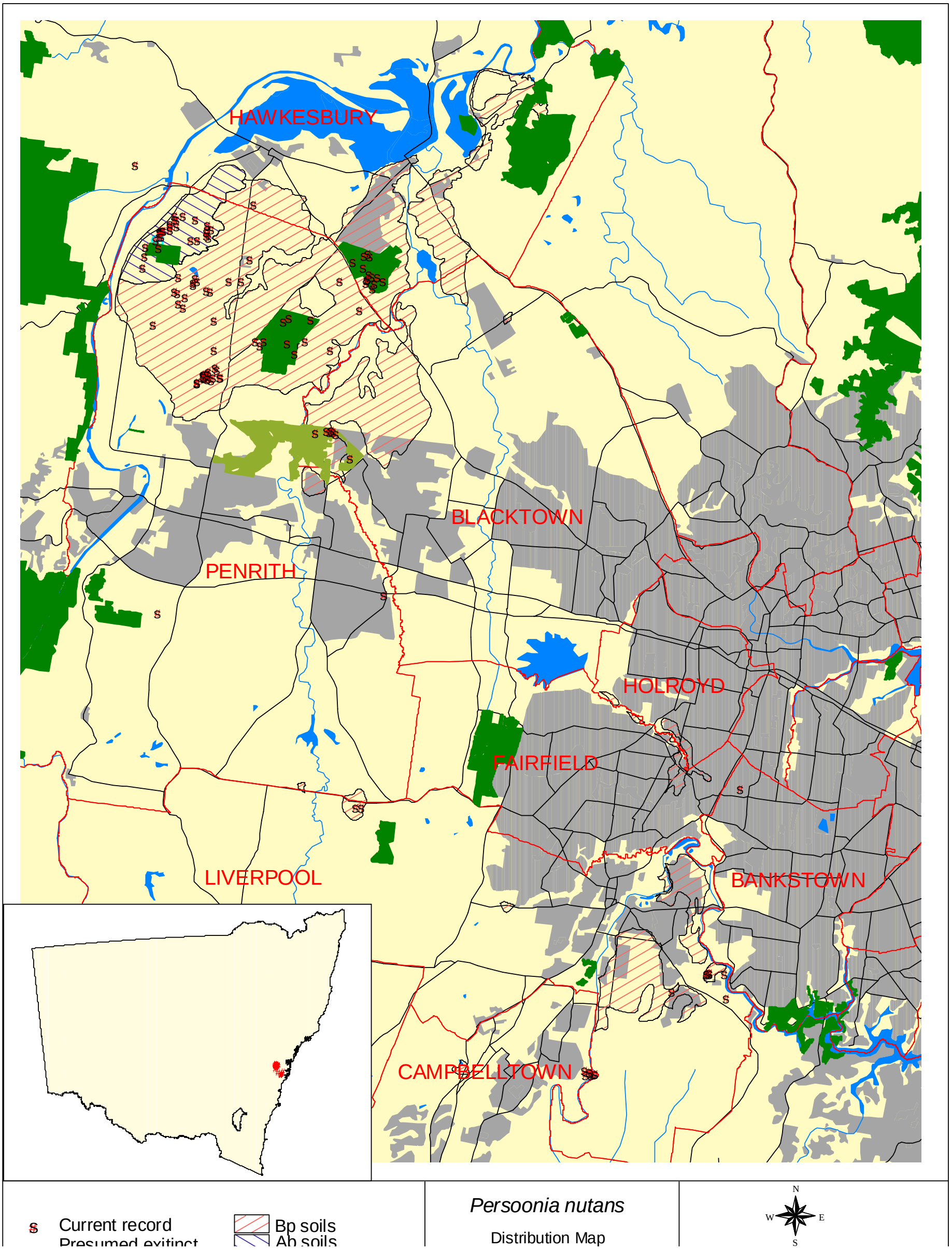

Figure 1. The known distribution of *Persoonia nutans* within western Sydney, NSW. The distribution of *P. nutans* is influenced by associated soil types, which include the Berkshire Park (Bp soil) and Agnes Banks (Ab soil) soil landscapes.

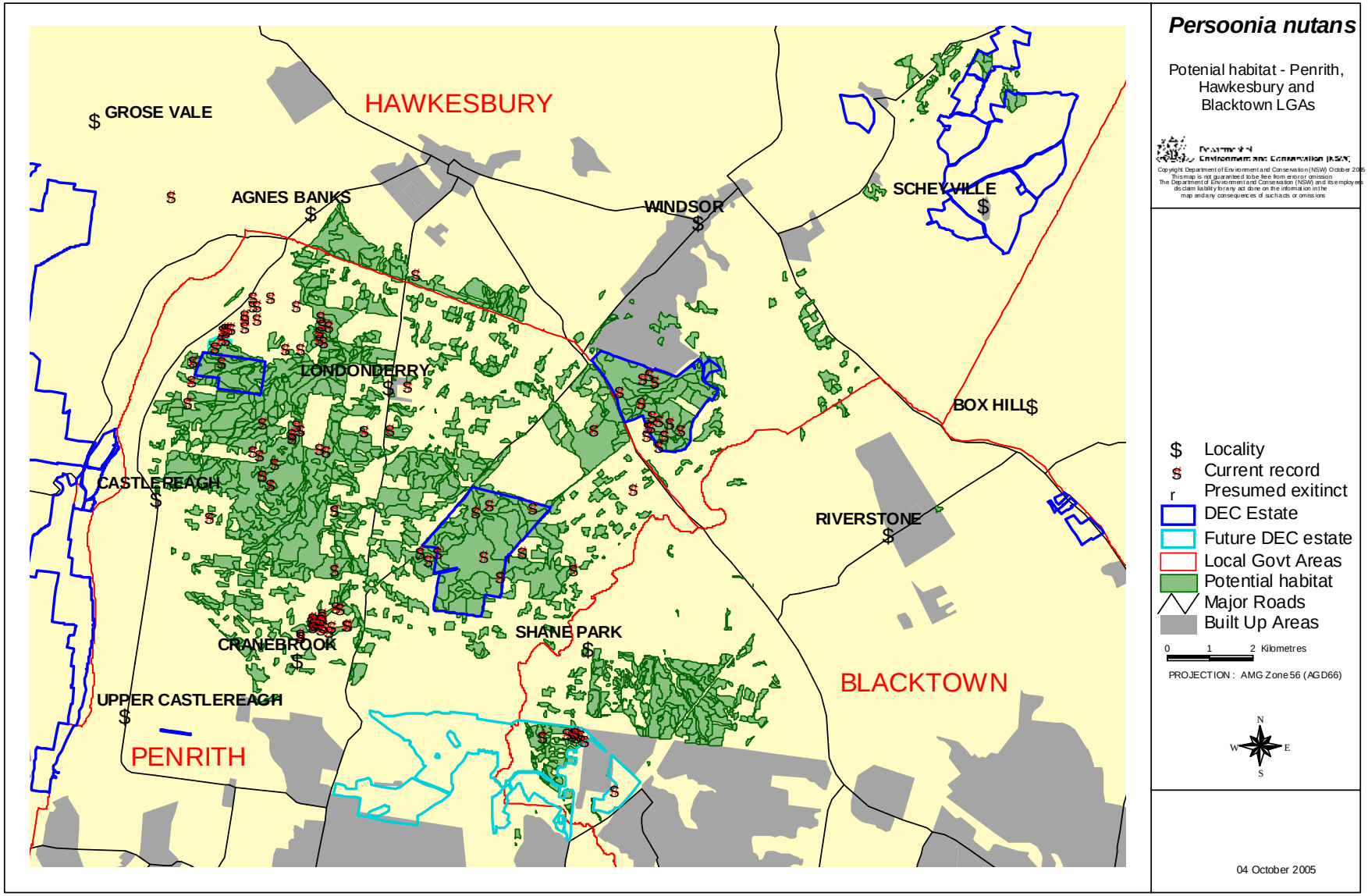

Figure 2. Potential habitat for *Persoonia nutans* within the north of the species distribution. The identified potential habitat represents those areas that possess suitable soil type (Agnes Banks or Berkshire Park soil formations) and also support suitable vegetation (see Table 4) as identified in NSW NPWS 2002a).

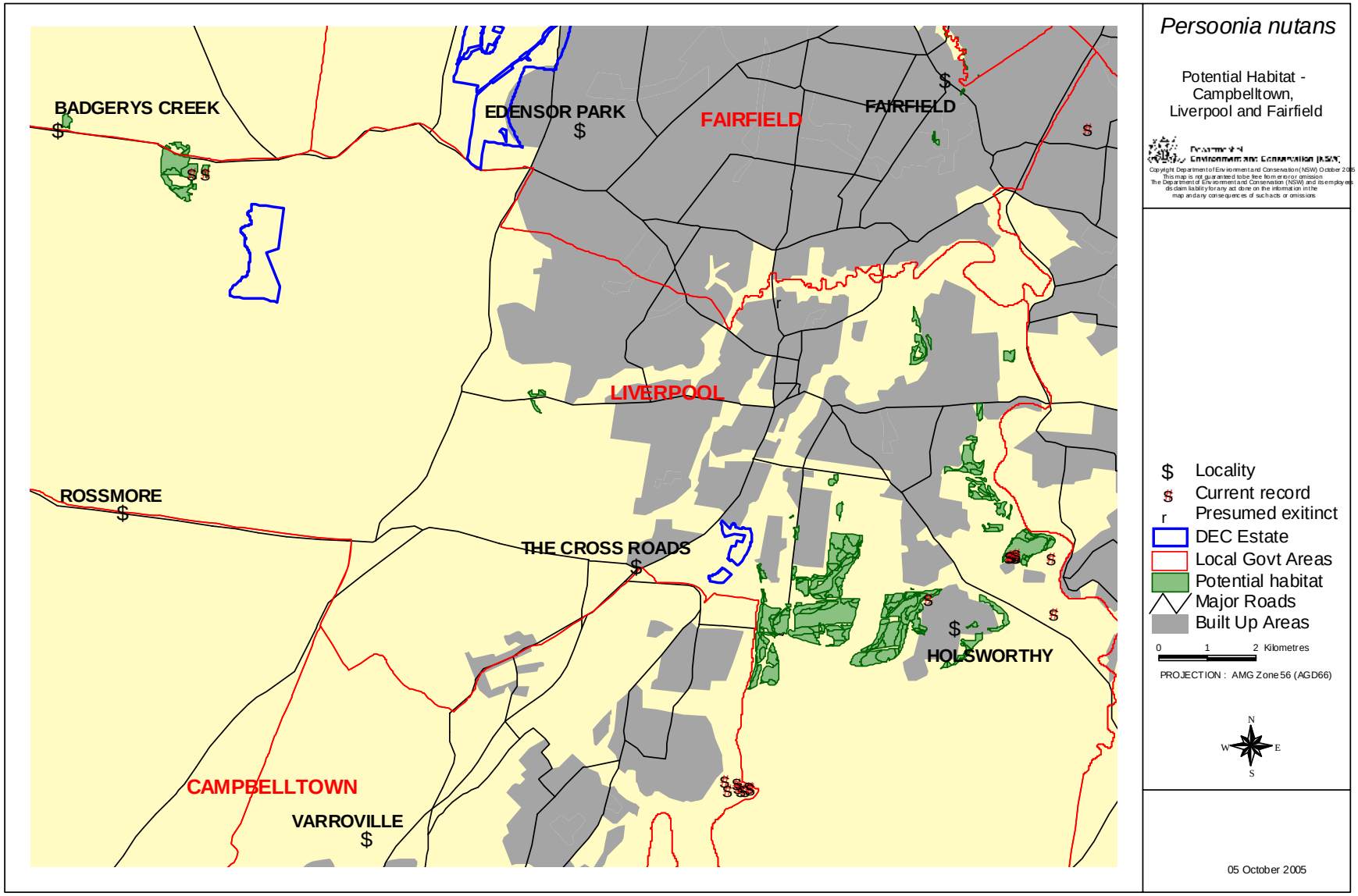

Figure 3. Potential habitat for *Persoonia nutans* within the south of the species distribution. The identified potential habitat represents those areas that possess suitable soil type (Agnes Banks or Berkshire Park soil formations) and also support suitable vegetation (see Table 4) as identified in NSW NPWS 2002a).

5 Habitat

5.1 Landform, geology & soils

Persoonia nutans is confined to aeolian and alluvial sediments and is found primarily on the Agnes Banks and Berkshire Park soil landscapes (see Figure 1) (Bannerman and Hazelton, 1990). The Agnes Banks soil landscape forms low parallel sand dunes deposited on a flat tertiary surface. The soil comprises quartz sands derived from sandstones of the upper Hawkesbury and Nepean catchment. The Berkshire Park formation is a Tertiary alluvial sediment derived from sandstone and clay, and consists of sandy loams, sandy clays, clay loams and heavy clays. The topography of these areas is gently undulating low rises.

P. nutans appears more common on the deeper sands of the Agnes Banks soil landscape than at the edge of the deposit. For the Berkshire Park formation, *P. nutans* occurs on low rises as opposed to swales or other low lying areas (NSW NPWS 1996).

5.2 Associated vegetation

Vegetation mapping of the Cumberland Plain (NSW NPWS 2002a) reveals that *Persoonia nutans* occurs within a range of vegetation communities (Table 4), with the majority of individuals (99%) occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland. A number of populations also occur within other Tertiary alluvium communities including Cooks River Castlereagh Ironbark Forest and Shale/Gravel Transition Forest. Two small populations have been recorded in Shale Sandstone Transition Forest. Some individuals recognised as occurring in Agnes Banks Woodland may in fact occur within Castlereagh Swamp Woodland. Further survey will be necessary to determine whether the species does or does not occur within this vegetation community.

As indicated in Table 4, the majority of these vegetation communities are listed as endangered ecological communities under the NSW *TSC Act 1995*, with one also listed under the Commonwealth *EPBC Act 1999*.

Detailed information on each of the associated vegetation communities can be found in NSW NPWS (2002a). In summary, **Agnes Banks Woodland** is a low woodland community dominated by scribbly gum (*Eucalyptus sclerophylla)* and *Angophora bakeri* with a diverse understorey of scleophyllous shrub species (including *Banksia aemula, Banksia oblongifolia, Cononspermum taxifolium* and *Dillwynia sericea).*

Castlereagh Scribbly Gum Woodland is dominated by *Eucalyptus parramattenis* subsp. *parramattensis, Agophora bakeri* and *E. sclerophylla.* A small tree stratum of *Melaleuca decora* is sometimes present. The community has a well developed shrub stratum consisting of sclerophyllous species such as *Banksia spinulosa* subsp. *spinulosa, M. nodosa, Hakea sericea* and *H. dactyloides.*

Cooks River/Castlereagh Ironbark Forest is a community that ranges from open forest to low woodland, with a canopy dominated by broad-leaved ironbark (*Eucalyptus fibrosa*) and paperbark (*Melaleuca decora*), with *E. longifolia* occurring at lower frequency. The typically dense shrubby understorey is dominated by *Melaleuca nodosa* and *Lissanthe strigosa*.

Shale Sandstone Transition Forest (High Sandstone Influence) is dominated by *Eucalyptus punctata* and *E. crebra*, with *E. fibrosa*, Corymbia gummifera and Syncarpia glomulifera occurring less frequently. A smaller tree stratum is usually present and is most often dominated by *Allocasuarina littoralis, Syncarpia glomulifera, Persoonia linearis* and *Acacia decurrens.*

Table 4: Associated vegetation community type for the 27 known extant populations of *Persoonia nutans* and whether the vegetation community is listed as an endangered ecological community (EEC) under the NSW *TSC Act 1995* and the Commonwealth *EPBC Act 1999*. The extent of loss of each community since European settlement is also provided.

Vegetation Community[#]	Number of populations*	% of total number of individuals	*TSC Act 1995*	*EPBC Act 1999*	Proportion of pre 1750 extent remaining[@]
Agnes Banks Woodland^	3	65	EEC	Not listed	15.9%
Castlereagh Scribbly Gum Woodland	16	34	Not listed	Not listed	52.7%
Cooks River Castlereagh Ironbark Forest	5	<1	EEC	Not listed	8.3%
Shale/Gravel Transition Forest	4	<1	EEC	Not listed	31.7%
Shale Sandstone Transition Forest	2	<1	EEC	EEC	22.6%
Castlereagh Swamp Woodland	?	?	EEC	Not listed	61.2 %

[#] as determined by NSW NPWS (2002a)
* where a population occupies two different vegetation communities it has been recorded as two separate populations.
[@] as determined by NSW NPWS (2002a)
^ some of these individuals may actually occur within Castlereagh Swamp Woodland.

6 Biology & ecology

The biology and ecology of *P. nutans* are not well understood. Current knowledge is based largely on general observations made during survey work.

6.1 Life-history

Persoonia nutans is an obligate seed regenerator (NSW NPWS 2002b; Benson and McDougall 2000). In the event of a fire all existing plants of *P. nutans* are killed and regeneration is dependent upon recruitment from a soil stored seed bank. Consequently, *P. nutans* populations are likely to be dynamic throughout the landscape, particularly in the north of the species range, and fluctuations in space and time of above ground individuals will be a natural occurrence.

6.2 Pollination & seed production

Peak flowering is from December to January (Benson and McDougall 2000) with sporadic flowering all year round (Bernhardt & Weston, 1996).

Bees and wasps appear to be the major foragers on the flowers of *Persoonia* in eastern Australia (Bernhardt & Weston, 1996). Bernhardt & Weston (1996) collected long-tongue bees of the *Chalicodma* and *Leioproctus* genera foraging on *P. nutans* flowers.

Plants appear to set abundant fruit. Fruit has been observed on plants as small as 30 cm (up to 60 fruit) and plants c. 1m high can support in excess of 300 fruit (NSW NPWS 1996). Large plants (>1m high) found in the Agnes Banks area were observed to produce thousands of fruit (NSW NPWS 1996). The fruit is fleshy, with one or two seeds enclosed in a hard woody stone, shed at maturity (from December to October) (Benson and McDougall 2000).

6.3 Seed dispersal & seed bank dynamics

Seed is likely to be dispersed, after consumption of the fruit, by large birds such as Currawongs, and mammals such as rats, kangaroos and possums (Low 1991; Benson and McDougall 2000). P. Rymer (pers com. 2004) investigated seed dispersal in four *Persoonia* sp. and found Wallabies removed large numbers of *Persoonia* seeds and viable *Persoonia* seeds were found in numerous Wallaby scats. The eastern Grey Kangaroo, Common Walleroo and Swamp Wallaby have all been recorded in the habitat of *P. nutans* in recent years (Atlas of NSW Wildlife) and potentially disperse *P. nutans* seed.

Historically, indigenous peoples may have also dispersed seed. *Persoonia* species were a popular Aboriginal food source and large quantities of the fruit was eaten when in season (Low 1991; Wreck Bay Community and Renwick 2000; Mason 2001). 'They swallowed the pulp and the stone, which they squeezed from the skin with their fingers' (Low 1991). The aboriginal use of *Persoonia* sp. is discussed in more detail in Section 8.7.

Nothing is known of the longevity of the soil-stored seed bank of *P. nutans*. It appears germination is promoted, not only by fire, but also by physical disturbance (NSW NPWS 1996; D. Wotherspoon pers. com.). It is not known whether the seed bank is completely exhausted by a single fire. The extent to which germination occurs in the absence of disturbance is unknown, although observations during the 1996 survey (NSW NPWS 1996) indicate such germination is likely to be rare.

6.4 Disturbance ecology

The frequency of disturbance, particularly fire, is of vital importance for the management and conservation of *P. nutans*. It is highly likely that too frequent disturbance, and also potentially a long-term absence of disturbance, may be detrimental to the persistence of *P. nutans*.

For species killed by fire the presence of a seed bank is essential for persistence after a fire event unless propagules of the species are widely dispersed (Auld et al. 2000; Keith 1996). If fires occur at an interval too small to allow re-establishment of a soil stored seed bank following a previous fire then local extinction will occur. The critical fire frequencies for survival of *P. nutans* have not yet been determined, although NSW NPWS (2002b) suggest > 7 year intervals and the *Draft Threatened species Hazard Reduction List* for the *Bush Fire Environmental Assessment Code* states that fire should not occur more than once every ten years in the habitat of *P. nutans*. Fires do occur within the habitat at *P. nutans* at greater than 7 year frequencies and local extinctions due to frequent fire are very likely to occur (see Section 8.2.2).

A long-term absence of fire may also be detrimental to *P. nutans* population persistence given that recruitment is likely to be largely dependent upon disturbance. However, it appears that most of the largest populations in the north of the species range burn relatively frequently. It is likely therefore that frequent rather than infrequent fire poses the greatest threat to the persistence of *P. nutans* (Section 8.2.2).

7 Previous recovery actions

7.1 Preparation & implementation of a draft recovery plan

A Conservation Research Statement and Species Recovery Plan for *P. nutans* was prepared by the NSW National Parks and Wildlife Service in 1996 (NSW NPWS 1996). The 1996 plan was prepared in order to satisfy the requirements for a recovery plan under the Commonwealth *Endangered Species Protection Act 1992*. The implementation of this previous plan was not funded.

7.2 Profile & environmental impact assessment guidelines

A species profile and environmental impact assessment guidelines were prepared for *P. nutans* in 2001 and revised in 2003, 2004 and 2005 (Appendix 3). The aim of these documents is to assist the assessment of potential impacts on the species during the preparation and review of assessments under Parts 4 and 5 of the *EP&A Act 1979* and Part 6 of the *TSC Act 1995*.

7.3 Surveys

The majority of then known populations were surveyed in 1996 during preparation of the 1996 recovery plan (NSW NPWS 1996). Subsequent opportunistic surveys by consultants have located previously unrecorded *P. nutans* populations and these are now incorporated into the NSW Wildlife Atlas.

No further formal surveys of the populations have been undertaken since the production of NSW NPWS (1996), although as preparation for this current recovery plan, a brief survey of some sites was conducted. Surveying of known sites and potential habitat is proposed as part of the implementation of this plan.

7.4 *Ex situ* propagation

The Mt Annan Botanic Garden houses *P. nutans* material collected from sites in Villawood (site BA1) and Londonderry. Propagation of this material has been successful using cuttings (NSW NPWS 1996). There are approximately three surviving individuals in the living collection at Mt Annan and the Seed Bank houses 96 seeds collected from a single plant at Villawood (T. Armstrong pers. com. 2004). This species is not a priority for *ex situ* conservation and the surviving plants are used only for display purposes (P. Cuneo pers. com. 2003).

7.5 Preparation of management plans

Campbelltown Council has prepared a management plan for Simmos Beach Reserve, including actions to manage *P. nutans*.

8 Management issues

8.1 Introduction

The management and conservation of *P. nutans* requires the development of a recovery program which considers: (i) the factors that threaten the survival of the species; (ii) limits to current knowledge; (iii) the social, political and organisational parameters that may affect the success or otherwise of the program; and (iv) the economic factors which may influence the plan's implementation. As such, this section discusses these management issues.

8.2 Threatening processes

The main threats to the survival of *P. nutans* are habitat loss and fragmentation (due to clearing for mining, and rural/residential development) and inappropriate fire regimes, particularly frequent fire. The species is also threatened by habitat degradation due to disturbance associated with unrestricted access to *P. nutans* habitat.

8.2.1 Habitat loss and fragmentation

The key threatening process *'Clearing of native vegetation'* is one of the major threats to the survival of *P. nutans*. Clearing of the habitat of *P. nutans* has occurred over many years and continues to occur for mining and rural, residential and industrial development (Section 4.2). For example, Agnes Banks Woodland, the vegetation community that supports the majority of *P. nutans* individuals (see Section 5.2) has been reduced to only 15.9% of its pre-European settlement extent (NSW NPWS 2002a). This loss is due primarily to sand and gravel extraction, which has occurred throughout much of the Agnes Banks sand deposits. Around 90% of the aeolian dunes at Agnes Banks have been extracted since the 1960s (NSW NPWS 1999). As summarised in Table 4, all other vegetation communities that support *P. nutans* have suffered considerable losses since European settlement.

This loss of habitat from clearing impacts *P. nutans* directly through the loss of individuals and also indirectly through fragmentation of existing populations. Habitat fragmentation can potentially reduce the long-term viability of remnant populations of *P. nutans* because the species is dependent upon recolonisation via seed dispersal (see section 6.3) in the event of local extinction due to frequent fire. Habitat fragmentation will reduce the chances of, or even prevent, recolonisation following local extinction. In order to ensure the long-term viability of *P. nutans*, it is important that any further loss of the species' habitat does not increase fragmentation of existing habitat and in particular does not further decrease connectivity between the four conservation reserves (and any

future conservation reserves) within the north of the species range.

Given that only seven of the 25 known populations and 17.8% of potential habitat occurs within conservation reserves (Section 4.4.3) and that many populations occur on small rural lots, habitat loss is likely to continue for *P. nutans*. Particularly concerning is the potential loss of currently unknown populations. As outlined in Section 6, *P. nutans* populations are likely to be dynamic throughout the landscape, particularly in the north of the species range, and fluctuations in space and time of above ground individuals will be a natural occurrence. Therefore if pre-development surveys occur at a recently burnt, or long unburnt site, then *P. nutans* may be present only in a soil stored seed bank and may go undetected. In addition, given that the species appears to often occur as scattered individuals at low densities (NSW NPWS 1996), the species may be missed unless the subject of sufficient targeted survey.

8.2.2 Inappropriate fire regimes

As outlined in Section 6, *P. nutans* is threatened by frequent and also potentially infrequent fire. Due to its urban setting, arson is a major problem in the bushland remnants of western Sydney, increasing the frequency of fire. In addition, many of the smaller remnants have been excluded from fire for long periods.

Some of the largest populations of *P. nutans*, occupying Castlereagh NR (P1), Agnes Banks NR (P10), Windsor Downs NR (H2), and the Castlereagh-Londonderry Crown Lands (P8), are subject to frequent fires (DEC 2004). NSW NPWS (1999) suggests that in recent times the above Nature Reserves have been subject to high intensity fires every five to seven years. For example, the entire known *P. nutans* population within Windsor Downs NR (H2) burnt in the 1997/98 fire season. The majority of the known population then burnt again during the 2002/03 fire season (a fire-free interval of only five years) (DEC 2004). In addition, smaller fires occur at more frequent intervals resulting in a fire regime of approximately 3-5 years across the reserve (NSW NPWS 1999). The frequent fire within Windsor Downs NR has altered the vegetation community composition and lead to the localised dominance of pyrogenic species such as Blady Grass (NSW NPWS 1999). A brief survey in 2004 of some of the Windsor Downs NR *P. nutans* sites revealed no *P. nutans* and it is possible this population is now locally extinct due to frequent fire. Castlereagh NR has suffered similarly high frequency fire in recent years (Jonathan Sanders pers. com. 2004).

The critical fire frequencies for survival have not yet been determined, although NSW NPWS (2002b) suggest > 7 year intervals for *P. nutans* and the *Threatened species Hazard Reduction List* for the *Bush Fire Environmental Assessment Code* states that fire should not occur more than once every ten years in the habitat of *P. nutans*. Consequently, fire frequencies of less than 10 years should be avoided within the habitat of *P. nutans*.

Persoonia nutans is listed on the *Threatened Species Hazard Reduction List* (TSHRL) and consequently, if a particular site is identified as supporting *P. nutans* in the TSHRL, or a certifying authority determines the species is likely to be present at a site, then the management actions identified within the schedule of that list must be incorporated as a condition of the bush fire hazard reduction certificate. Management actions identified in the TSHRL include: no fire more than once every ten years; and no slashing, trittering or tree removal. For these procedures to protect *P. nutans* from frequent fire it is vital that the NSW Wildlife Atlas (source of TSHRL records) contains records for all 'known' *P. nutans* sites.

The Plan of Management (POM) for Castlereagh, Agnes Banks and Windsor Downs NR's (NSW NPWS 1999) recognises the threat frequent fire imposes upon the vegetation communities within these reserves and acknowledges that fire needs to be carefully managed to maintain biodiversity. The POM specifies a range of policies and actions for preventing, managing and suppressing fire within the reserves. In addition, a Fire Management Plan is being prepared for the reserves and will address the threat frequent fire poses to the vegetation of these reserves (J. Sanders pers comm. 2004).

For the nature reserve populations, the fire management measures outline within the POM (NSW NPWS 1999) and the future Fire Management Plan are likely to meet the general fire management needs of *P. nutans*. However, the need for additional fire prevention and suppression measures needs to be evaluated, particularly within Windsor Downs NR and Castlereagh NR.

A better understanding of the lower and upper thresholds (of inter-fire intervals) for *P. nutans* would provide greater insight into the degree an inappropriate fire frequency threatens the species and would provide more detailed recommendations for appropriate fire management.

Given the difficulty of controlling frequent fire and that local extinctions are likely to occur due to frequent fire, it is important that habitat fragmentation is minimised, thereby increasing chances of re-colonisation following local extinction (Section 8.2.1).

8.2.3 Habitat degradation and rubbish dumping related to unrestricted access

The majority of populations outside of the nature reserves (the nature reserves are now fenced to exclude vehicular access), particularly the unoccupied crown lands (Castlereagh-Londonderry Crown Lands), are subject to high levels of disturbance associated with unrestricted access. Disturbances include damage by inappropriate vehicular access and rubbish dumping.

Persoonia nutans habitat is commonly dissected by an extensive network of tracks. The flat terrain, open woodland and often sparse understorey make it easy for drivers to leave the existing tracks to avoid obstacles. Several *P. nutans* populations have been damaged by vehicles (NSW NPWS 1996). The extensive track network has opened up sites to rubbish dumping. Large quantities of rubbish (household, garden, building and industrial) are often dumped and can smother the populations of *P. nutans.* Stolen cars are also regularly dumped within *P. nutans* habitat. This may have an immediate impact on individuals, but more seriously the vehicle is often burnt, providing the additional threat of frequent fire (see Section 8.2.2).

The Regional Illegal Dumping (RID) Squad (see www.resource.nsw.gov.au/RID/rid.htm), which was established in 1999 to combat illegal dumping in Western Sydney, is also contributing towards the minimisation of rubbish dumping within the Castlereagh-Londonderry Crown Lands. However, the problem of illegal rubbish dumping within these lands is still huge and is unlikely to be controlled while vehicles have access to the lands (Laurie Caffarella pers. com. 2004).

Additional targeted protection methods such as fencing, the erection of bollards or placement of rocks to prevent vehicular access may be required around the most significant populations. Signage of a general nature, regarding the damage vehicles may cause to threatened plant species, could also be placed in areas where illegal access frequently occurs. Education to encourage an appreciation of the local natural environment within the local community is needed, however this is unlikely to have much effect in the short term.

Typically, a major consequence of habitat degradation and fragmentation is weed invasion. Survey of *P. nutans* sites in 1996 revealed that weed invasion did not then pose a major threat to any populations (NSW NPWS 1996). The Castlereagh Scribbly Gum Woodlands and Agnes Banks Woodlands (the predominant habitat for *P. nutans*; Section 5.2) grow on acidic, nutrient poor soil which is not highly susceptible to extensive weed invasion (Benson 1992). However, NSW NPWS (1996) did note a number of weed species in close proximity to *P. nutans* individuals including; Prickly Pear (*Opuntia* sp.), African Lovegrass (*Eragrostis curvula*) and Whisky grass (*Andropogon virginicus*). Dumping of garden waste also has the capacity to introduce additional weeds. It is important that the current threat posed by weed invasion for *P. nutans* is evaluated.

8.3 Limits to current knowledge

Our ability to manage a threatened species is dependent on our knowledge of the ecological requirements of that species and the circumstances that threaten population persistence. In order to effectively manage and conserve *P. nutans*, greater understanding is required of: the impact of fire frequency on population persistence; the current status, distribution and abundance of the species; and on the impact of habitat fragmentation on the long-term viability of populations (Table 5).

8.4 Translocation/*ex situ* conservation

8.4.1 Translocation

Translocation is the deliberate transfer of plants or regenerative plant material, from an *ex situ* collection or natural population, to a location in the wild, including existing or new sites or those where the taxon is now locally extinct (Vallee et al. 2004). Translocation is often raised as a possible method of conserving threatened flora. However, given the high cost and risk associated with the technique, translocation should only be considered as a last resort when all other management options are deemed inappropriate or have failed. As stated by Vallee et al. (2004), 'where possible, resources will be more effective when directed towards conserving existing populations *in situ* through habitat protection and/or habitat rehabilitation measures and through the control of threatening processes'.

Translocation is not currently considered necessary for the survival of *P. nutans* as the *in situ* conservation measures proposed in this recovery plan are expected to meet the conservation needs of the species. Further, primarily due to the uncertainty of success and the risks associated with translocation, the technique should not be considered by consent/determining authorities to be an appropriate means of ameliorating the impact of a proposal on the species (Vallee *et al.* 2004). In addition, the use of translocation as a compensatory measure should not be considered when determining the potential impact of a development (i.e. translocation does not decrease the significance of an impact) (Vallee *et al.* 2004).

8.4.2 Ex situ collection

As outlined in Section 7.4, limited *P. nutans ex situ* material (seed and plants) is housed at Mount

Annan Botanic Garden. There are no plans to expand the *ex situ* collection as *ex situ* conservation is not currently considered necessary for *P. nutans*.

8.5 Ability to recover

'Recovery' in the context of this plan, is to ensure the continued and long-term survival of *P. nutans* in the wild. The likelihood of recovery of the species in this context is high provided the recovery actions outlined in this recovery plan are implemented, monitored and amended as required.

8.6 Social and economic consequences

8.6.1 Social consequences

Negative social impacts are not envisaged as the implementation of this recovery plan is not expected to affect responsible public land usage to any great extent, and modification of private land management patterns will occur at the land managers discretion. Liaison with the local community, affected landholders and government agencies will address and minimise any unforeseen negative social impacts arising from the conservation of *P. nutans.*

It is expected that the implementation of this recovery plan will have positive social impacts. The main social benefit of conserving the habitat in which *P. nutans* survives is in meeting the desire of many in the community that further loss of remnant urban bushland and threatened species should be prevented. The involvement of the local communities in the implementation of recovery actions (including site monitoring, surveys and site protection measures) will provide benefits to the environment and/or enhance the general well being of the community and individuals involved.

Table 5. Limits to current knowledge for *Persoonia nutans*. The justification for the research and the methodology that may be used to address each question is broadly identified, as are the potential benefits of the increased knowledge.

Knowledge gap	Justification	Potential methodologies	Benefits of increased knowledge
1. Impact of fire frequency on population persistence. What are the lower and upper thresholds of inter-fire intervals for *P. nutans*?	*P. nutans* is threatened by frequent (and also potentially infrequent) fire (Sections 6.4 & 8.2.2).	Long-term monitoring of selected *P. nutans* sites and collection of fire frequency, intensity and season data for monitored sites. Monitoring should include: timing of seedling recruitment following fire, age at which plants become reproductively mature, level of seed production in relation to plant age, and adult survival. Collation of available fire frequency data for *P. nutans* habitat and exploration in relation to current and past known occurrences of *P. nutans*.	Provide land managers with more detailed recommendations for appropriate fire management. Provide greater insight into the degree frequent fire threatens the species and hence assist in identifying how much effort should be placed on fire suppression activities in *P. nutans* habitat.
2. Current status, distribution and abundance of the species.	There are likely to be numerous additional sites supporting *P. nutans* that have not yet been recorded (Section 4.1). Many of the previously recorded sites, including some within NRs, may now be locally extinct due to frequent fire (see Section 8.2.2).	Targeted survey of known sites to assess current status and abundance. Targeted survey of selected areas of potential habitat where the species hasn't been recorded previously.	Greater understanding of the current status of the species. Consent and determining authorities would have greater information to enable them to effectively determine the impact of a proposed development on the species.
3. Impact of habitat fragmentation on the long-term viability of populations	*P. nutans* has suffered, and is likely to continue to suffer, high rates of habitat loss and fragmentation (Section 8.2.1). Greater understanding of gene flow (particularly the likely seed dispersal distances) will provide insight into the extent habitat fragmentation threatens population persistence.	Genetic study to investigate the level of gene-flow within and among populations to gain insight into effective population size and the potential impact of habitat fragmentation on gene flow.	Provide information that can guide the selection of corridors to retain connectivity between core *P. nutans* populations. Consent and determining authorities would have greater information to enable them to effectively determine the impact of a proposed development on the species.

8.6.2 Economic consequences

The economic consequences of this recovery plan are those costs that are associated with its implementation. These include on-ground habitat management, conducting survey and monitoring, community education and participation, and on-going recovery program coordination. These costs can be off-set and minimised by:

- implementing a long-term strategic framework for managing the species and its habitat;
- seeking funds from external sources;
- maintaining accurate information on the distribution and status of sites; and
- adopting a cooperative approach to management, involving the relevant land managers and the community.

The improved environmental impact assessment that will result from mechanisms established in this recovery plan will assist consent and determining authorities to meet their statutory responsibilities. The production of this recovery plan will decrease the costs associated with collating available information on *P. nutans* when undertaking impact assessment.

8.7 Special knowledge/roles/interests of indigenous people

The *TSC Act 1995* requires that in the preparation of a recovery plan, that consideration must be given to any special knowledge or interests that indigenous people may have in the species and in the measures to be contained in the plan. In addition, the *EPBC Act 1999* requires that in the preparation of a recovery plan, that regard must be had to the role and interests of Aboriginal people in the conservation of Australia's biodiversity.

Although no information on the use of *P. nutans* specifically has been obtained, *Persoonia* species were a popular Aboriginal food source and large quantities of the fruit was eaten when in season (Low 1991; Wreck Bay Community and Renwick 2000; Mason 2001). As outlined in Section 6.3, it is possible that historically, Aboriginal consumption of the raw fruit may have contributed to seed dispersal. In addition to consuming the raw fruit, aboriginals also roasted and cracked the seed and ate the nut inside (Mason 2001). *Persoonia* species were also used as seasonal plant indicators, with the fruiting season indicating that small marsupials such as possum, bandicoot and wallaby could be caught feeding in the area (Mason 2001).

There are a number of Aboriginal community groups in the area affected by this recovery plan, including the Deerubbin, Gandangarra, and Thararwal Local Aboriginal Land Councils (LALC); the Darug Custodial Aboriginal Corporation; and the Darug Tribal Aboriginal Corporation. The majority of *P. nutans* populations occur in the Deerubbin LALC area and this LALC owns land that supports at least one known population of *P. nutans*. In addition, a Land Claim has been lodged for Crown lands that support *P. nutans.*

These Aboriginal community groups were provided with an opportunity to comment on this plan prior to its public exhibition. In addition, implementation of recovery actions under the plan will include consideration of the roles and interests of indigenous communities in the region.

8.8 Biodiversity benefits

The conservation of *P. nutans* will benefit the endangered ecological communities (EECs) that provide habitat for *P. nutans*. As outlined in Section 5.2, these EECs include Agnes Banks Woodland, Cooks River Castlereagh Ironbark Forest and to a lesser extent Shale/Gravel Transition Forest and Shale Sandstone Transition Forest. The conservation of *P. nutans* will also benefit other threatened flora species that share the same habitat as *P. nutans*, including *Dillwynia tenuifolia*, *Pultenaea parviflora*, *Acacia bynoeana*, *Micromyrtus minutiflora*, *Allocasuarina glariecola* and *Grevillea juniperina* subps. *juniperina*.

The raised awareness of *P. nutans* created during the implementation of this recovery plan will raise the profile of all threatened species in the community. This in turn will lead to greater opportunities for the conservation of threatened species and increased protection of biodiversity.

8.9 International obligations

In making a Commonwealth recovery plan, regard must be had to meeting Australia's obligations under relevant international agreements, which include;

- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).
- Convention on Biological Diversity, ratified by Australia in 1993
- The Global Strategy for Plant Conservation.

Persoonia nutans is not identified in the CITES Schedules and the actions proposed within this plan are consistent with Australia's obligations under these international agreements.

9 Proposed recovery objectives, actions & performance criteria

Overall recovery objective

The overall objective of this recovery plan is to ensure the continued and long-term survival of *P. nutans* in the wild by promoting the *in situ* conservation of the species across its natural range.

This plan consists of six specific recovery objectives that will each contribute to the overall objectives:

- minimise the loss and fragmentation of *P. nutans* habitat using land-use planning mechanisms.
- identify and minimise the operation of threats at sites where *P. nutans* occurs;
- implement a survey and monitoring program that will provide information on the extent and viability of *P. nutans*;
- provide public authorities with information that assists in conserving the species;
- raise awareness of the species and involve the community in the recovery program; and
- promote research questions that will assist future management decisions.

Specific recovery actions and performance criteria follow.

Specific Objective 1: To minimise the loss and fragmentation of P. nutans habitat using land-use planning mechanisms.

Only 17.8% of potential *P. nutans* habitat occurs within conservation reserves (Section 4.4.3) and habitat loss and fragmentation is likely to continue (Section 8.2.1). This objective aims to minimise the loss and fragmentation of *P. nutans* habitat through the following mechanisms:

- Environmental Planning Instruments under Part 3 of the *EP&A Act 1979*;
- Environmental impact assessment under parts 4 and 5 of the *EP&A Act 1979*; and
- Consideration of a critical habitat declaration under the *TSC Act 1995*.

Action 1.1: *Councils and the Department of Planning will ensure that all relevant Environmental Planning Instruments (prepared under Pt 3 of the EP&A Act) are prepared, or reviewed, with reference to this recovery plan and any future advice from the Department of Environment and Conservation regarding the species.*

Action 1.2: *All relevant consent and determining authorities (under Pt 4 & 5 of the EP&A Act) will assess developments and activities with reference to this recovery plan, environmental impact assessment guidelines (Appendix 3) and any future advice from the Department of Environment and Conservation regarding the species.*

For the purposes of Action 1.2, consent and determining authorities include:

- Department of Environment and Conservation;
- Department of Planning; and
- the councils of Campbelltown, Liverpool, Bankstown, Blacktown, Hawkesbury, and Penrith.

Performance Criterion for actions 1.1 and 1.2: *The level of protection afforded P. nutans populations and habitat is increased through conservation planning and land-use decisions.*

Action 1.3: *The Department of Environment and Conservation will reconsider the need for a recommendation of critical habitat by the final year of implementation of this plan.*

Performance Criterion 1.3*: Need for recommendation of critical habitat re-evaluated in year five.*

Specific Objective 2: To identify & minimise the threats operating at sites where the species occurs

Threats operating at *P. nutans* sites (in addition to land clearing) include: inappropriate fire regimes (particularly frequent fire) (section 8.2.2) and habitat degradation and rubbish dumping related to unrestricted access (Section 8.2.3). Actions under this objective aim to minimise these threats through the provision of information regarding the management of *P. nutans* to selected land managers and public authorities; the incorporation of appropriate threat abatement measures into relevant management plans; and the implementation of appropriate *in situ* threat abatement measures.

Management of threats to *P. nutans* on Department of Environment and Conservation estate:

Action 2.1: *The Department of Environment and Conservation (DEC) will prepare site management statements for populations located on DEC estate.*

The DEC will survey known sites located on DEC estate. The DEC will then prepare site management statements (following the proforma in Appendix 4)

that detail any specific threat abatement measures required and a timetable to implement these measures.

Performance Criterion 2.1*: Site management statements for relevant populations prepared within three years.*

Action 2.2: *The Department of Environment and Conservation will implement any necessary threat abatement measures in accordance with the site management statements prepared under Action 2.1.*

Performance Criterion 2.2*: In situ threat abatement measures implemented for P. nutans on DEC estate as required.*

Action 2.3: *The Department of Environment and Conservation to ensure any Plan of Management or Fire Management Plan for DEC estate supporting P. nutans provides for the species' conservation.*

Performance Criterion 2.3: *Plans of Management for DEC estate supporting P. nutans provides for the conservation of P. nutans.*

Management of threats to *P. nutans* on community land managed by local government:

Action 2.4: *Councils will incorporate site specific threat abatement measures for P. nutans into Plans of Management for community land.*

Currently, Campbelltown City Council is the only council known to manage community land that supports *P. nutans* (Simmos Beach Recreation Reserve- site C1a). Campbelltown City Council, and any other councils subsequently found to manage community land that supports *P. nutans*, will incorporate site specific *in situ* protection measures for the species into Plans of Management for community land where the species occurs.

Site specific information to be incorporated into these plans includes:

- an estimate of the number of *P. nutans* individuals and location details (specific location details not to be included in the public document);
- an assessment of existing and potential threats to *P. nutans* at the site;
- details of threat abatement measures to be implemented to address these threats; and
- details of a monitoring program that (i) assess the effectiveness of threat abatement measures and (ii) provides information on the viability of *P. nutans* within the reserve.

Where a Plan of Management has already been prepared that does not address the matters listed above, an addendum to the plan will be prepared to address these matters.

Performance Criterion 2.4: *In situ protection measures for the species incorporated into Plans of Management for council managed community land within three years.*

Action 2.5: *Councils will implement threat abatement measures in accordance with the site specific recommendations incorporated into the Plan of Management prepared under Action 2.4.*

Performance Criterion 2.5: *Threat abatement measures for relevant sites implemented in accordance with Plan of Management by year five.*

Management of threats to *P. nutans* on lands managed by other public authorities:

Action 2.6: *Other public authorities that manage land that supports P. nutans will prepare a site management statement(s) (following the proforma in Appendix 4), in consultation with the Department of Environment and Conservation, for P. nutans habitat under their management.*

For the purposes of this action 'other public authorities' include:

- Department of Lands
- Department of Corrective Services.

Performance Criterion 2.6: *Site management statements for relevant populations prepared within three years.*

Action 2.7: *Other public authorities (as identified in action 2.6) will implement any necessary and feasible threat abatement measures within the habitat of P. nutans to mitigate against habitat degradation related to unrestricted access, and frequent fire, in accordance with the site management statements prepared under Action 2.6.*

Performance Criterion 2.7: *Threat abatement measures implemented in accordance with the site management statements by year 4 of the plan.*

Action 2.8: *The Department of Environment and Conservation will liaise with the Commonwealth Defence Department to facilitate the implementation of threat abatement measures at sites within Holsworthy Military Area.*

Performance Criterion 2.8: *Threat abatement measures implemented at all sites within Holsworthy Military Area within five years.*

Management of threats to *P. nutans* on private property

Action 2.9: *The Department of Environment and Conservation will encourage and assist private landholders in the preparation of site management statements (following the proforma in Appendix 4) for sites located on freehold land.*

Performance Criterion 2.9: *Site management statements prepared for at least 5 sites on freehold land within three years, subject to landholder approval.*

Action 2.10: *The Department of Environment and Conservation will encourage landholders in the implementation of threat abatement measures on freehold land in accordance with the site management statements prepared under Action 2.8.*

Performance Criterion 2.10: *Threat abatement measures for relevant sites implemented in accordance with site management statements within five years, subject to landholder approval.*

Strategic management of frequent fire:

Action 2.11: *The Department of Environment and Conservation will liaise with the Rural Fire Service and relevant Bush Fire Management Committees to ensure that the fire requirements of P. nutans are taken into consideration when relevant Bush Fire Risk Management Plans are drafted and reviewed.*

Performance Criterion 2.11: *Relevant Bush Fire Risk Management Plans take into account the fire requirements of P. nutans.*

Action 2.12: *Department of Environment and Conservation) and the NSW Rural Fire Service will review the mitigative conditions for P. nutans on the Threatened Species Hazard Reduction List of the Bush Fire Environmental Assessment Code.*

DEC will review the available biological and ecological information to reassess the immediate and cumulative impact of bush fire hazard reduction works on *P. nutnas* and the adequacy of the mitigative conditions required to be applied under the *Bush Fire Environmental Assessment Code.*

Performance Criterion 2.12: *The mitigative conditions for P. nutans on the Threatened Species Hazard Reduction List (TSHRL) reviewed by year 5 of this plan.*

Specific Objective 3: Develop & implement a survey & monitoring program that will provide information on the extent and viability of P. nutans.

Action 3.1: *The Department of Environment and Conservation will design and facilitate a long-term monitoring program that will enable long-term monitoring of the viability of selected populations and in particular will provide insight into the lower and upper thresholds of inter-fire intervals for P. nutans.*

Performance Criterion 3.1: *A long-term monitoring program to be designed by year two and implemented by year three.*

Action 3.2: *The Department of Environment and Conservation to facilitate surveys of potential habitat on public lands and to promote community involvement in the surveys.*

Performance Criterion 3.2: *At least one survey to be conducted annually for P. nutans and resultant data submitted to the NSW Wildlife Atlas.*

Specific Objective 4: To provide public authorities with information that assists in conserving the species

The prompt and effective distribution of information on *P. nutans* is an important component of ensuring that the conservation requirements of the species are appropriately considered in decisions regarding land-use planning, development control and hazard reduction activities. Actions under this objective use the following mechanisms to aid the dissemination of information about the species:

- verification and prompt distribution of accurate location records to relevant parties; and
- revision and distribution of a species profile and environmental impact assessment guidelines for *P. nutans.*

Action 4.1: The *Department of Environment and Conservation will coordinate the prompt distribution of site records through the Atlas of NSW Wildlife.*

Performance Criteria for action 4.1: *Location records available on the Atlas of NSW Wildlife within four months of verification.*

Action 4.2: *The Department of Environment and Conservation will update the profile and environmental impact assessment guidelines for the species to incorporate information acquired during the implementation of this recovery plan.*

Performance Criterion 4.2: *Profile and environmental impact assessment guidelines for the species updated as required.*

Action 4.3: *Councils and the Department of Planning (DoP) will inform the Department of Environment and Conservation (DEC) of decisions (made under the EP&A Act 1979) that may affect P. nutans.*

Councils and DoP will inform the DEC if planning or development decisions are made that may affect *P. nutans* or its habitat. This includes information on decisions that protect habitat, as well as those that lead to a reduction in habitat and/or individuals. This information will assist the DEC in the coordination of the species' recovery program.

The Rural Fire Service will implement this action, with respect to bush fire hazard reduction, by ensuring that there is adequate access for the Department of Environment and Conservation to temporal and spatial data from the Bushfire Risk Information Management System (BRIMS).

Performance Criterion 4.3: *Department of Environment and Conservation informed of land-use and planning decisions that affect P. nutans or its habitat.*

Specific Objective 5: To raise awareness of the species and involve the community in the recovery program

In order to enhance the social benefits of the recovery program for *P. nutans* and assist in its implementation, actions under this objective aim to raise awareness of the recovery plan and involve the community in its implementation.

Action 5.1: *The Department of Environment and Conservation will distribute information on the progress of the recovery program to raise awareness of the recovery program and encourage community involvement in its implementation.*

The DEC will prepare an annual newsletter on threatened species recovery planning in western Sydney and will include information on the progress of the *P. nutans* recovery program. The newsletter will be distributed to public authorities, community groups, interested individuals and selected affected landholders.

Performance Criterion 5.1: *Newsletter produced and distributed annually.*

Action 5.2: *The Department of Environment and Conservation will raise awareness of, and encourage community involvement in, the recovery program.*

The DEC will raise awareness of the recovery program amongst community groups and interested individuals, and will encourage involvement in the implementation of recovery actions including survey and monitoring (Specific Objective 1).

Performance Criterion 5.2: *The local community is involved in at least two days of recovery plan implementation each year.*

Specific Objective 6: To promote research projects that will assist future management decisions

As outlined in Section 8.3 and Table 5, there are a number of potential research questions that could assist in the management of *P. nutans*. However, given the absence of funds to conduct this research, this plan advocates the promotion of potential research questions rather than funding the actual research.

Action 6.1: *The Department of Environment and Conservation to promote potential research projects as identified in this recovery plan*

The Department of Environment and Conservation will encourage tertiary and research institutions to conduct research into the species consistent with the priorities outlined in Section 8.3.

Performance Criterion 6.1: *All major tertiary and research institutions within the Sydney/Illawarra regions contacted regarding potential research areas by year 3.*

10 Implementation

The total cost to implement this plan is estimated to be at least $40,600 over five years. This amount does not include site specific threat abatement costs (which are yet to be determined) or the costs associated with the preparation and incorporation of site specific threat abatement measures into plans of management for community land. This amount also does not include the cost of conducting any research on *P. nutans*.

A total of $21,350 will be provided as in-kind contributions with an additional $19,250 required to implement currently unfunded actions. Additional funds for unsecured actions and site specific threat abatement works will be sought from various sources including the Natural Heritage Trust, Environmental Trust, industry sponsors, Threatened Species Network, and Department of

Environment and Conservation annual provisions for implementation of threatened species programs.

Table 6 details the costs and identifies the parties responsible for the implementation of specific recovery actions.

11 Preparation details

This recovery plan was prepared by Tricia Hogbin, Meredith Henderson, and Ray Giddins of the Department of Environment and Conservation (DEC) Threatened Species Unit, Central Directorate. This plan is a revision of a conservation research statement and recovery plan prepared for the Australian Nature Conservation Agency (ANCA - now Australian Government Department of the Environment and Water Resources) and DEC (then NSW NPWS) in 1996 (NSW National Parks and Wildlife Service 1996). The conservation research statement and recovery plan was authored by Geoff Robertson, Maria Matthes and Sharon Nash.

12 Review date

This recovery plan is to be formally reviewed and updated by the Department of Environment and Conservation five years from the date of its publication.

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14 Acronyms used in this document

DEC – Department of Environment and Conservation

DEW – Australian Government Department of the Environment and Water Resources

DoP – Department of Planning

DOL – Department of Lands

EP&A Act 1979 – NSW *Environmental Planning and Assessment Act 1979*

EPBC Act 1999 – Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

LALC - Local Aboriginal Land Council

LGA – Local Government Area

NPW Act – NSW *National Parks and Wildlife Act 1974*

NPWS – NSW National Parks and Wildlife Service

NR – Nature Reserve

POM – Plan of Management

RFS – NSW Rural Fire Service

TSC Act 1995 – NSW *Threatened Species Conservation Act 1995*

TSHRL- Threatened Species Hazard Reduction List

Table 6: Estimated costs, funding source and responsible parties for implementing the actions identified in the *Persoonia nutans* Recovery Plan.

Action No.	Description	Responsible party[1]	Priority[2]	Fund source[3]	Estimated cost/yr[4]					Total Cost
					Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	
					2004/05	2005/06	2006/07	2007/08	2009/10	
1.1	Preparation and review of EPIs	DoP, and Local Government	1	-	#	#	#	#	#	-
1.2	Environmental impact assessment	DEC, DoP, and Local Government	1	-	#	#	#	#	#	-
1.3	Consider critical habitat	DEC	3	In kind	-	-	-	-	$700	$700
2.1	Preparation of site management statements for DEC estate	DEC	1	In kind	$1750	$1750	$1750	-	-	$5200
2.2	Implement threat abatement for DEC estate	DEC	1	In kind	*	*	*	*	*	-
2.3	Plans of management for DEC estate	DEC	1	In kind	#	#	#	#	#	-
2.4	Plans of Management for community land	Campbelltown City Council	1	In kind	*	*	*	-	-	-
2.5	Threat abatement on community land	Campbelltown City Council	1	Unsecured	*	*	*	*	*	-
2.6	Preparation of site management statements for other public lands	DEC, DOL, Corrective	1	In kind	$1750	$1750	$1750	-	-	$5200
2.7	Threat abatement on other public lands	DOL, Corrective	1	Unsecured	*	*	*	*	*	-
2.8	Liase with Department of Defence	DEC	1	In kind	√	√	√	√	√	-
2.9	Preparation of site management statements for freehold sites	DEC	2	Unsecured	$700	$700	$700	$700	$700	$3500
2.10	Encourage threat abatement for freehold sites	DEC	2	Unsecured	$700	$700	$700	$700	$700	$3500
2.11	Liase re Bush Fire Risk Management Plans	DEC	1	In kind	$350	$350	$350	$350	$350	$1750
2.12	Review TSHRL	DEC & RFS	1	In kind	-	-	-	-	$700	$700
3.1	Design and implement long-term monitoring	DEC	1	Unsecured	$1750	$1750	$1750	$1750	$1750	$8750
3.2	Facilitate surveys of potential habitat	DEC	2	Unsecured	$700	$700	$700	$700	$700	$3500
4.1	Review and update Wildlife Atlas records	DEC	1	In kind	$1050	$350	$350	$350	$350	$2450
4.2	Update species profile and EIA guidelines	DEC	1	In kind	-	-	$700	-	-	$700
4.3	DEC informed of planning and land-use decisions	DoP, Local Government	1	In kind	*	*	*	*	*	-
5.1	Prepare and distribute annual newsletter	DEC	2	In kind	$350	$350	$350	$350	$350	$1750
5.2	Encourage community involvement in recovery program	DEC	1	-	#	#	#	#	#	-
6.1	Promote Research Projects	DEC	1	In kind	$700	$700	$700	$700	$700	$3500
	Annual and total cost			Unsecured	$3850	$3850	$3850	$3850	$3850	$19250
				In kind	$5950	$5250	$5950	$1750	$2450	$21350
				TOTAL	$9800	$9200	$9800	$5600	$6300	$40,600

[1] **DEC** : Department of Environment and Conservation; **DoP**: Department of Planning; '**Local Government**' refers to the Campbelltown City Council, Liverpool City Council, Bankstown City Council, Blacktown City Council, Hawkesbury City Council, and Penrith City Council; **DOL**: Department of Lands; **Corrective:** Department of Corrective Services and **RFS**: Rural Fire Service.

[2] **Priority ratings are: 1** - Action critical to meeting plan objectives, **2** - Action contributing to meeting plan objectives, **3** – Desirable but not essential action.

[3] **In kind** funds represent the salary component of permanent staff and recurrent resources. Salary for in-kind contributions is calculated at $350 per day, which includes officer salary and on-costs, provision of office space, vehicles, administration support and staff management. **Unsecured** funds will be sought from sources including DEC annual provisions for the implementation of threatened species programs, the Natural Heritage Trust, Environmental Trust, industry sponsors, the NSW State Biodiversity Program, Threatened Species Network, Threatened Species Appeal and DEC annual provisions for implementation of threatened species programs.

[4] **#** - No direct cost (either cost of action is negligible or action is a statutory responsibility of the responsible party), **√** - No additional costs (included in the cost of other actions), ***** - Amount to be determined by the responsible party

15 Appendices

Appendix 1: Review of the conservation status of *Persoonia nutans*
Appendix 2: *Persoonia nutans* general location details and population specific information
Appendix 3: Revised species profile and environmental impact assessment guidelines
Appendix 4: Site Management Statement Proforma
Appendix 5: Advice on draft recovery plan received from the Scientific Committee.

Appendix 1: Review of the conservation status of *Persoonia nutans*

A review of the conservation status of *Persoonia nutans* found that the species is appropriately listed as **Endangered**. Assessment of the current conservation status of *P. nutans* was conducted using two internationally accepted risk assessment schemes; the IUCN Red List Criteria Version 3.1 (2000) (IUCN 2000) and the Endangered Flora Network (EFN) modified IUCN criteria (Keith et al. 1997; Keith 1998; Keith et al. 2000) (Table 1).

Table A1. Summary of the EFN Modified IUCN Red List Criteria and IUCN Version 3.1 assessment for *Persoonia nutans* as assessed 24/02/04. P = pessimistic assessment, B = Best estimate, and O = Optimistic assessment.

	Overall			**Rule A**			**Rule B**			**Rule C**			**Rule D**			**Rule E**			**Rule F**		
Assessment scheme	**P**	**B**	**O**	**P**	**B**	**O**	**P**	**B**	**O**	**P**	**B**	**O**	**P**	**B**	**O**	**P**	**B**	**O**	**P**	**B**	**O**
EFN Modified IUCN Red List Criteria (1998)	**EN**	**EN**	**EN**	DD	DD	DD	EN	EN	EN	VU	VU	VU	LR	LR	LR	DD	DD	DD	VU	VU	VU
IUCN Red List Criteria 3.1 (2000)	**CR**	**EN**	**EN**	DD	DD	DD	CR	EN	EN	VU	VU	VU	LR	LR	LR	DD	DD	DD	na	na	na

From the current information available, the conservation status for *P. nutans* was assessed as **Endangered** through rule B using the 1998 EFN modified IUCN Assessment Scheme and Critically Endangered through rule B using the 2000 (v 3.1) IUCN Red List Criteria. The contrast between the two schemes is due to modifications made to the EFN modified IUCN criteria to make them more applicable to sessile plants (in contrast to mobile animals). The main factors that influences the species' current status as endangered are its restricted extent of occurrence; that the majority (90%) of individuals are restricted to only two populations; and that continuing declines are expected.

Summary of the pessimistic assessment using EFN Modified IUCN Red List Criteria (1998)

A. Data Deficient. There is no data on the time frame over which population declines have occurred.

B. Endangered. Extent of occurrence estimated to be c. 50km^2 (<500 km^2), and the following conditions exist:
1. At least 90% of mature individuals are known to exist at no more than 5 locations.
2. Continuing declines are predicted in extent of occurrence, area of occupancy, area and extent of habitat, number of subpopulations and the number of mature individuals.
3. Extreme fluctuations are expected in the number of mature individuals given that the species is a fire sensitive obligate seeder.

C. Vulnerable. Total population may be as low as c. 5400 mature individuals (<10000) and the following conditions exist:
1. At least 90% of mature individuals are known to exist at no more than 5 locations.
2. Continuing declines are predicted in extent of occurrence, area of occupancy, area and extent of habitat, number of subpopulations and the number of mature individuals.
3. Extreme fluctuations are expected in the number of mature individuals given that the species is a fire sensitive obligate seeder.

D. Low risk. There are greater than 1000 individuals. Area of occupancy or number of subpopulations are not considered to be acutely restricted.

E. Data deficient. No information on the quantitative analysis of extinction probability.

F. Vulnerable. 90% of all individuals contained within only 2 subpopulations, only one of which is free of Class I threats.

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Appendix 2: *Persoonia nutans* general location details and population specific information

Popn code	Site code	LGA	General Location	E	N	No. mature individs	Current status*	Vegetation Community	Tenure (Land manager)	Zoning
BA1	BA1a	Bankstown	Birmingham Avenue, Villawood			<10 (1996)	Extant	CSGW	Freehold	Industrial
BA2		Bankstown	Bankstown Biodiversity Strategy also lists a potential site near east Hills Park.			???	Unknown	???	???	???
BL1	Bla	Blacktown	Eastern Section of Australian Defence Industries (ADI) Site			<10 (1997)	Extant	CRCIF & SGTF		
BL2	BLb	Blacktown	Eastern Section of Australian Defence Industries (ADI) Site			<10 (1993)	Extant	CRCIF	Currently Freehold (To be included within DEC Managed Conservation Reserve in future)	Regional Park under SREP30
BL3 & 4		Blacktown	UBBS also lists popns for Shanes park and E of Bells creek			???	Unkown	???	???	???
C1	C1a	Campbelltown	Simmo's Beach Recreation Reserve, Maquarie Fields			11<50 (2004)	Extant	SSTF	Community Land (Campbelltown City Council – partially owned DoP)	6b Regional Open Space
L1	L1a	Liverpool	North Holsworthy			? (1998)	Extant	SGTF	Holsworthy Military Area (Comonwealth Defence Department)	7b Environmental Protection - 'Bushland'.
L2	L2a	Liverpool	Pleasure Point, on track parallel and N of Heathcote Rd			0.00	Potentially extinct	CSGW	Unknown	5c- Special uses - Arterial Rd.
L3	L3a	Liverpool	Western side of Georges River at Voyager Point, North of footbridge.			<10 (2001)	Extant	CSGW	Freehold	7b - Environmental Protection - 'Bushland'.
	L3b	Liverpool	North of East Hills military barracks at Voyager Point.			<10 (2004)	Extant	CSGW	Freehold.	Deferred Matter' or may now be zoned as 7b - Environmental Protection - 'Bushland'.
L4	L4a	Liverpool	Orange Grove Rd, industrial area, Hargrave Park.			0.00	Extinct (Industrial development)			
L5	L5a	Liverpool	Christadelphian Heritage School, Cnr Cross St & Devonshire Road, Kemps Ck.			11<50 (1997)	Extant	CSGW	Freehold	1(b) rural - small holdings
" "	L5c	Liverpool	Land to the west of Kemps Ck Primary School.			<10 (2003)	Extant	CSGW	Freehold	7(b) Environmental Protection - 'Bushland'.
P1	P1a	Penrith	Castlereagh Nature Reserve			11<50 (1996)	Extant	CSGW	Nature Reserve (DEC)	Nature Reserve
" "	P1b	" "	" "			<10 (1996)	Extant	CSGW	" "	" "
" "	P1c	" "	" "			200<500 (1996)		CSGW	" "	" "
P2	P2a	Penrith	Castlreagh Nature Reserve			<10 (1996)	Extant	CRCIF	Nature Reserve (DEC)	Nature Reserve
" "	P2b	" "	Castlreagh Nature Reserve			<10 (1996)	Extant	CRCIF	" "	" "
" "	P2d	" "	Cnr Spence and Llandilo Rds, Llandilo			0 (2004)	Potentially extinct (Residential development)	CSGW	Freehold	1(A) (Rural A Zone-Gen) (LEP 201)
" "	P2e	" "	Eastern side Llandilo Road.			<10 (1990)	Extant	CSGW	Freehold??	??

Popn code	Site code	LGA	General Location	E	N	No. mature individs	Current status*	Vegetation Community	Tenure (Land manager)	Zoning
P18	P18a	Penrith	Corner Spence and Government Roads, Berkshire Park			<10 (1995)	Extant	CRCIF	Crown Land (Department of Lands)	1(A) (Rural A Zone-Gen) (LEP 201)
P3	P3a	Penrith	Berkshire Park in bushland contiguous with Castlreagh Nature Reserve			< 10 (?)	Extant	CSGW	Crown Land (Department of Lands)	TPLN Zone FA open Space (Existing) (PPS)
" "	P3b	" "	" "			< 10 (1995)	Extant	CSGW	" "	" "
" "	P3c	" "	Castlereagh Nature Reserve			<10 (1996)	Extant	CSGW	Nature Reserve (DEC)	Nature Reserve
P4	P4a	Penrith	Trail S of Smeaton Rd, Rickaby's Ck - east of Londonderry Road, Londonderry			<10 (1996)	Extant	CSGW	Deerubbin Local Aboriginal Land Council	1(A) (Rural A Zone-Gen) (LEP 201)
P5	P5a	Penrith	Londonderry			<10 (2002)	Extant	CSGW	Freehold	1(A) (Rural A Zone-Gen) (LEP 201)
P8	P8a	Penrith	Castlereagh - Londonderry Crown Lands			<10 (1996)	Extant	CSGW	Crown Land (Department of Lands)	1(A) (Rural A Zone-Gen) (LEP 201)
" "	P8b	Penrith	" "			11<50 (1996)	Extant	CSGW	" "	" "
" "	P8c	Penrith	" "			>500 (1996)	Extant	CSGW	" "	" "
" "	P8d	Penrith	" "			<10 (1996)	Extant	CSGW	" "	" "
" "	P8e	Penrith	" "			<10 (1996)	Extant	CSGW	" "	" "
" "	P8f	Penrith	" "			<10 (1996)	Extant	CSGW	" "	" "
" "	P8g	Penrith	" "			51<200 (1996)	Extant	CSGW	" "	" "
" "	P8h	Penrith	" "			>500 (1996)	Extant	CSGW	" "	" "
" "	P8i	Penrith	" "			<10 (1996)	Extant	CSGW	" "	" "
" "	P8j	Penrith	" "			<10 (1996)	Extant	CSGW	LALC (but council says crown??)	Zone (8) National Park & Nature Reserve) (LEP 201)
" "	P8k	Penrith	" "			< 10 (1996)	Extant	CSGW	Crown Land (Department of Lands)	1(A) (Rural A Zone-Gen) (LEP 201)
" "	P8l	Penrith	Private Property north of Devlin Road, Londonderry			11<50 (2000)	Extant	CSGW	Freehold	1(A) (Rural A Zone-Gen) (LEP 201)
" "	P8m	Penrith	Spencer road, Londonderry.			<10 (??)	Extant	CSGW	Freehold	??
P9	P9a	Penrith	Agnes Banks on Portion 157 near Richards Rd. nr track			11<50 (1985)	Unknown- may be the same as P9b	ABW	Crown Land (Department of Lands)	1(A) (Rural A Zone-Gen) & 5(C) (A RDS/A RD W) (LEP 201)
" "	P9b	Penrith	Agnes Banks, Richards road. In remnant north of speedway and opposite lot 14.			<10(2004)	Extant	ABW	Freehold??	1(B) (Rural B Zone Smlhldings)(LEP 201)???
P10	P10a	Penrith	Agnes Banks Nature Reserve (& new addition to the north)			>500 (1996)	Extant	ABW (& potentially also Castlereagh Swamp Woodland)	Nature Reserve (DEC)	Nature Reserve
	P10a						Extant			
	P10a						Extant			
	P10b	Penrith	Private property & road verge across the road from the Agnes Banks NR fire trail entry off Richards Road.			<10 (2004)	Extant	ABW	Freehold	??

Popn code	Site code	LGA	General Location	E	N	No. mature individs	Current status*	Vegetation Community	Tenure (Land manager)	Zoning
	P10c	Penrith	Prev CSR lands north of Agnes Banks NR and additions			Prior to development 7000-12000 (but probably mostly seedlings)	Potentially extinct, or soon to be extinct (residential development)	ABW	Freehold	??
P11	P11a	Penrith	Between First and Second Roads, Berkshire Park			25 (2000)	Extant	SGTF	Freehold	1(B) (Rural A Zone-Gen)(LEP 201)
P13	a	Penrith	Bushland between John Morony Centre and Llandilo Rd			<10 (1996)	Extant	CSGW	Freehold (Department of Corrective Services)	Open space (existing) PPS
P15	P15a	Penrith	Castlereagh - Londonderry Crown Lands			<10 (1996)	Extant	ABW	Crown Land (Department of Lands)	1(A) (Rural A Zone-Gen) (LEP 201)
" "	P15b	" "	" "			<10 (1996)	Extant	ABW	Crown Land (Department of Lands)	1(A) (Rural A Zone-Gen) (LEP 201)
" "	P15c	" "	" "			11<50 (1996)	Extant	ABW	Crown Land (Department of Lands)	1(A) (Rural A Zone-Gen) (LEP 201)
" "	P15d		" "			11<50 (1996)	Extant	ABW	Crown Land (leased to a mining company?)	???
P17	P17a	Penrith	Sheridan Road, Castlereagh			<10 (2004)	Extant	CSGW	Freehold	1(B) (Rural B Zone Smlhldings)(LEP 201)
P19	P19a	Penrith	O'Brien Rd, Londonderry			0.00	Extant	CSGW	Freehold	Residential?
P20	P20a	Penrith	101 Londonderry road, Londonderry			<10 (????)	Extant	CSGW	Freehold	??
P21	P21a	Penrith	Former Air Services Australia property, Cranebrook			31	Extant	CSGW, CRCIF	Freehold	Special Uses?
P22	P22a	Penrith	Sth of M4, W of Erskine Park Rd, St Clair			1	Extant	SGTF	Unknown	Unknown
H1	H1a	Hawkesbury	The Driftway, Western Sydney University			??	Extant	CSGW	Freehold (western Sydney university)	??
H2	H2a	Hawkesbury	Windsor Downs Nature Reserve			11<50 (1996)	Extant	CSGW	Nature Reserve (DEC)	Nature Reserve
" "	H2b	" "	" "			<10 (1986)	" "	CSGW	" "	" "
" "	H2c	" "	" "			<10 (1996)	" "	CSGW	" "	" "
" "	H2d	" "	" "			<10 (1986)	" "	CSGW	" "	" "
" "	H2e	" "	" "			<10 (1996)	" "	CSGW	" "	" "
" "	H2f	" "	" "			<10 (1996)	" "	CSGW	" "	" "
" "	H2g	" "	" "			11<50 (1996)	" "	CSGW	" "	" "
" "	H2h	" "	" "			<10 (1996)	" "	CSGW	" "	" "
" "	H2i	" "	" "			11<50 (1996)	" "	CSGW	" "	" "
" "	H2j	" "	" "			<10 (1996)	" "	CSGW	" "	" "
" "	H2k	" "	" "			<10 (1996)	" "	CSGW	" "	" "
" "	H2l	" "	" "			<10 (1996)	" "	CSGW	" "	" "
" "	H2m	" "	" "			<10 (1996)	" "	CSGW	" "	" "
" "	H2n	" "	" "			<10 (1996)	" "	CSGW	" "	" "
H3	H3a	Hawkesbury	London place Grose Wold			<10 (2002)	Extant	SSTF	Freehold	??

*Each site has been identifies as extant unless specific information has been provided to indicate otherwise. Hence it is possible that some of the populations listed as extant may now in fact be locally extinct.

Appendix 3: Revised species profile and environmental impact assessment guidelines

THREATENED SPECIES INFORMATION

Persoonia nutans R.Br.

Common Name: Nodding Geebung

Conservation Status

Persoonia nutans is listed as an endangered species on Schedule 1 of the NSW Threatened Species Conservation Act 1995 and as an endangered species under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.

Description

Persoonia nutans R. Br. (Proteaceae) (syn: P. nutans R. Br. subsp. A in Jacobs and Prickard 1981) is an erect to spreading shrub to 2.5m high. Flowers are yellow pendent shaped and drooping. Leaves are linear, 1-3 cm long, 1-1.8 mm wide, usually flat, with recurved margins, sparsely hairy when immature, and glabrescent when mature, smooth. Inflorescences usually growing on into a leafy shoot; flowers mostly subtended by leaves; pedicels 7-12 mm long, recurved, glabrous. Tepals 8.5-11 mm long, caudate, glabrous. Ovary glabrous (Weston 2002, Fairley & Moore 1989).

Distribution

Persoonia nutans is a NSW endemic, restricted to the Cumberland Plain in western Sydney, between Richmond in the north and Macquarie Fields in the south (Figure 1). The species has a disjunct distribution, with the majority of populations (& 99% of known individuals) occurring in the north of the species range in the Agnes Banks, Londonderry, Castlereagh, Berkshire Park and Windsor Downs areas. This disjunct distribution is presumably influenced by soil type given that the species is confined to aeolian and alluvial sediments (DEC 2005). In the north, these deposits are extensive, whereas in the south these deposits are limited and the species is less abundant.

The species core distribution occurs within the Penrith, and to a lesser extent, Hawkesbury, Local Government Areas (LGA), with isolated and relatively small populations also occurring in the Liverpool, Campbelltown, Bankstown and Blacktown LGAs.

Based on available information, there are 27 known extant populations of *P.nutans*. Survey, particularly within the north of the species range, is likely to reveal additional occurrences (DEC 2005).

Recorded occurrences in conservation reserves

Persoonia nutans occurs in Windsor Downs Nature Reserve (NR), Agnes Banks NR and Castlereagh Nature NR. The species also occurs within the proposed Regional Parklands within the ADI site, St Marys.

Habitat

Persoonia nutans is confined to aeolian and alluvial sediments and is found primarily on the Agnes Banks and Berkshire Park soil landscapes (see Figure 1) (Bannerman and Hazelton, 1990).

Vegetation mapping of the Cumberland Plain (NSW NPWS 2002) reveals that *P. nutans* occurs within five different vegetation communities, with the majority of individuals occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland (DEC 2005). The species also occurs within Cooks River Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Shale Sandstone Transition Forest. All

these communities, except Castlereagh Scribbly Gum Woodland are listed as endangered ecological communities under the NSW *TSC Act 1995*. Additional details on these vegetation communities can be found in DEC (2005) and NSW NPWS (2002).

Ecology

The biology and ecology of *P. nutans* are not well understood. Current knowledge is based largely on general observations made during survey work.

Persoonia nutans is an obligate seed regenerator (Benson and McDougall 2000). In the event of a fire all existing plants of *P. nutans* are killed and regeneration is dependent upon recruitment from a soil stored seed bank. Consequently, *P. nutans* populations are likely to be dynamic throughout the landscape, particularly in the north of the species range, and fluctuations in space and time of above ground individuals will be a natural occurrence (DEC 2005).

Peak flowering is from December to January (Benson and McDougall 2000) with sporadic flowering all year round (Bernhardt & Weston, 1996). Bees and wasps appear to be the major foragers on the flowers of *Persoonia* in eastern Australia (Bernhardt & Weston, 1996).

Plants appear to set abundant fruit (NSW NPWS 1996). Seed is likely to be dispersed, after consumption of the fruit, by large birds such as Currawongs and large mammals such as kangaroos and possums (Benson and McDougall 2000).

Seed germination is promoted, not only by fire, but also by physical disturbance (NSW NPWS 1996). The frequency of disturbance, particularly fire, is of vital importance for the management and conservation of *P. nutans* and it is likely that frequent fire threatens the persistence of *P. nutans*. If fires occur at an interval too small to allow re-establishment of a soil stored seed bank following a previous fire then local extinction will occur. The critical fire frequencies for survival have not yet been determined, although NSW NPWS (2002b) suggest > 7 year intervals for *P. nutans* and the *Draft Threatened species Hazard Reduction List* for the *Bush Fire Environmental Assessment Code* states that fire should not occur more than once every ten years.

Threats

The main threats to the survival of *P. nutans* are habitat loss and fragmentation (due to clearing for mining, and rural/residential development) and inappropriate fire regimes, particularly frequent fire (DEC 2005). The species is also threatened by habitat degradation due to disturbance associated with unrestricted access to *P. nutans* habitat.

Management

The recovery plan for *P. nutans* (DEC 2005) identifies a range of actions required to effectively conserve the species. Management should be aimed at minimising habitat loss and fragmentation; reducing fire frequency in areas prone to frequent fire; and controlling habitat degradation related to unrestricted access to many sites. Other management initiatives should include: survey and monitoring; community education and awareness; and also conducting research that will assist future management decisions.

Recovery Plans

A recovery plan has been prepared for *Persoonia nutans* (DEC 2005).

For Further Information contact

Threatened Species Unit, Metropolitan Branch, NSW DEC, PO Box 1967, Hurstville NSW 2220. Phone 02 9585 6678. www.environment.nsw.gov.au

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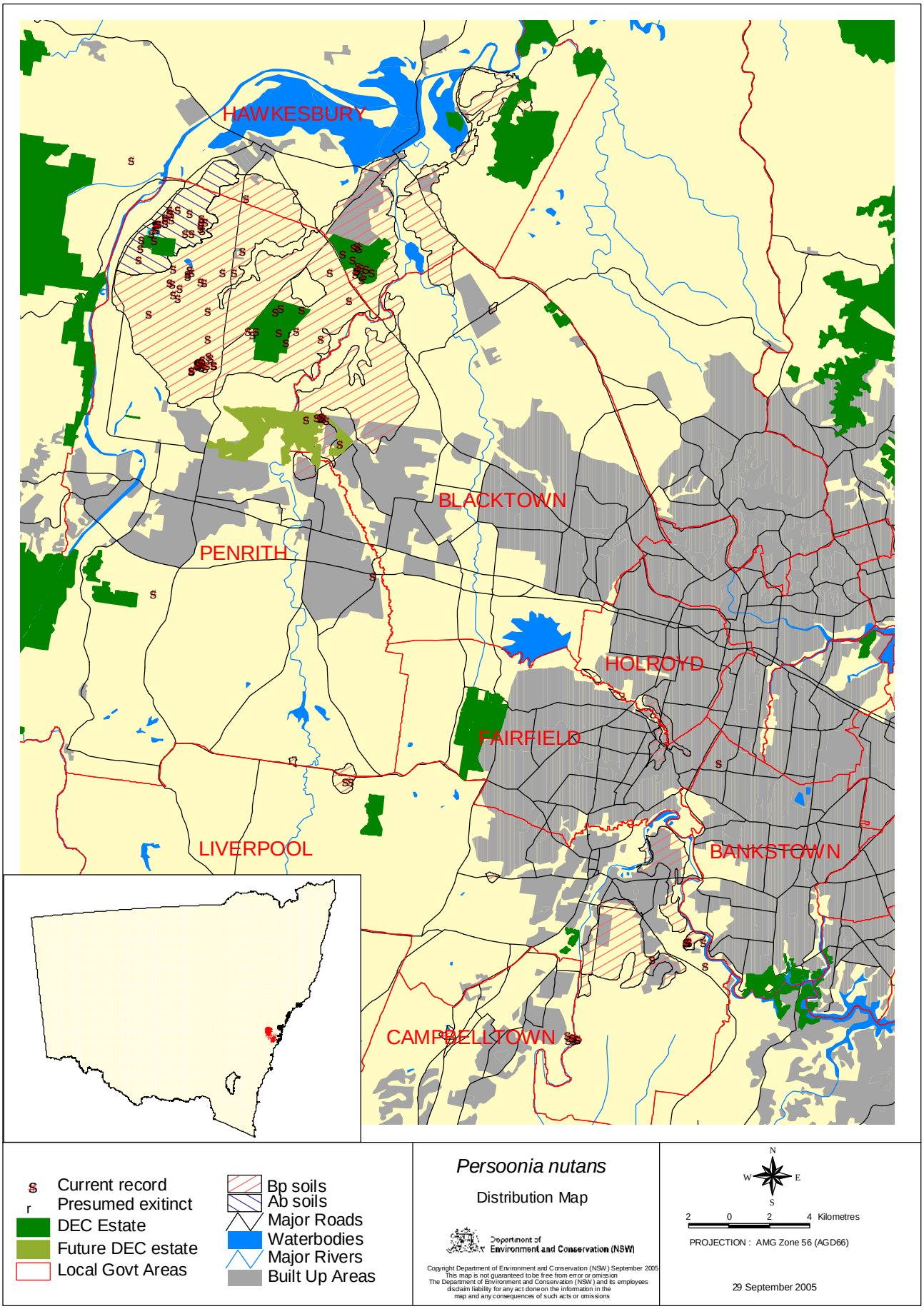

Figure 1. The known distribution of *Persoonia nutans* within western Sydney, NSW. The distribution of *P. nutans* is influenced by associated soil types, which include the Berkshire Park (Bp soil) and Agnes Banks (Ab soil) soil landscapes.

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Persoonia nutans R. Br.

Nodding Geebung

The following information is provided to assist authors of Species Impact Statements, development and activity proponents, and determining and consent authorities, who are required to prepare or review assessments of likely impacts on threatened species pursuant to the provisions of the *Environmental Planning and Assessment Act* 1979. These guidelines should be read in conjunction with the NPWS *Information Circular No. 2: Threatened Species Assessment under the EP&A Act: The '8 Part Test' of Significance* (November 1996) and the accompanying 'Threatened Species Information' profile.

Survey

Persoonia nutans is most easily detected when in flower. Peak flowering is from December to January, with sporadic flowering all year round. Targeted survey should therefore be carried out over the summer months.

Persoonia nutans is an obligate seed regenerator and in the event of a fire all existing plants are killed and regeneration is dependent upon recruitment from a soil stored seed bank. Consequently, *P. nutans* populations are likely to be dynamic throughout the landscape, and fluctuations in space and time of above ground individuals will be a natural occurrence (DEC 2005). Therefore if survey occurs at a recently burnt (<3 years), or long unburnt site, then *P. nutans* may be present only in a soil stored seed bank or as young seedlings and may go undetected. In addition, given that the species appears to often occur as scattered individuals at low densities (NSW NPWS 1996), the species may be missed unless the subject of sufficient targeted survey.

Consequently, consent and determining authorities should assume, particularly in the north of the species range, that all potential habitat for the species supports the species, irrespective of whether or not the species is detected during targeted survey. *[Note: This recommendation (that all potential habitat should be assumed to support the species) does not automatically trigger significance (under the 8-part test) within potential habitat. Species presence is only one of a number of considerations when determining significance of impact.]*

Reference should be made to DEC (2005) for additional detail on the potential habitat for *P. nutans*. Figures 1 and 2 identify potential habitat for *P. nutans* (based on soil and vegetation type) in the north and south of the species range respectively. Briefly, the species is confined to aeolian and alluvial sediments and is found primarily on the Agnes Banks and Berkshire Park soil landscapes. The species has been recorded from a range of vegetation communities including Agnes Banks Woodland, Castlereagh Scribbly Gum Woodland, and to a lesser extent Cooks River Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Shale Sandstone Transition Forest (DEC 2005).

Surveys should aim to determine presence of potential habitat, species presence, number of individuals, and area of suitable habitat.

Life cycle of the species

Proposals which are likely to impact on the life cycle of the species, such that a local population is put at risk of extinction would include proposals that:

- result in total destruction of habitat;
- result in a partial destruction or modification of habitat (including changes to hydrology and nutrification of the soil substrate) which may result in changes to vegetation community structure;
- result in increased fragmentation of *P. nutans* habitat;

Department of **Environment and Conservation (NSW)**

- result in a requirement for frequent (<10 year) hazard reduction activities (fire or slashing), preventing establishment of a soil stored seed bank;
- increase vehicular, bike, pedestrian, or other, access to habitat; or
- increase rubbish dumping and associated weed invasion or arson (for example, through adjacent residential development).

Threatening processes

Seven key threatening processes listed under the *TSC Act 1995* (as of December 2005) are likely to, or potentially, threaten *P. nutans*.

- *'Clearing of native vegetation'*, has reduced and fragmented the habitat of *P. nutans.*
- *'High frequency fire resulting in the disruption of life cycle process in plants and animals and loss of vegetation structure and composition'*, is highly likely to threaten the persistence of *P. nutans* populations.
- '*Competition from feral honeybees Apis mellifera L.*' may also threaten *P. nutans* given that feral honeybees may reduce seed set in species of *Persoonia* due to inefficient transfer of pollen (Bernhardt and Weston 1996).
- '*Invasion of native plant communities by exotic perrenial grasses'*, *'Competition and grazing by the feral European Rabbit'*, '*Infection of native plants by Phytopthora cinnamomi'* and '*Anthropogenic climate change'* may also affect *P. nutans*.

Additional details of the threats to *P. nutans* can be found in DEC 2005. In addition to the above listed KTPs, *P. nutans* is also threatened by habitat degradation due to disturbance associated with unrestricted access to *P. nutans* habitat.

Viable local population

Very little information is available as to the viability of known populations of *P. nutans*. In the absence of such information, DEC considers that all populations should be considered viable.

It appears the species is capable of persisting at very small population sizes. Based on available information, 84% of all populations support less than 50 individuals, with only two populations supporting >500 plants (Table 1).

Table 1: Size class distribution for the 27 known extant populations of *Persoonia nutans*

Size class[#]	Number of populations*	% of total no. of popns
≤ 10	17	63
11 ≤ 50	6	22
51 ≤ 200	1	4
201 ≤ 500	1	4
≥501	2	7

[#]number of mature individuals
*using lowest (pessimistic) estimate of population size

A significant area of habitat

The estimated area of potential habitat for *P. nutans* (i.e. suitable vegetation community type and condition and suitable soil type) is currently 5300 ha in the north of the species range and 573 ha in the south of the species range (Figures 1 and 2). These values considerably overestimate the area occupied by *P. nutans* given that the species will not occupy all these areas at a particular point in time and some of this potential habitat may not be suitable habitat (e.g. may be subject to high fire frequency).

Given the relatively small and fragmented amount of habitat remaining in the south of the species distribution (Figure 2), any area of known habitat in the south should be considered as a significant area of habitat.

In the north of the species range, where *P. nutans* does not typically appear in discrete populations, but rather, occurs as scattered individuals throughout suitable habitat, it is more difficult to quantify what is a significant area of habitat.

Each case should be assessed individually, and the following factors will need to be considered when determining whether a site supports a significant area of *P. nutans* habitat:

- the area and condition of habitat on the site;
- the area, condition and security, of other, nearby, habitat;
- connectivity with other areas of habitat;
- the impact of the loss of that habitat on potential seed dispersal among *P. nutans* populations, in particular among the four conservation reserves (Agnes Banks Nature Reserve (NR), Castlereagh NR, Windsor Downs NR, and the Regional Parklands within the east of the ADI site, St Marys).

Isolation/fragmentation

Habitat fragmentation and isolation is a particularly strong threat to the persistence of *P. nutans*. Habitat fragmentation can potentially reduce the viability of remnant populations of *P. nutans* because the species is dependent upon recolonisation via seed dispersal in the event of local extinction due to frequent fire. Habitat fragmentation will reduce the chances of, or even prevent, recolonisation following local extinction.

As outlined in DEC (2005) such local extinctions are likely to occur, particularly within the north of the species range, given the high fire frequencies within the area. Indeed, given recent fire frequencies within Castlereagh Nature Reserve and Windsor Downs Nature Reserve, it is possible that *P. nutans* is now locally extinct within these reserves (DEC 2005).

In order to ensure the long-term viability of *P. nutans*, it is important that any further loss of the species' habitat does not increase fragmentation of existing habitat and in particular does not further decrease connectivity between the four conservation reserves (and any future conservation reserves) within the north of the species range.

Regional distribution of the habitat

Persoonia nutans occurs within the Sydney Basin Bioregion and is restricted to the Cumberland Plain in western Sydney, between Richmond in the north and Macquarie Fields in the south. The species has a disjunct distribution, with the majority of populations (& 99% of known individuals) occurring in the north of the species range in the Agnes Banks, Londonderry, Castlereagh, Berkshire Park and Windsor Downs areas.

Limit of known distribution

The current known distribution of *P. nutans* extends from Richmond in the north to Macquarie Fields in the south. The eastern most population occurs at Villawood and the western most at Grose Wold and Agnes Banks.

Adequacy of representation in conservation reserves or other similar protected areas

Persoonia nutans is inadequately represented in conservation reserves, particularly within the south of the species range. Only 17.8% of potential habitat (see Figures 1 & 2) and only seven of the 25 known populations, occur within conservation reserves. The conservation reserves that support *P. nutans* occur within the north of the species range and include Agnes Banks Nature Reserve (NR), Windsor Downs NR, Castlereagh NR and the Regional Parklands within the ADI site (Figure 1). None of the southern populations occur within a formal conservation reserve, although, one of the southern populations (C1) is relatively protected within Simmos Beach Recreation Reserve (managed by Campbelltown City Council).

Critical habitat

Critical habitat has not been declared for *Persoonia nutans*.

For Further Information contact

Biodiversity Conservation Section, Metropolitan Branch, NSW DEC, PO Box 1967, Hurstville NSW 2220. Phone 02 9585 6678. www.environment.nsw.gov.au

Last updated September 2005

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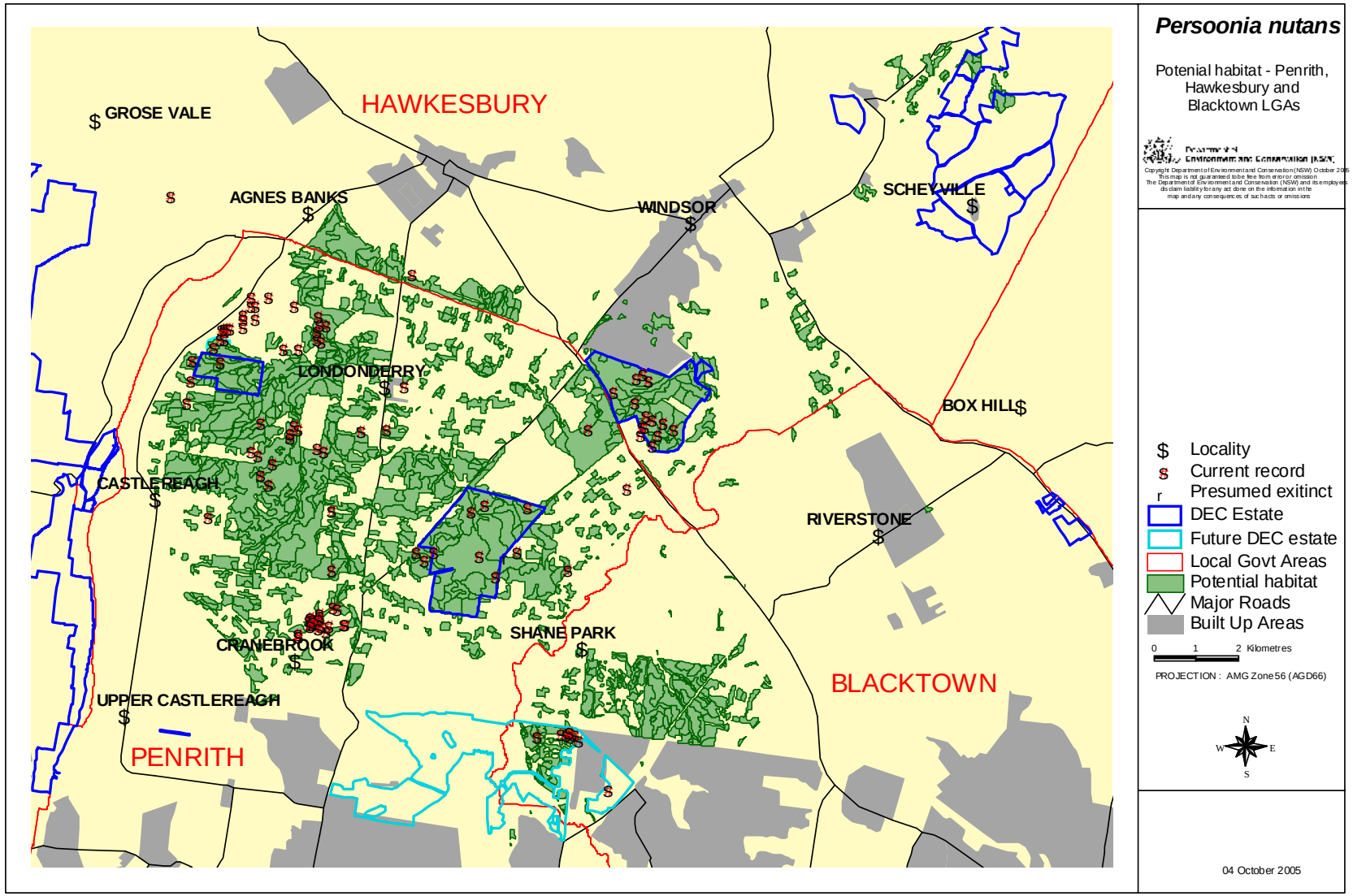

Figure 1. Potential habitat for *Persoonia nutans* within the north of the species distribution. The identified potential habitat represents those areas that possess suitable soil type (Agnes Banks or Berkshire Park soil formations) and also support suitable vegetation (see Table 4) as identified in NSW NPWS 2002a).

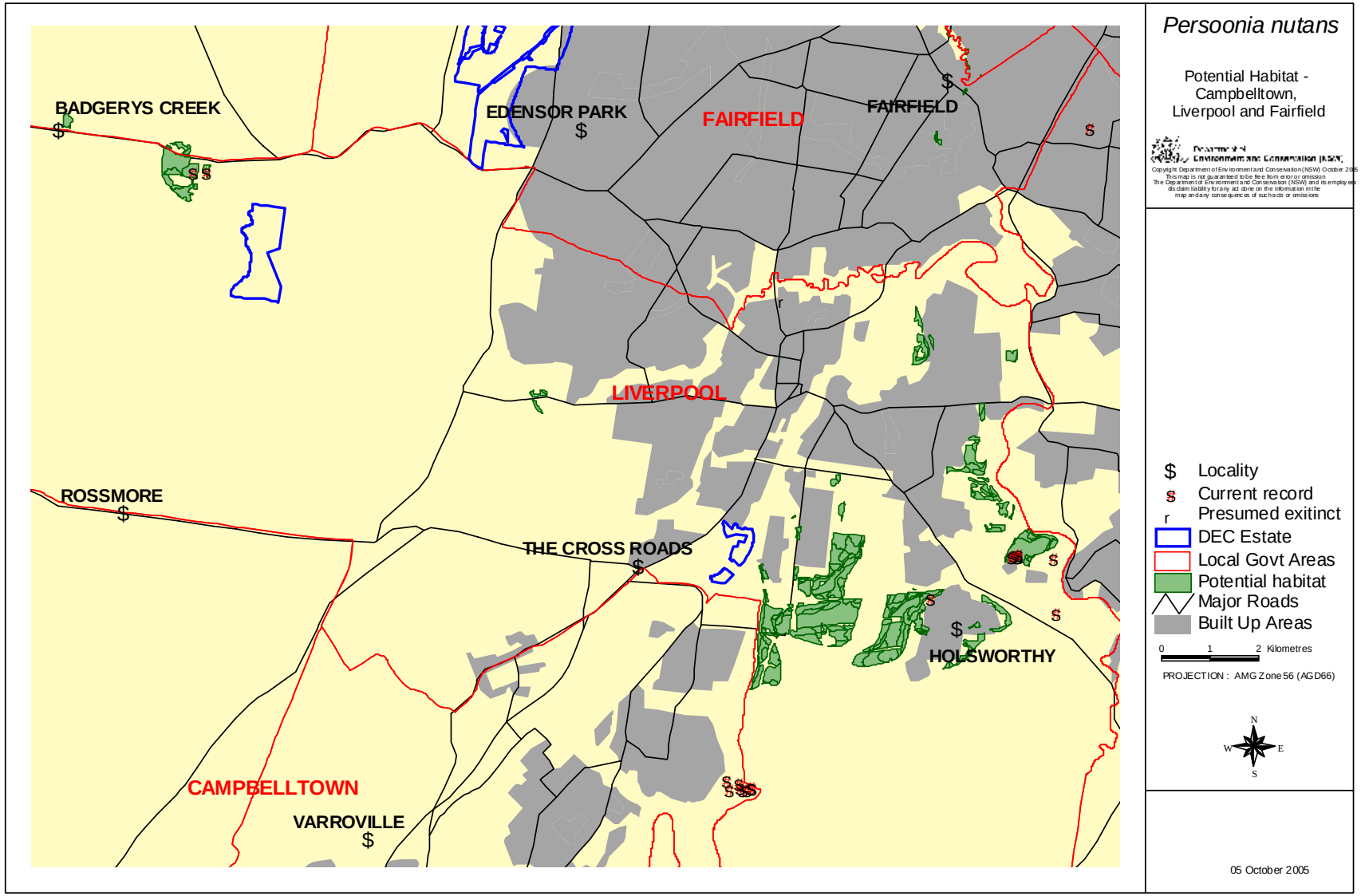

Figure 2. Potential habitat for *Persoonia nutans* within the south of the species distribution. The identified potential habitat represents those areas that possess suitable soil type (Agnes Banks or Berkshire Park soil formations) and also support suitable vegetation (see Table 4) as identified in NSW NPWS 2002).

Appendix 4: Site Management Statement Proforma

Site Management Statement

Prepared by: ……..

Date: …….

Site details:

Site Name: ……

Site Code: …….

Location: ……..

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Easting: ……..…..…..Northing: ……...……..AMG Zone: …….…..……..

Landowner/Landmanager contact details

Name: ……..

Phone number: …….

Postal address: ……..

……...

Parcel details:

LGA: ……

Portion/Lot: ……..

Street address: ……..

……...

Zoning: …….

Tenure: …….

Current landuse:……

Population details:

No. adults: Count: [ ] Estimate: [ ]
Lowest estimate =…….…...….Best estimate =…….…..….Upper estimate =…….…….….

No. seedlings: Count: [ ] Estimate: [ ]
Lowest estimate =…….…...….Best estimate =…….…..….Upper estimate =…….…….….

Area of Occupancy: …….…….Accurate: [ ] Estimate: [ ]

Detailed site map attached: Yes/No

Reproduction: Buds: [ ] Flowers: [ ] Fruit: [ ]

Habitat: ……..

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Dominant Associated species: ……...

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Threats: ……...

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Predominant weed species and abundance: ……..

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Previous management actions (describe apparent success): ……
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Th**reat abatement actions required:** …….
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Recommended monitoring and evaluation program: …….
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Timetable for implementation of actions and monitoring: ……
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Appendix 5: Advice on draft recovery plan received from the Scientific Committee.

The NSW Scientific Committee made three comments on the draft recovery plan. They are listed below, together with a response from the DEC and a note on any changes made to the recovery plan in light of those comments.

1. "Tables 2, 3 and 4 all have the words "25 known extant populations" in the title, yet all have more than 25 populations listed – 32, 29 and 27+, respectively"

   All three tables have a footnote indicating that, where a single populations occurs on more than one tenure, zoning or vegetation type, they are listed more than once in the table. Hence total numbers add up to more than the total number of populations.

2. "Section 7.4 – states that "This species is not a priority of ex-situ conservation." It would be desirable to give some brief reasons why this is so."

   That section is stating that the species is not a priority for ex-situ conservation for the Mount Annan Botanic Garden, not that it is not an overall priority.

3. Given that 28% of the total number of individuals of this species occur on Dept. of Lands property, DOL should be listed as one of the consent and determining authorities under Action 1.2.

   For Part 5 authorities (such as the the Dept of Lands) this action is restating an existing statutary requirement under s.112A of the Environmental Planning and Assessment Act. There is therefore no need to make this modification to the recovery plan.