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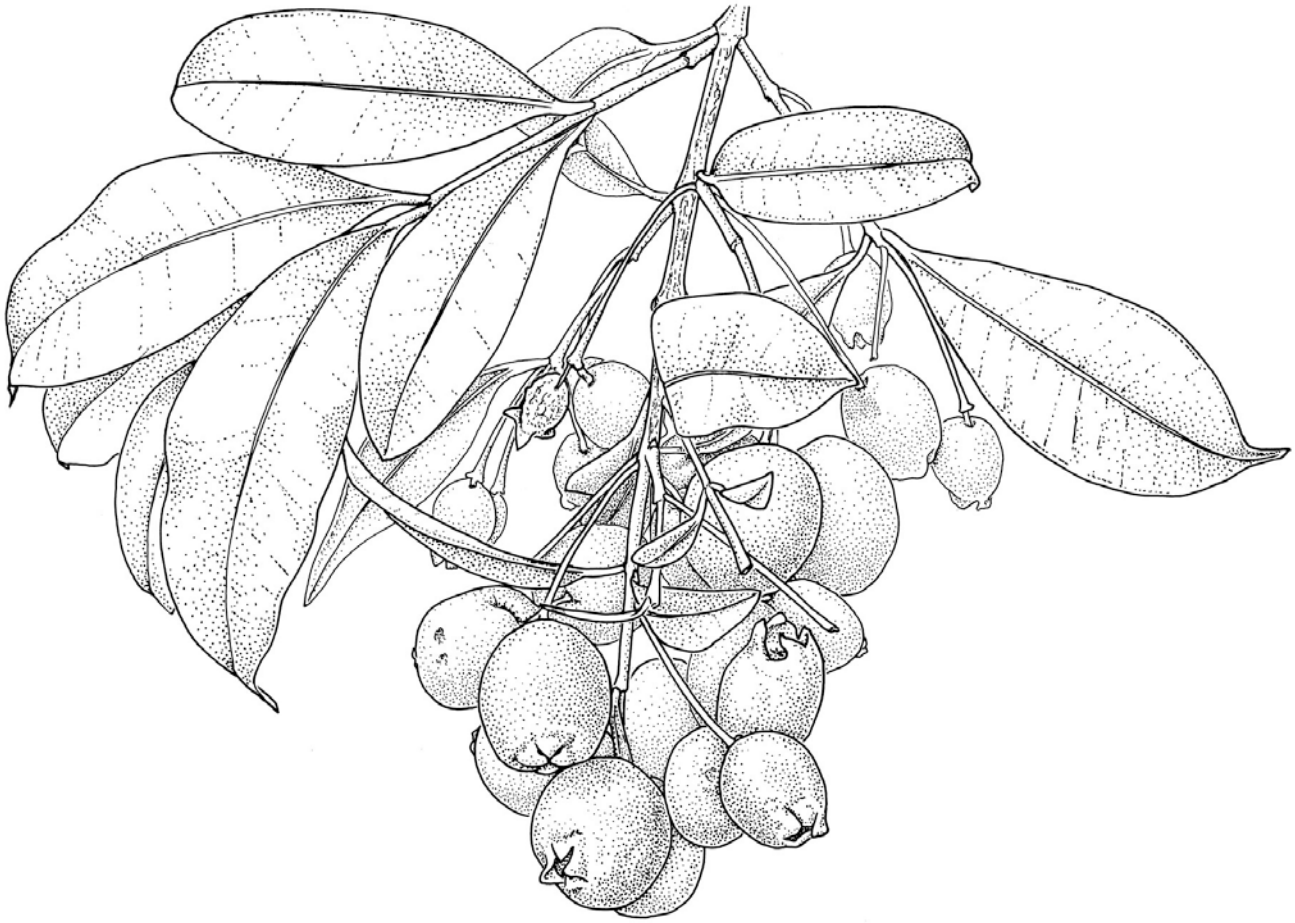

National Recovery Plan

Magenta Lilly Pilly *Syzygium paniculatum*

June 2012

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Office of Environment and Heritage NSW
59 Goulburn Street, Sydney NSW 2000
PO Box A290, Sydney South NSW 1232
Phone: (02) 9995 5000 (switchboard)
Phone: 131 555 (environment information and publications requests)
Phone: 1300 361 967 (national parks, climate change and energy efficiency information, and publications requests)
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Requests for information or comments regarding the recovery program for Magenta Lilly Pilly are best directed to:
The Magenta Lilly Pilly Coordinator
Biodiversity Assessment and Conservation Section, North East Branch
Conservation and Regulation Division
Office of Environment and Heritage
Department of Premier and Cabinet
Locked Bag 914
Coffs Harbour NSW 2450
Phone: 02 6651 5946

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Recovery Plan for Magenta Lilly Pilly *Syzygium paniculatum*

Foreword

This document constitutes the national recovery plan for Magenta Lilly Pilly (*Syzygium paniculatum*) and, as such, considers the conservation requirements of the species across its known range. It identifies the actions to be taken to ensure the long term viability of the species in nature and the parties who will undertake these actions.

Magenta Lilly Pilly is listed as vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and endangered under the NSW *Threatened Species Conservation Act 1995*. The species is a small to medium-sized rainforest tree endemic to New South Wales, with a coastal distribution between Upper Lansdowne near Taree in the north and Conjola National Park near Sussex Inlet in the south. It is found on a range of land tenures and is represented in a number of national parks and nature reserves.

The overall objective of this recovery plan is to protect known subpopulations of Magenta Lilly Pilly from decline and to ensure that wild populations of the species remain viable in the long term. Specific recovery objectives include:

- ensuring a coordinated and efficient approach to the implementation of recovery efforts
- establishing the full extent of the distribution of Magenta Lilly Pilly
- increasing the understanding of Magenta Lilly Pilly biology and ecology
- minimising the decline of Magenta Lilly Pilly through in situ habitat protection and management
- reducing impacts of Myrtle Rust on Magenta Lilly Pilly and its habitat
- maintaining a representative ex situ collection of Magenta Lilly Pilly
- raising awareness of the conservation significance of Magenta Lilly Pilly and involving the broader community in the recovery program.

It is intended that the recovery plan will be implemented over a five year period.

Acknowledgments

The preparation of this recovery plan was funded by the Australian Government's Natural Heritage Trust and has involved the combined effort of a number of people. The Office of Environment and Heritage, Department of Premier and Cabinet would like to acknowledge the following people for their contribution:

Ian Hanson, Ian Wilkinson, Shane Ruming and Katrina McKay (Office of Environment and Heritage, Department of Premier and Cabinet) who prepared this recovery plan.

Peter Richards and Phil Gilmour (Eco Logical Australia Pty Ltd) who collated information on the status of the species, much of which forms the basis for the background of this plan.

Katie Thurlby who, along with supervisors William Sherwin (University of NSW), Maurizio Rossetto (Botanic Gardens Trust) and Peter Wilson (Botanic Gardens Trust), conducted the genetic research which frames the management context for many of the actions in this plan.

Robert Payne (Ecological Surveys and Management), Kevin Mills (Kevin Mills & Associates), Ian Turner, Mel Schroder, Deb Holloman, Doug Beckers, John Eaton and Pete Turner (all Office of Environment and Heritage, Department of Premier and Cabinet), Chrissy Locke and Mark Armstrong (Department of Defence), Peter Wilson and Kim Hamilton (Botanic Gardens Trust), Alex Floyd (North Coast Regional Botanic Garden), Andrew Paget (Hunter-Central Rivers Catchment Management Authority), Martin Fortescue and Andrew Chalklen (Department of Sustainability, Environment, Water, Population and Communities) and Carole Helman (consultant) all provided valuable information and helpful feedback in relation to the species and the plan.

The Office of Environment and Heritage, Department of Premier and Cabinet would also like to acknowledge the efforts of the many volunteer groups who have contributed to the protection of Magenta Lilly Pilly through their involvement in bush regeneration and the restoration of habitat.

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1. Introduction

Magenta Lilly Pilly *Syzygium paniculatum* Gaertn. (Myrtaceae) is a small to medium-sized tree endemic to coastal New South Wales (NSW) between Taree in the north and Sussex Inlet in the south. The species is currently known from approximately 44 subpopulations in five metapopulations.

This document constitutes the national recovery plan for Magenta Lilly Pilly and, as such, considers the requirements of the species across its known range. It identifies the actions that need to be undertaken to ensure the long term viability of the species in nature and the parties who will undertake such actions. The attainment of the objectives of this recovery plan is subject to budgetary and other constraints affecting the parties involved. The information in this recovery plan is accurate to January 2011.

To secure the recovery of Magenta Lilly Pilly this recovery plan advocates recovery actions that favour a mix of in situ and ex situ management and provide for a greater understanding of the biology of the species.

This plan has been prepared by the Office of Environment and Heritage, Department of Premier and Cabinet (OEH) in consultation with the Australian Government Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), the Australian Government Department of Defence (DoD), local governments and other interested parties.

2. Legislative Context

2.1 Legal status

Magenta Lilly Pilly is listed as vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and endangered under the NSW *Threatened Species Conservation Act 1995* (TSC Act).

Magenta Lilly Pilly is known to occur within the 'littoral rainforest and coastal vine thickets' threatened ecological community listed under the EPBC Act and its TSC Act equivalent, 'littoral rainforest in the NSW North Coast, Sydney Basin and South East Corner bioregions'.

This recovery plan has been prepared to comply with the requirements of the EPBC Act.

3. Species Information

3.1 Taxonomy and description

3.1.1 Taxonomic relationships

Magenta Lilly Pilly belongs to the family Myrtaceae. There are between 500 and 1000 species in the genus *Syzygium* worldwide. Of these, 52 occur in Australia, with 47 of them being endemic (Hyland 1983; Wilson 2002).

Prior to a major revision of the Australian members of *Syzygium* and other related genera (Hyland 1983), the species now known as *Syzygium paniculatum* was often referred to as *Syzygium coolminianum* (for instance, see Helman 1979), a totally separate species that is actually *Syzygium oleosum*. Confusingly, the current species *Syzygium australe* had, in the past, been referred to as *Syzygium paniculatum* and, as a consequence, most published records of *Syzygium paniculatum* that predate Hyland's (1983) revision are actually *Syzygium australe*.

3.1.2 Taxonomic description

Magenta Lilly Pilly is a small to medium-sized tree growing to a height of 18 m and a diameter at breast height of 40 cm. Occasionally, specimens up to 25 m in height and 1–2 m in diameter have been recorded (P. Gilmour pers. comm., R. Payne pers. comm. in Eco Logical Australia 2006). In exposed situations the species may take the form of a small, coppiced tree or shrub.

The trunk varies from straight to crooked (Floyd 2008), and coppices sometimes arise from the base or damaged sections (Payne 1997). Buttressing is not apparent (Floyd 2008), although shallow lateral roots may resemble spur buttresses on occasion. The outer bark is pinkish to reddish-brown, flaky on smaller trunks but becoming more platy on larger trunks (Floyd 2008; Wilson 2002). The branchlets are green, becoming brown. When fresh, these are slightly angular and dorsiventrally flattened. The older branchlets are rounded and slightly scaly (Floyd 2008).

The leaves are opposite, simple, entire, and lanceolate to slightly obovate, growing up to 10 cm in length and 3 cm in width. They possess prominent, tapered 'drip-tips', wedge-shaped bases, glossy, dark green upper surfaces with slightly sunken midribs, and paler lower surfaces. They also possess small, distinct, scattered oil glands and numerous lateral veins. An intra-marginal vein is discernible, and is close to the lamina edge. The petiole is 2–10 mm long (Floyd 2008; Wilson 2002).

The flowers of the species are white and borne in terminal and upper-axillary panicles. They consist of four rounded petals, each one of which is 4–5 mm in width (Floyd 2008; Wilson 2002). The stamens are numerous and 6–16 mm long. The fruit is a magenta, globose to ovoid berry, although it can be white, pale pink or purple (Floyd 2008; Wilson 2002). Fruit diameter is 12–25 mm. The fruit is also shiny and possesses fleshy distal calyx lobes (Floyd 2008). The seed, which is 5–15 mm in diameter, is brown, solitary, globular and polyembryonic, consisting of one to nine tightly packed embryos (Figure 1) (Thurlby 2010). The species flowers from summer to early autumn (December to March) and the fruits are evident in autumn, winter and early spring (March to September).

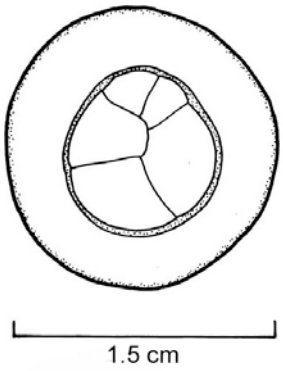

Figure 1. **Transverse section of Magenta Lilly Pilly fruit showing seed containing multiple embryos.**

Illustration: Lesley Elkan © Botanic Gardens Trust.

Magenta Lilly Pilly is superficially similar to Brush Cherry (*Syzygium australe*), Blue Lilly Pilly (*S. oleosum*) and Lilly Pilly (*Acmena smithii*), which occur sympatrically within part or all of the natural range of Magenta Lilly Pilly. Magenta Lilly Pilly has also been widely planted throughout and beyond its known range, making it difficult at times to identify individuals based upon provenance. Table 1 provides a summary of the chief features used to distinguish Magenta Lilly Pilly from superficially similar species.

Table 1. **Features used to distinguish Magenta Lilly Pilly from similar species**

Feature	Species			
	Magenta Lilly Pilly (*S. paniculatum*)	**Brush Cherry (*S. australe*)**	**Blue Lilly Pilly (*S. oleosum*)**	**Lilly Pilly (*Acmena smithii*)**
Branchlets	Rounded, smooth, green turning brown.	Four-angled, winged, smooth, reddish-green.	Rounded, smooth, green, often red on upper surface.	Rounded, smooth, green turning brown.
Leaves	Glossy above, pale and dull below. Lanceolate. Mid-rib obscurely sunken above. Scattered, small but distinct oil dots. Pleasant, vaguely citrus-like odour when crushed.	Glossy above, pale and dull below. Elliptic, bluntly pointed. Mid-rib obscurely sunken above. Scattered, small, indistinct oil dots. Slight pleasant odour when crushed.	Glossy above, pale below. Lanceolate. Mid-rib obscurely sunken above, groove continuing down leaf stalk. Numerous distinct oil dots. Very strong, citrus-like odour when crushed. Sticky oil released.	Dull dark green above, paler below. Broadly elliptic to narrow-lanceolate. Mid-rib clearly sunken above. Oil dots numerous, distinct. Odour weak, slightly citrus-like.
Outer bark	Pinkish to reddish-brown, flaky, becoming platy.	Brownish-grey, softly scaly.	Reddish-brown to grey, scaly, sheds in narrow longitudinal scales.	Brown, finely scaly.
Fruit	Magenta, globose to ovoid berry, 12–25 mm diameter. Calyx lobes formed. Seed solitary, polyembryonic (Figure 1).	Deep red, oval to pear-shaped berry 15–25 mm long. Calyx lobes formed. Seed solitary.	Purplish-blue, globose berry 13–40 mm diameter. Calyx persistent, but not forming lobes. Seed solitary.	White or purplish globular berry 8–20 mm diameter. Calyx shed. Seed solitary.

3.2 Distribution

3.2.1 Current distribution

Based upon available information, the known total population of Magenta Lilly Pilly is estimated to be approximately 1200 plants that are distributed along a 400 kilometre stretch of coastal NSW between Upper Lansdowne in the north to Conjola National Park in the south (Figure 2). The species occurs naturally in the Jervis, Sydney Cataract, Pittwater and Wyong subregions of the Sydney Basin Bioregion, and in the Karuah-Manning and Macleay-Hastings subregions of the NSW North Coast Bioregion (after Commonwealth of Australia 2005). Records from the Cumberland subregion of the Sydney Basin Bioregion are discussed below separately.

Occurrences of Magenta Lilly Pilly are disjunct. Five metapopulations are identified, based on the assumption of an approximately 30 kilometre foraging range for the species' larger potential dispersal agents such as the Grey-headed Flying-fox (*Pteropus poliocephalus*) (Eby 1995; Tidemann 1995) and White-headed Pigeon (*Columba leucomela*) (Payne 1991). The five metapopulations are: (i) Jervis Bay; (ii) Coalcliff; (iii) Botany Bay; (iv) Central Coast; and (v) Karuah-Manning. These metapopulations consist of 44 known subpopulations, as identified in Table 2. Other potential subpopulations have been identified, although these require further investigation. This is covered by appropriate actions in Section 6.

The Jervis Bay and Central Coast metapopulations support the largest number of individuals and subpopulations. There are 12 and 24 recorded subpopulations in these metapopulations respectively. Up to two-thirds of all individuals of the species occur in three major subpopulations of the Central Coast metapopulation. One of these subpopulations is protected in Wyrrabalong National Park while the other two, at Ourimbah Creek and Martinsville, occur on private property.

The Coalcliff metapopulation is represented by a single subpopulation of about ten plants (A. Bofeldt pers. comm. in Eco Logical Australia 2006). The Botany Bay metapopulation appears to support a small number of individuals within three subpopulations (R. Payne pers. comm. in Eco Logical Australia 2006; NSW herbarium label information).

Figure 2. **Distribution of Magenta Lilly Pilly**

The Karuah-Manning metapopulation consists of at least six small subpopulations of approximately 20 mature plants (Eco Logical Australia 2006; Atlas of NSW Wildlife 2010; A. Paget pers. comm.).

It is likely that further targeted surveys for the species will reveal additional subpopulations, particularly on private property in the hinterland valleys of the Central Coast. Furthermore, a thorough assessment of selected subpopulations may improve current population estimates. For instance, the Martinsville subpopulation contains a significant number of trees which occur sporadically along creek lines on private property (R. Payne pers. comm. in Eco Logical Australia 2006). However there are currently no vouchered herbarium or reliable observational records for this subpopulation, nor has a thorough survey been undertaken. Likewise, the full extent of the sizeable Ourimbah Creek subpopulations have not been ascertained.

There are historical Magenta Lilly Pilly records from 'Buladelah' (1923), 'Stroud' (1917), 'Blaxland', (1943), and 'Kurrajong Heights' (1953). Although these records are supported by herbarium specimens, locations could refer to general localities (for example, 'Buladelah' could refer to a nearby coastal location) or consist of collections made from cultivated plants. A number of early records labelled 'Gosford' may refer to legitimate localities, but specific locations are unknown due to the use of vague locality descriptions. One 1916 collection from 'Hogan's Brush, Gosford' refers to what is now known as Strickland State Forest. The species has not been recorded from this State Forest since this date, although suitable habitat is thought to occur in the area (Binns 1996).

In recent years, a number of new Magenta Lilly Pilly locations have been recorded in the Sydney metropolitan area. For example, 14 new locations were recorded between 2000 and 2005. Only one record is supported by a specimen lodged with the National Herbarium of NSW, and it is unclear whether the record in question relates to a natural occurrence or a planted tree. The remaining 13 records appear to have been made by botanical consultants during the course of environmental assessment work. Recent attempts at field verifications of similar records across new residential areas in the Jervis Bay region have either failed to re-locate individuals, or have confirmed that the records in question refer to planted trees (P. Gilmour pers. comm. in Eco Logical Australia 2006).

It is considered likely that a proportion of the Sydney metropolitan records will prove legitimate, as small patches of potential habitat can still be found in Sydney (including the littoral rainforest at Bundeena and the moist vegetation types on sandy soil in areas such as Balmoral, Pittwater and Lane Cove (Benson & Howell 1990)). Any record of an isolated Magenta Lilly Pilly individual in the Sydney Metropolitan area should be treated with caution, due to the popularity of the species in ornamental plantings (P. Wilson pers. comm. in Eco Logical Australia 2006).

3.2.2 Historical distribution

There is little evidence to suggest that the natural range of Magenta Lilly Pilly was historically greater than it is today. Herbarium or reliable observational records from localities outside of the species' currently accepted distributional limits are lacking. Notwithstanding this, potential habitat exists to the north of the current range of the species, which may support individuals.

There is evidence to suggest that the abundance of Magenta Lilly Pilly within its natural range has been markedly reduced since European settlement, and that a number of subpopulations may have been entirely eliminated. For example, there are fewer trees on the Kurnell Peninsula today than there were in 1770 when Cook and Solander were reported to have provided an abundance of fruits to their fellow explorers (Robinson 1991). Additionally, Mills (1996) postulates that Magenta Lilly Pilly was lost from the northern Illawarra as a result of large-scale disturbance of local sand dune systems.

Magenta Lilly Pilly mostly occupies a near-coastal distribution in specific, restricted habitats. Much littoral rainforest has been cleared and now exists only in small fragments, many of which remain vulnerable to further clearing and modification (Floyd 1990a, 1990b). The clearing of valley floor vegetation, including lowland rainforest and riparian gallery forest for agriculture, has almost certainly led to a contraction in the area of habitat available to the species, and a

reduction in species numbers within extant subpopulations. Even where Magenta Lilly Pilly still exists in riparian remnants, underscrubbing of habitat and grazing by livestock has reduced the ability of the species to regenerate through seedling recruitment (Payne 1991). In more recent times, urban expansion has encroached upon agricultural areas, exacerbating habitat loss.

3.2.3 Land tenure and zoning

Of the 44 naturally occurring Magenta Lilly Pilly subpopulations currently verified, 18 occur partly or wholly within conservation reserves. Sixteen of these are located within a NSW national park, nature reserve or state conservation area, and the other two occur within the Commonwealth's Booderee National Park at Jervis Bay. Ten subpopulations occur entirely on private property, with the remainder located on other publicly-managed land or straddling public-private property boundaries. A summary of the general locations and underlying tenures of each subpopulation is presented in Table 2.

3.2.4 Habitat

Magenta Lilly Pilly has been reported to occur on sandy soil or stabilised sand dunes in coastal areas (Hyland 1983), in littoral rainforest on sand or subtropical rainforest on sandy soil derived from sandstone (Floyd 2008), in littoral or subtropical rainforest on sandy soils or stabilised Quaternary sand dunes (Quinn et al 1995), or in subtropical and littoral rainforest on sandy soils or stabilized dunes near the sea (Wilson 2002).

The species has been recorded growing mainly on flat to gently sloping sites on floodplains, creek banks, perched sand dunes, in swales of hind dunes, and on old dunal ridges. It has also been less commonly recorded on steep sites in gullies, such as in Bouddi National Park and at Green Point Foreshore Reserve.

The majority of collection notes for the species describe the soil type as being of a sandy nature. It has been recorded on sandy alluvium, deep sands, podsolised quartz sand, unconsolidated and permeable deep white-yellow azonal sands, sandstone-derived alluvium, deep silty sands (flood deposition), dark heavily littered sand; and sandy grey soil on sandstone. Only a few records describe a non-sandy soil type. For example, the Green Point Foreshore Reserve subpopulation at Gosford occurs on a deep medium-clay.

Most Jervis Bay subpopulations occur in littoral rainforest or depauperate subtropical rainforest. On Beecroft Peninsula the vegetation is characterised by dominants such as Small-leaved Fig (*Ficus obliqua*), Red Olive Plum *(Elaeodendron australe*), Plum Pine (*Podocarpus elatus*) and Lilly Pilly. Some sites on Beecroft Peninsula are dominated by Magenta Lilly Pilly, which occurs with the abovementioned overstorey species. At St Georges Basin, Magenta Lilly Pilly co-dominates with Cheese Tree (*Glochidion ferdinandi*) and Lilly Pilly beneath emergent Blackbutt (*Eucalyptus pilularis*) and Bangalay (*E. botryoides*), with an understorey including Cabbage Palm (*Livistona australis*), Muttonwood *(Myrsine variabilis*) and Scentless Rosewood (*Synoum glandulosum*).

The Coalcliff metapopulation occurs in riverine subtropical rainforest, with associated species including Lilly Pilly, Blue Lilly Pilly and Water Gum (*Tristaniopsis laurina*).

A number of the Central Coast subpopulations occur in littoral rainforest remnants, which sometimes grade into swamp sclerophyll forest where drainage is impeded. Vegetation associates in these areas include Blue Lilly Pilly, Hard Quandong (*Elaeocarpus obovatus*), Lilly Pilly, Cabbage Palm, Black Apple (*Planchonella australis*), Cheese Tree, Tuckeroo (*Cupaniopsis anacardioides*), Port Jackson Fig (*Ficus rubiginosa*), Broad-leaved Paperbark (*Melaleuca quinquenervia*) and Flax-leaved Paperbark (*M. linariifolia*).

Table 2. **Location and tenure summary of Magenta Lilly Pilly populations**

Metapopulation	Subpopulation	Local government area	General location	Tenure
Jervis Bay	1	Commonwealth	East St Georges Basin	Booderee NP
	2	Commonwealth	St Georges Head	Booderee NP
	3	Shoalhaven	Tomerong Creek	Council/private
	4	Commonwealth	Duck Hole	Department of Defence
	5	Commonwealth	Target Beach	Department of Defence
	6	Commonwealth	Dart Point	Department of Defence
	7	Commonwealth	Honeymoon Bay	Department of Defence
	8	Shoalhaven	Long Beach North	Council
	9	Shoalhaven	Long Beach South	Council
	10	Shoalhaven	Cabbage Tree	Council
	11	Shoalhaven	Abrahams Bosom	Crown reserve
	12	Shoalhaven	Conjola NP	Conjola NP
Coalcliff	13	Wollongong	Coalcliff	Illawarra Escarpment SCA/ private
Botany Bay	14	Sutherland	Towra Point	Towra Point NR
	15	Sutherland	Captain Cook Drive	Council
	16	Sutherland	Kurnell	Botany Bay NP
Central Coast	17	Gosford	Fletcher's Glen	Bouddi NP
	18	Gosford	Bouddi Grand Deep	Bouddi NP
	19	Gosford	Gosford	Council/private
	20	Gosford	Avoca	Council/private
	21	Gosford	Wamberal Lagoon	Wamberal Lagoon NR
	22	Wyong	Ourimbah Creek	Private
	23	Wyong	Ourimbah Creek, Dog Trap Gully	Private
	24	Wyong	Lower Ourimbah Creek	Private
	25	Wyong	Wyong River	Private
	26	Wyong	Wyong River, Deep Creek	Private
	27	Wyong	North Entrance	Wyrrabalong NP
	28	Wyong	Noraville	Council/private
	29	Wyong	Budgewoi	Council/private
	30	Wyong	Munmorah	Council/private/Munmorah SCA
	31	Lake Macquarie	Dora Creek	Private
	32	Lake Macquarie	Pulbah Island	Pulbah Island NR
	33	Lake Macquarie	Wallarah – Cams Wharf	Council/private
	34	Lake Macquarie	Wallarah – Nesca Park	State-owned corporation
	35	Lake Macquarie	Wallarah – Swansea	Council/private
	36	Lake Macquarie	Martinsville	Private
	37	Lake Macquarie	Green Point Foreshore Reserve	Council
	38	Newcastle	Glenrock	Glenrock SCA
Karuah-Manning	39	Great Lakes	Yacaaba Head	Myall Lakes NP
	40	Great Lakes	Mungo Brush	Myall Lakes NP
	41	Great Lakes	Seal Rocks	Myall Lakes NP
	42	Great Lakes	Booti Booti	Booti Booti NP
	43	Greater Taree	Saltwater	Saltwater NP
	44	Greater Taree	Upper Lansdowne	Private

Note: NP – national park, NR – nature reserve, SCA – state conservation area

Many of the subpopulations on the Central Coast also occur within riparian forest. The remnant gallery rainforest along Ourimbah Creek comprises Jackwood (*Cryptocarya glaucescens*), Lilly Pilly, Sassafras (*Doryphora sassafras*) and Native Tamarind (*Diploglottis cunninghamii*). Other riparian forest habitat consists of an emergent stratum of eucalypts such as Sydney Blue Gum (*E. saligna*) and Mountain Blue Gum (*E. deanei*) or Blackbutt overlying a rainforest understorey of species such as Lilly Pilly, Brown Myrtle (*Choricarpia leptopetala*), Coast Canthium (*Cyclophyllum longipetalum*), Blue Lilly Pilly, Lilly Pilly, and Gosford Wattle (*Acacia prominens*).

Some Central Coast subpopulations also occur in warm temperate rainforest gullies containing Coachwood (*Ceratopetalum apetalum*), Crabapple (*Schizomeria ovata*), Ribbonwood (*Euroschinus falcatus*), Guioa (*Guioa semiglauca*) and Sweet Pittosporum (*Pittosporum undulatum*).

Most Karuah-Manning subpopulations occur in littoral rainforest. At Elizabeth Beach (Booti Booti National Park) the rainforest is part of a remnant, complex mosaic of palm forest, swamp sclerophyll forest, and drier coastal scrub. The rainforest is dominated by Yellow Tulipwood (*Drypetes deplanchei*), Hard Quandong and Small-leaved Fig, with Grey Myrtle (*Backhousia myrtifolia*), Myrtle Ebony (*Diospyros pentamera*) and Big Yellow Wood (*Sarcomelicope simplicifolia*).

At Seal Rocks the rainforest is dominated by Yellow Tulipwood, Small-leaved Fig, Giant Water Gum (*Syzygium francisii*), Myrtle Ebony, and Coogera (*Arytera divaricata*). At Upper Lansdowne the species occurs in subtropical rainforest with Red Cedar (*Toona ciliata*), Bangalow Palm (*Archontophoenix cunninghamiana*), Soft Corkwood (*Caldcluvia paniculosa*), Lilly Pilly and Blue Lilly Pilly.

Thurlby (2010) found that there is extremely low genetic diversity within 11 subpopulations sampled across the species range, with a distinct north-south genetic divide centred on the Central Coast. Given this, all confirmed naturally occurring populations of Magenta Lilly Pilly are considered to be important and, therefore, all habitat in which these populations occur is considered to be critical to the survival of the species.

3.3 Life history and ecology

3.3.1 Habit, growth rate and longevity

Although generally a small tree, individual Magenta Lilly Pilly are known to grow up to 25 m tall and 1 m in diameter at breast height (P. Gilmour pers. comm. in Eco Logical Australia 2006). The largest specimen known, with a diameter of almost 2 m, was reported from Ourimbah Creek (R. Payne pers. comm. in Eco Logical Australia 2006). In some of the more exposed sites, the species tends to take the form of a low, coppiced shrub or small tree.

Large specimens such as those described above are likely to be very old trees. Exactly how old is difficult to determine in the absence of site histories. Estimated life expectancy is in the order of 75 to 200 years (A. Bofeldt cited in Benson & McDougall 1998).

3.3.2 Reproductive biology

As mentioned previously, Magenta Lilly Pilly is polyembryonic, producing up to nine seedlings per seed. Recent work by Thurlby (2010) has shown the species to also be facultative apomictic; that is, it has the ability to produce fertile seed both sexually (with fertilization) and asexually (without fertilization). Where the species is reproducing asexually through apomixis (i.e. producing fertile seed without fertilization), offspring are clones of the maternal plant, and this can has important implications for conservation of the species.

Magenta Lilly Pilly has a generalised pollination strategy, exhibiting the ability to self-pollinate and to outcross (Payne 1997). Pollination would most likely be aided, both at the local level and between subpopulations, by visits to flowers by nectar and pollen-feeding vertebrates and invertebrates, such as flying-foxes, possums, honeyeaters, lorikeets, introduced and native bees, beetles, moths and butterflies.

Magenta Lilly Pilly flowers from December to March (occasionally to May) and produces fruits from January to May (and sometimes as late as September). Flowering has been observed in two pulses in some Central Coast subpopulations (Payne 1997). This flowering pulse may be the reason why fruit have been recorded over so many months of the year.

Fruit production by the species appears to be sporadic (R. Payne pers. comm. in Eco Logical Australia 2006) but prolific where it has been observed. The seed is contained within a succulent berry, which quickly breaks down after the fruit has ripened (P. Richards pers. comm. in Eco Logical Australia 2006). The life expectancy of seed is thought to be less than three months (A. Bofeldt cited in Benson & McDougall 1998). It is therefore unlikely that Magenta Lilly Pilly populations support lasting soil seed banks.

Dispersal of seeds is likely to be achieved through several agents. Water would disperse fruits in riparian habitats subjected to periodic flooding, such as Ourimbah Creek and Martinsville. Gravity and animals which feed on the fruits of the species are also likely agents. The White-headed Pigeon (Payne 1991), Pied Currawong (*Strepera graculina*) (Buchanan 1989) and Grey-headed Flying Fox (Eby 1995) have all been recorded feeding on the fruit of Magenta Lilly Pilly, and it is likely that other fruit-eating birds and small native mammals also consume the fruit (Payne 1997).

Floyd (2008) reports ready and rapid germination of seed within 20 days. Payne (1997) found that the species prefers canopy cover for in situ seed germination due to the greater availability of moisture under closed canopy conditions. However, seedlings emerging under adult trees are thought to be short lived (Benson & McDougall 1998). Like many rainforest species, seedling progression may require a disturbance event, such as a tree fall or storm, which opens up the canopy.

3.3.3 Population genetics

Thurlby (2010) found that there is extremely low genetic diversity within 11 subpopulations sampled across the species range. It was also found that, between subpopulations, there is a distinct north-south genetic divide centred on the Central Coast somewhere near Cams Wharf and Green Point.

In evolutionary terms, this divide suggests two main genetic units as opposed to the five metapopulations identified on a purely geographic basis. Subpopulations sampled north of this divide exhibit a higher level of genetic diversity than those that were sampled south of the divide. In the case of these southern subpopulations, there was virtually zero genetic diversity between them. Therefore, when referring to metapopulations and subpopulations in this recovery plan, it should be taken to mean geographically distinct populations unless otherwise stated.

3.3.4 Disturbance ecology

Fire may be a regenerative mechanism in some Magenta Lilly Pilly subpopulations, with Payne (1991) observing coppicing from the bases of burnt-out main trunks of trees at North Entrance. It appears that wildfires can also kill trees (R. Payne cited in Benson & McDougall 1998), so it is possible that only fires of low intensities induce coppicing. This response to fire is similar to that exhibited by other species occupying drier sites and into which fire may occasionally encroach, such as Grey Myrtle and Lilly Pilly. It is considered that Magenta Lilly Pilly would not tolerate a frequent fire regime. Magenta Lilly Pilly is also thought to tolerate a certain amount of inundation (Payne 1991).

3.3.5 Cultivation

Magenta Lilly Pilly is widely cultivated in eastern Australia as an ornamental garden plant (Nicholson & Nicholson 1994; Wrigley & Fagg 1996; Floyd 2008). The species is widely used in planting schemes in many areas along the NSW coast and is known by such common names as Magenta Cherry, Pocketless Brush Cherry, Brush Cherry, Scrub Cherry, and Creek Lilly Pilly. A range of horticultural varieties have been developed by the nursery industry, and a number of

registered names exist, including ‘Lillyput’, ‘Undercover’, ‘Little Lil’, ‘Orange Twist’, ‘Beachball’, and ‘Variegata’.

4. Threats and Management Issues

4.1 Current threats

Magenta Lilly Pilly subpopulations are subject to a number of active threatening processes. The major threats are as follows:

4.1.1 Habitat clearing and fragmentation

Clearing can directly destroy individuals and their habitat. It can also lead to degradation of habitat through the disruption of ecosystem processes and through the exposure of remnants to potentially damaging agents (including strong and drying winds, high temperatures, direct and prolonged solar radiation, chemical drift, pests, weeds, and diseases). Degradation can also occur through the altering of the composition and structure of remnants (the latter a direct consequence of increased edge effects).

Habitat likely to support Magenta Lilly Pilly continues to be cleared for urban expansion and infrastructure development. This is particularly evident in the Central Coast and Jervis Bay regions, where residential and associated developments have expanded rapidly in recent years. A golf course complex has recently been constructed adjacent to the largest known subpopulation at North Entrance (Central Coast metapopulation). It is unclear at this stage what effects this development may have on the subpopulation, in terms of altering local hydrological regimes (runoff and water use), increasing vulnerability to weed infestations, and increasing exposure to fertilizer and pesticide drifts. Other habitat losses are threatened by highway expansion and car park encroachments into habitat.

4.1.2 Low genetic diversity

So far, Magenta Lilly Pilly has persisted in the wild with low genetic variation. However, this low variation, (particularly for those subpopulations south of the Central Coast) may have long term conservation implications for the species. Persistence of the species in the current environment is likely due to the prolific reproduction afforded through polyembryony, as well as the fitness of existing genotypes to the current environment (Thurlby 2010). This low genetic diversity means that the species may have difficult adapting to future environmental change.

4.1.3 Inappropriate grazing regimes

The grazing and watering of livestock within riparian areas is contributing to a decline in some of the largest subpopulations along Ourimbah Creek and along watercourses in the Martinsville area. Although many Magenta Lilly Pilly individuals are present in both areas, there is little or no evidence of recruitment at either location due to the effects of trampling by livestock (R. Payne pers. comm. in Eco Logical Australia 2006).

Grazing, including physical damage to the understorey, has been identified as a threat to the rainforest habitat of Magenta Lilly Pilly in NSW (NSW Scientific Committee 2004; DEWHA 2009).

4.1.4 Weed infestations

Weeds are a threat to Magenta Lilly Pilly in that they can compete with the species for water, nutrients and sunlight. Weeds can also suppress or prevent the early growth and development of other rainforest species, alter nutrient cycles, increase the risk and intensity of fires, and physically damage plants. In addition, weed infestation can severely reduce the areas available for regeneration.

Numerous weeds have been identified as posing a threat to Magenta Lilly Pilly or its habitat (see NSW Scientific Committee 2004; Threatened Species Scientific Committee 2008). In particular, Lantana (*Lantana camara*) and Bitou Bush (*Chrysanthemoides monilifera* subsp. *rotundata*) have been identified as a direct threat (Coutts-Smith & Downey 2006; DEC 2006; National Lantana Management Group 2010).

Subpopulations in Wyrrabalong National Park, Bouddi National Park and Wamberal Lagoon Nature Reserve have been threatened by infestations of Lantana and Bitou Bush. Those at

Green Point Foreshore Reserve and Swansea have been impacted upon by Lantana, Bitou Bush and Morning Glory (*Ipomoea indica*). Other littoral rainforest remnants on private property and council-managed lands near Lake Macquarie have been threatened by Small-leaved Privet (*Ligustrum sinense*) and Japanese Honeysuckle (*Lonicera japonica*). All of these sites have active weed management programs in place. The small Jervis Bay subpopulation at Abrahams Bosom is currently infested with Asparagus Fern (*Asparagus aethiopicus*).

4.1.5 Inappropriate fire regimes

Magenta Lilly Pilly has been known to coppice after low intensity fire (Payne 1991). Fires occurring at frequencies or intensities that are too high for the species to tolerate, however, have the potential to kill or weaken plants, interfere with their reproductive mechanisms, and alter or destroy rainforest habitat. Fire may also encourage weed invasions along remnant edges.

A number of subpopulations of the species are potentially threatened by high frequency fire. Although habitat is generally located in areas where a degree of fire protection is afforded, some patches, such as at Honeymoon Bay, Long Beach, and Duck Hole on Beecroft Peninsula are potentially at risk from wildfires originating from nearby campsites or resulting from military training exercises. However, Littoral rainforest on Beecroft Peninsula is excluded from hazard reduction burning, and there have been no wildfires through the rainforest since the late 1940s to early 1950s (M. Armstrong pers. comm.).

Habitat of several subpopulations on the Central Coast has been subjected to regular fires. For example, approximately 33 fires were recorded in Bouddi National Park between 1968 and 1990 (McRae 1990), although there is no indication that Magenta Lilly Pilly individuals were directly affected. The North Entrance area, however, has been subjected to wildfire that has directly impacted upon the Magenta Lilly Pilly subpopulation, resulting in the death of 35 individuals (Benson & McDougall 1998).

Inappropriate fire regimes are recognised as posing a threat to the margins of littoral rainforest, which provides much of the habitat for Magenta Lilly Pilly (NSW Scientific Committee 2004; Threatened Species Scientific Committee 2008).

4.1.6 Climate change

Steffen et al. (2009) reports that predicting the future effects of climate change on biodiversity in Australia is complicated. Even so, rainforests and coastal ecosystems of NSW have been identified as being particularly vulnerable to the effects of climate change (NSW Inter-agency Biodiversity and Climate Change Impacts and Adaptation Working Group 2007), both of which constitute Magenta Lilly Pilly habitat.

Although climate change impacts on the species itself are difficult to predict, impacts on habitat through such things as sea level rise, increased storm events and altered fresh-saline hydrology are possible. For example, the subpopulation at Towra Point is situated near the extreme high water mark and may be at risk from sea level rise (NSW Scientific Committee 2009). Climate change may also exacerbate existing threats such as altered fire regimes and potential new weed threats. Human adaptive responses to things such as sea level rise may also add further pressure on the species and its habitat. The effects of any future environmental change will be exacerbated by the low level of genetic diversity exhibited in the species.

For a general overview on possible impacts on ecosystems that may contain Magenta Lilly Pilly see NSW Inter-agency Biodiversity and Climate Change Impacts and Adaptation Working Group (2007), DECC (2008a, 2008b, 2008c), DECCW (2009) and Steffen et al. (2009).

4.1.7 Introduced vertebrate pests

Introduced vertebrate pests such as feral deer can impact upon Magenta Lilly Pilly and its habitat. Feral deer are known to occur in many conservation reserves, including Bouddi National Park and Illawarra Escarpment State Conservation Area (NSW Scientific Committee 2005).

An exclosure experiment using planted saplings of Magenta Lilly Pilly found that exposure to browsing by the Javan Rusa Deer (*Cervus timorensis*) for several months led to major defoliation, bark stripping, stem breakages and some mortality (Keith & Pellow 2004 cited in NSW Scientific Committee 2005). In addition to browsing and physical disturbance of individuals, deer browse and disturb the seedlings of other species which collectively constitute Magenta Lilly Pilly habitat. The NSW Scientific Committee (2005) reports that grazing and trampling by deer could alter the composition and structure of littoral rainforest habitat of Magenta Lilly Pilly.

4.1.8 Recreational activities

Some subpopulations of Magenta Lilly Pilly are subjected to frequent human visitation, and are threatened by the construction and maintenance of roads, walking tracks and car parks. For instance, bush camping at Honeymoon Bay on Beecroft Peninsula occurs adjacent to a patch of rainforest which contains Magenta Lilly Pilly. The picnic and recreation areas at the St Georges Basin and Abrahams Bosom sites are used regularly, with visitors passing through the habitat of the species (both sites have car parks within Magenta Lilly Pilly habitat). The Elizabeth Beach subpopulation occurs adjacent to a walking track to the beach. Human visitation may impact upon the ability of a species to regenerate, as trampling of the understorey and soil compaction can inhibit seedling establishment.

4.1.9 Pathogens

Myrtle Rust (*Uredo rangelii*) is a pathogen that affects species from the family Myrtaceae that was first detected in Australia on the NSW Central Coast in 2010. The rust is now considered to be widespread along the eastern seaboard (Industry & Investment NSW 2011a) and Magenta Lilly Pilly has been identified as a known host in the field (Industry & Investment NSW 2011b), along with several other Myrtaceae species occurring in the same habitat.

The entire distribution of Magenta Lilly Pilly occurs within the known or predicted distribution of Myrtle Rust in NSW. Although its effects on most Australian Myrtaceae species are unknown (Department of Agriculture, Fisheries and Forestry 2010), Myrtle Rust is closely related to Eucalypt/Guava Rust (*Puccina psidii*), a serious disease of Australian Myrtaceae growing in North America and South America (Australian Quarantine and Inspection Service 2009).

4.1.10 Changes to local water regimes through water extraction

A proposal to temporarily supplement the Central Coast's water supply by pumping up to four million litres per day from Ourimbah Creek was recently approved by the NSW Government. This proposal may have significant consequences for the Ourimbah Creek subpopulations. Such a draw down on Ourimbah Creek may lead to a reduction in the frequency of flood events and a drop in the water table, with the likely result being a loss of remnant riparian vegetation along much of the creek's middle and lower reaches.

4.2 Ability of species to recover

To ensure recovery of Magenta Lilly Pilly, this recovery plan advocates recovery actions that favour in situ management in the short to medium term. Magenta Lilly Pilly is primarily a species

of littoral and gallery rainforests, which are themselves under considerable pressure. Large areas have been lost to rural and urban development and the amount of habitat available to the species is being further limited. In addition, the ability of the species to naturally recolonise potential habitat where it does occur is often restricted by land management practices. The lack of recruitment in several subpopulations is a concern and is likely to have an impact upon the ability of the species to persist in some areas. Subpopulations are widespread, with a large number occurring on public lands. The probability of random events eliminating the entire species is therefore reduced.

The research of Thurlby (2010) on the reproductive biology and conservation genetics of Magenta Lilly Pilly has several implications for the long term management of the species. Reproduction by facultative apomixis, low genetic diversity within existing populations and the genetic divide between north and south populations suggest that all subpopulations of the species are equally important. All existing subpopulations and the full range of genetic diversity they contain should be afforded equal protection.

In the long term, ex situ forms of conservation may be required if the species fails to adapt to environmental change, particularly if the ability to adapt to a changing environment is exacerbated by other threats such as weeds or Myrtle Rust. This makes ex situ conservation a long term priority for the species' persistence and, as a consequence, associated contingency planning for such a situation should be an important short term consideration.

All forms of in situ and ex situ conservation must take into account the widespread horticultural use of the species in landscape and garden plantings. As many of these are hybrids or of unknown genetic origin, they should be excluded from all actions related to the conservation of the species in the wild.

5. Previous Recovery Actions

5.1 Status review

The TSC Act status of Magenta Lilly Pilly was reviewed in 2009 (NSW Scientific Committee 2009). As a result of this review, the status of the species on the TSC Act was changed from vulnerable to endangered. This was due to the restricted area and small sizes of its subpopulations, indicating that the species is undergoing a continuing decline, or likely to undergo a future decline in abundance, and in habitat area and quality.

5.2 Research

Research into the reproductive biology and genetic diversity of Magenta Lilly Pilly was undertaken in 2010 (Thurlby 2010; Thurlby et al. 2011). Key findings of this research have been reported in Sections 3.4 and 4.1 and are being used to inform management actions identified in this recovery plan.

Research has also been undertaken into the suitability of Magenta Lilly Pilly seed for long term storage. As part of the Rainforest Seed Project, the Botanic Gardens Trust tested seed for tolerance to the drying that occurs for long term storage of seeds in conventional seedbanks. The project found that Magenta Lilly Pilly seed was not tolerant to desiccation and, therefore, cannot be seedbanked (K. Hamilton pers. com.).

5.3 Management planning

Plans of management have been prepared for the majority of the NSW conservation reserves where Magenta Lilly Pilly is known to occur. These include Booti Booti National Park, Botany Bay National Park, Conjola National Park, Glenrock State Conservation Area, Munmorah State Conservation Area, Myall Lakes National Park, Pulbah Island Nature Reserve, Towra Point Nature Reserve, Wamberal Lagoon Nature Reserve and Wyrrabalong National Park (draft plan). Booderee National Park has an approved Australian Government management plan and

is jointly managed by the Wreck Bay Aboriginal Community Council and the Australian Government.

The natural range of Magenta Lilly Pilly is covered by the Hunter-Central Rivers, Sydney Metropolitan, Southern Rivers and, potentially, Hawkesbury-Nepean catchment management authorities (CMAs). These CMAs operate under catchment action plans to coordinate and guide natural resource management and investment across their respective regions. The catchment action plan of each of these CMAs identifies targets that relate to biodiversity and threatened species management.

5.4 Surveys and mapping

Magenta Lilly Pilly populations and habitat have been identified, surveyed and mapped under various projects. Examples include:

- *The Distribution and Reproductive Ecology of* Syzygium paniculatum *and* Syzygium australe *(Myrtaceae) in the Gosford-Wyong Region* (Payne 1997) which, amongst other things, determined the extent and distribution of Magenta Lilly Pilly on the NSW Central Coast.
- *Magenta Lilly Pilly* Syzygium paniculatum -*Collation of Information for the Preparation of a Recovery Plan* (Eco Logical Australia 2006), a report initiated to undertake collation and validation of information and records to facilitate preparation of this plan.
- *State Environmental Planning Policy 26 Littoral Rainforest* (SEPP 26), which maps important littoral rainforest stands along the NSW coast. This mapping is not definitive, however, and stands occur at locations not mapped under this SEPP (NSW Scientific Committee 2004).

Populations and habitat have also been identified, surveyed and mapped as part of various national park and state forest planning processes. During preparation of this plan, potential new sites and unconfirmed records have been discovered. The ongoing implementation of the plan will involve investigating the reliability of these and incorporating them into management actions where appropriate.

5.5 Habitat protection and management

Private native forest harvesting operations across the natural range of Magenta Lilly Pilly in NSW require approval in the form of a property vegetation plan, and must comply, or become compliant with, one of two codes of practice – the *Private Native Forestry Code of Practice for Northern NSW* or the *Private Native Forestry Code of Practice for Southern NSW*. These codes specify that all Magenta Lilly Pilly individuals in northern and southern NSW are to be protected during private native forest operations. The codes also specify that forest operations, excepting the maintenance of existing roads, must not occur within rainforest, although this does not apply to isolated clumps or linear strips of rainforest less than 0.5 hectares in size.

5.6 Weed management

Weed management in known and potential Magenta Lilly Pilly habitat is undertaken on public lands as a component of general or specific public land management programs by state government agencies, local councils and community-based organisations. For example, in 2005, eight Landcare groups were actively restoring and managing rainforest in the Lake Macquarie area. Private landholders are also involved in weed management activities in suitable habitat, often as a legislative requirement or through funded programs.

The NSW *Bitou Bush Threat Abatement Plan* (DEC 2006) and the *Plan to Protect Environmental Assets from Lantana* (National Lantana Management Group 2010) each identifies sites for weed control where Magenta Lilly Pilly is present. Appendix 1 lists the priority sites where Magenta Lilly Pilly is present. There is also a process underway in NSW to develop control priorities for widespread weeds at a CMA level so that management programs can target those areas where control will result in the best outcome for biodiversity.

5.7 Fire management

In NSW fire management strategies have been prepared for Booti Booti National Park, Botany Bay National Park, Bouddi National Park, Conjola National Park, Glenrock State Conservation Area, Illawarra Escarpment State Conservation Area, Munmorah State Conservation Area, Myall Lakes National Park, Pulbah Island Nature Reserve, Saltwater National Park, Wamberal Lagoon Nature Reserve and Wyrrabalong National Park. A fire management plan also exists for the Royal Australian Navy Weapons Range at Beecroft Peninsula (M. Armstrong pers. comm.).

Magenta Lilly Pilly is listed on the NSW threatened species hazard reduction list under the Bush Fire Environmental Assessment Code (Rural Fire Service 2006). Under this Code, bush fire hazard reduction works at sites where Magenta Lilly Pilly is present must be consistent with the relevant conditions identified in hazard reduction list.

5.8 Pathogens

The management of Myrtle Rust in NSW is overseen by Department of Primary Industries. The role of managing the effects of the rust on threatened Myrtaceae occurring in OEH estate is the responsibility of OEH, which has prepared a Myrtle Rust management plan to try and minimise the impact of the pathogen on conservation reserves (OEH 2011).

6. Proposed Recovery Objectives, Actions and Performance Criteria

The overall objective of this recovery plan is to protect known subpopulations of Magenta Lilly Pilly from decline and to ensure that wild populations of the species remain viable in the long term.

Specific objectives of the recovery plan are listed below. For each of these objectives a number of recovery actions have been identified, each with its own performance criterion.

6.1 Coordination of recovery efforts

Objective 1: To ensure a coordinated and efficient approach to the implementation of recovery efforts.

Action 1.1: OEH will coordinate the implementation of the actions outlined in this recovery plan.

A coordinated approach is essential for overseeing and assisting in the implementation of the recovery actions outlined in this plan, in a timely, cost-effective and efficient manner. Coordination will be effected through the incorporation of recovery actions into the Priorities Action Statement as well as other suitable programs.

Performance criterion: OEH has coordinated the recovery actions outlined in this recovery plan for the life of the plan.

6.2 Targeted survey

Objective 2: To establish the full extent of the distribution of Magenta Lilly Pilly

Action 2.1: OEH will support targeted surveys for Magenta Lilly Pilly.

The current known distribution of Magenta Lilly Pilly is detailed in Section 3.2. OEH will support targeted surveys in suitable habitat to determine whether additional subpopulations of the species exist. The following are priorities for additional survey work:

- areas to the north of Port Stephens
- areas in the vicinity of Martinsville and Watagans National Park

- sections of Strickland State Forest, Ourimbah State Forest and Jilliby State Conservation Area
- the Illawarra
- areas of Conjola National Park and Booderee National Park
- sites across the Sydney metropolitan area.

Surveys are also required to determine the size, structure, and localised extent of known subpopulations. The following subpopulations are priorities:

- the larger Central Coast subpopulations in the vicinity of Ourimbah Creek and Martinsville. In particular, the long-term effects of water extraction on the Ourimbah Creek subpopulations are unknown and any surveys or monitoring for this subpopulation should be supported (also see Action 5.1).
- Coalcliff
- the Jervis Bay subpopulations at Tomerong Creek and in Conjola National Park
- known localities in the Sydney metropolitan area.

Samples of new subpopulations of the species will be collected for lodgement with herbaria. Records of new subpopulations will be entered into the Atlas of NSW Wildlife.

Performance criterion: Proposals to develop and conduct targeted surveys in priority areas of known and potential habitat of Magenta Lilly Pilly have been supported over the life of the recovery plan.

6.3 Research

Objective 3: To increase the understanding of Magenta Lilly Pilly biology and ecology

Action 3.1: OEH will support research into aspects of the biology and ecology of Magenta Lilly Pilly.

Although some research has been conducted into aspects of genetic structure, reproductive biology and seed storage potential, there is a need for further research on Magenta Lilly Pilly to guide both in situ and ex situ management. Research should target the following priorities:

- assess the impact of Myrtle Rust on Magenta Lilly Pilly in the wild and investigate the effectiveness of various treatment options (as part of broader research into impacts and treatment of Myrtaceae species in general). This should not be limited to the direct effects of Myrtle Rust on the species itself but, also, the potential effects of rust on the viability of its broader habitat.
- undertake further genotyping of offspring using a larger sample size and greater number of subpopulations
- determine if viable forms of ex situ germplasm storage exist
- determine the species' effective population size
- investigate the species response to potential climate change across its genetic and geographical range
- investigate the species response to disturbance, including fire.

Performance criteria: Research on Magenta Lilly Pilly is initiated over the life of the plan, and research outcomes are used to improve in situ and ex situ management of the species.

6.4 Habitat and threat management

Objective 4: To minimise the decline of Magenta Lilly Pilly through in situ habitat protection and management

Action 4.1: OEH will continue to implement on-ground management of Magenta Lilly Pilly and its habitat on OEH estate, and will negotiate with relevant land managers to ameliorate threats to Magenta Lilly Pilly on other public lands.

Weeds, fire, infrastructure construction and maintenance, and other threats are impacting upon Magenta Lilly Pilly subpopulations and habitat on public lands. OEH and other public land managers already undertake management to protect the species. OEH will continue to do so on its estate through existing plans and programs.

Ameliorative measures on other public land will also be encouraged. OEH will negotiate with relevant land managers, with the aim of implementing actions or modifying existing site management arrangements.

Some site-specific actions that have been identified are:

- control of Bitou Bush and Lantana at priority sites that contain Magenta Lilly Pilly (Appendix 1)
- relocation of a car park at St Georges Basin and regeneration of original Magenta Lilly Pilly habitat;
- protection of the Green Point Foreshore Reserve subpopulation from fire;
- relocation or modification and fencing off of a car park at Abrahams Bosom Reserve;
- control of Asparagus Fern at Abrahams Bosom Reserve; and
- modification of maintenance activities at Cams Wharf and Nesca Park to create favourable conditions for natural regeneration of Magenta Lilly Pilly habitat.

Depending on the outcomes of negotiations, project proposals may be developed for each of the activities identified above.

Performance criteria: OEH has continued to implement on-ground management on OEH estate over the life of the recovery plan and has negotiated ameliorative measures with relevant public land managers over the life of the recovery plan.

Action 4.2: OEH will support funding applications for restorative and management activities in known and potential Magenta Lilly Pilly habitats on private land.

Weed invasions, inappropriate fire and grazing regimes, and introduced vertebrate pests are impacting on a number of known and potential Magenta Lilly Pilly habitats on private lands.

OEH will encourage the restoration and ongoing management of suitable habitats by supporting funding applications for on-ground works including littoral rainforest expansion and rehabilitation, fire management, protection from domestic stock and vertebrate pest control.

Performance criterion: Funding applications are supported for private land activities over the life of the recovery plan.

Action 4.3: OEH will investigate the benefits and feasibility of incorporating subpopulations of Magenta Lilly Pilly adjoining conservation reserves into those reserves.

The Coalcliff and Munmorah subpopulations of Magenta Lilly Pilly occur across council, private property and conservation reserve boundaries. OEH will investigate whether there would be a benefit to extend the southern boundary of Munmorah State Conservation Area and whether it would be feasible. This will only be undertaken with agreement of Wyong Shire Council and all affected private landholders. Similarly, OEH will investigate the potential benefit and feasibility of incorporating the Coalcliff subpopulation, with the full agreement of all affected landholders, into the Illawarra Escarpment State Conservation Area.

Performance criterion: OEH has investigated the benefits and feasibility of incorporating the entire Munmorah and Coalcliff subpopulations of Magenta Lilly Pilly into adjacent conservation reserves.

6.5 Disease and pathogens

Objective 5: To reduce impacts of Myrtle Rust on Magenta Lilly Pilly and its habitat.

Action 5.1: OEH will continue to manage the effects of Myrtle Rust on Magenta Lilly Pilly on OEH estate via the Management Plan for Myrtle Rust on National Parks Estate *(OEH 2011). For sites that are not on OEH estate, OEH will liaise with land managers using the* Management

Plan for Myrtle Rust *as a guide. This should include liaison with the Australian Government over sites on Commonwealth land via the National Myrtle Rust Coordination Group*

The OEH Management Plan for Myrtle Rust will be used to undertake management of Myrtle Rust impacts on priority Magenta Lilly Pilly subpopulations and sites on OEH estate. Where Magenta Lilly Pilly occurs outside OEH estate, OEH will assist with prioritising and managing subpopulations and sites using the Management Plan for Myrtle Rust as a guide. Other threats should also be considered when undertaking prioritisation for subpopulations (e.g. the unknown effects of water extraction on the Ourimbah Creek subpopulations).

Ex situ conservation actions identified in Section 6.6 will also have a role in protecting Magenta Lilly Pilly from Myrtle Rust.

Performance criteria: OEH has identified priority sites for monitoring within six months of commencement of the recovery plan, has undertaken management if required, and has monitored the effectiveness of treatment throughout the life of the recovery plan.

Action 5.2: Magenta Lilly Pilly sites on Commonwealth land will be monitored for signs of Myrtle Rust and potential management coordinated via the appropriate agency in consultation with the National Myrtle Rust Coordination Group.

A National Myrtle Rust Coordination Group has been established, chaired by the Commonwealth with technical and policy support by state and territory agencies. The Group is coordinating ongoing actions to respond to Myrtle Rust focusing on mitigating its impact on the natural environment, including threatened and endangered species, and on industries that rely on myrtaceous species (DSEWPaC 2011).

Where metapopulations of Magenta Lilly Pilly occur across NSW and Commonwealth boundaries, coordination of prioritisation and management can be undertaken as a single unit via the National Myrtle Rust Coordination Group.

Performance criteria: Monitoring for Myrtle Rust on Commonwealth land has been undertaken within six months of commencement of the recovery plan and any required management has been coordinated across the metapopulation via the National Myrtle Rust Coordination Group throughout the life of the recovery plan.

6.6 Ex situ conservation

Objective 6: To maintain a representative ex situ collection of Magenta Lilly Pilly

Action 6.1: OEH will ensure there is an ex situ collection of representative wild populations maintained in appropriate botanic gardens.

Magenta Lilly Pilly is already in cultivation in botanic gardens located at Adelaide, Canberra, Sydney, Melbourne, Coffs Harbour, Toowoomba and Mount Annan (Quinn et al. 1995). A check is required to determine if collections represent wild plants of known provenance. It would be desirable to have unrepresented populations established. Given potential climate change, long term consideration should be given to those subpopulations most under threat from climate change, although any prioritisation for ex situ establishment should not ignore other, more immediate threats such as Myrtle Rust.

Magenta Lilly Pilly seed is intolerant to desiccation and unsuitable for storage in conventional seedbanks such as the NSW Seedbank. Ex situ conservation, therefore, is limited to tree collections, although alternative technologies for the long term ex situ storage of germplasm are to be investigated as part of the Rainforest Seed Project at Mt Annan (K. Hamilton pers. com.).

Performance criteria: The source of all ex situ collections has been established and unrepresented subpopulations identified within a year of the commencement of the plan. Ex situ populations are maintained in appropriate botanic gardens on an ongoing basis.

6.7 Community liaison, education, awareness and involvement

Objective 7: To raise awareness of the conservation significance of Magenta Lilly Pilly and involve the broader community in the recovery program

Action 7.1: OEH will liaise with landholders and land managers to convey the conservation significance of Magenta Lilly Pilly and its habitat on or adjacent to their properties. This includes ensuring landholders and managers are aware of voluntary protection measures and conservation incentive schemes available to help protect and manage the species and its habitat.

OEH will seek to secure sympathetic management of Magenta Lilly Pilly habitat from private landholders, although the nature of these arrangements will depend on the circumstances and cooperation of individual landholders. Liaison will commence in the first year of implementation of the recovery plan and continue throughout the life of the plan. Local councils will be informed of any management agreements for entry into their property information systems.

A number of mechanisms are available to help protect Magenta Lilly Pilly and its habitat, including:

- appropriate zonings under local environmental plans
- property vegetation plans under the *Native Vegetation Act 2003*
- conservation agreements and wildlife refuges under the *National Parks and Wildlife Act 1974*
- joint management agreements under the TSC Act
- Nature Conservation Trust agreements negotiated under the *Nature Conservation Trust Act 2001*.

Performance criterion: Landholders and land managers are aware of the conservation significance of Magenta Lilly Pilly and its habitat and appropriate mechanisms for the conservation of the species and its habitat are sought over the life of the plan.

Action 7.2: OEH will update and maintain information requirements for Magenta Lilly Pilly.

OEH will update the information available to the public for Magenta Lilly Pilly to provide current information on the species. OEH will also update and maintain data associated with the species that is utilised by tools such as the BioBanking and Native Vegetation assessment tools.

Performance criterion: Information requirements for Magenta Lilly Pilly are updated and maintained over the life of this recovery plan.

Action 7.3: OEH will engage with relevant Local Aboriginal Land Councils and Aboriginal communities when undertaking recovery actions on sites of cultural significance.

Magenta Lilly Pilly occurs in a number of areas of cultural significance to Aboriginal people. Prior to the commencement of on-ground recovery actions in such areas, OEH will seek to engage Local Aboriginal Land Councils and Aboriginal communities to identify any issues that may be of concern to Aboriginal people and to seek opportunities for involvement in the recovery actions.

Performance criterion: The engagement of relevant Local Aboriginal Land Councils and Aboriginal communities is sought prior to the implementation of on-ground recovery actions in areas of cultural significance to Aboriginal people throughout the life of the plan.

7. Implementation

Implementation of recovery actions specified in this recovery plan for the period of five years from publication are the responsibility of OEH and the Australian Government.

8. Social and Economic Consequences

The total cost of implementing the recovery actions is estimated to be $460 500 over the five-year period of the plan (Table 3). Some savings may be made where costs are split between Magenta Lilly Pilly recovery and other programs or where actions costed for contingency purposes might not required (e.g. management for Myrtle Rust in some subpopulations).

It is anticipated that there will be no significant adverse social or economic consequences associated with the implementation of this recovery plan, and the overall benefits to society resulting from its implementation will outweigh any potential negative consequences.

The costs required to maintain Magenta Lilly Pilly as part of Australia's natural heritage are small compared to the scientific, cultural and biodiversity values of the species. Increased community awareness will enhance the profile of threatened species in general. This in turn will lead to greater opportunities for conserving biodiversity across NSW and Australia.

9. Role and Interests of Indigenous People

Magenta Lilly Pilly occurs along a 400 kilometre stretch of the east coast of Australia. Within this area, the interests of Indigenous people are represented by numerous groups and individuals. Implementation of actions within this recovery plan will need to consider the roles and interests of these groups and individuals on a case-by-case basis. Action 7.3 will require the engagement of relevant Local Aboriginal Land Councils and Aboriginal communities prior to the implementation of on-ground recovery actions in areas managed by Aboriginal communities or areas of cultural significance to Aboriginal people throughout the life of the plan.

10. Benefits to other species/ecological communities

Implementation of the actions of this plan will assist in the conservation of the general biodiversity that share Magenta Lilly Pilly habitat. In particular, Littoral Rainforest and Coastal Vine Thickets of Eastern Australia is listed as a critically endangered ecological community on the EPBC Act and actions undertaken to conserve Magenta Lilly Pilly will assist in conserving this ecological community where they co-occur.

11. Preparation Details

This recovery plan was prepared by Ian Hanson, Ian Wilkinson, Shane Ruming and Katrina McKay, with assistance from Peter Richards and Phil Gilmour.

12. Review Date

The Australian Government will review this plan in five years.

13. References

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14. Acronyms

CMA	Catchment Management Authority
DECCW	Department of Environment, Climate Change and Water
DEWHA	Australian Government Department of the Environment, Water, Heritage and the Arts (now DSEWPaC – see below)
DoD	Australian Government Department of Defence
DSEWPaC	Australian Government Department of Sustainability, Environment, Water, Population and Communities
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
NSW	New South Wales
OEH	Office of Environment and Heritage, Department of Premier and Cabinet
SEPP	State Environmental Planning Policy
TSC Act	NSW Threatened Species Conservation Act 1995

Table 3. **Cost and implementation details of the Magenta Lilly Pilly Recovery Plan**

Action	Action title	*Priority	Cost estimate ($/year)					Total cost ($)	Responsible party	#In-kind	^Cash
			Year 1	Year 2	Year 3	Year 4	Year 5				
1.1	Recovery plan coordination	1	7 500	6 500	6 500	6 500	6 500	33 500	OEH	33 500	
2.1	Targeted surveys	2	26 500					26 500	OEH	6 500	20 000
3.1	Research	2		40 000	12 500	7 500		60 000	OEH	10 000	50 000
4.1	On-ground management on public land	1	32 000	32 000	27 500	27 500	27 500	146 500	OEH	46 500	100 000
4.2	Support for private land management	1	1 500	1 500	1 500	1 500	1 500	7 500	OEH	7 500	
4.3	Feasibility of incorporating subpopulations into conservation reserves	3				12 000		12 000	OEH	12 000	
5.1	Myrtle Rust in NSW	1	9 500	6 000	6 000	6 000	6 000	33 500	OEH	31 000	2 500
5.2	Myrtle Rust in on Commonwealth land	1	4 400	2 900	2 900	2 900	2 900	16 000	OEH, Australian Government	8 500	7 500
6.1	Ex situ conservation	1	12 000	11 000	3 000	3 000	3 000	32 000	OEH	19 000	13 000
7.1	Landholder awareness and liaison	1	4 500	4 500	4 500	4 500	4 500	22 500	OEH	20 000	2 500
7.2	Maintain information requirements	3	1 500	1 000	1 000	1 000	1 000	5 500	OEH	5 500	
7.3	Liaison with local Aboriginal groups	1	13 000	13 000	13 000	13 000	13 000	65 000	OEH	15 000	50 000
Total	Annual cost of Magenta Lilly Pilly recovery program		112 400	118 400	78 400	85 400	65 900	460 500		215 000	245 500

* Priority rankings are: 1 - Action critical to meeting plan objectives; 2 - Action contributes to meeting plan objectives; 3 - Action desirable but not essential.
# In-kind funds represent salary component of permanent staff and current resources.
^ Cash funds represent the salary component for temporary staff and other costs such as the purchasing of equipment. Cash amounts are to be sourced unless stated.

Appendix 1: Priority sites for Bitou Bush and Lantana Control

The tables below identify priority sites for Bitou Bush and Lantana control that contain Magenta Lilly Pilly. The ranking of these sites is based on the overall benefit to biodiversity present at a site and all priority species and ecological communities present at a site are listed. Some of these sites may contain cultivated Magenta Lilly Pilly or misidentified *Syzygium* species and presence of naturally occurring individuals should be confirmed prior to any on-ground management. Note that some of these sites have also been identified for control of other widespread weeds under the OEH Regional weed management priorities for biodiversity conservation.

Table 4. **Priority sites identified in the NSW Bitou Bush Threat Abatement Plan (DEC 2006) where Magenta Lilly Pilly is present. Sites are listed from highest priority to lowest.**

Site ID	Site name	Rank	Priority species or community	CMA
Category 1				
SM40	Towra Point NR	5	*Westringia fruticosa* *Viminaria juncea* (prostrate form) *Bossiaea stephensonii* *Syzygium paniculatum* *Cupaniopsis anacardioides* *Glycine clandestina* (blf) Littoral rainforest Kurnell dune forest Swamp Oak floodplain Sydney freshwater wetlands Coastal saltmarsh	Sydney Metro
HCR108	Wamberal Lagoon NR	7	*Chamaesyce psammogeton* *Senecio spathulatus* *Stackhousia spathulata* *Westringia fruticosa* *Macarthuria neocambrica* *Syzygium paniculatum* Littoral rainforest Frontal dune vegetation complex Headland heath Headland woodland Dune grasslands Swamp Oak floodplain	Hunter-Central Rivers
HCR96	Munmorah SCA	7	*Pultenaea maritima* *Diuris praecox* *Westringia fruticosa* *Macarthuria neocambrica* *Syzygium paniculatum* *Rulingia hermanniifolia* *Eucalyptus camfieldii* *Tetratheca juncea* *Macrozamia flexuosa* *Caladenia tessellata* Littoral rainforest Coastal sand dune complex Grassy headlands Frontal dune vegetation complex Freshwater wetlands Swamp sclerophyll forest on coastal floodplain	Hunter-Central Rivers

Site ID	Site name	Rank	Priority species or community	CMA
HCR43	Mungo Brush, Myall Lakes NP	13	*Chamaesyce psammogeton* *Stackhousia spathulata* *Senecio spathulatus* *Syzygium paniculatum* *Senna acclinis* *Cynanchum elegans* Littoral rainforest	Hunter-Central Rivers
HCR105	Wyrrabalong NP and Council Rd Reserve	19	*Acianthus exiguus* *Syzygium paniculatum* *Eucalyptus camfieldii* *Acianthella amplexicaulis* Littoral rainforest Frontal dune vegetation complex Coastal sand dune complex Coastal wetlands (SEPP14) Swamp sclerophyll forest on coastal floodplains	Hunter-Central Rivers
HCR20	One Mile Beach, Forster	29	*Syzygium paniculatum* *Senna acclinis* *Cynanchum elegans* Littoral rainforest Coastal sand dune complex Coastal banksia woodlands	Hunter-Central Rivers
SR18	Beecroft Peninsula, Jervis Bay	41	*Syzygium paniculatum* *Prostanthera densa* *Cryptostylis hunteriana* Littoral rainforest Bangalay sand forest Coastal saltmarsh	Southern Rivers
SR19	Beecroft Head, Jervis Bay	47	*Westringia fruticosa* *Syzygium paniculatum* *Prostanthera densa* Littoral rainforest Bangalay sand forest Coastal wetlands (SEPP14)	Southern Rivers
HCR97	Budgewoi	63	*Chamaesyce psammogeton* *Diuris praecox* *Syzygium paniculatum* Littoral rainforest	Hunter-Central Rivers
HCR26	Booti Booti NP	63	*Stackhousia spathulata* *Syzygium paniculatum* *Senna acclinis* *Cynanchum elegans* Littoral rainforest	Hunter-Central Rivers
HCR39	Seal Rocks, Myall Lakes NP	72	*Syzygium paniculatum* *Senna acclinis* Littoral rainforest Headland heath	Hunter-Central Rivers
HCR 50	Yacaaba Head, Myall Lakes NP	81	*Syzygium paniculatum* *Cynanchum elegans* Littoral rainforest Headland heath	Hunter-Central Rivers
Category 2				
HCR75	Glenrock SCA	184	*Syzygium paniculatum* *Cynanchum elegans* Littoral rainforest	Hunter-Central Rivers
HCR88	Cardiff Point	187	*Syzygium paniculatum* *Tetratheca juncea* Littoral rainforest	Hunter-Central Rivers
HCR104	Norah Head	187	*Syzygium paniculatum* *Caladenia porphyrea* Low woodland with heathland (Norah Head)	Hunter-Central Rivers
HCR103	Cantong Beach	195	*Syzygium paniculatum*	Hunter-

Site ID	Site name	Rank	Priority species or community	CMA
			Swamp sclerophyll forest on coastal floodplains	Central Rivers
SM36	Towra Point	208	*Syzygium paniculatum*	Sydney Metro
Category 3				
HCR81	Awaba Bay, Lake Macquarie SCA	242	*Syzygium paniculatum* *Tetratheca juncea* *Macrozamia flexuosa* Sydney freshwater wetlands Swamp oak floodplain Swamp sclerophyll forest on coastal floodplains	Hunter-Central Rivers
HCR86	Pulbah Island NR	243	*Syzygium paniculatum* *Macrozamia flexuosa* Swamp Oak floodplain Swamp sclerophyll forest on coastal floodplains	Hunter-Central Rivers
HCR102	Noraville	250	*Syzygium paniculatum* Swamp sclerophyll forest on coastal floodplains	Hunter-Central Rivers
HCR106	Wyrrabalong NP, Terilbah Island, Pelican Island and Nth Entrance Road Reserve	258	*Syzygium paniculatum* Coastal saltmarsh	Hunter-Central Rivers
SR22	Sanctuary Point (edge of St Georges Basin, south of Wright Beach in Booderee NP)	267	*Syzygium paniculatum*	Southern Rivers
SR23	St Georges Basin, Jervis Bay	267	*Syzygium paniculatum*	Southern Rivers
Category 4				
HCR98	Budgewoi, Mackenzie Reserve	321	*Syzygium paniculatum*	Hunter-Central Rivers

Table 5. **Higher priority sites identified in the Plan to Protect Environmental Assets from Lantana (National Lantana Management Group 2010) where Magenta Lilly Pilly is present.**

Site ID	Site name	Rank	High priority assets at risk	CMA
Priority 1				
1-14	Jilliby SCA	8	*Callistemon shiressii* *Grevillia parviflora* ssp. *parviflora* Lowland rainforest *Melaleuca biconvexa* *Syzygium paniculatum*	Hunter-Central Rivers
1-49	Myall Lakes NP (Mungo Brush)	45	Littoral rainforest *Syzygium paniculatum*	Hunter-Central Rivers
Priority 2				
1-53	Wamberal NR-2	158	Littoral rainforest *Syzygium paniculatum*	Hunter-Central Rivers
1-93	Limbodalla Wildlife	168	*Syzygium paniculatum*	Southern Rivers
2-35	Myall Lakes NP (Seal Rocks/Lighthouse Beach)	194	Littoral rainforest *Senna acclinis* *Syzygium paniculatum*	Hunter-Central Rivers
Priority 3				
2-58	Pulbah Island NR	236	*Syzygium paniculatum* Swamp Oak floodplain forest	Hunter-Central Rivers
2-71	Booti Booti/Elizabeth Beach	236	Littoral rainforest *Syzygium paniculatum*	Hunter-Central Rivers


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