Appendix C

Pagoda Dependent Species - Profiles, Maps and Analysis

This appendix provides a literature review on habitat and known distribution on a number of species identified by Washington and Wray (2011) and subsequently the PAC Report as being dependant on SPLs.

C.1 Flora Species

C.1.1 Leucochrysum graminifolium (Pagoda Rock Daisy)

i. Conservation Status:

Leucochrysum graminifolium (Pagoda Rock Daisy) is not listed under the TSC Act or EPBC Act. It is considered to be a species of least concern according to the IUCN (Bell 2008). It is classified as ROTAP: 2R, a rare species with a distribution of less than 100km.

This species is endemic to the Greater Blue Mountains World Heritage Area (The Blue Mountains Botanic Garden- Mount Tomah 2013) within the Wollemi and Gardens of Stone National Parks.

ii. Species habitat:

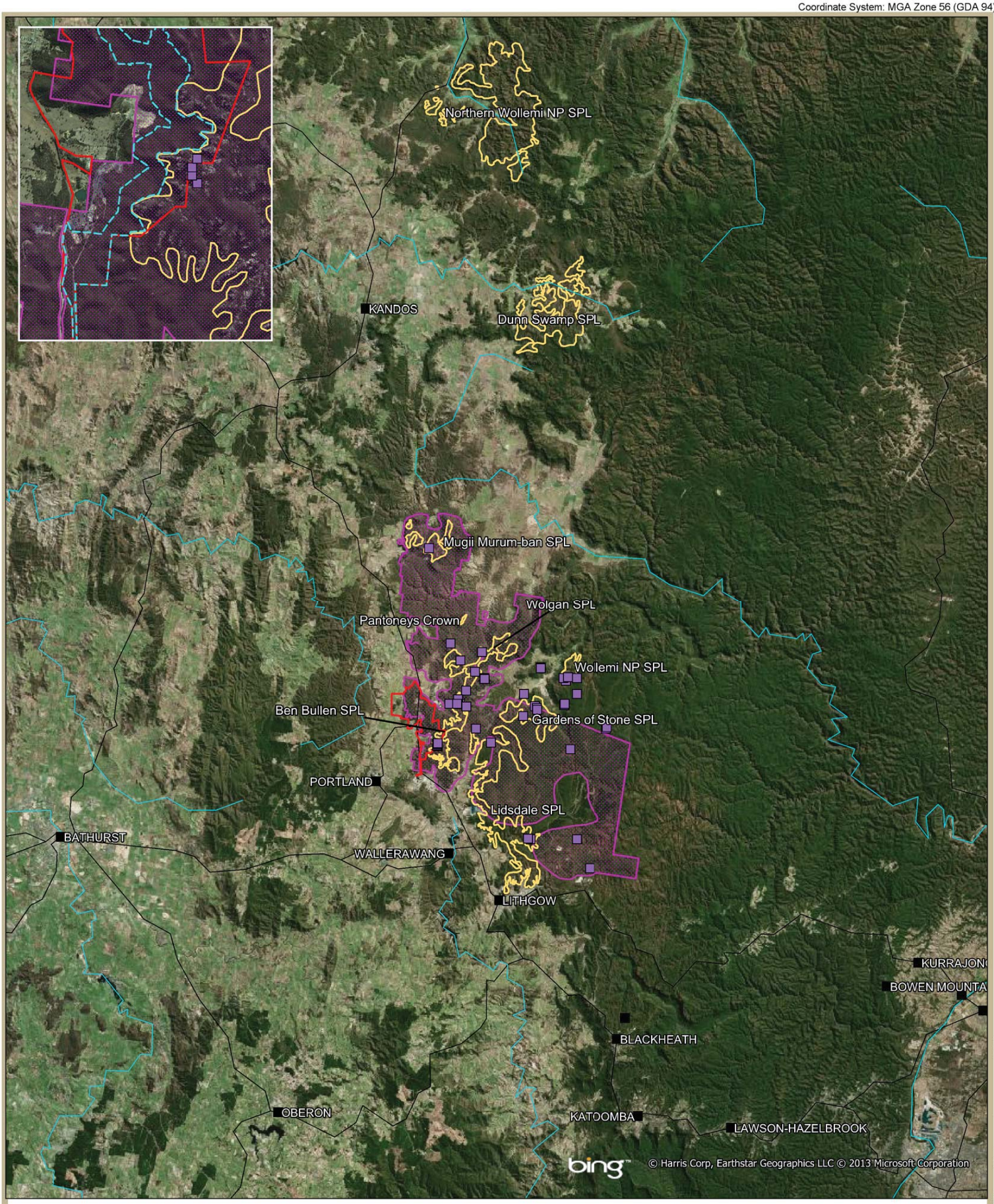
L. graminifolium grows on exposed sites on sandy soils and in sand deposits in cracks and depressions in sandstone pagoda and rock shelf formations and rocky heath (Bell 2008, Botanic Gardens Trust 2013a).

iii. Species Distribution:

The species is endemic to the Greater Blue Mountains World Heritage Area and distributed from the Lithgow district to Rocky Creek and Mt Dawson in the south-west of Wollemi National Park, to the Newnes Plateau (Bell 2008, Botanic Gardens Trust 2013a). It has been recorded in Wolgan State Forest, Ben Bullen State Forest, Birds Rock Nature Reserve and Newnes State Forest (CHAH 2013).

iv. Assessment of Dependency on SPLs:

Although *L. graminifolium* is generally associated with pagoda habitat, it is not entirely restricted to pagodas and also occurs on rock shelf formations and rocky heaths.



Legend

- Project Boundary
- Pagoda Country (as mapped by Washington and Wray 2011)
- Significant Pagoda Landforms
- Contracted Project Disturbance Boundary
- River
- Road
- Town
- *Leucochrysum graminifolium*

Scale 1:484,000

Data Source:
NPWS Atlas Data: dated 18/01/2013
Washington, H.G. and Wray, R.A.L., 2011
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I:\...\13007\Figures\RP1_SOE_20130306\Figure C.1. Leucochrysum graminifolium

Figure C.1. Leucochrysum graminifolium Records (ROTAP: 2R)

5 0 5 10 15 20 km

C.1.2 Prostanthera hindii

i. Conservation Status:

Prostanthera hindii is not listed under the TSC Act or EPBC Act. It is considered to be a species of least concern according to the IUCN (Bell 2008). It is classified as ROTAP: 2KC- (geographic range of less than 100km, distribution poorly known, at least one population occurs in a national park (i.e Wollemi), size unknown). Conn (1997) estimates this population to be less than 1,000 plants whilst Bell (2008) estimates it to be over 1,000.

ii. Species Habitat:

The species grows in shrubland and woodland and is confined to shallow quartz-rich sandy soils of rocky sandstone or conglomerate platforms and outcrops, amongst steep rocky turret faces and deep rubble-filled fissures (Conn 1997) in Wollomi National Park and the Rylstone district (Botanic Gardens Trust 2013a).

According to Conn (1997) this species is confined to Eucalyptus woodlands with an understorey shrubbery of *Lepidosperma sp., Leptospermum sp., Leucopogon sp., Platysace sp.* and *Calytrix tetragona.* In the Wollemi, known records of *P. hindii* are found in pagoda heath environments with considerable variation in associated species, reflecting the variation in elevation and rainfall along the western regions of Wollemi (Conn 1997, Bell 2008).

iii. Species Distribution:

The species has very localised and disjunct distribution, restricted to the Wollemi National Park and Rylstone district of NSW (Conn 1997, Botanic Gardens Trust 2013a). In Wollemi National Park the species has been recorded in pagoda heath vegetation at three locations along the western edge of the park; Lee Creek, Dunns Swamp and Rocky Creek near the Newnes Plateau (Bell 2008). Washington (2001) has recorded this species near Mt Jamison and at Point Cameron within the Gardens of Stone National Park.

iv. Assessment of Dependency on Pagoda Landforms:

P. hindii is associated with rocky platforms and pagoda habitats but is not entirely restricted to pagodas. A number of records occur outside of the core Pagoda Country mapping, as mapped by Washington and Wray (2011) and outside 'significant pagoda landforms' as mapped by Cumberland Ecology (2013).

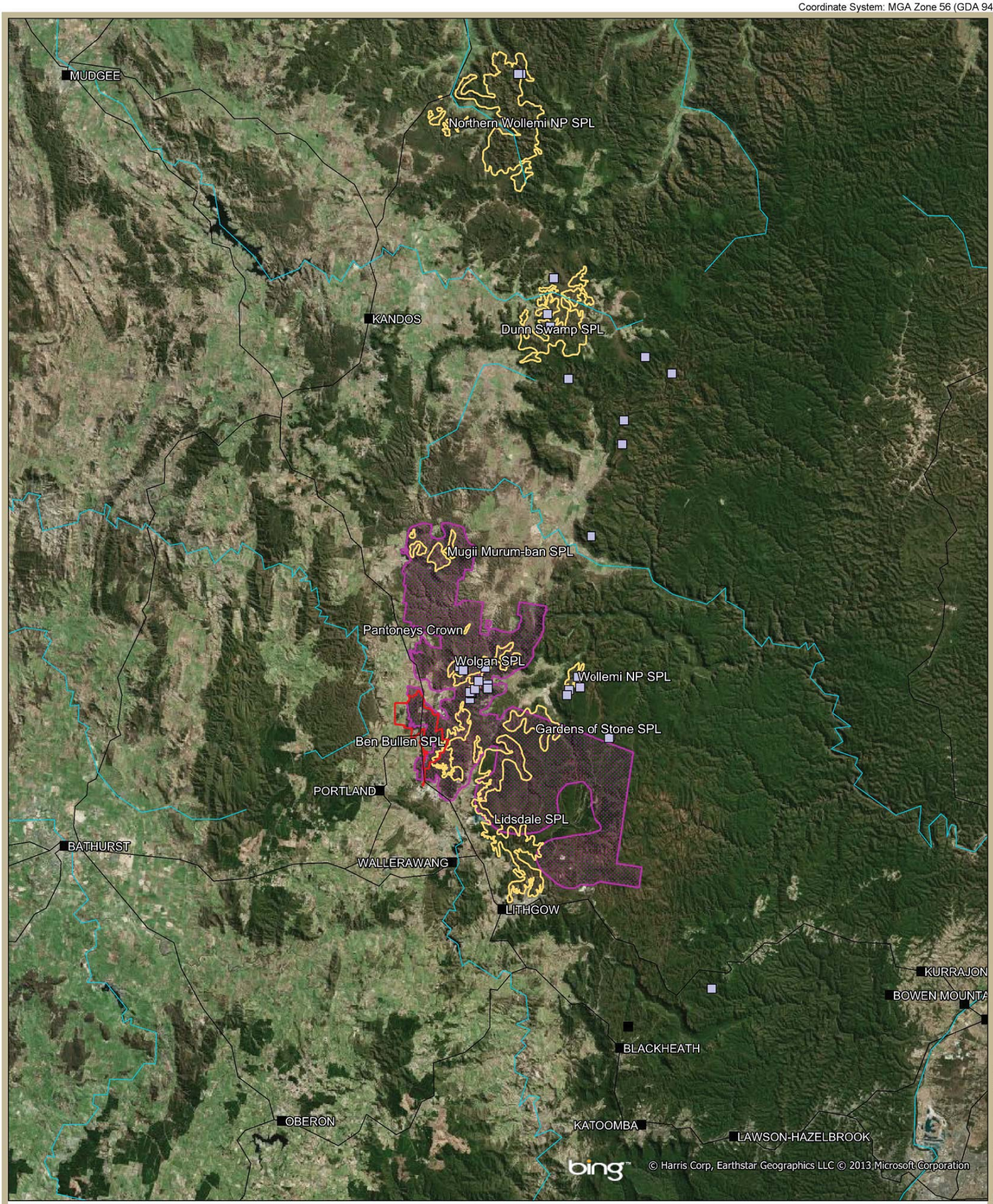


Figure C.2. Prostanthera hindii Records (ROTAP: 2RCi)

C.1.3 Leionema scopulinum

i. Conservation Status

This species is not listed under the TSC Act or the EPBC Act. It is listed as vulnerable by the IUCN (Bell 2008). *Leionema scopulinum* is classified as ROTAP 2Rcit (geographic range of < 100km, rare, with at least one population in a National Park or reserve) (Horton et al. 2004). The population is considered to consist of less than 1,500 plants, with all known populations occurring within Wollemi National Park (Horton et al. 2004).

ii. Species habitat:

Leionema scopulinum is associated with 'Pagoda' sandstone rock formations and grows on rocky ledges and in the clefts associated with this rock formation (Botanic Gardens Trust 2013a). It occurs within eucalypt open forest and heathlands but has been recorded in disturbed areas (described as cleared or non native vegetation (CHAH 2013).

iii. Species Distribution:

The species is thought to be restricted to an area of 14km by 7km within Wollemi National Park (Horton et al. 2004).

iv. Assessment of Dependency on Pagoda Landforms:

This species appears to have a very restricted distribution within Wollemi National Park and is know from rocky ledges in pagoda habitats.

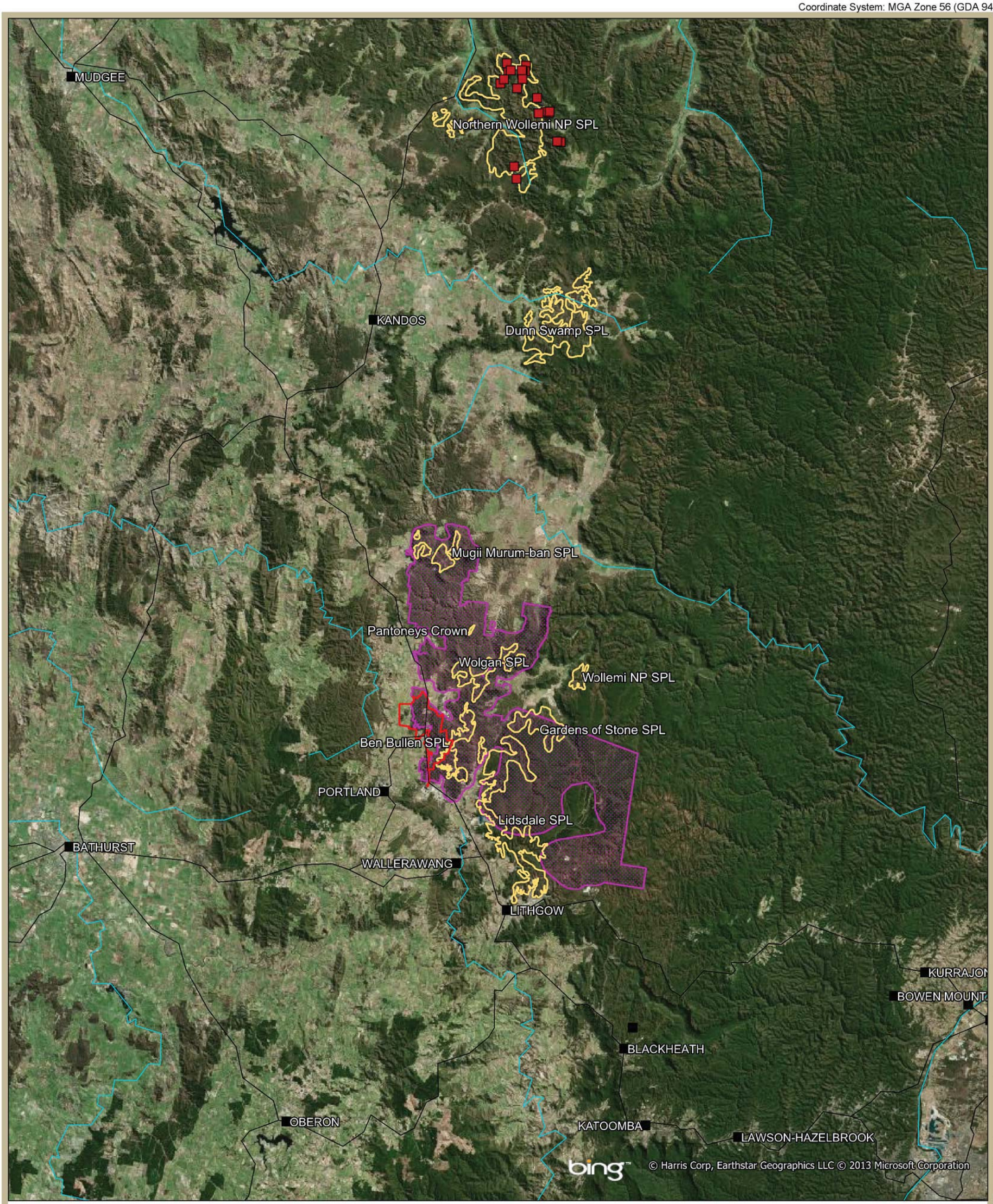


Figure C.3. Leionema scopulinum Records (Not Threatened)

C.1.4 Pseudanthus divaricatissimus

i. Conservation Status:

Pseudanthus divaricatissimus is not listed under the TSC Act or the EPBC Act. It is classified as ROTAP 3Rca (Botanic Gardens Trust 2013a). This means that its geographical range in Australia is thought to be greater than 100km, that it is rare (although not currently under any identifiable threat), has at least one population within a National Park or conservation reserve and 1,000 plants or more occur within a conservation reserve (Bell 2008).

P. divaricatissimus is conserved in the Blue Mountains National Park, Wollemi National Park, Kanangra-Boyd National Park, Morton National Park, Snowy River National Park and Dangelong Nature Reserve (CHAH 2013).

ii. Species habitat:

This species occurs in sandy soils on sandstone rock formations (Botanic Gardens Trust 2013a). It occurs within Eucalypt open forest and heathlands but has been recorded in disturbed areas (described as cleared or non native vegetation) (CHAH 2013).

iii. Species Distribution:

P. divaricatissimus is found in North Coast, Central Coast, Central Tablelands, Southern Tablelands and Central Western Slopes botanical sub-divisions in NSW between Muswellbrook and Bega although there are records from other states and outlying populations near Dubbo and Urbenville (Botanic Gardens Trust 2013a). The majority of recordings of this species are from between Katoomba and Victoria Pass in NSW. Its distribution includes parts of Morton National Park between Ulladulla and Bundanoon, Blue Mountains National Park, Kanangra-Boyd National Park and Dangelong Nature Reserve. There are records of this species near Cowra, NSW and also in Victoria. The records in Victoria occur in Lerderderg State Park, Snowy River National Park, Alpine National Park and one in a state forest southeast of Coopracambra National Park approximately 40km northwest of Mallacoota (CHAH 2013).

iv. Assessment of Dependency on Pagoda Landforms:

P. divaricatissimus has a fairly wide distribution and is known to occur on sandstone rock formations in Eucalypt open forest and heath. It has also been recorded from disturbed areas and is not considered to be dependent on Pagoda landforms.

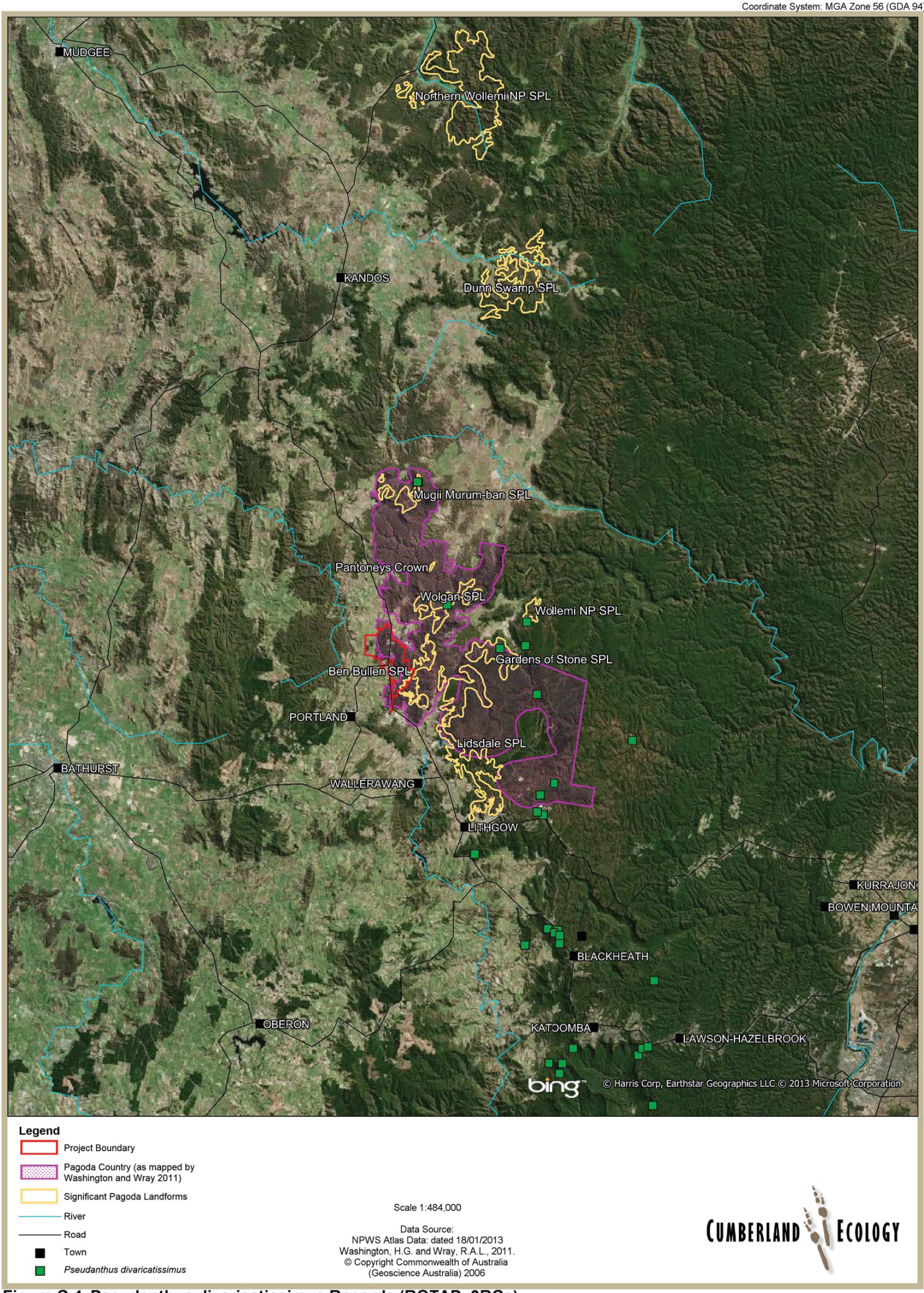


Figure C.4. Pseudanthus divaricatissimus Records (ROTAP: 3RCa)

C.1.5 Banksia pencillata (Old-man Banksia)

i. Conservation Status:

The species is not listed under the TSC Act or the EPBC Act. It is classified as ROTAP 3RC (Briggs and Leigh 1995). This means that its geographical range in Australia is thought to be greater than 100km, that it is rare (although not currently under any identifiable threat) and has at least one population within a National Park or conservation reserve (Bell 2008). *Banksia penicillata* is listed by the IUCN as least concern (Bell 2008).

B. pencillata is conserved in Wollemi National Park and Blue Mountains National Park (CHAH 2013).

ii. Species habitat:

It occurs in dry sclerophyll forest or woodland on sandstone cliffs or steep slopes and around rocky outcrops (Botanic Gardens Trust 2013a). It occurs within Eucalypt open forest and heathlands but has been recorded in disturbed areas (described as cleared or non native vegetation) (CHAH 2013).

iii. Species Distribution:

B. pencillata occurs in the Central Coast, Central Tablelands and Central Western Slopes botanical subdivisions (Botanic Gardens Trust 2013a) particularly in the northern and northwestern parts of the Blue Mountains National Park (CHAH 2013). It occurs in Wollemi National Park, Newnes State Forest and Coricudgy State Forest. There is also an outlying record northeast of Kandos and east of Mudgee (CHAH 2013).

iv. Assessment of Dependency on Pagoda Landforms:

This species is known to occur on pagoda landfroms but is not restricted to pagoda habitats, also occurring on slopes and ridges within Eucalypt open forest on the deeper sands around Hefrons Gap (Bell 2008).

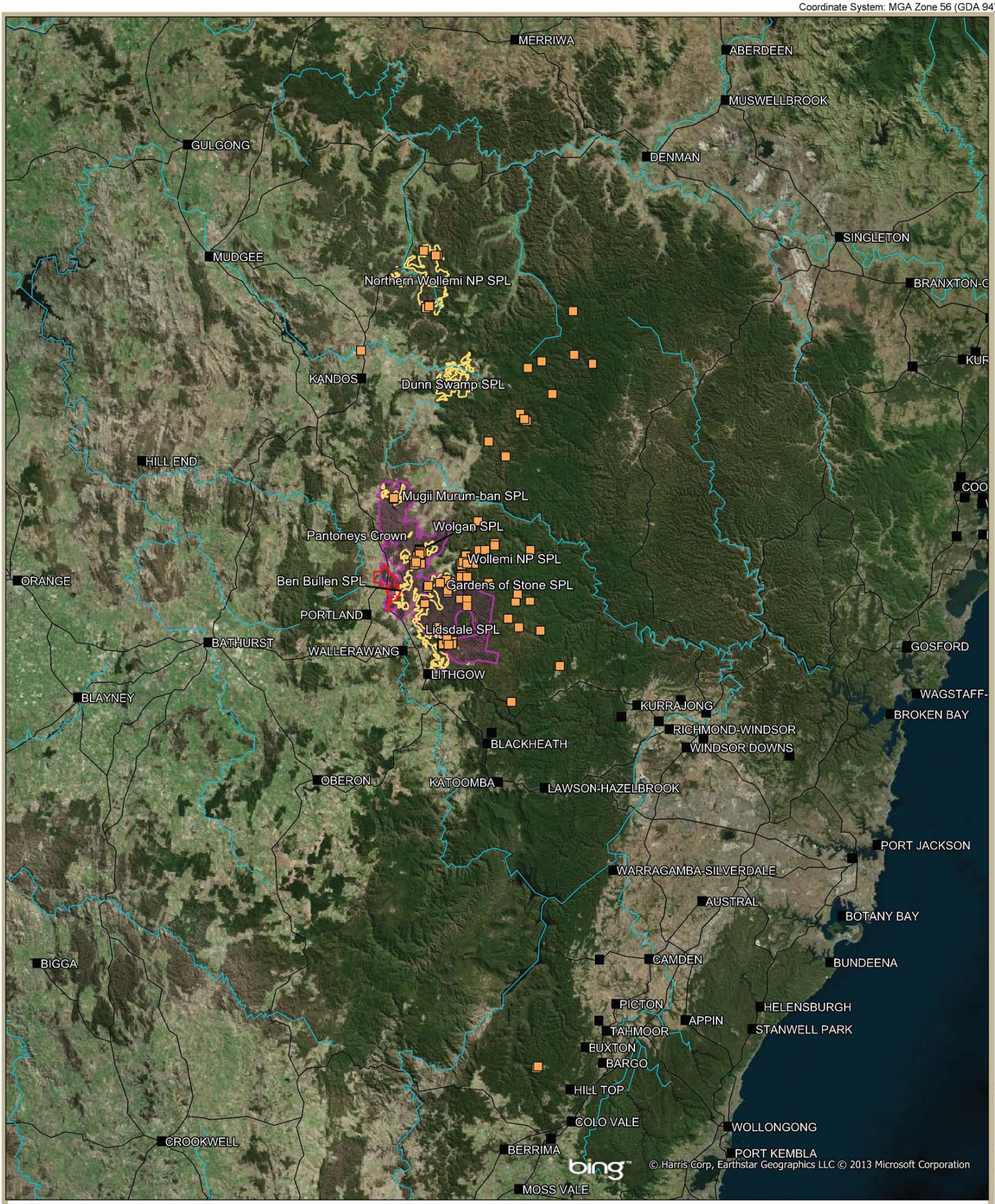


Figure C.5. Banksia penicillata Records (Not Threatened)

C.1.6 Acacia asparagoides

i. Conservation Status:

Acacia asparagoides is not listed under the TSC Act or the EPBC Act. It is classifed ROTAP 2R, with a geographical range of less than 100km and rare (but not currently under an identifiable threat) (Briggs and Leigh 1995). It is conserved in Wollemi National Park and the Blue Mountains National Park (CHAH 2013).

ii. Species habitat:

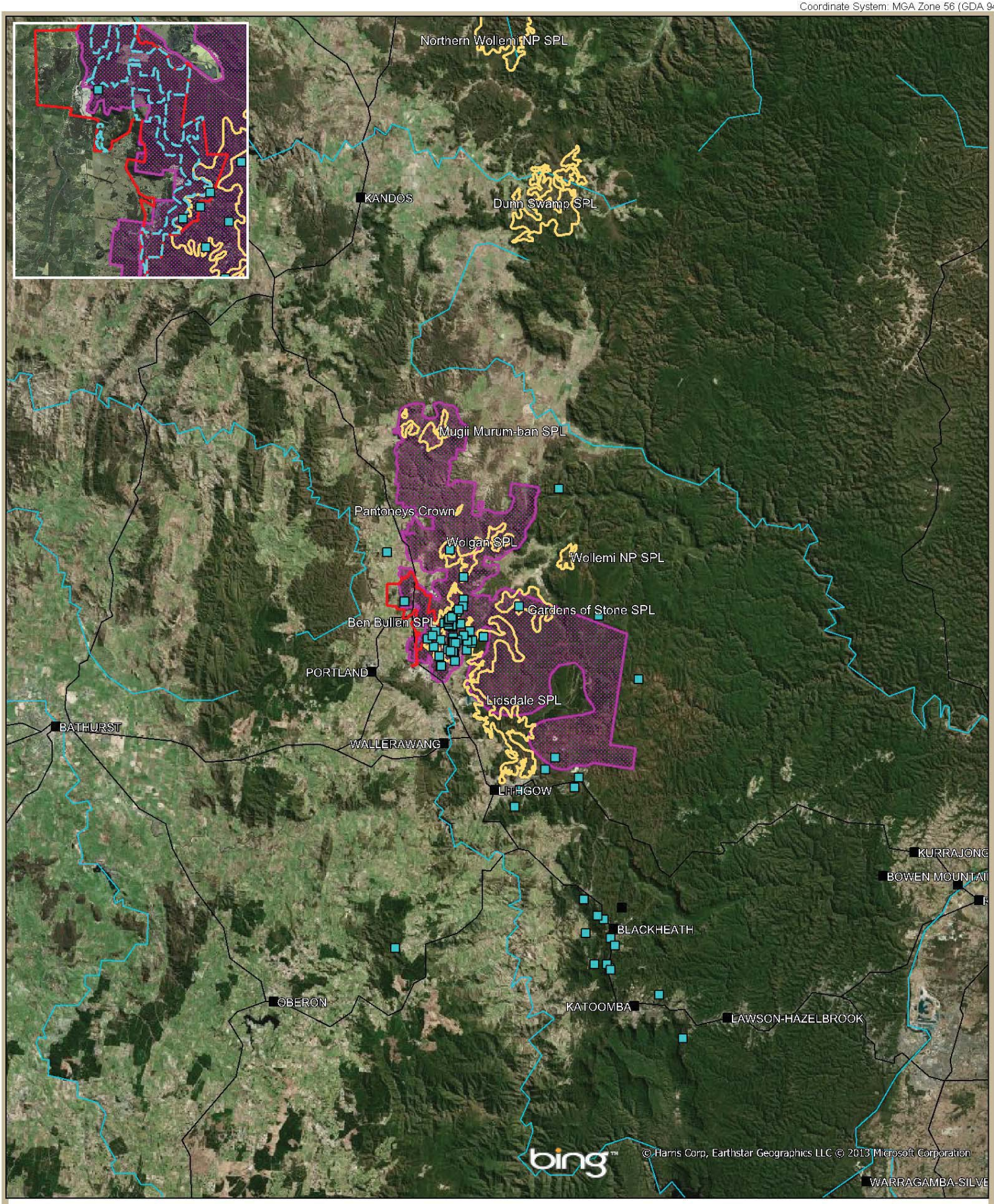
A. asparagoides occurs in dry sclerophyll forest, and occasionally on heathland, on sandstone rock formations (Botanic Gardens Trust 2013a). It has also been recorded in disturbed areas (described as cleared or non native vegetation (CHAH 2013)).

iii. Species Distribution:

This species mainly occurs in the Central Coast (Botanic Gardens Trust 2013a) and Central Tablelands botanical subdivision in NSW and particularly between Katoomba/Lawson and the Gardens of Stone National Park (CHAH 2013). Records occur across this area in the vicinity of Blackheath, Lithgow, Victoria Pass, Newnes State Forest and Ben Bullen State Forest (CHAH 2013). Two outlying records that occur: one from 40km north of Toowoomba in Queensland and one from 15km southwest of Omeo in Victoria (CHAH 2013).

iv. Assessment of Dependency on Pagoda Landforms:

This species is associated with open forest and heath habitats on sandstone plateaus in the Blue Mountains (Tame 1992) and is not restricted solely to pagoda habitats.



Legend

- Project Boundary
- Pagoda Country (as mapped by Washington and Wray 2011)
- Significant Pagoda Landforms
- Contracted Project Disturbance Boundary
- River
- Road
- Town
- *Acacia asparagoides*

Scale 1:484,000

Data Source:
NPWS Atlas Data: dated 18/01/2013
Washington, H.G. and Wray, R.A.L., 2011

CUMBERLAND ECOLOGY

5 0 5 10 15 20 km

I:\...\13007\Figures\RP1_SOE_20130306\Figure C.6. Acacia asparagoides

Figure C.6. Acacia asparagoides Records (ROTAP: 2R)

C.1.7 Epacris muelleri

i. Conservation Status:

This shrub grows in skeletal soils on damp rock faces on sandstone in the Blue Mountains and Wollemi National Parks (Botanic Gardens Trust 2013a). It has also been recorded in the Gardens of Stone National Park (Washington 2001).

Epacris meulleri is not currently listed as threatened under the EPBC Act or the TSC Act. It is considered to be a vulnerable species according to the IUCN (Bell 2008). It is classified as ROTAP 3RC-, a rare species with a geographical range of more than 100km with at least one population (size unknown) occurring within a National Park or Conservation Reserve (Bell 2008).

ii. Species Habitat:

E. meulleri grows in sheltered sites with skeletal soils and low nutrients on damp rock faces, pagoda rock formations, rock crevices and cliffs at an altitude of 600-1100m (Botanic Gardens Trust 2013a), (Bell 2008). It can be found in cliff-line vegetation associated with species such as *Dracophyllum secundum*, and in shrub/heath vegetation associated with species such as *Leptospermum arachnoides, Allocasuarina nana, Leptospermum macrocarpum* and *Eucalyptus oreades*.

iii. Species Distribution

North from Katoomba, to Koricudgy State Forest east of Kandos (CHAH 2013). Within Wollemi, the species has been recorded on damp rock faces in a number of places, including the southern and south-western sections of the park, around Mt Irvine and Glen Davis; also in the central portion near the Kekeelbon Mountains, Mt Duran Duran, Cyrils Rocks, and Dunns Swamp (Kandos Weir) (Bell 2008).

Near Box Hole Clearing, it occurs on rocky outcrops in a mallee heathland, whilst further to the south near Wolgan Lookout, *E. muelleri* occurs within sheltered open forest (Bell 2008).

iv. Assessment of Dependency on Pagoda Landforms:

Whilst *E. muelleri* is associated with sandstone cliffs and rock faces, including pagodas, it is not restricted to pagoda landforms *per se,* and occurs in a number of other rocky environments throughout Wollemi and the Blue Mountains National Parks and surrounds.

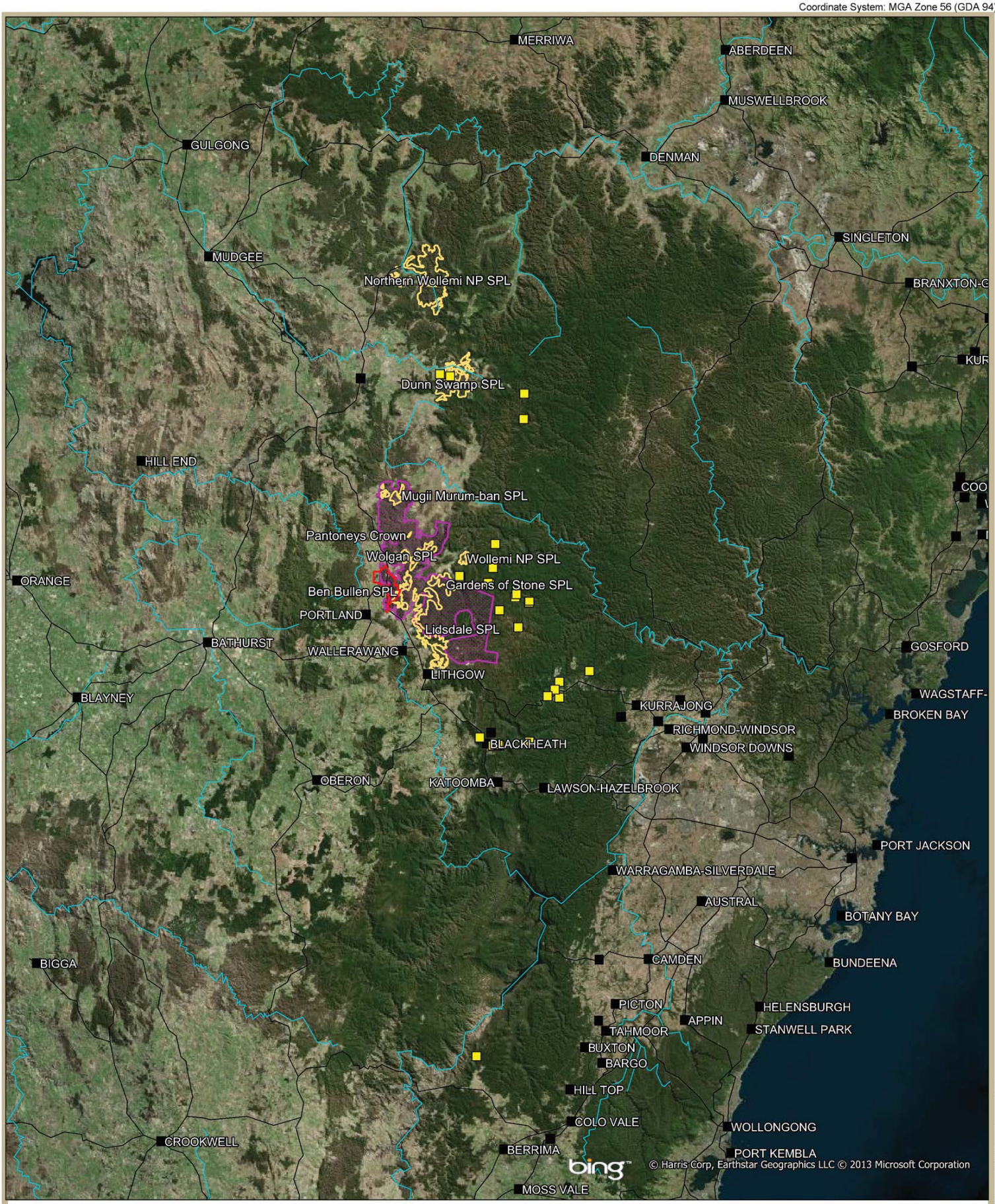


Figure C.7. Epacris muelleri Records (ROTAP: 3RC-)

C.1.8 Philotheca obovalis

i. Conservation Status

Philotheca obovalis grows in heath and dry sclerophyll forest on sandstone in the Blue Mountains (ANPS 2013a). Briggs and Leigh (1995) considered this species to be adequately conserved in the Blue Mountains National Park, with insufficient information available on population sizes within Wollemi National Park. It has also been recorded near Mt Jamison and Point Cameron in the Gardens of Stone National Park (Washington 2001).

Not currently listed as threatened under the EPBC Act or TSC Act. It is considered to be a species of least concern according to the IUCN (Bell 2008). Regarded as rare in the wild and classified as 3RCa (a geographical range of more than 100km, with at least one population of 1,000 plants or more in a Reserve or National Park) under the ROTAP system (Briggs and Leigh 1995).

ii. Species Habitat

Where it occurs north of Newnes plateau, it does so on montane rocky heath and is associated with species such as *Banksia ericifolia, Leptospermum parvifolium, Eucalyptus laophila, Dillwynia floribunda var. teretifolia, Kunzea ambigua, Baeckea densifolia, Allocasuarina nana* and *Grevillea sericea* (Bell 2008). It is also known to occur in open forest along the Mt Cameron Fire Trail, with overstorey species including *Eucalyptus sclerophylla, E. piperita* and *E. sieberi* and an understorey of sclerophyllous species including *Dillwynia phylicoides, Hakea spp., Hibbertia serpyllifolia, Leptospermum sphaerocarpum, , Banksia serrata, Lomandra obliqua* and *Patersonia glabrata* (Bell 2008).

iii. Species Distribution

As well as being recorded in the Blue Mountains on the northern Newnes Plateau and east along Mt Cameron Fire Trail (Bell 2008), this species has also been recorded at Kydra Mountain, NSW (Botanic Gardens Trust 2013a).

iv. Assessment of Dependency on Pagoda Landforms:

This species is associated with rocky heath and dry sclerophyll forest on sandstone across the Blue Mountains. Whilst numerous records occur within ‘pagoda country’, as mapped by Washington and Wray (2011) and ‘significant pagoda landforms’ as mapped by Cumberland Ecology (this report), the species has a much wider distribution across the Blue Mountains and is not considered to be dependent on pagoda landforms.

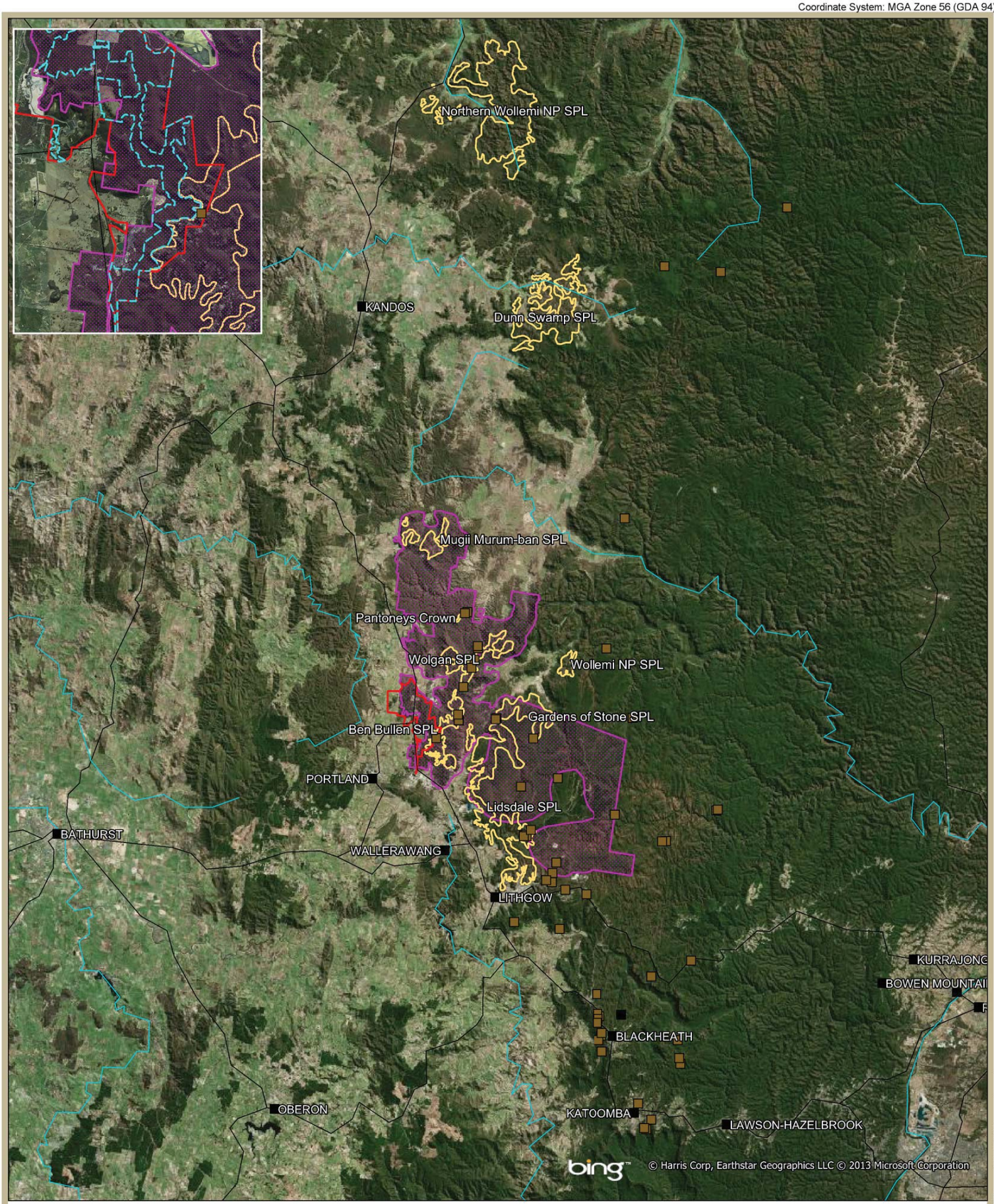


Figure C.8. Philotheca obovalis Records (ROTAP: 3RCa)

C.1.9 Eucalyptus oreades (Blue Mountains Ash)

i. Conservation Status:

Eucalyptus oreades (Blue Mountains Ash) is not listed under the TSC Act or EPBC Act. No other legal or conservation status is applicable to this species.

ii. Species habitat:

E. oreades occurs in wet or dry sclerophyll forest, usually on poor skeletal or sandy soils on high sloping country (Botanic Gardens Trust 2013a).

iii. Species Distribution:

E. oreades has sporadic but locally frequent distribution in Queensland and NSW. In NSW, the species occurs disjunctly in the North and Central Coast, and Northern and Central Tablelands regions. Within these areas, it is distributed from the Nattai River near Mittagong to the Blue Mountains west of Sydney, and north to the McPerson Range in the NSW-QLD border region (Brooker and Kleinig 1990).

iv. Assessment of Dependency on Pagoda Landforms:

This species is associated with steep slopes and ridges mainly in the Upper Blue Mountains where it is locally frequent (Benson and McDougall 1998). It is not restricted to pagoda landforms and numerous records occur outside the area mapped as Pagoda Country by Washington and Wray (2011).

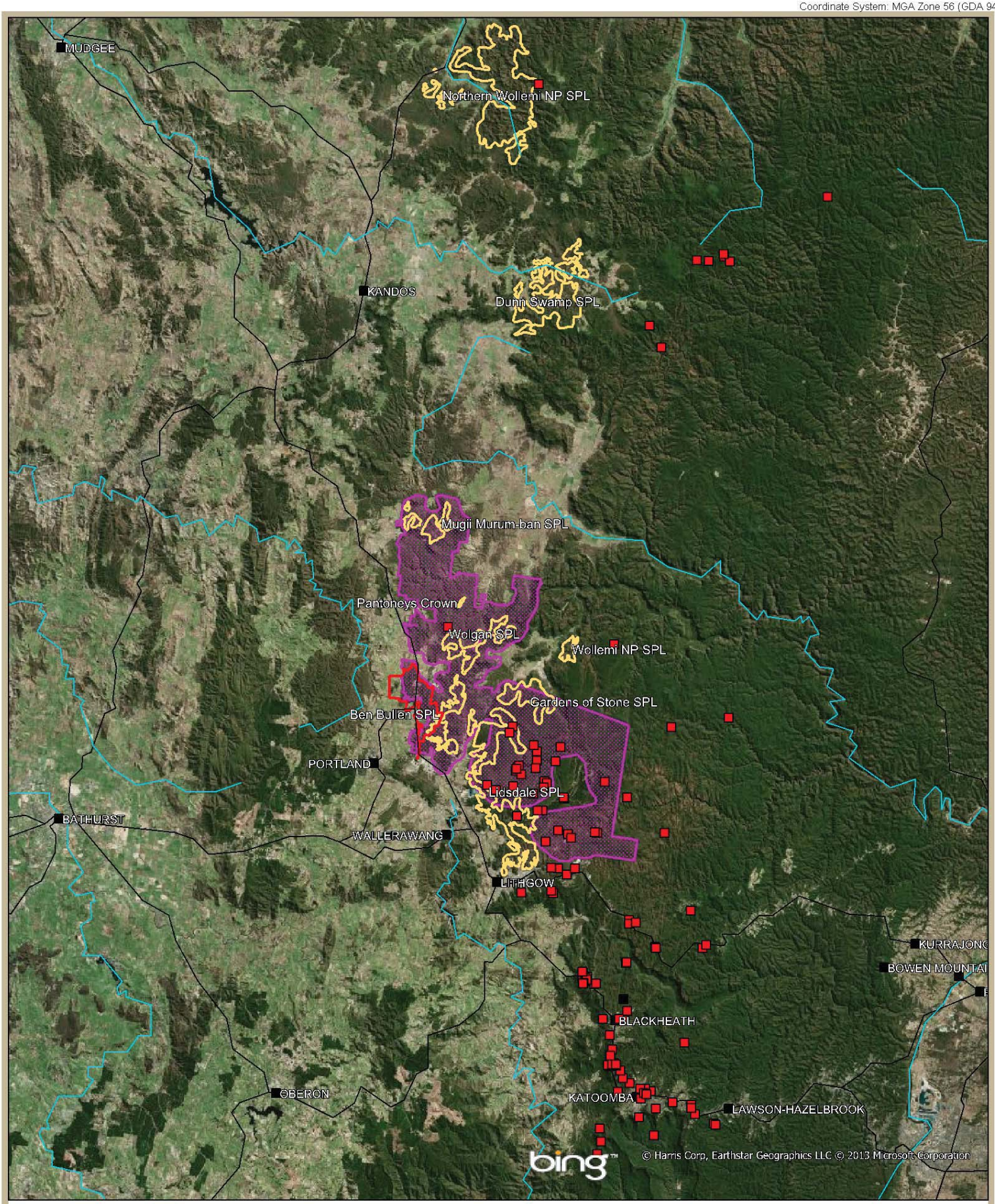


Figure C.9. Eucalyptus oreades Records (Not Threatened)

C.1.10 Leionema lamprophyllum ssp. orbiculare

i. Conservation Status:

Leionema lamprophyllum subsp. *orbiculare* is not listed under the TSC Act or EPBC Act. It is considered to be data deficient according to the IUCN (Bell 2008). It is classified as ROTAP: Recommend 2R-P3, with a geographic range of less than 100km. It is known from several populations, at least some of which are not believed to be under immediate threat (i.e. not endangered). Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey (Briggs and Leigh 2006).

ii. Species habitat:

Leionema lamprophyllum subsp. *orbiculare* grows in heath on exposed ridges at higher altitudes (Botanic Gardens Trust 2013a).

In the Wollemi National Park the species is restricted to pagoda habitats (Bell 2008). The species has been recorded in habitat of open heath to open shrubland of *Acacia* and *Calytrix* species to low open Eucalypt dominated woodland and is associated with *Banksia ericifolia, B. spinulosa, Calytrix tetragona* and *Brachyloma daphnoides* (Benson and McDougall 2001). Bell (2008) notes that such habitat is fairly common in restricted areas along the western escarpment of Wollemi, and that as a consequence, there is considerable potential habitat for this taxa.

iii. Species Distribution:

The species has restricted distribution from Kandos Weir (east of Rylstone) to Lithgow where it is known from isolated patches of individuals (Botanic Gardens Trust 2013a). Records for the species occur within and near Wollemi National Park in the vicinity of Dunns Swamp (Kandos Weir) and Newnes and Coricudgy State Forests (Bell 2008, CHAH 2013). The species has been recorded in rocky heath near the Coalpac Banner Drop site above Invincible Colliery high-walls (Blue Mountains Conservation Society 2011)

iv. Assessment of Dependency on Pagoda Landforms:

This species is associated with pagoda rocky on heath and within 'pagoda country', as mapped by Washington and Wray (2011) and 'significant pagoda landforms' as mapped by Cumberland Ecology (this report).

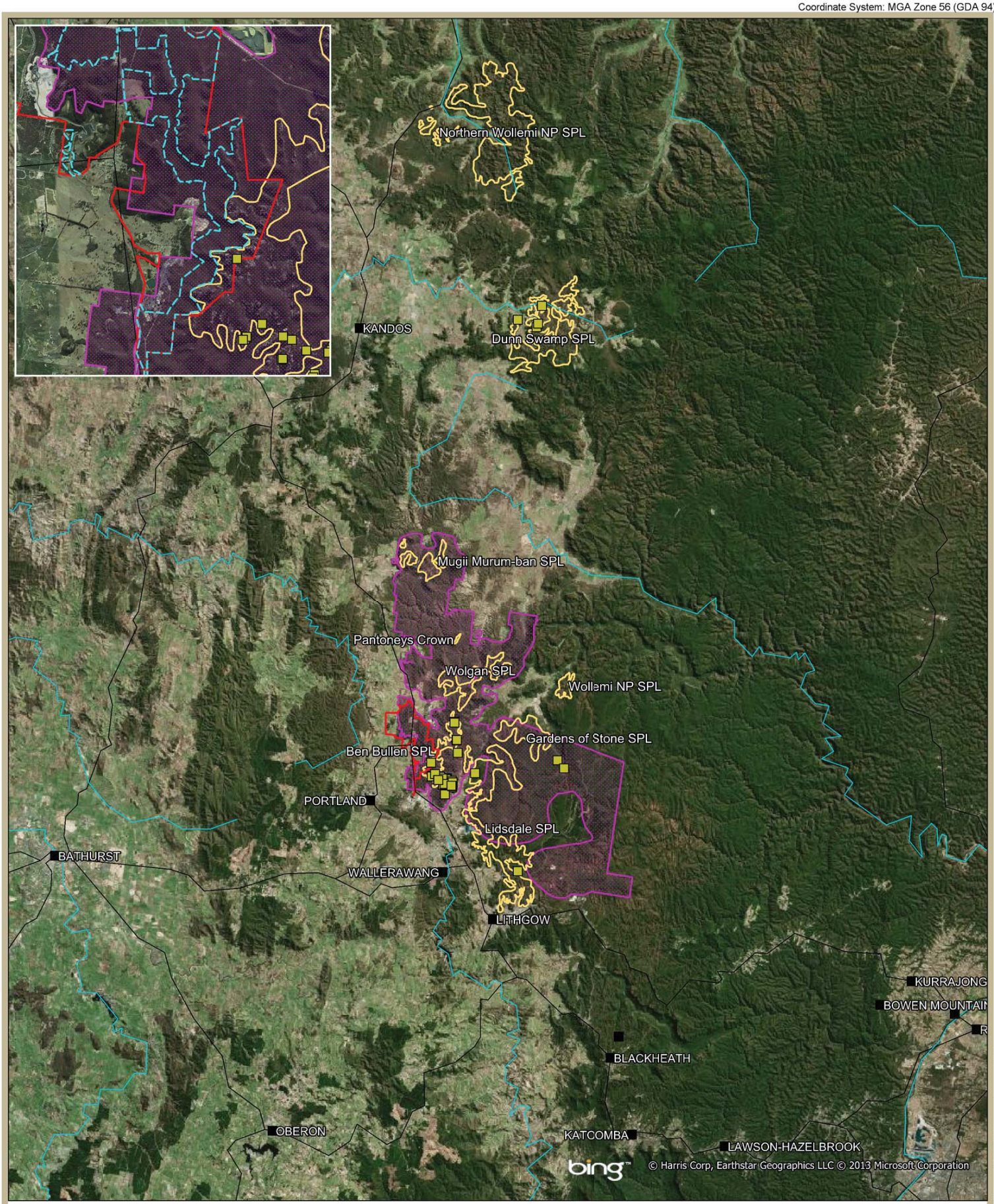


Figure C.10. Leionema lamprophyllum subsp. orbiculare Records (ROTAP: Recommend 2R-P3)

C.2 Fauna Species

C.2.1 Broad-headed Snake (Hoplocephalus bungaroides)

i. Conservation Status

The Broad-headed Snake is listed as Vulnerable under the EPBC Act and as Endangered under the TSC Act. Internationally it is listed as Vulnerable by the International Union for the Conservation of Nature (IUCN).

The species habitat is conserved in the following National Parks: Blue Mountains, Heathcote, Morton, Royal, Yengo, Dharug, Popran and Wollemi, as well as the Parr State Recreation Area (SEWPaC 2011c). It was historically known from areas now within Garigal, Ku-ring-gai, Lane Cove and Marramarra National Parks (NSW NPWS 1999b).

Other important areas of distribution where the species is protected include: Avon, Cataract, Cordeaux, Nepean and Woronora Catchment areas and the Holsworthy Military Lands on the southern outskirts of Sydney (NSW NPWS 1999b). It also occurs in the following State Forests: Colymea, Yalwal, Yerriyong, and Mount Keira (Cogger et al. 2003).

ii. Species Habitat

The preferred habitat of the Broad-headed Snake is centred on the communities occurring on the Triassic sandstone of the Sydney Basin. The most suitable sites occur in sandstone ridgetops (Cogger et al. 1993). Suitable habitat is patchily distributed throughout the species range (Cogger et al. 2003).

The sites where Broad-headed Snakes occur are typified by exposed sandstone outcrops and benching and in these locations the vegetation is mainly woodland, open woodland and/or heath. The Broad-headed Snake seasonally occupies distinctive microhabitats within these broader habitat types. Adults use rocks and crevices as shelter sites in rocky outcrops in autumn, winter and early spring. Occupied crevices have a sunny aspect (Webb and Shine 1998) and rocks used by snakes are those that receive the most warmth from the sun (Pringle et al. 2003). Thermally suitable microhabitat may be a limiting resource for the species (Pringle et al. 2003).

In late spring and summer, when temperatures under rocks become too hot for many snakes, adult males and non-breeding adult females move up to 780 m above sea level into adjacent woodland (Webb and Shine 1997a). Gravid females and juveniles remain in rocky habitat, using cooler, shaded rocks and crevices (Webb and Shine 1998).

In woodland, snakes shelter in hollows in a variety of tree species including Red Bloodwood (*Eucalyptus gummifera*), Grey Gum (*E. punctata*), Sydney Peppermint (*E. piperita*) and Blue Leaf Stringybark (*E. agglomerata*). Snakes show preferences for large trees, trees with multiple hollows, and dead trees. Most snakes use hollow branches rather than hollow stems. Individual snakes use between one and nine trees (SEWPAC 2013a).

iii. Species Distribution

The Broad-headed Snake is restricted to the sandstone ranges in the Sydney Basin and within a radius of approximately 200 km of Sydney (NSW NPWS 1999b). Numbers have declined in recent years, however historical evidence suggests that the species has long been confined to a small geographic range.

The species was once common in rocky coastal areas near Sydney including Port Jackson, Botany Bay, Middle Harbour, Lane Cove and Parramatta. There have been no records in these areas since the 1970s (Cogger et al. 2003). Similarly there are also older records from outlying sandstone extensions at the NW edge of the Sydney Basin between Bathurst and Mudgee (NSW NPWS 1999).

The current distribution of this species extends from Wollemi National Park in the north, the Clyde River catchment in ranges south-west of Nowra in the south, east to the Royal National Park and near Illawarra, and west to the upper Blue Mountains at Blackheath and Newnes. Major populations occur in the Blue Mountains, southern Sydney, an area north-west of the Cumberland Plain, and the Nowra hinterland (NSW NPWS 1999)

iv. Assessment of Dependency on Pagoda Landforms:

Although this species is highly likely to find suitable habitat in pagoda landforms, its requirements are relatively broad in that it requires suitable rocky areas to facilitate thermo-regulation and shelter habitat. These kinds of habitat features are found in many areas of sandstone escarpments and are not specifically limited to pagoda formations. This species is historically known from several areas where pagodas are not present. It is therefore considered that although pagodas provide suitable habitat this species, it is not dependent on pagoda landforms.

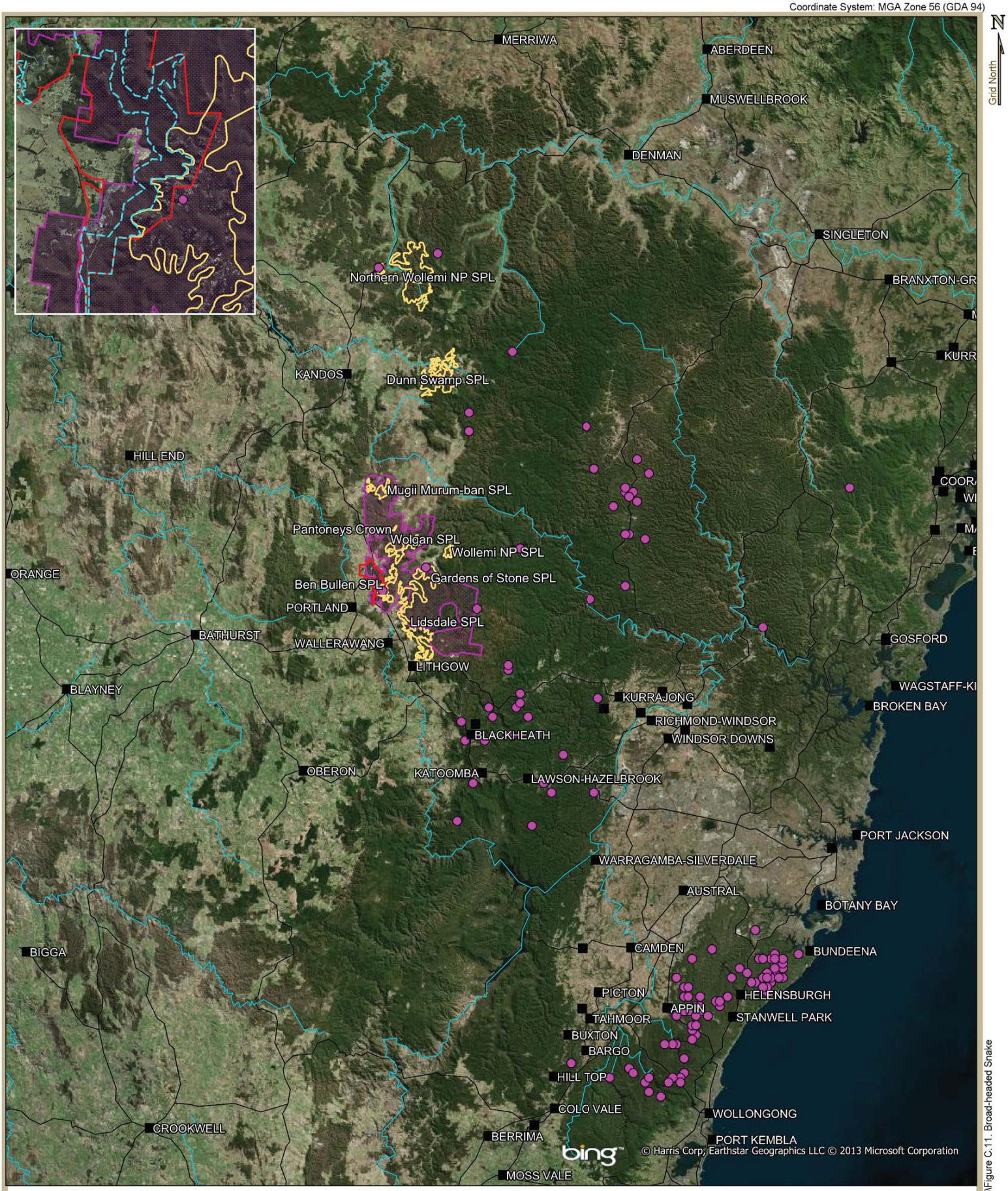


Figure C.11. Broad-headed Snake Records (TSC Act: Endangered; EPBC Act: Vulnerable)